FEWA 150 MIGD SWRO Independent Water Project

Umm Al Quwain, UAE

Environmental & Social Impact Assessment

Volume 4 – Appendices

Prepared for:

October 2019

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1	Financial Capital
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3	Natural Capital
4	Manufactured Capital
5	Human Capital

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APPENDIX A – ENVIRONMENTAL SCOPING STUDY REPORT INCLUDING LETTER FROM UAQ MUNICIPALITY PHED

FEWA 45 MIGD SWRO Independent Water Project
Umm Al Quwain, UAE

Environmental Impact Assessment: Scoping Report

Prepared for:

ACWA Power

August 2018

Document Information

Project Name	FEWA 45 MIGD SWRO IWP, Umm Al Quwain, UAE
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	26/07/2018	Internal Review	EMK	MKB	-
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LIST OF ABBREVIATIONS

Abbreviation	Meaning
$Ca(OH)_2$	Calcium hydroxide
$CaCO_3$	Calcium carbonate
CEMP	Construction Environmental Management Plan
CO_2	Carbon dioxide
E&S	Environmental & Social
EIA	Environmental Impact Assessment
EMS	Environmental Management Systems
FEWA	Federal Electricity and Water Authority
GCC	Gulf Cooperation Council
IFC	International Finance Corporation
IFIs	International Financial Institutions
IUCN	International Union for Nature Conservation
IUCN	International Union for Conservation of Nature
lmh	Litres/m^2/hour
MIGD	Million imperial gallons per day
OEMP	Operational Environmental Management Plan
PHED	Public Health and Environment Department
RO	Reverse Osmosis
SWRO	Sea Water Reverse Osmosis
TDS	Total dissolved solids
TPH	Total Petroleum Hydrocarbons
TSS	Total suspended solids
UAE	United Arab Emirates
VOC	Volatile Organic Compounds
SDI	Silt Density Index
5 Capitals	5 Capitals Environmental and Management Consulting

1 INTRODUCTION

To meet the future potable water demand of the Emirate of Umm Al Quwain, the Federal Electricity and Water Authority (FEWA) is planning to develop a Sea Water Reverse Osmosis (SRWO) desalination plant near Marjan island at the border with Ras Al Khaimah. The proposed project will have a capacity of 45 MIGD desalinated water.

According to the Federal Law No. 24 of 1999, the project will be required to obtain a license from the Public Health and Environment Department (PHED) of Umm Al Quwain Municipality prior to the commencement of the project. It is also understood that the project will seek an amount of its financing from International Financial Institutions (IFIs) who will likely be signatories of the Equator Principles (EP) or have their own internal Environmental and Social (E&S) investment guidelines such as the IFC. In line with their requirements and guidelines the IFIs will require the submission of an Environmental Impact Assessment (EIA).

1.1 Key Project Information

Table 1-1KeyProject Information

Project Title	FEWA 45 MIGD SWRO IWP, Umm Al Quwain, UAE
Project Proponent/Owner	Federal Electricity and Water Authority (FEWA)
Project Developer	ACWA Power
Environmental Consultant	5 Capitals Environmental and Management Consulting PO Box 119899 Dubai, UAE Tel: +971 (0) 4 343 5955 Fax: +971 (0) 4 343 9366 www.5capitals.com
Point of Contact	Ken Wade: Director Environmental Planning Ken.wade@5capitals.com

1.2 Scope of Work

5 Capitals Environmental and Management Consultancy (5 Capitals) has been engaged by ACWA Power to undertake the independent assessment of the Project's environmental and social impacts and other environmental & social related aspects. This includes the statutory EIA process required by Umm Al Quwain Municipality, as well as meeting the prospective project lenders requirements for Environmental & Social Impact Assessment (ESIA)

For consistency in terminology the remainder of this document refers to the impact assessment process as an EIA as per the requirements of the Umm AL Quwain Municipality.

This is the EIA Scoping Report for the FEWA 45 MIDG SWRO Independent Water Project. The scope of work includes the assessment of site footprint for the installation of one (1) 205, 570 m^3 per day Sea Water Reverse Osmosis Desalination Plant at the Project site in Umm Al Quwain. It will also include the construction site laydown area, seawater intake and outfall routings both onshore and offshore.

The project also includes the following associated facilities, which do not fall under ACWA Power's construction and operational scope:

- Potable water pumping stations located near FEWA's potable water storage tanks 5 km from the project site;
- Potable water pipeline works connecting to FEWA's potable water network; and
- Power supply for the SWRO plant extending from FEWA's nearby station which is 6/7 km north of the site in Ras Al Khaimah.

At this stage the above associated facilities, their design and routings have not been confirmed. It is understood that each of these associated facilities will be tendered to separate contractors and will be subject to their own permitting process which may trigger environmental impact assessment. Given that there are no available designs for these facilities, this EIA scope of works does not include provision for their assessment. If such design information is made available an assessment will be included in the EIA stage.

This document outlines the anticipated environmental and social risk and impacts associated with the Project and identifies the scope of work required for the subsequent EIA. This Scoping Report will be submitted to PHED for clearance before the commencement of the EIA studies.

1.3 Objectives of the EIA Scoping Report

The main objectives of this report in relation to the "Project" are as follows:

- To provide an overview of the project, to enable context for the reviewer;
- To provide an overview of the regulation context requiring EIA, other obligations and environmental & social standards applicable to the project;
- To identify preliminary environmental & social baseline conditions and receptors to ensure that proposed assessment techniques (including required baseline surveys) are designed to enable the establishment of representative environmental conditions for the Project and its areas of impacts/influence;
- To identify preliminary environmental & social potential impacts relating to the construction and operational phases of the project, at an early stage to ensure assessment techniques for the subsequent EIA address these issues specifically; and
- To specify the structure and content of the subsequent EIA.

This Scoping report has been informed by:

- Analysis of the Project details and proposed works;
- Study of the relevant mapping and aerial photography;
- Experience and review of EIAs for similar projects and other local projects;
- Visit to the Project site; and
- Review of secondary information (e.g. available online databases and reports).

2 PROJECT INFORMATION

2.1 Project Location

The proposed Project will be located in the northernmost extent of the Emirate of Umm Al Quwain in the United Arab Emirates. The specific plot of land has been allocated by FEWA and is immediately south of the Umm Al Quwain border with the Emirate of Ras Al Khaimah, approximately 20 km north of the city of Umm Al Quwain.

The Project will primarily be located on land with intake and outfall facilities extending into the Arabian Gulf. The land-based section of the Project will be approximately 10 hectares in area and will be situated between the E11 Highway, as shown in Figure 2-1 below.

Figure 2-1 Location of the Proposed Project

Figure 2-2 View of the Marjan Island from the proposed Project Site

2.2 Land Use and Land Condition

2.2.1 Land Ownership

The land ownership for the proposed project site will be governed by a Land Lease Agreement (LLA) which will set the terms of use and enjoyment of the site. The land ownership has been transferred by the Emir of Umm Al Quwain to FEWA which allows FEWA to grant lease over the site to the Project Company. The LLA will initially be set at 28 years covering the 25 years Water Purchase Agreement (WPA) after which the Project Company will be required to return the site to FEWA at the end of this term.

2.2.2 Land Use

The proposed site is undeveloped and there is no evidence of any historical use. The site has an undulating topography with scattered vegetation amongst the sandy soils.

Figure 2-3 View of the Proposed Project Site

During the site visit, evidence of vehicle tracks were identified on and off the project site used by vehicles connecting to the E11 highway located at the eastern and western extents of the project site.

Figure 2-4 Vehicle tracks connecting E11 to the Eastern and Western Extents of the Project (on and off the site)

During the site reconnaissance, animal faeces were observed which was presumed to be camel dung based on the hoof prints on the sand. There was also evidence of fire pits and scattered waste such as bottles and plastic bags.

Figure 2-5 Fire pit and animal faeces observed during the Site Visit


A waste water plant was also identified approximately between 64 m north east of the proposed project site. At the time of the initial site visit a wind mast and a boundary marker between Umm Al Quwain and Ras Al-Khaimah were also identified close to the project boundary, but off-site as shown in the photos below.

Figure 2-6 Wastewater Treatment Plant, Wind Mast and boundary marker off site


The coastal zone of the project is characterized by a gently sloping sandy beach from the E11 highway which is built on made ground above the high tide level and includes some boulders with sporadic vegetation that has established itself on the slope of the beach. During the site visit, there was evidence of an isolated man-made rock armour which is presumed to protect a drainage system though this has not been officially confirmed. There was no evidence of human activity on the beach apart from a set of human and dog footprints. However, the Umm Al Quwain Municipality has put up a sign board which prohibits swimming and fishing in this area.

Figure 2-7 The Coastal Zone at the Proposed Project Site



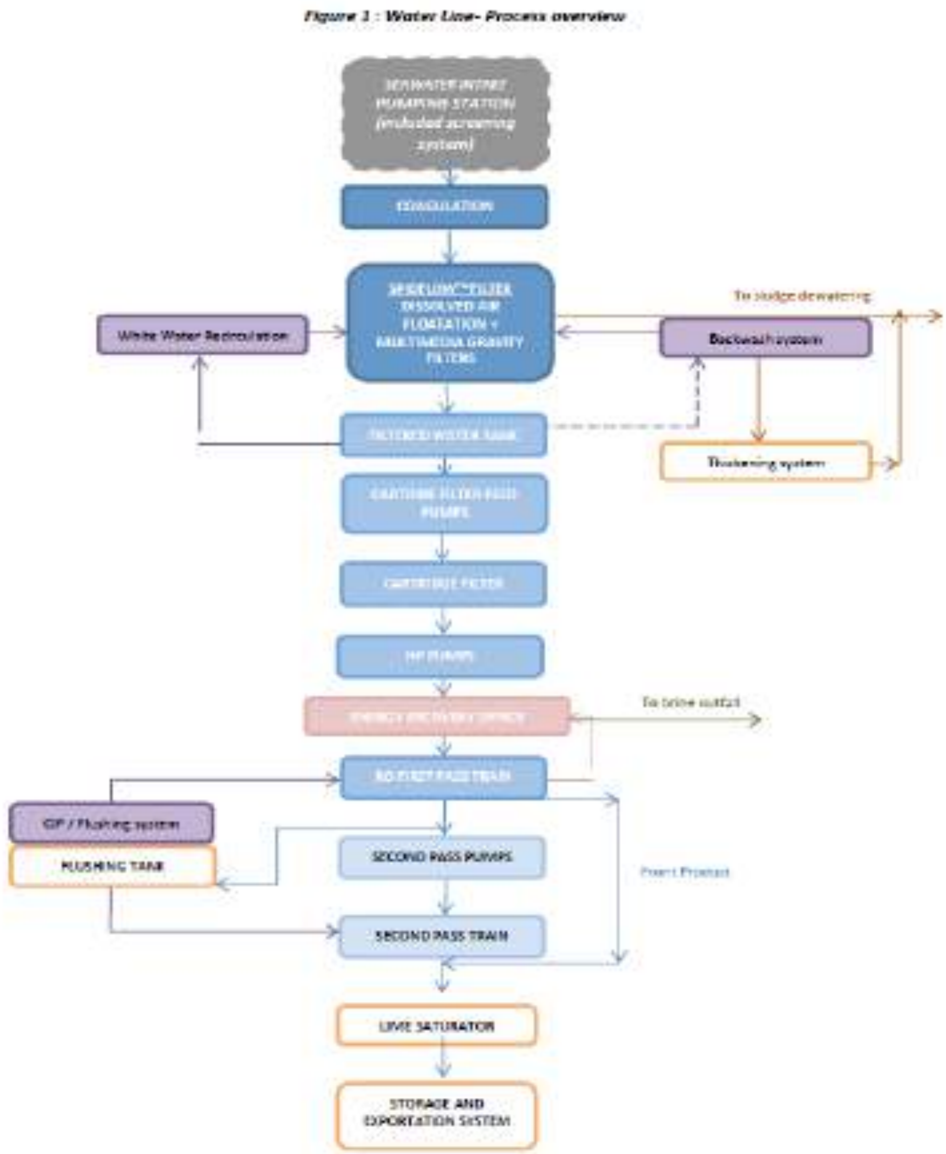
2.3 Project Description

The SWRO will include the following key stages to produce desalinated water:

- Seawater system;
- Pre-treatment system;
- Treatment system/ Reverse osmosis; and
- Water quality instrumentation for SWRO.

A brief description of each of the following components is provided below.

Figure 2-8 SWRO implementation phases



2.3.1 Seawater System

Intake system

The proposed project will have 2 intake pipelines installed 2 metres below the seabed to a single intake riser installed at least 2 metres above the seabed and be a minimum of 3.25 m below the sea level.

The intake head opening will be 0.75 m in width and have screens with a mesh width of 100mm to avoid the passage of large organisms. The maximum flow velocity in each pipe will not exceed 2.0m/s. For inspection and maintenance purposes, manholes with a minimum diameter of 1,200 mm will be provided at least every 200m.

Pumping station

The pump stations will comprise 3 pumps in duty and 1 pump in stand-by. The screens and seawater pumps will be designed to allow particular pipes and associated pumps to be operated independently from each other. In addition, the seawater pumps will be designed to accommodate required flow, while operating on a 3 × 33% basis.

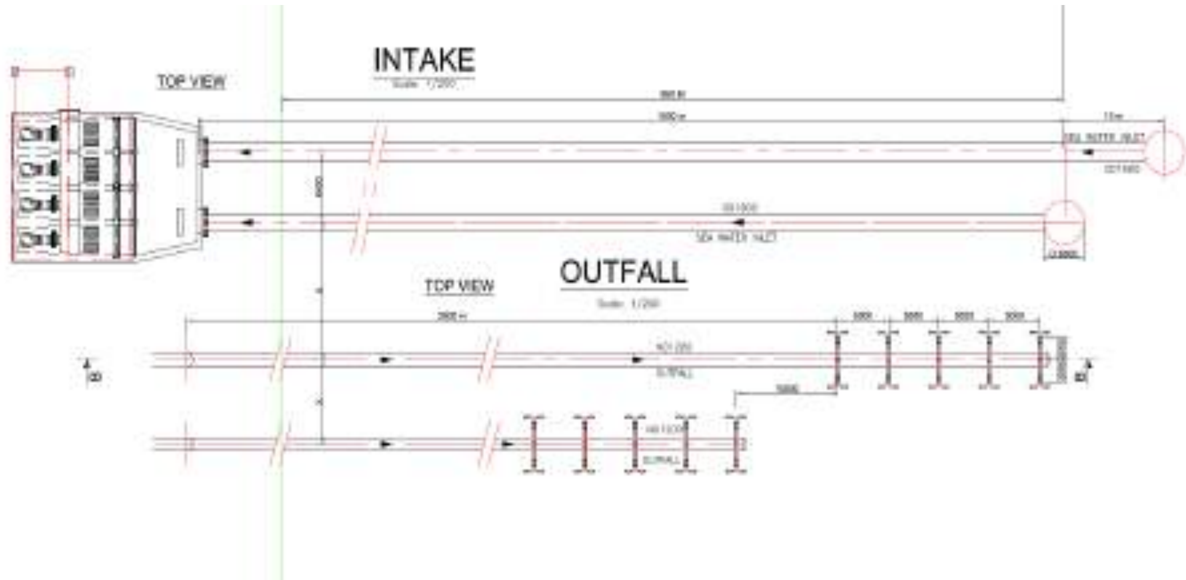
A screening system, capable of screening solids (e.g. floating matter, algae, mussels, fish or jellyfish) down to at least 5 mm in size will be provided. The bar screens and travelling band screens, drum screens or high-performance debris filters (as applicable) will be of seawater resistant material with an automatic cleaning system.

Provisions will also be made for intermittent shock chlorination (with hypochlorite solution) to avoid bio fouling in the system.

Outfall System

The discharge pipe will be installed to commonly return the concentrate and treated process effluents from the desalination plant. The upper part of the pipe will be buried at least 2 meters below the seabed to avoid problems throughout the operation phase caused by marine hydrodynamics. Also, the discharge will ensure through-out mixing and dispersion of the concentrate.

Figure 2-9 Profile of the Intake & Outfall Pipes



2.3.2 Pre-treatment Process

The proposed plant will be equipped with a robust, reliable and proven pre-treatment process capable of achieving a Silt Density Index (SDI_{15}) less than 3.0 for 95% of the time and 4 for 100% of the time upstream cartridge filters. The cartridge filters will act as a safety feature of the Reverse Osmosis system and swill not take part in the pre-treatment process.

In addition to having the capacity to treat the seawater and provide the RO trains with the required water quality, the pre-treatment system will be able to treat the seawater under all condition without any impact on the quality and quantity of product water: red tide events are considered as a potential scenario.

The pre-treatment will be composed by at least two stages which will include but not limited to coagulation and acid storage, dosing and mixing, flocculation, high rate Dissolved Air Flotation (DAF). The second stage will be composed of a combination of the following systems: Gravity Multi Media Filtration (MMF), pressurized Multi Media filtration and Micro/Ultrafiltration.

Coagulation and Flocculation

Ferric Chloride will be used as a coagulant in order to stabilise the natural particles causing turbidity. The Ferric Chloride will be mixed such that the Coefficient of Variation (CoV) is <0.05 at a distance no greater than three pipe diameters downstream of the rapid mixing device.

On the other hand, flocculation tanks will generally comprise 2 or 3 separate stages utilizing mechanical agitation (utilizing variable speed motor drives), ensuring that subsequent shear forces within the 2nd and 3rd stage flocculation stages will not exceed the intensity of agitation within the upstream flocculation stage.

Dissolved Air Floatation

The DAF design will take into consideration that one DAF cell will always out of service for maintenance. The DAF system will include recirculation pump, interconnection piping inlet distribution chambers, flotation chamber, mechanical skimmers, air saturation system, treated water tank, chemical dosing system, sludge treatment system and compressed air facilities.

Multi Media Filter (MMF)

The plant will be designed to handle feed water with one filter under back-washing and with the remaining filters able to treat the required feedwater to the RO in case of maintenance of filter unit (s). The filters will be designed for a maximum of one backwash per day, and to guarantee satisfactory discharge water quality for all downstream plant.

Properly graded filter materials in the multimedia will be provided. Sand, Anthracite and Garnet will be of high quality with the following requirements:

- Sand: Chemical and Physical quality according to EN 12904 type; uniformity coefficient lower than 1.5, moisture lower than 0.2%.
- Anthracite: Chemical and Physical quality according to EN 12909, uniformity co-efficient lower than 1.5; moisture lower than 2%.
- Garnet: Chemical and Physical quality according to EN 12910.
- Other natural and artificial media will be accepted, provided that they have a proven track record of successful operation for similar waters.

The free board minimum values to be proposed will include: Anthracite 100%, Sand 35 % and Garnet at 10%.

Open gravity filters will be protected from sunlight to avoid biological growth within the feed water and where pressure filters are applied, they will be protected against corrosion by internal rubber lining.

The design and rating of distributors and filter nozzles will permit the full design back-wash velocities of air and water, separately as well as combined. The density of individual filter nozzles will be equal or higher than 50 per $m^{2.}$

The DAF and MMF system will be able to produce treated water with a Total Suspended Solids (TSS) value ≤ 2 and guarantee and algae removal of > 95 %.

Cartridge Filter

Cartridge filter will be used for safety and protection of high pressure system and will not be operated as a pre-treatment stage.

Micron filter sized will be 5 μ nominal. These filters will be arranged so that each RO train has a filter upstream of the high-pressure pump. The filter cartridges will be constructed in polypropylene of microwind or blow molded types.

The cartridge filter system will be able to produce treated water with a maximum SDI_{15} value of < 3 for 95 % of the time and < 4 100 % of the time.

Figure 2-10 Example of Cartridge Filters

2.3.3 Reverse Osmosis

The main components of the RO system will include the following:

- High pressure pumps
- Energy recovery devices
- Energy recovery booster pumps
- Two pass RO trains
- Cleaning in place System
- Flushing system

Full and complete interchangeability of RO membranes between a minimum of three RO membrane suppliers will be provided. This interchangeability will ensure that the required permeate flows and quality can be achieved under the range of seawater temperatures and salinity conditions prevalent when utilising RO membranes from a minimum of three different RO membrane suppliers.

A minimum straight pipe length of 5 times the pipe diameter will be provided feeding the suction of RO high pressure feed pumps. In addition, the RO flux for first pass will not exceed 16 lmh and second pass will not exceed 34 lmh.

CIP System-Flushing System

The dedicated cleaning in place (CIP) system will be composed of:

- Preparation mixing/ recirculation tank
- Electric heater
- Cooling arrangement
- Pumps
- Valves and piping
- On line temperature indicator and switch
- Cartridge filter
- Isolation valves
- Pressure gauge

SWRO Chemical Systems

Antiscalant dosing will be required in order to achieve the absolute minimum design SWRO plant recovery and minimum RO membrane cleaning frequency; provision for at least two different antiscalant products will be provided.

Sodium bisulphite dosing will be provided, in order to remove any residual chlorine from the seawater feed and protect the RO membranes. Cartridge filters will also be provided within the main sodium bisulphite dosing pipework for the dosed sodium bisulphite solution, to remove particulate matter present within the sodium bisulphite storage / dosing tank.

Sodium hydroxide will be provided between the first and second pass RO system to modify the pH of the RO 2nd pass feed water.

Storage and dosing facilities for non-oxidising biocides such as DBNPA will also be provided.

2.3.4 Water Quality Instrumentation for SWRO

The following analysers will be included on the pre-treatment system:

- Online Chlorophyll
- TOC
- Turbidity analysers

Conductivity and pH measurement for each of the following:

- RO feed line
- Brine line
- Permeate line

The following parameters for the product water will be monitored:

- pH- online
- Conductivity- online
- Hardness
- Turbidity- online
- Chlorine-online
- Temperature-online
- Alkalinity

Brine and Energy Recovery

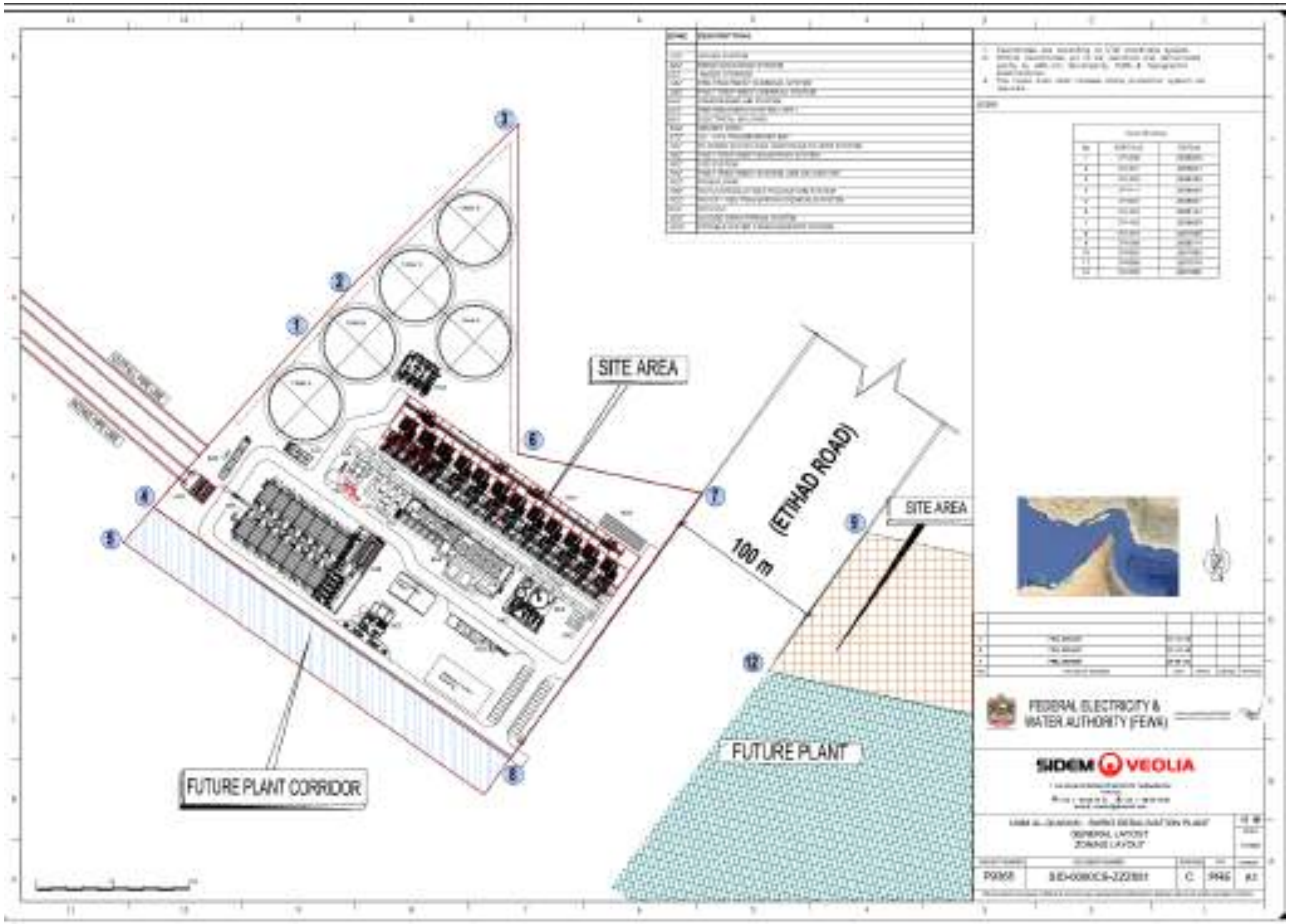
The guaranteed minimum efficiency of the energy recovery system will be an absolute of 94% under all seawater flow, temperature and salinity conditions. Energy recovery will be by the use of isobaric energy recovery devices in order to maximise the system energy performance.

Post-treatment Plant

The product water from the SWRO plant will be treated in the post-treatment plant. A remineralisation system based on up flow limestone filters ($CaCO_3$) or lime slurry techniques ($Ca(OH)_2$) will be proposed considering the Plant operation and maintenance aspects.

The post treatment plant will use CO_2 produced outside the Plant area.

Figure 2-11 Overall Project Layout



2.4 Associated Facilities

2.4.1 Electrical Works

The electrical scope of works will include electrical system design, engineering, manufacturing, factory inspections, supply, packing, delivery to site, storage, installation, termination, testing, commissioning and performance trial for all equipment.

The SWRO power supply will be dispatched from two 33 Kv cables (2× 100%) provided by FEWA from a nearby substation approximately 7km north of the site in Ras Al-Khaimah. This will cater for the estimated 38 MW power load requirement for the 45 MIGD.

2.4.2 Pipeline Works

The pipeline works will include but not limited to the following;

- Supply installation of GRP pipeline from permeate/flushing tank to storage water tank;
- Right of way construction;
- Pipeline crossing protection for powerline, road;
- Protection of pipeline; and
- Pipping support.

2.4.3 Access Roads

The proposed project site will be accessed from the E11 highway which is directed to the north and south. However, the project Contractor will be required to construct access roads into and within the site. The roads will be designed of sufficient width and load as well as with regard to the frequency of traffic (such as heavy load transportation).

The access road to the Plant Area will be an asphalt road with a width of 10m (3.5 m for each lane) and 1.5 m for the verge at each side. In addition, it will have a lateral slope of 2% to both sides, in order to ensure rainwater drainage.

The access roads will have a grade aggregate of thickness not less than 30 cm and one or more asphalt layers of a total thickness of not less than 10 cm.

2.4.4 Sanitary and waste water facilities

During the construction and operation period sanitary waste water will be treated onsite by a means of a dedicated sewage treatment facility or connected to an existing sewage system.

On the other hand, process waste water will be processed at the waste water treatment plant to meet the requirements for liquid discharges into the sea.

Sludge resulting from process waste water will be dewatered and removed by the Contractor via trucks for disposal to approved landfill facilities.

2.5 Construction of the Plant

2.5.1 Temporary Construction Facilities

It was understood that the laydown area will be located at the "Future Project site" west of the proposed project location. The laydown area is expected to include temporary construction facilities required to enable works (materials storage, staging areas), as well as construction administration facilities. The impacts of the laydown area will be stated and assessed in the EIA.

Figure 2-12 Proposed SWRO Site and Laydown Area

2.5.2 Manpower Requirements

It has not been confirmed the number of project workforce required for the project or whether their accommodation facilities will be located on the project site or off-site.

2.6 Project Schedule

An outline delivery schedule highlighting important milestones for the project is provided in the table below.

Table 2-1 Outline of the Project Schedule

Implementation Milestone	Date
Contract Milestones	
Limited Notice to Proceed	1-Oct-2018
Financial Close – Full Notice to Proceed	01-Nov-2018
Access to Site, Permits and NOCs granted	1-Oct-2018
Commercial Operation Date	31-Dec-2020

The construction schedule is yet to be finalised and will be included in the EIA.

2.7 Project Alternatives

2.7.1 Location

According to the preliminary EIA for the 45 MIGD SWRO Desalination Plant, the proposed location was selected through a series of feasibility and high-level screening studies. The following criteria was used:

- Geological and land area requirement;
- Biological resources;
- Oceanographic conditions;
- Concentration discharge area;
- Proximity to consumers; and
- Raw water quality and proximity

2.7.2 Technology

The most common types of desalination technology include the following:

- Reverse Osmosis (RO);
- Thermal Desalination;
- Multiple-Stage Flash (MSF); and

- Multiple Effect Distillation (MED)

Globally, RO is the most commonly used method of desalination based on its relative energy efficiency and desalination capacity (Sackinger, 1982). In addition, it is noted that there has been a downward trend in the costs and energy use of desalinated water over the last 30 years, due to technological advances enabling better performance.

3 REGULATORY FRAMEWORK AND EIA REQUIREMENT

3.1 National Regulations

3.1.1 International and Regional Conventions/Protocol

The proposed Project must comply with the environmental requirements of the following regional protocols and conventions listed in table below to which the UAE is a signatory:

Table 3-1Regional Protocols and Conventions

Name of Regional Protocol/ Convention	Signed/ Ratified
Convention on Conservation of Wildlife and its Natural Habitats in the GCC Countries, 2001	2003

The UAE is a signatory to, and has ratified, several international protocols and conventions. As such the UAE is committed to the principles and policies therein. The proposed Project must therefore comply with the environmental requirements of the international treaties and conventions listed in the table below to which the UAE is a signatory:

Table 3-2 International Protocols and Conventions

Name of International Protocol/Convention	Signed/ Ratified
Memorandum of Understanding concerning the Conservation of Migratory Birds of Prey in Africa and Eurasia	2008
Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), 1997 - Non-Annex I Country	2005
Stockholm Convention on Persistent Organic Pollutants (POPs), 2001	2002
Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), 1997 - Non-Annex I Country	2005
United Nations Convention to Combat Desertification (UNCCD), 1994	1999
United Nations Convention on Biological Diversity, 1992	1999
United Nations Framework Convention on Climate Change (UNFCCC), 1992	1995
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989 and amendments in 1995	1992
Montreal Protocol on Ozone Depleting Substances, 1987 and Montreal Amendments (London 1990, Copenhagen 1992, Vienna 1995, Montreal 1997, Beijing 1999)	1989
Vienna Convention for the Protection of the Ozone Layer, 1985	1989
Geneva Convention on Long-Range Transboundary Air Pollution, 1979	-
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973	1990

Name of International Protocol/Convention	Signed/ Ratified
Convention Concerning the Protection of World Cultural and Natural Heritage, 1972	-
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar), 1971	2007

In addition to the above, the UAE contributes to many regional and international organisations that are concerned with the protection of environment and conservation of natural resources, such as the United Nations Environment Program, World Health Organisation, United Nations Food and Agriculture Organization, World Meteorological Organization, UNESCO, the Regional Organization for Protection of Marine Environment and the relevant organizations working under the Arab League.

The UAE is also a member of the International Labour Organisation (ILO). The ILO is committed to advancing opportunities for women and men to obtain decent and productive work in conditions of freedom, equity, security and human dignity. Its main aims are to promote rights at work, encourage good employment opportunities, enhance social protection and strengthen dialogue in handling work-related issues.

3.1.2 UAE Federal Environmental Law, Regulations and Standards

The Federal Law No. 24 of 1999 for the Protection and Development of the Environment was the first and most comprehensive federal environmental law in the UAE. The main objective of this Law is to promote the protection and conservation of the environment across the UAE through:

- Control of all forms of pollution and avoidance of any immediate or long term harmful effects resulting from industrial, economic or agricultural development;
- Conservation of natural resources and biological diversity;
- Protection and conservation of the quality and natural balance of the environment, human health and the health of other living creatures from environmentally harmful activities; and
- Compliance with international and regional conventions ratified or approved by the UAE regarding environmental protection and control of pollution.

Federal Law No. 24 of 1999 contains several environmental principles and standards as part of its Executive Order, which was issued by the Cabinet of Ministers in two Decrees:

- Ministerial Decree No. 37 of 2001 including the following regulations:
    - Regulation concerning Environmental Impact Assessment of Projects;
    - Regulation concerning Handling of Hazardous Substances, Hazardous Wastes and Medical Wastes; and
    - Regulation concerning Protection of the Marine Environment.

- Ministerial Decree No. 12 of 2006 on Regulation concerning the Protection of Air from Pollution.

Other Federal Laws also applicable to this Project are:

- Federal Law No. 8 of 1980 concerning Regulation of Working Relations, as amended by Law No 12 of 1986. This is known as 'Labour Law' and is a comprehensive law that regulates all aspects of labour relations between employers and employees from employee entitlements to industrial safety, preventive measures, health and social care for workers and its Ministerial Orders or Decrees:
- Ministerial Order No. 32 of 1982 Specifying Preventive Methods and Measures for Protecting Workers against Work Hazards;
- Ministerial Decision No. 37/2 of 1982 on the Medical Care which the Employer is Obliged to Provide to his Workers;
- Cabinet Resolution No. 13 of 2009 Approving the General Standards Manual of the Labour Collective Accommodation and Attached Services;
- Ministerial Decree No. 764 of 2015 on Ministry approved Standard Employment Contracts;
- Ministerial Decree No. 765 of 2015 on Terminating Employment; and
- Ministerial Decree No. 766 of 2015 on Rules and Conditions for granting Work Permits.
- Federal Law No. 11 of 2002 for 'Regulation and Control the International Trade in Species of Wild Fauna & Flora'; and
- Federal Law No. 21 of 2005 concerning 'Traffic Law'.

3.2 Lender Requirements

The project will pursue an amount of its financing from International Financial Institutions (IFIs) who are expected to either have their own internal E&S investment guidelines (e.g. IFC Performance Standards), be signatories to the Equator Principles, or will align themselves with the OECD Common Approaches (updated 2016). The IFI requirements are likely to include one or more of the followings:

- Equator Principles III (2013);
- OECD Common Approaches (2016)
- IFC Performance Standards (2012);
- IFC EHS Guidelines;

3.2.1 Equator Principles

The Equator Principles (EPs) form the baseline for the assessment and management of environmental and social risks in project financing. They also stipulate the reporting and monitoring requirements to be met by a project for the Equator Principles Financial Institutions (EPFIs).

Based on the Equator Principles, FEWA 45 MIGD SWRO Independent Water Project is located in a Non-Designated Country (UAE), the project will therefore be required to undergo an assessment process. 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).

3.2.2 OECD Common Approaches

The Common Approaches are a set of recommendations for addressing environmental and social aspects of officially supported export credit and applies to Export Credit Agencies (ECAs) based in OECD countries. If applicable for the project, the OECD Common Approaches, the 'Recommendation of the Council on Common Approaches for Officially Supported Export Credits and Environment and Social Due Diligence (the 'Common Approaches')' (Ref: TAD/ECG (2016)3), require project implementation of all eight IFC Performance Standards and IFC EHS Guidelines, including the relevant sector specific IFC EHS Guidelines.

3.2.3 IFC Performance Standards

The IFC Performance Standards are a key component of the IFC's Sustainability Framework and directed towards clients (i.e. party responsible for implementing and operating the project that is being financed), providing guidance on how to identify risks and impacts. The IFC Performance Standards are designed to help avoid, mitigate, and manage risks and impacts throughout the life of a project as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities.

The IFC Performance Standards (2012) are listed below:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
- Performance Standard 2: Labour and Working Conditions
    - Including International Labour Organisation (ILO) Conventions
- Performance Standard 3: Resource Efficiency and Pollution Prevention
- Performance Standard 4: Community Health, Safety, and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement

- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage

3.2.4 IFC EHS Guidelines

In terms of specific guidelines to control environmental externalities (e.g. wastewater quality etc.), these have been set out by the IFC in terms of General Guidelines.

In summary, it should be noted that the following IFC EHS Guidelines are relevant to this project:

- General EHS Guidelines, Environmental:
    - Air Emissions and Ambient Air Quality;
    - Energy Conservation;
    - Wastewater and Ambient Water Quality (relevant for groundwater standards);
    - Water Conservation;
    - Hazardous Materials Management;
    - Waste Management;
    - Noise; and
    - Contaminated Land.
- General EHS Guidelines, Occupational Health & Safety:
    - General Facility Design and Operation;
    - Communication and Training;
    - Physical Hazards;
    - Chemical Hazards;
    - Biological Hazards;
    - Radiological Hazards;
    - Personal Protective Equipment (PPE);
    - Special Hazard Environment; and
    - Monitoring.
- Community Health & Safety:
    - Water Quality and Availability;
    - Structural Safety of Project Infrastructure;
    - Life and Fire Safety (L&FS);
    - Traffic Safety;
    - Transport of Hazardous Materials;
    - Disease prevention; and
    - Emergency Preparedness and Response.

- Construction and Decommissioning:
    - Environment;
    - Occupation Health & Safety; and
    - Community Health & Safety.
- IFC EHS Sector Specific Guidelines for Water and Sanitation (2007)

3.3 EIA Requirements

In accordance with Federal Environmental Law No. 24 of 1990, Article 3 states that "The Agency, in consultation with the competent authorities and concern parties shall to set the standards, specifications, principles and regulations for the assessment of environmental impact of the projects and establishment applying for license and shall specially undertake the following:

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

In addition to this, Article 4 states that "No project or establishment shall start the activity before obtaining the license aforementioned in the previous article including environmental impact assessment."

3.3.1 Scope of Work and Key Deliverables

The main deliverables of the EIA process are:

- Environmental Scoping Report
- EIA Report

The purpose of the Environmental Scoping Report is to identify the key environmental issues and sensitive receptor sites at an early stage to ensure that the baseline surveys and assessment techniques for the subsequent EIA address these issues. In addition, it identifies the structure and content of the EIA at an early stage.

In Umm Al Quwain, the initial stage of the EIA process is the 'Environmental Scoping Report', which is required for submission to PHED. The general content of the Environmental Scoping report includes:

- The environmental assessment, documentation and approval requirements for the proposed development;
- The key features of the proposed project facilities;
- A brief description of the existing environmental conditions of the project site and an evaluation of existing environmental information on the area;
- A gap analysis to determine the additional information that needs to be gathered;
- Potential environmental issues and constraints (and opportunities) associated with the proposed project facilities based on the existing information; and
- An outline of the scope of work, structure and content of the EIA Report.

4 Approach to EIA

4.1 EIA Methodology

This section outlines the expected methodology that will be used to describe the sensitivity of environmental receptors, to predict the magnitude of environmental impacts and to assess the significance of the effect of the project activities on each relevant environmental aspect or component.

4.1.1 Delineation of Study Boundaries and Scope of Assessment

Assessment of the Project Area

The primary study area comprises of the site footprint for the installation of one (1) 205, 570 m^3 per day Sea Water Reverse Osmosis Desalination Plant at the Project site in Umm Al Quwain. It will also include the construction site laydown area, seawater intake and outfall routings both onshore and offshore, potable water pumping stations located near FEWA's potable water storage tanks located 5 km from the project site. However, the locations of such facilities are yet to be identified at this stage and where identified or information relating to these facilities are made available, such impacts will be assessed in the EIA.

The EIA will also include the assessment of the power supply for the for the SWRO plant which will be extended from FEWA's nearby station which is 6/7 km north of the site in Ras Al Khaimah.

4.1.2 Baseline Surveys

Forming an integral part of the EIA, the baseline surveys provide a benchmark of the existing conditions by which the potential impacts of the proposed project can be assessed for the construction and operational phases.

The baseline surveys shall correspond to those outlined in the project's Environmental scoping report and in accordance with any comments received from PHED in regard to the scoping.

The baseline surveys will be described in each relevant chapters of the EIA, with analysis results provided, and included to the applicable appendices. The surveys are intended to provide representative data in regard to the areas that may potentially be impacted by the project. Justification of the scope of such studies shall be provided in the Environmental Scoping Report.

4.1.3 Project Stakeholder Analysis and Consultation

Consultation with stakeholders is an essential part of the environmental assessment process. The main objective of the consultation is to establish a dialogue with those parties who may be involved in aspects of the Project or may have an interest in the outcome of the EIA process. However, regulatory procedures for EIA public consultation have not yet been developed in Umm Al Quwain or the UAE to enable such consultation.

Where the project requires financing from international lenders, there is an expectation that an appropriate level of consultation with potentially affected stakeholders is undertaken. It is therefore important that the project undertakes selected consultation that is in agreement with the project client and proponent. Impact Assessment Significance Criteria

In order to obtain a credible assessment of environmental impacts, the assignment of "effect significance" to each identified impact needs to be a robust, consistent and transparent process. The methodology to assess 'effect significance' is outlined below and follows an International Best Practice based on the assumption that the significance of an impact on resources or receptors is considered to result from an interaction between three factors:

- The nature and magnitude of the impact (i.e. a change in the environment, social and/or health baseline conditions);
- The number of resources or receptors affected (i.e. humans and the environment); and
- The environmental value or sensitivity of those resources or receptors to the change.

A three-step approach has been used to determine the significance of environmental effects, as follows:

Step 1 – Evaluation of value/sensitivity of resource or receptor;

Step 2 – Assessing the magnitude of the impact on the resource or receptor; a

Step 3 – Determining the significance of effects.

4.1.4 Identification and Evaluation of Sensitive Receptors

Sensitive receptors are defined as:

Elements of the ***environment*** that are of value to the functioning of natural systems (i.e. areas or elements of ecological, landscape or heritage value, species, habitats and ecosystems, soil, air and water bodies or land-use patterns);

Human receptors, such as stakeholders (i.e. users of dwellings, places of recreation, places of employment, community facilities or household relocation) and human systems (e.g.

employment market, population disease susceptibility and disease communicability, exposure to toxicity of chemicals).

The environmental value (or sensitivity) of the resource or receptor has been defined by using the criteria in the table below.

Table 4-1 Environmental Value of Receptor or Resources

Value (sensitivity)	Description of Value
Very High	High importance and rarity on an international scale and limited or no potential for substitution. The receptor has already reached its carrying capacity, so any further impact is likely to lead to an excessive damage to the system that it supports. Locations or communities that are highly vulnerable to the environmental impact under consideration or critical for society (e.g. indigenous peoples, hospitals, schools).
High	High importance and rarity on a national scale, and limited potential for substitution. The receptor is close to reaching its carrying capacity, so a further impact may lead to a significant damage to the system that it supports. Locations or communities that are particularly vulnerable to the environmental impact under consideration (e.g. residential areas, vulnerable/marginalized groups).
Medium	High or medium importance and rarity on a regional scale, limited potential for substitution. The receptor is already significantly impacted, but it is not close to reaching its carrying capacity. Further impacts will get increase the stress of the underlying system, but evidence does not suggest that it is about to reach a critical point. Locations or groups that are relatively vulnerable to the environmental impact under consideration (e.g. commercial areas).
Low (or Lower)	Low or medium importance and rarity on a local scale. The receptor is not significantly impacted and shows a large spare carrying capacity. Impacts are not likely to generate any noticeable stress in the underlying system. Locations or groups that show a low vulnerability to the environmental impact under consideration (e.g. industrial areas).
Very Low	Very low importance and rarity on a local scale. The receptor is not impacted and shows a very large spare carrying capacity. Impacts are very unlikely to generate any noticeable stress in the underlying system. Locations or groups that show a very low vulnerability to the environmental impact under consideration (e.g. industrial areas).

4.1.5 Identification and Evaluation of Potential Impacts

During the evaluation undertaken as part of the EIA process, the following types of impacts have been considered:

- Direct Impacts - Potential impacts that may result from the construction and occupation of the Project acting directly on an environmental or social receptor (e.g. land take for construction of the camps);
- Indirect Impacts – Potential impacts which are not a direct result of a Project activity, often produced later in time or further removed in distance, but are normally a result of a complex pathway (e.g. dust deposition on vegetation which causes reduction in photosynthetic rates);
- Beneficial Impacts – Those impacts that have a positive, desirable or favourable effect on the sensitive resources or receptors (e.g. landscape providing artificial habitat for a variety of species, creating jobs during the construction and/or occupation phases of a project);
- Adverse Impacts – Those impacts that are detrimental and have a negative influence on sensitive resources or receptors;
- Secondary Impacts - Potential impacts that may result from the implementation of protection measures applied to mitigate potential direct impacts;
- Event Related Impacts - Potential unplanned or accidental impacts stemming from an unintentional event such as fire, explosion, oil spill, etc.; and

4.1.6 Defining Impact Magnitude

The magnitude of the impact will be defined wherever possible in quantitative terms. The magnitude of an impact has a number of different components, for example:

- The extent of physical change;
- The level of change in an environmental condition;
- The permanence of impact and the reversibility of the impacted condition;
- Its spatial footprint;
- Its duration, its frequency; and
- Its likelihood of occurrence where the impact is not certain to occur.

The criteria used for identifying the magnitude of impacts is provided within the table below.

Table 4-2 Criteria for magnitude of Impacts

Magnitude of Impact	Description of Magnitude
Major	Adverse: Loss of resource and/or quality and integrity; severe damage to key characteristics, features or elements. A major impact is usually large scale, permanent and irreversible. Beneficial: Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality.
Moderate	Adverse: Significant impact on the resource, but not adversely affecting the integrity; Partial loss of/damage to key characteristics, features or elements. Moderate impacts usually extend above the site boundary, and are usually permanent, irreversible or cumulative. Beneficial: Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Minor	Adverse: Some measurable change in attributes quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. Minor impacts usually are only noticeable within the site and are temporary and reversible. Beneficial: Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.
Negligible	Adverse: Very minor loss or detrimental alteration to one or more characteristics, features or elements. Beneficial: Very minor benefit to or positive addition of one or more characteristics, features or elements.
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

4.1.7 Determination of Significance of Effects

The significance of effects is a combination of the environmental value (or sensitivity) of a receptor or resource and the magnitude of the project impact value (change). In other words, it is this product of the impact acting on the receptor that produces an environmental effect. The table below provides criterion used for determining the significance of environmental effects through consideration of the potential magnitude of impact and sensitivity of the associated receptor. Definitions of each significance categories are provided.

Table 4-3 Criteria for Determining Significance of Effects

		Magnitude of impact (degree of change)				
		No change	Negligible	Minor	Moderate	Major
Sensitivity of Receptor	Very High	Neutral	Minor	Moderate to Major	Major	Major
	High	Neutral	Minor	Minor to moderate	Moderate to Major	Major
	Medium	Neutral	Negligible to minor	Minor	Moderate	Moderate to Major
	Low	Neutral	Negligible to minor	Negligible to minor	Minor	Minor to moderate
	Very Low	Neutral	Negligible	Negligible to minor	Minor	Minor

Table 4-4 Definition of Significance of Effects

Significance Category	Criteria
Very Large	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.
Large	Important considerations at a local scale but, if adverse, are potential concerns to the project and may become key factors in the decision-making process.
Moderate	These effects, if adverse, while important at a local scale, are not likely to be key decision-making issues. Nevertheless, the cumulative effect of such issues may lead to an increase in the overall effects on a particular area or on a particular resource.
Slight	Local issue unlikely to be of importance in the decision-making process. Effects do not exceed statutory limits. Nevertheless, they are of relevance in enhancing the subsequent design of the project and consideration of mitigation or compensation measures.
Neutral	No effect or effect that is beneath the level of perception, within normal bounds of variation or within the margin of forecasting error. No mitigation is required.

4.1.8 Mitigation & Management Measures

It is noted that the project already includes a variety of mitigation measures as outlined in the project description. The mitigation measures described ensures that the required regulations are complied with and will be additionally addressed within each relevant chapter of the EIA.

The projects impact assessment process as outlined above therefore takes into consideration those mitigation measures included to the projects design. In addition to the mitigation implemented at the design phase, the EIA outlines numerous other measures for construction and the operational phase upon which the project can further minimise or avoid negative impacts and ameliorate positive impacts.

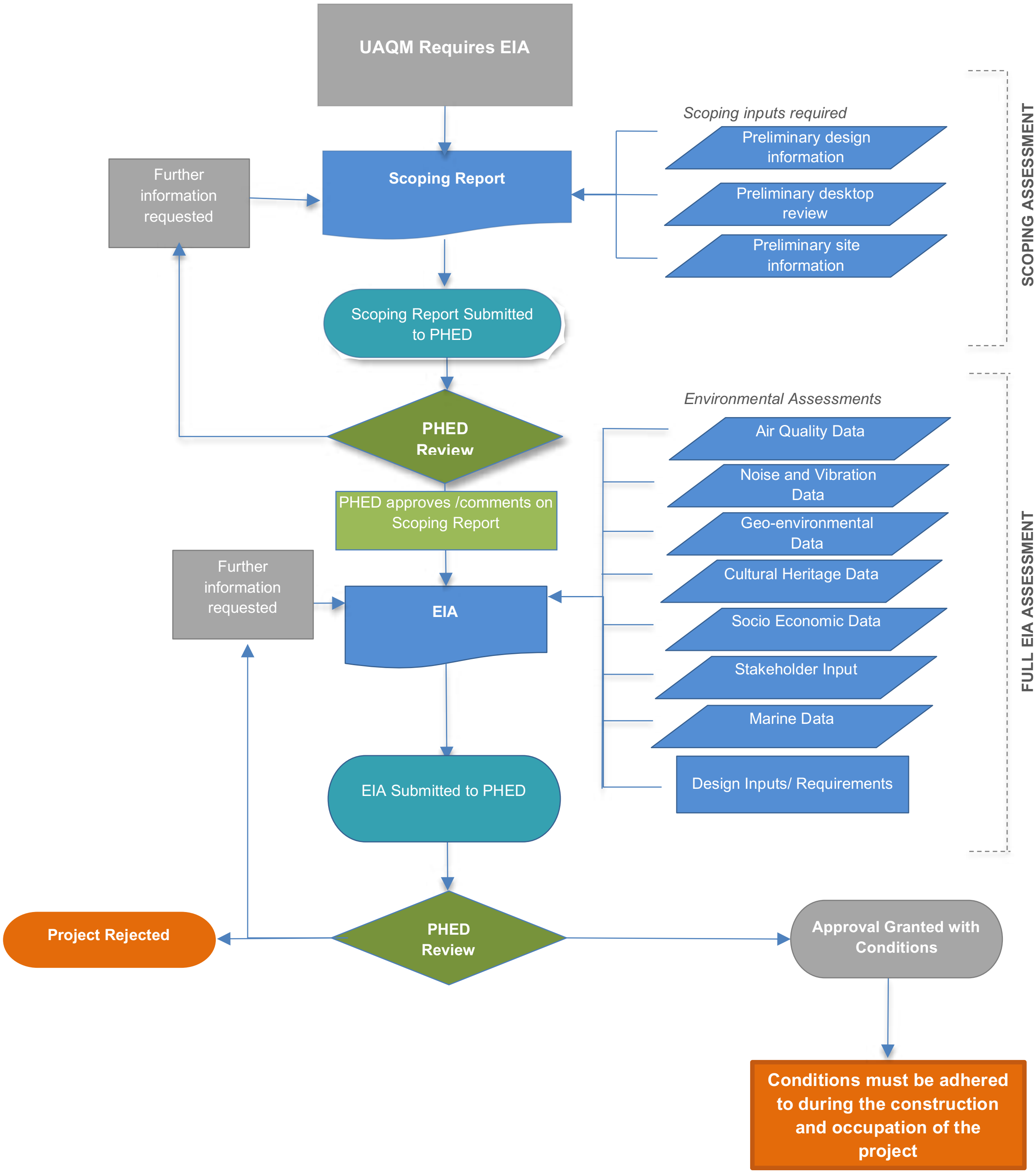
4.1.9 Residual Impacts

The residual impacts section considers the overall significance of impacts following the implementation of the additional Mitigation & Management measures not included by design. The significance of such impacts is based upon the same criteria used to determine the impact significance in Section 4.1.8.

4.1.10 EIA Process Flow

The figure below provides an on outline of the EIA process for the project.

Figure 4-1 Scoping/EIA Process



5 MARINE ENVIRONMENT

5.1 Observation and Baseline Conditions

The Arabian Gulf is a shallow and almost land-locked sea that is 1000 km long by 230-250 km wide, with a 60 km wide entrance from the Gulf of Oman at the Strait of Hormuz. The average depth is 35 meters with a maximum of 100m on the Iranian side. There is no continental shelf and18% of the area of the Gulf is less than 5 m deep (27.2% of the Gulf is less than 10m deep, MEPA 1987).

The physico-chemical properties of the Arabian Gulf reflect an extreme environment, which limits the ecological biodiversity. Temperatures in particular experience extreme fluctuations between summer and winter, with maximum highs reaching 34 °C and lows of 17 °C, although the average fluctuation is around 10°C between summer and winter. The Gulf's salinity is uncharacteristically high, and this is due to the high evaporation rate and minimal input of fresh water. The average salinity, in the UAE is 39 ppt, however winter salinities will be slightly higher at 40-42 ppt. It should be noted, that in shallow intertidal areas, where flushing is limited, the salinity can be significantly higher. For example, in the bays around Qatar and Kuwait, salinity has been recorded as high as 48-52 ppt. Notwithstanding this extreme marine environment, the Arabian Gulf supports a variety of ecosystems and a healthy diversity and density of fauna and flora.

The characteristics of the Arabian Gulf' coastline, particularly along UAE's coast has been significantly developed and altered. Commercial fishing harbour and marinas, industrials ports and power/desalination plants share the coastline with commercial, hospitality and residential developments. This heavy and intense interface with the coastal environment has resulted with changes to the bathymetry, currents, water quality and ecology of the Arabian Gulf.

5.1.1 Marine Ecology

Desktop research regarding the marine environment did not identify any evidence of natural reef outcrops or reef systems. This was further corroborated during the initial site visit where there was no evidence of corals fragments that had washed up along the shoreline or present at the high tide mark. However, there were different types of seaweeds and algae that had been washed to the beach by the waves as shown below.

Plates 5-1Seaweeds on the coastline of the Proposed Project Site

A section of man-made rock armour extends from the E11 to the water line perpendicular across the beach which was covered in algae such as the *barnacles Balanus* sp. which were attached to the rocks as shown in the figure below.

Plates 5-2 Algae Attached to the rocks in the Coast Zone of the Proposed Site

It was also observed that the beach was scattered with shells and crab burrows. These burrows are characteristic of those made by ghost crabs *(Ocypode ceratophthalma)* or sand bubblers crabs *(Scopimera sp.)*.

Plates 5-3 Crab Burrows along the Project Site Coastline

Desktop research revealed that the proposed site is 3.24 km away from the Al-Sinniyah Island where blacktip reef sharks and green turtles have been observed swimming. The blacktip reef sharks are listed as Near Threatened (Heupel, 2009) while the green turtles are listed as Endangered (Seminoff, 2004) on the IUCN Red List of Threatened Species. A marine ecology survey will be carried out as part of the EIA to determine the marine species found within the project site.

Desktop research indicated that the project's coastal zone comprises of unconsolidated sediments with a high percentile of soft sediment cover.

5.1.2 Sensitive Receptors

The table below identifies the sensitive receptors in relation to the Marine Ecology and Sea Water Quality.

Table 5-1 Marine Environment – Receptors

Receptor	Justification
Marine Ecology	Impacts to the marine flora and fauna from marine construction works and project brine discharge have the potential to be significant where mitigation and management measures are not adequately incorporated.
Marine Water Quality	Water visibility in the Gulf Region can become turbid during stormy conditions. Dredging activity during construction will also generate suspended sediments which will temporarily affect marine water quality.
Sediment Quality	Dredging activity will extract sediment from the shoreline which will disturb any marine fauna living in the project area.

5.2 Potential Impacts

5.2.1 Construction Phase

Dredging the alignment of the intake and outfall pipelines

Dredging activity will permanently alter the sea bed, including potential temporary loss of associated benthic fauna and localised adverse impacts to water chemistry associated with increases in suspended sediments. The requirements for dredging are to be confirmed, however, where dredging is required, there is the potential for the dispersion of sediment which may increase TSS and turbidity within the water column as well as potentially smothering adjacent sea bed benthic habitats and disturbing faunal species. However, the benthic fauna is expected to re-establish itself after construction because the intake and outfall pipes will be buried and the sea bed restored.

Dewatering and Dredged Material Runoff

The storage of dredged materials will result in the runoff of water to the sea, which may include high loads of suspended sediments, potentially reducing water quality.

On the other hand, dewatering will result in continuous removal of ground water and its consequent discharge into the sea. This may result in high loads of sediments being discharged into the sea which will degrade sea water quality. However, provisions will be made to allow for sediment settlement before the water is discharged into the sea.

5.2.2 Operational Phase

Dependant on intake design and local habitat type, the intake could result in the entrainment and/or impingement of fish, with adverse impacts for local populations.

During operation, brine and backwash generated from the reverse osmosis process will be discharged to the marine environment and will impact water chemistry within proximity to the discharge point with potential adverse impacts for the local ecosystem. Such impacts will include increases in the salinity of ambient water quality.

In addition, wastewater treatment will be afforded to all wastewater streams on-site.

5.3 Standards and Regulatory Requirements

5.3.1 National Standards

The following section provide the discharge standards which are applicable to the proposed project as shown in the tables below. In the absence of UAE and Umm Al Quwain Municipality standards, the following Environment Agency Abu Dhabi Technical Guidance Document TG-003R-have been referenced as a good practice local standard as shown in the table below. This standard was reference d in the Preliminary Environmental Impact Assessment (PEIA) issued with the Project RFP by FEWA. These standards will be referenced in the subsequent EIA.

Table 5-2 EAD Marine Industrial Discharge Standards

Parameter	Symbol	Unit	Suggested Limits
Physical Properties			
Total Suspended Solids	TSS	mg/l	50
Total Dissolved Solids	TDS	mg/l	1500
Ph		pH Units	6 - 9
Floating Particles		mg/m2	None
Temperature	T	° C	5
Turbidity		NTU	75
Inorganic Chemical Properties			
Ammonia Total as N	$NH4^{+}$	mg/l	2
Nitrate	$NO3^{-N}$	mg/l	40
Chlorine Residual	Cl^{-}	mg/l	1
Cyanide	CN^{-}	mg/l	0.05
Dissolved Oxygen	DO	mg/l	>3
Fluoride	F^{-}	mg/l	20
Sulphide	S^{-2}	mg/l	0.1
Biochemical Oxygen Demand	BOD5-20	mg/l	50
Total Kjeldahl Nitrogen as N	$PO4^{-3}$	mg/l	10
Total Phosphorus as P	$PO4^{-3}$	mg/l	2
Chemical Oxygen Demand	COD	mg/l	100
Trace Metals			
Aluminium	Al	mg/l	20
Antimony	Sb	mg/l	0.1
Arsenic	As	mg/l	00.5
Barium	Ba	mg/l	2
Beryllium	Be	mg/l	0.05
Cadmium	Cd	mg/l	0.05
Chromium, total	Cr	mg/l	0.2
Chromium VI	Cr^{+6}	mg/l	0.15
Cobalt	Co	mg/l	0.2

Parameter	Symbol	Unit	Suggested Limits
Copper	Cu	mg/l	0.5
Iron	Fe	mg/l	2
Lead	Pb	mg/l	0.1
Manganese	Md	mg/l	0.2
Mercury	Hg	mg/l	0.001
Nickel	Ni	mg/l	0.1
Selenium	Se	mg/l	0.02
Silver	Ag	mg/l	0.005
Zinc	Zn	mg/l	0.5
Organic Chemical Properties			
Halogenated Hydrocarbons & Pesticides		mg/l	Nil
Hydrocarbons	HC	mg/l	15
Oil & Grease		mg/l	10
Phenols		mg/l	0.1
Solvent		mg/l	None
Total Organic Carbon	TOC	mg/l	75
Biological Properties			
Total Coliform		MPN/100ml	1000
Faecal Coliform Bacteria		cells/100 ml	1000
Colon Group		No. /100 cm^2	5000
Egg Parasites			None
Warm Parasites			None

5.3.2 FEWA RfP Requirements

In accordance with several clauses in Volume III of the FEWA RfP, the discharge at the outfall shall be in compliance with 'Iran environmental discharge requirements'.

'All industrial complexes which produce waste water with higher quantities of pollutants than those above the National Standard of Environmental Protection Agency of Islamic Republic of Iran should have waste water treatment facilities before the final release to the environment. The effluent standards for direct discharge are reported in the table below. The table below lists the limit values for wastewater characteristics prior to be discharged.

Dilution of a waste water discharge shall not be used to meet effluent discharge limitations.

The use of pond for untreated wastewater is allowed only by the permission of National Environmental Protection Agency of Iran.'

Table 5-3 Iran Effluent Discharge Standards

Substance	Surface water (mg/l)	Agriculture and Irrigation Use	Soakaway Well (mg/l)
Al	5	5	0.1
Ag	1	0.1	5
As	0.1	0.1	0.1
Bo	2	1	1
Ba	5	1	1
Be	0.1	0.5	1
Ca	75	-	-
Cd	0.1	0.05	0.1
Cl	1	0.2	1
Cl^-	(1) 600	600	600(6)
CH_2O	1	1	1
C_6H_5OH	1	1	Petty (trace)
CN	0.5	0.1	0.1
Co	1	0.05	1
Cr VI	0.5	1	1
Cr III	2	2	2
Cu	1	0.2	1
F	2.5	2	2
Fe	3	3	3
Hg	Under limit	Under limit	Negligible
Li	2.5	2.5	2.5
Mg	100	100	100
Mn	1	1	1
Mo	0.01	0.01	0.01
Ni	2	2	2
NH_4	2.5	1	1
NO_2	10	10	10
NO_3	50	10	10
Phosphates/ phosphorous	6	-	6

Substance	Surface water (mg/l)	Agriculture and Irrigation Use	Soakaway Well (mg/l)
Pb	1	1	1
Se	1	0.1	0.1
H_2S	3	3	3
SO_3	1	1	1
SO_4	(1) 400	500	400(6)
V	0.1	0.1	0.1
ZN	2	2	2
Oil and Grease	10	10	10
Detergent (ABS)	1.5	0.5	0.5
BOD 5	30 (50) (*)	100	30 (momentarily (100))
COD	60 (100) (*)	200	60 (momentarily (100))
DO	2	2	-
TDS	(1)	-	(6)
TSS	40 (90) (*)	100	-
Soluble Salt	0	0	-
pH	6.5 – 8.5	6.0 - 8.5	5 - 9
Radioactivit y	0	0	-
Turbidity	50	50	-
Colour	85	85	75
Temperature	(3)	-	-
Faecal Coliforms (/10ml)	400	-	400
Nematodes	-	4	-
Total Coliforms	1000	1000	1000

Notes

(*): The concentration in () is the value accepted for peak;

(1): Concentration < 10% after 200 m of the discharge point;

(2): Concentration < 10% of their standards;

(3): The temperature increase of the water must be less than 3°C after 200 m from the discharge point;

(4): The number of nematodes for the ultimate purpose of irrigation of products which are used in the raw form, should not be more than 1 nematode per lit.

(5): Not more than 1 of potable water.

(6): Not more than 10% of potable water.

The above limits have been obtained from "Extract of rules and regulations for the protection of the environment practice and standards applicable for Oil industry" prepared by the Ministry of Petroleum Department of Environmental Protection – 1997.

The reference waste water concentration limits to be applied to the project are those referred to the direct discharge to surface waters (e.g. river, channel, sea).

Further requirements for discharges to the Environment are set by FEWA in Volume III, Form Sheet 6: Performance Guarantees.

Table 5-4 FEWA Performance Guarantees in Regards to the Liquid discharges into the Environment

Description	Unit	Data
Ammoniacal nitrogen	mg/l	≤ 0.5
Arsenic (As)	mg/l	≤ 0.1
Biochemical Oxygen Demand (BOD)	mg/l	≤ 30
Cadmium (Cd)	mg/l	≤ 0.1
Chlorine (residual)	mg/l	≤ 0.15
Chromium, total (Cr)	mg/l	≤ 0.5
Copper (Cu)	mg/l	≤ 0.5
COD	mg/l	≤ 100
Cyanide (CN)	mg/l	≤ 0.1
Oil	mg/l	≤ 10
Iron, total (Fe)	mg/l	≤ 1
Lead (Pb)	mg/l	≤ 0.1
Manganese (Mn)	mg/l	≤ 1
Mercury (Hg)	mg/l	≤0.001
Nickel (Ni)	mg/l	≤0.5
pH		6.5 – 8.5
Phenols	mg/l	≤ 0.1
Phosphate (total as P)	mg/l	≤ 3
Selenium (Se)	mg/l	≤ 0.05
Silver (Ag)	mg/l	≤ 0.1
Sulphide	mg/l	≤ 0.2
Suspended solids	mg/l	≤ 30
Vanadium	mg/l	≤ 1.0

Description	Unit	Data
Zinc (Zn)	mg/l	≤ 1.0
TDS	mg/l	Not more than 5% above receiving water at the boundary of the mixing
Max. cooling seawater temperature rise	°C	5

5.4 Proposed Requirements for EIA

In accordance with the described potential impacts the table below details the impacts that may require detailed assessment at the EIA stage.

Table 5-5 Marine Environment Impacts for Further Assessment at the EIA stage

Potential Impact	Justification
Construction	
Dredging of Seabed / Installation of Intake and Outfall	Marine habitats may be sensitive to such activities and may result in the loss of any benthic fauna as well as corals and seagrass that may be present (if any).
Disturbance of Marine Fauna	It is expected that fauna will avoid the working area during construction due to noise and reduction in ambient water quality. As such, potential impacts to fauna during dredging will be assessed in the EIA.
Impacts to Zooplankton	Impacts to zooplankton communities from marine works or equipment discharge have the potential to be significant where mitigation and management measures are not adequately incorporated. Any impacts will be managed through a CEMP which will include measures to limit this type of impact.
Impacts to Phytoplankton	The mitigation and management measures proposed for zooplankton will sufficiently address the impact on phytoplankton. The EIA will not further assess the impacts upon phytoplankton specifically.
Impacts on Sediment Quality	Impacts to marine sediment quality from marine works or equipment discharge have the potential to be significant where mitigation and management measures are not adequately incorporated. Any impacts will be managed through a CEMP which will include measures to limit this type of impact.
Degradation of Water Quality	Impacts to ambient water quality from marine works could potentially be significant, where mitigation and management measures are not adequately incorporated. Any impacts will be managed through a CEMP which will include measures to limit this temporary impact.
Operation	
Entrainment of fauna to intake	Impacts upon fish are expected to be minimal as the intake velocity will be optimised to reduce such effects. The EIA will not further assess the impacts upon marine fauna but will provide mitigation measures to reduce the impacts.
Increased Salinity	It is necessary to determine the extent of the brine mixing zone to ensure that it can meet the necessary standards and to ensure that

Potential Impact	Justification
	the size of the mixing zone can be reduced as far as practically possible in accordance with the applicable requirements.
Discharge of Treated Wastewater Effluents	No discharges to marine environment other than brine from RO desalination process.

In order to provide a representative assessment of the significance of potential impacts, the following methods listed in the table below have been proposed to enable further assessment of identified potential impacts in the EIA.

Table 5-6 Marine Environment Impact Assessment Methodology at the EIA Stage

Potential Impact	EIA Assessment Methodology
Construction Phase	
Dredging of Seabed / Installation of Intake and Outfall	Baseline Study: The EIA phase will include a project specific marine baseline survey that will be undertaken to provide a baseline assessment of habitat, flora & faunal species, water quality and sediment quality. The marine survey will be undertaken by SCUBA technique and will collect survey results at six (6) sample locations. One (1) situated at the expected marine intake and one (1) at the outfall location (within the expected area of influence by dredging). Two (2) locations will be located upstream either side of the most eastern peninsula of Al-Sinniyah island and two (2) locations towards the northern area of the project. These upstream and downstream locations will serve as 'control locations'. At each location, water and sediment samples will be collected for physicochemical analysis. Water quality samples will be taken at middle water column depth. A 50 m transect will be carried out at each location, including benthic analysis every 5m along the transect using 1m^2 quadrats. The transect will compile an inventory of observed flora and faunal species and to assess their health, density, and abundance. All fish and marine fauna observations will be noted and recorded per location. These results will be incorporated with the findings from six (6) locations surveyed along the expected intake and outfall marine corridor in October 2017 for the Project's Preliminary EIA. The baseline section will identify any sensitive habitats and will identify species with respect to any conservation status (e.g. IUCN). The marine survey will report all data, methods and photographs as an appendix to the EIA.
	Assessment of Impact Significance: The EIA will assess and quantify areas of seabed that will potentially be damaged from the dredging works of the intake and outfall pipelines (including construction working area where applicable) and will seek to estimate the extent of impacts upon marine habitats based upon the density and health of any flora. Sediment plume modelling from management of dredged material will be assessed in the EIA. Sediment dispersion as a result of dredging works during construction will be simulated using 3D hydrodynamic modelling software to predict turbidity/ suspended solids plume dispersion .

Potential Impact	EIA Assessment Methodology
Disturbance of Marine Fauna	<u>Baseline Study:</u> The baseline assessment will be linked to the marine survey to identify fish species and any other marine fauna, and their significance.
	<u>Assessment of Impact Significance:</u> Based on the sensitivity of the fauna identified, the EIA will include a qualitative assessment in regard to the impacts upon fish and marine fauna. The EIA will also assess potential impact on any IUCN classified wildlife species that may be present in the area.
Operational Phase	
Increased Salinity	<u>Baseline Study:</u> The EIA will compile ambient water quality data from the samples taken during the marine survey described above.
	<u>Assessment of Impact Significance:</u> The project design will be modelled to predict the dispersion characteristics and areas of mixing zone. The area of the predicted mixing zone will be assessed against the baseline habitat maps to identify potential impacts to marine ecology during operations. Hydrodynamic modeling enables the investigation of nearfield and far field interactions between the discharged effluent on the marine environment through simulation of seabed resistance, wind forcing, baroclinic forcing, hydrographic boundary conditions and atmospheric influence (e.g. pressure and temperature. A 'baseline' simulation will be carried out for validation/calibration purposes) which will include natural tidal and wind influences only (i.e. no outfalls). Calibration/validation will be conducted by comparing measured data with simulated data for the same time period. Where required, various factors within the model (e.g. seabed roughness, wind influence, initial conditions etc.) will be tweaked in an iterative process to obtain the best fit of measured data as possible. Past available ADCP data will be used for calibration/validation. The simulation of the effluent plume from the SWRO within a hydrodynamic model which is ideal for visualising the advection and dispersion behaviour of effluents which are released at a different density to the ambient environment. The fully baroclinic nature of modelling software enables density currents caused by this differential density to be simulated accurately, in conjunction with other dispersal effects associated with dispersion, tide and wind driven flows and atmospheric effects (such as surface cooling). The software also incorporates near-field simulations which can accurately simulate the 'jet' phase of the effluent (where the effluent momentum influences trajectory and mixing behaviour). These near-field simulations enable the influence of ambient currents on 'jet' behaviour to be portrayed within the hydrodynamic model.
Discharge of Treated Wastewater Effluents	<u>Baseline Study:</u> The EIA will compile ambient water quality data from the samples taken during the marine survey described above.
	<u>Assessment of Impact Significance:</u> Based on the ambient water quality analysis, a qualitative assessment in regard to the impacts upon water quality will be made based on the projects discharge guarantees.

Figure 5-1 Map of Water and Sediment Survey Locations

6 Terrestrial Ecology

6.1 Observations and Baseline Condition

The flora and fauna diversity of the UAE is influenced by the habitats that are created by the varying topography, geology and localised climate conditions. The vast majority of the UAE is characterised by arid desert conditions and extreme temperatures which presents a harsh environment for species to live in. This is true for the proposed project site conditions.

However, by comparison the coastal zones in the UAE provide greater diversity of flora and fauna species, owing to increased variability of the landscape and climate conditions, as well as the habitats afforded by the marine environment. For instance, the proposed project site is approximately 3.24 km from Al-Sinniyah Islands which is recognised for its flora and fauna diversity.

The Island has the largest Socotra Cormorant colony in the UAE (Muzaffar et al. 2017) which is listed as Vulnerable by the IUCN Red List of Threatened Species (IUCN, 2017). The Island also provides habitat for wading birds such as heron species, flamingos, the Great Knot and Crab Plover among other species like gazelles, red foxes and feral cats.

6.2 Sensitive Receptors

6.2.1 Habitats

The habitat present within the project can be broadly categorised into two types namely:

- Beach sands, with loose sand mixed with washed up remnants of marine life
- Sand dunes and dune troughs with irregular patches of vegetation

Habitats immediately outside the project site comprise beach sands and sand dunes.

Plates 6-1 Habitat within the Proposed Project Site

With respect to habitat types and based on the baseline conditions, the project footprint, the habitat around the project site can be classified as "Modified habitat" as it has been substantially modified due to the construction and operation of the E11 highway and the existence of vehicle tracks connecting E11 to the eastern and western extents of the project (on and off the site)

Plates 6-2 Example of Modified Habitat Within the Project Site

6.2.2 Species

During the site visit the following sensitive receptors were identified in the proposed project site.

Table 6-1 Flora and Fauna Species Identified During the Site Visit

Description	Photo
Tetraena qatarense This species was frequently sighted across the Project site	
Cornulaca monacantha This species was frequently sighted across the proposed project site	
A few *Acacia* trees were spotted across the proposed project site	 
Cyperus conglomeratus This species was encountered across the site	

This thorny bush was among a few spotted during the site visit	 
A high number of burrows were seen across the site during the visit. These could belong to any reptiles or small mammals like mice commonly found in UAE even though fresh lizard footprints were visible in the sand in some cases.	
This skeleton was spotted during the site visit and based on its structure it is assumed to be that of a camel.	

6.3.1! Construction Phase

In general, it is expected that site preparation activities will include the removal of vegetation in the project footprint, followed by grading for foundations, excavations for below ground infrastructures, and trenching and backfilling for cables and pipelines. Trenching activities could result to direct mortality of small fauna. These impacts are considered direct and permanent, as fauna may be required to find suitable alternative habitat in the surrounding area.

If the project site is not properly graded and no erosion barriers are installed, then runoff composed of sediment and organic material may be washed into the sea and potentially compromising the water quality.

Disturbance of Fauna

Fauna at the project site and local areas may also be disturbed due to the loss of the habitat and temporary effects of noise and vibration during construction. This may result in a flight response form the project area, with fauna likely to migrate away from the works.

However, neither the proposed project site nor the local area is found in an ecologically designated habitat and there are no known protected flora or fauna species in the area. Therefore, site preparation works are expected to have negligible terrestrial ecological impacts given the nature of the proposed project site as described in the baseline.

Direct Mortality of Fauna

The movement of vehicles and heavy machinery within the project site as well as site clearance and excavation could cause direct mortality of fauna species such as invertebrates, reptiles, birds or small mammals. Reptiles such as lizards and small mammals could be particularly affected since they may retreat back to their burrows which potentially exposes them to the risk of being injured or killed by the construction equipment.

6.3.2 Operational Phase

Due to the likely paving and hard standing construction over the majority of the proposed site, it is anticipated that impacts during the operational phase to any on site vegetation will be minimal. As such, the only activities that could negatively impact the ecology of the site would be through indirect measures, relating to poor management practices of any designated landscaped areas; or to the introduction of alien or invasive species.

6.4 Proposed Assessment Requirement for EIA

In accordance with the outlined potential impacts, the table below details those impacts that will require further assessment at the EIA stage.

Table 6-2 Terrestrial Ecology Impacts for Further Assessment at the EIA Stage

Potential Impact	Justification
Construction	
Habitat Loss	It will be necessary to determine the existing ecology and habitats site by undertaking a baseline survey in the project footprint as well as an overview of the local area.

Disturbance of Fauna	Baseline assessment of the project area will be required in order to identify the species that may potentially be affected by the projects construction works or affected by habitat loss.
Operation	
As additional impacts to terrestrial ecology are not expected during operation of the RO Plant, further impact assessment is not proposed in the EIA	

In order to provide a representative assessment of the significance of potential impacts, the following methods in the table below have been proposed to enable further assessment of potential impacts in the EIA.

Table 6-3 Terrestrial Ecological Impacts Assessment Methodology at the EIA Stage

Potential Impact	EIA Assessment Methodology
Construction Phase	
Habitat Loss & Disturbance of Fauna	Baseline Study: The EIA will incorporate the undertaking of a plant species inventory to confirm that flora within the project area is not afforded national protection or associated with any international conservation status. Habitat survey of flora will be undertaken of the area within the project footprint to assess the floral diversity and associated fauna. For the fauna, dawn and dusk surveys will be undertaken by a walkover survey of the project site to record sightings, tracks and evidence of mammals and reptile species. The survey will be repeated to ensure that all species have been recorded together with GPS locations. A review of available data sources will be assessed for the potential presence of species of importance of conservation concern on the site. This will be validated by site-based observations. The baseline surveys will output inventories for flora and fauna with details of any related conservation status (e.g. in alignment with IUCN). The importance and sensitives of habitats on-site will be assessed in accordance with a best practice methodology. Sensitive habitats will be delineated on habitat maps.
	Assessment of Impact Significance: If sensitive species or habitats of concern are identified by the baseline surveys, further detailed assessment will be undertaken to assess the significance of impacts. Specifically, construction activities will need to be controlled to ensure against any unnecessary impacts for the potentially any sensitive habitats in the area. This should be achievable through the implementation of a robust CEMP.

7 Soils, Geology and Groundwater

7.1 Observations and Baseline Condition

7.1.1 Topography

The proposed project is located immediately adjacent to the Arabian Gulf coastline of Umm Al Quwain. The western side of the site slopes gently towards the sea while the eastern side is characterised by sand dunes gently sloping to form dune troughs with scattered vegetation.

The E11 highway is slightly elevated above the site level and gently slopes towards the beach on the west side. The coastal zone of the project site is characterised by a flat sandy beach with limited vegetation.

Plates 7-1 Topography of the Proposed Project Site

7.1.2 Geology

The UAE and Umm Al Quwain lies over the Arabian Platform, which is a Phanerozoic terrain consisting of clastic, calcareous and evaporitic successions dipping gently eastward away from the Arabian Shield. These sedimentary layers crop out as relatively flat lying beds of sandstone, siltstone, limestone, and evaporites (salt deposits), and were deposited on the underlying Precambrian basement. Therefore, the age of the platform is from the pre-Cambrian to the present.

The youngest deposits in the region include coral limestone and unconsolidated sand, silt, gravel, and sabkha, which have accumulated in well-known areas such as the Rub al Khali and An Nafud, and have filled dried-up lake beds and wadis, and fringed the coastlines.

The coastal plains of the UAE rise gently towards the Hajar mountains, consisting of granular soils (sands, gravels, boulders and cobbles), overlying tertiary limestone, shale, siltstone and sandstone) or crystalline rocks.

7.1.3 Soil Quality

The soil in the proposed project site can be characterised as loose, unconsolidated sand which is bound together in places where there is vegetation. Review of satellite imagery did not identify previous use of the project site or evidence of pollution. During the site visit, it was observed that there were vehicle tyre tracks, fire pits, waste and a minor localised fuel spillage at the project site all of which may have an influence on the soil quality (Plates 7-2). This is however unlikely to cause a specific threat to the soil quality since it may be localised.

7.1.4 Groundwater

As the proposed project is adjacent to the Gulf Coastline of Umm Al Quwain, groundwater quality at the project site is likely to resemble that of the sea. In addition, the level and recharge rate of the groundwater may also be influenced by tidal movement.

During the site visit, 5 Capitals did not identify any groundwater users in the vicinity of the project. It was further observed that the wastewater treatment plant near the project site discharges some of its water in an area close to the proposed project boundary as shown below. In the event that this water percolates to the groundwater, it may have an influence on the quality of the groundwater. In addition, any discharge may also have an influence on the localised level of groundwater in this area although this is more likely to be influenced by the tides.

Plates 7-2 Possible Contamination of the Proposed Project Site

7.2 Potential Impacts

7.2.1 Construction Phase

Leaks and Spillage

Soil and groundwater may be susceptible to contamination from various sources during the construction phase. Primary sources of contamination are typically those placed along the handling of products where liquid waste and hazardous liquids/materials can escape directly into the soil potentially resulting in contamination to exposed soils and potentially being transferred via the high porosity sandy soils to the groundwater.

The risk of accidental spillage and leakage of various chemical products, are often attributable to storage areas of the construction site as well as during the transportation of such materials on and off the site. Improper methods of storing, transferring, and handling of these products can result in spillage to the ground and result in soil contamination.

If pollutants reach the groundwater, the spread of pollution can increase quite rapidly and can prove difficult to control.

Cross Contamination of Historic Contamination

The risk of cross contamination arising from encountering contaminated soils from accidental spills or leaks (as discussed above) in the area is likely and cannot be ruled out. As such, there is a potential risk of cross-contamination of any contaminated soil within the proposed project site.

Groundwater Dewatering

Groundwater dewatering maybe required as a result of excavation activities. Where this is the case there is a potential for any existing groundwater contamination (if it exists) to be transferred or cross-contaminated to other environmental components.

Inadequate Waste Management

Construction of the proposed project will involve activities that generate solid and hazardous waste, as well as potential liquid wastes. Hazardous wastes generated during these activities pose a threat to the site soils if not effectively managed, particularly where direct or indirect exposure may occur.

7.2.2 Operational Phase

Spill and Leaks Associated with Operation

In-effective storage, handling and usage of any hazardous materials (e.g. chemicals) and the management of wastewater from sanitary facilities during the operational phase may introduce risks associated with spills and leaks to ground. These factors pose a potential risk to soil and groundwater pollution.

7.3 Standards and Regulatory Requirements

7.3.1 National Standards

Since Umm Al Quwain does not have specific standards for soil and groundwater quality, the project will comply with the DM standards for prevention of land contamination including Federal Law No. (24) of 1999 and Local Order No. 61 of 1991 which strictly prohibit the uncontrolled pollution of soils and groundwater.

Table 7-1 DM Land Contamination Indicator Levels

Parameter	DM Soil mg/kg
Arsenic	50
Barium	400
Cadmium	5
Chromium (total)	250
Copper	100
Lead	200
Manganese	700
Mercury	2
Zinc	500
Selenium	2
Pesticides	2
Fluoride	500
Phenol	1
Benzene	1
BTEX(total)	100
Chlorinated Hydrocarbons (total)	1
Polychlorinated Biphenyls	0.5
TPH <C9	1,000
TPH>C9	10,000
Cyanide (free)	10

7.3.2 Lenders Requirements

The UAE Federal regulations have not set the guidelines for groundwater quality. As such, the Dutch Ministry of Housing, Soil and Groundwater Intervention Values Guidelines will be used as a good practice reference.

Table 7-2 Dutch Groundwater Standard Values

Parameters	Target value	Intervention value
Heavy Metals		
Arsenic	10	60
Barium	50	625
Cadmium	0.4	6
Chromium	1	30
Chromium III	-	-
Chromium IV	-	-
Cobalt	20	100

Parameters	Target value	Intervention value
Copper	15	75
Lead	15	75
Mercury	0.05	0.3
Molybdenum	5	300
Nickel	15	75
Zinc	65	800
Other Inorganic Substances		
Chloride	100 mg/l	-
Cyanide free	5	1500
Cyanide Complex	10	1500
Thiocyanate	-	1500
Aromatic Compounds		
Benzene	0.2	30
Ethyl benzene	4	150
Toluene	7	1000
Xylene (sum)	0.2	70
Styrene (vinyilbenzene)	6	300
Phenol	0.2	2000
Cresols (sum)	0.2	200
Chlorinated Hydrocarbons		
Volatile Hydrocarbons		
monochloroethene (vinyl chloride)	0.01	5
dichloromethane	0.01	1,000
1,1-dichloroethane	7	900
1,2-dichloroethane	7	400
1,1-dichloroethene	0.01	10
1,2-dichloroethene (sum)	0.01	20
Dichloropropanes (sum)	0.8	80
Trichloromethane (chloroform)	6	400
1,1,1-trichloroethane	0.01	300
1,1,2-trichloroethane	0.01	130
Trichloroethene (Tri)	24	500
Tetrachloromethane (Tetra)	0.01	10
Tetrachloroethene (Per)	0.01	40
Chlorobenzenes		
Monochlorobenzene	7	180
Dichlorobenzenes (sum)	3	50
Trichlorobenzenes (sum)	0.01	10
Tetrachlorobenzenes (sum)	0.01	2.5
Pentachlorobenzene	0.003	1

Parameters	Target value	Intervention value
Hexachlorobenzene	0.00009	0.5
Chlorophenols		
Monochlorophenols (sum)	0.3	100
Dichlorophenols (sum)	0.2	30
Trichlorophenols (sum)	0.03	10
Tetrachlorophenols (sum)	0.01	10
Pentachlorophenol	0.04	3
Pesticides		
Chlordane (sum)	0.02 ng/L	0.2
DDT	-	-
DDE	-	-
DDD	-	-
DDT/DDE/DDD (sum)	0.004 ng/L	0.01
Aldrin	0.009 ng/L	-
Dieldrin	0.1 ng/L	-
Endrin	0.04 ng/L	-

Note*: The soil values are calculated for a 'Standard Soil' with 10% organic matter and 25% clay. A case of environmental contamination is defined as 'serious' if >25 m³ soil or >100 m³ groundwater is contaminated above the intervention value.*

Source: Soil Remediation Circular 2009, Annex 1: Groundwater target values and soil and groundwater intervention values. (*Target values for soil refer to 2000 version as they are not present in the 2009)

7.4 Proposed Assessment Requirements for EIA

In accordance with the described potential impacts, the table below details those impacts that may require detailed assessment at the EIA stage.

Table 7-3 Soil, Geology & Groundwater Impacts for Further Assessment in the EIA

Potential Impact	Justification
Construction	
Cross Contamination of potential historic contamination	There is a risk of cross contamination arising from encountering contaminated soils during excavation and land grading activities during the construction phase. This risk can be largely negated through taking soil samples to determine the level of contamination and corrective measures needed.
Spill and Leaks Associated with Construction	Hazardous materials, fuels and chemicals will be on-site during the construction phase and there is a risk of direct contamination if not handled or stored correctly. Such risks will be managed through the implementation of a CESMP.

Potential Impact	Justification
Groundwater Dewatering	There is a risk of existing groundwater contamination (if it exists) to be transferred or cross-contaminated to other environmental components during construction.
Inadequate Waste Management	Potential project impacts are all attributable to improper site management and should be adequately controlled thought the implementation of a robust CESMP
Operation	
Spill and Leaks Associated with Operation	Small quantities of hazardous materials, fuels and chemicals will be on-site during the operations phase and there is a risk of direct contamination if not handled or stored correctly. Such risks will be managed through the implementation of an OESMP.

In order to provide a representative assessment of the significance of potential impacts, the following methods presented in Table 7-3 have been proposed to enable further assessment of potential impacts in the EIA

Table 7-4 Soil, Geology & Groundwater Impact Assessment Methodology at the EIA Stage

Potential Impact	EIA Assessment Methodology
Construction Phase	
Cross Contamination of Historic Contamination	<u>Baseline Study:</u> As a precautionary approach and to establish baseline soil quality conditions, the EIA baseline survey will include four (4) soil samples. A topsoil sample will be collected from each sampling location up to a depth of 10cm (after scraping away the immediate surface layer). The purpose of sampling in the topsoil is based on the likely influence of above ground features (i.e. construction laydown area). Soil samples will be sent for analysis at an accredited laboratory where they will be analysed for concentrations of pH, Oils & Greases, TPH and a suite of heavy metals.
	<u>Assessment of Impact Significance:</u> The assessment of impact significance will be determined on the baseline condition of the soils in combination with the expected likelihood and magnitude of impacts of cross-contamination to soils.

8 AIR QUALITY

8.1 Observations and Baseline Condition

8.1.1 General

The UAE is predominantly classified as a desert environment and experiences high temperatures, with many days of sunshine and high levels of humidity. Despite being generally low in volume, there are also periods of intermittent rainfall, which may occur several times a year. Average temperatures from January to December typically range from 17°C to 35°C while precipitation occurs between December to March. The prevailing winds in the UAE come from the Northwest and South and tend to vary depending on the time of year.

Due to the environment and low rainfall, dust hazes occur reasonably frequently, especially in the summer months. Dust storms can also occur in the region, and significantly impact upon ambient air quality, with high concentrations of suspended particulate matter.

8.1.2 Site Based Conditions

Air quality and in particular instances of poor air quality are influenced less by geographical considerations and more by proximity to pollution sources (e.g. cities, highways and industrial facilities). Typically, the air shed closer to a pollution source is of poorer quality than at a greater distance (due to pollutant dispersion), however air quality at a particular location is generally dependant on weather conditions particularly wind direction and wind strength; which has a large effect on the direction and dispersion of the pollutant plume.

The site is located adjacent to both carriageways of the E11 highway and a wastewater treatment plant and is therefore likely to be impacted by pollutant emissions from these sources.

Plates 8-1 Location of the E11 Highway Next to the Project Site

8.2 Sensitive Receptors

Table 8-1 Potential Air Quality receptors

Receptor	Justification
Project construction workers	The proximity of these receptors to the proposed project site introduces the risks associated with air quality degradation especially during the construction phase (i.e. from construction dust and construction equipment emissions).
Ras Al Khaimah Tourism Development Authority & Rixos Bab Al Bahr resort	
Workers at the wastewater treatment plant	

8.3 Potential Impacts

8.3.1 Construction Phase

Activities associated with the construction phase are likely to result in the temporary fugitive emissions of dust and gaseous pollutants associated with the use of plant, vehicles and machinery.

In particular, impacts are likely to be associated with:

- Dust deposition, resulting in the soiling of surfaces;
- Visible dust plumes, which are evidence of dust emissions;
- Increased Particulate Matter concentrations, as a result of dust generating activities on site and vehicle movement son unpaved surfaces;
- Localised temporary increase in concentrations of airborne particles and gaseous pollutants (e.g. nitrogen dioxide, carbon monoxide, sulphur dioxide)

due to exhaust emissions from diesel powered vehicles and equipment used on site (non-road mobile machinery) and vehicles accessing the site;

- Stored VOCs and other volatile hazardous materials due to release of volatile gases; and
- Odour from temporary wastewater facilities, or wastewater containment.

The site's boundary is approximately 64 m away from a wastewater treatment plant and approximately 44 m from Arabian sea. In addition, the site is approximately 500 m from Ras Al Khaimah Tourism Development Authority and Rixos Ban Al Bahr resort. The proximity of these receptors to the proposed project site introduces risks associated with air quality degradation especially during the construction phase of the project.

8.3.2 Operational Phase

As the proposed projects power demand will be met externally from FEWA's power grid, there are no additional fuel combustion requirements and as such there will be no direct air emissions from the operation of the project.

Operations of the project will result in a small additional number of commuter vehicles and delivery/removal vehicles along access roads to the project site. This additional number of vehicles is expected to be low (e.g. less than 150 trips per day), and as such this is not expected to result in a discernible impact on local air quality above existing impacts from vehicles using the E11.

8.4 Standards and Regulatory Requirements

The following sections provide the national and lender requirements air quality standards which are applicable to the proposed project. In accordance with the lender requirements, where more than one standard is available, the more stringent limit will be utilised for purpose of the EIA.

8.4.1 National Standards

Table 8-2 Federal Ambient Air Quality Standards

Parameter	FEA μg/Nm³ unless stated		
	1-hour	24-hour	Annual
PM_{10}	-	70	-
Nitrogen Dioxide	400	150	-
Sulphur Dioxide	350	150	60
Ozone	200	120 (8hr)	-

Parameter	FEA µg/Nm³ unless stated		
	1-hour	24-hour	Annual
Carbon Monoxide	30 mg/m3	10 mg/m3 (8hr)	-
TSP	-	230	90
Lead	-	-	1

* Source: Ambient Air Quality Standards, Air Protection System, Federal Cabinet of Ministers Decree No (12) of 2006, E.
(1) Emission levels are at 6% O2 v/v dry basis (0°C and 1 atm')

8.4.2 Lender Requirements

Table 8-3 IFC/WHO Ambient Air Quality Guidelines (µg/m³ unless stated)

Parameter	WHO Standards	
	24 hour	Annual
PM10	150 (Interim target 1)	70 (Interim target 1)
	100 (Interim target 2)	50 (Interim target 2)
	75 (Interim target 3)	30 (Interim target 3)
	50 (guideline)	20 (guideline)
PM2.5	75 (Interim target 1)	35 (Interim target 1)
	50 (Interim target 2)	25 (Interim target 2)
	37.5 (Interim target 3)	15 (Interim target 3)
	25 (guideline)	10 (guideline)
Nitrogen Dioxide	200 (1 hour)	40
Sulphur Dioxide	125 (Interim target 1)	500 (10-minute guideline)
	50 (Interim target 2)	
	20 (guideline)	
Ozone	100 (8 hour daily maximum guideline)	-

8.5 Proposed Assessment Requirements for EIA

In accordance with the outlined potential impacts, the following table details those impacts that may require further assessment at the EIA stage.

Table 8-4 Air Quality Impacts for Further Assessment at the EIA Stage

Potential Impact	Justification
Construction	
Dust Generation	In accordance with screening guidance of the UK's Institute of Air Quality Management (IAQM) for construction dust, the need for detailed assessment relating to dust impacts will normally be required where: *There is a 'human receptor' within 350 m of the boundary of the site, or within 50 m of a route used by construction vehicles on public roads (up to 500 m from the site entrance).* *There is an 'ecological receptor' within 50 m of the boundary of the site, or within 50 m of a route used by construction vehicles on public roads (up to 500 m from the site entrance).* With respect to the screening above, the site's boundary is approximately 64 m away from a wastewater treatment plant and approximately 44 m from Arabian sea. Therefore, since the project will require construction of intake and outfall pipelines a precautionary approach will be used in the assessment of dust generated during construction in the EIA stage.
Construction Equipment Gaseous & Particulate Emissions	Emissions from the operation of construction equipment and plant are not expected to result in noticeable incremental impacts to the local air shed, which is already affected by other source such as vehicle emissions from E11 amongst others.
VOC's	The potential for VOC impacts is expected to be minimal and limited to the site. This is primarily due to the limited potential for diffuse source VOC's from the site.
Odour	The potential for odour impacts could cause nuisance to nearby off-site receptors downwind.
Operation	
Vehicle Gaseous Emissions	Emission from vehicle movements are not expected to result in noticeable impacts to the local air shed, which is already affected by emission from local sources especially from E11.

In order to provide a representative assessment of the significance of potential impacts, the following methods have been proposed to enable further assessment in the EIA.

Table 8-5 Air Quality Impact Assessment Methodology at the EIA Stage

Potential Impact	EIA Assessment Methodology
Construction Phase	
Dust Generation	<u>Baseline Study:</u> A baseline assessment of particulates (PM_{10} & $PM_{2.5}$) will be undertaken for 72-hours at 2 locations. As a precautionary approach and to better understand baseline air quality conditions that may affect site personnel, the ambient air quality survey will also monitor ambient concentrations of nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and ozone (O_3). The monitoring campaign will run for a 72-hour period at each station to ensure the provision of representative conditions that can be compared with hourly and 24-hourly standards, as well as indicating diurnal fluctuations in ambient air quality, or fluctuation with the local weather conditions. A meteorological station will also be established for the period of the monitoring adjacent to the air quality monitoring station to measure wind speed, direction, humidity and temperature. **Figure 8-1 Location of Air Quality Monitoring Stations (AQ-1 and AQ-2)** 
	<u>Assessment of Impact Significance:</u> A determination of potential impacts will be made using the UK's IAQM Guidance on the Assessment of Dust from Demolition and Construction

	combined with baseline concentrations to determine the significance of impacts at the receptor locations. A comparison of the predicted impacts with the regulatory requirements for ambient air quality will be made.

The EIA will include best practice mitigation and management measures to reduce the potential for any associated effects to air quality. The intention will be for these best practice measures to be included into the OESMP and operational phase ESMS for effective management and implementation on-site. The same is relevant for potential impacts identified during the construction phase, whereby best practice mitigation and management measures will be included to the EIA for incorporation to the CESMP and construction phase ESMS.

9 Noise and Vibration

9.1 Observation and Baseline Condition

Noise

Field observations and review of satellite imagery as shown in the figure below have not identified any notable sources of noise that specifically propagate noise to the proposed location of the SWRO Plant. There are no specific industrial facilities or other large-scale commercial activities in the local project area that have the potential to generate noise. Despite this, the proposed project site is affected by the E 11 highway both on the eastern and western side.

Vibration

In terms of a baseline, no noticeable vibrations were encountered during the initial site visit whilst at the project site. Equally, there are no current facilities or processes in the vicinity of the proposed project site that are likely to result in vibrations at or around the area.

Localised vibration may be encountered adjacent to the E11 highway; however, these will typically be dependent on vehicle flows, and vehicle classification (e.g. ratio of HGV's to LGV's and private vehicles). The dissipation of any such vibration is expected to occur over a short distance due to the low magnitude of the vibrations.

9.2 Sensitive Receptors

Table 9-1 Potential Noise and Vibration Receptors

Receptor	Justification
Ras Al Khaimah Tourism Development Authority & Rixos Bab Al Bahr resort	These receptors are located approximately 440 meters from the project boundary and as a working area and tourist resort may be affected by construction noise, although noise levels will largely be attenuated due to propagation over distance.
Workers at the wastewater treatment plant	The wastewater treatment plant is located approximately 64m to 160m from the proposed project boundary. Therefore, the workers are considered to be sensitive to potential noise and vibration impacts especially during the construction period. Although it is recognised that such workers may already be exposed to noise and vibration impacts from the processes at the wastewater treatment plant.

9.3 Potential Impacts

9.3.1 Construction Phase

Construction Noise

Construction activities will likely result in temporary and short duration increases in the noise and vibration levels emanating from the project site, construction access road and the laydown areas.

Noise will be generated by construction and propagated to the surrounding areas via a range of processes. Pertinent construction activities at the project site in relation to noise are likely to include earthworks, movement of vehicles, compaction works and piling.

The accumulation of noise from the above sources can also introduce potential additional impacts when generated in tandem. All of these impacts may have a negative effect on the amenity to residents of Marjan Island and workers at the project site and the wastewater treatment plant.

Construction Phase Vehicle Noise

The construction phase will necessitate vehicle movements to move workers, materials and equipment to the site, whilst also removing wastes. Any increases in traffic during the construction phase may therefore lead to increases in the noise levels, which could potentially propagate to off-site receptors.

Vibration

Certain construction processes, particularly those involved with site preparation and civil works, e.g. breaking, piling, vibratory rollers etc. have the potential to create vibration within the vicinity of the works.

Vibratory impact is not expected to be discernible; due to the large attenuation of vibration over distance.

9.3.2 Operational Phase

Operational Noise

Reverse osmosis projects are typically low noise processes. Principle noise sources are anticipated to be associated with pumping stations and the flow of highly pressurised water. The reverse osmosis components of the project are typically not noisy and will be housed within internal structures therefore further attenuating any generated noise.

Given the existence of intermittent noise sources locally and the fact that the project is approximately 440 m from Ras Al Khaimah Tourism Development Authority, Rixos Bab Al Bahr resort and approximately 64 m from the wastewater treatment plant there will unlikely be a discernible impact to receptors.

Vibration

Vibration impacts are not expected during the operation of the SWRO as there will be none if any vibration inducing equipment or processes that may induce ground level vibration.

9.4 Standards and Regulatory Requirements

9.4.1 National Standards

The proposed project will be required to comply with the noise limits as specified by the UAE Federal Environment Agency Guidelines for residential, commercial and industrial areas during construction and Operation. The following tables provide a summary of the maximum allowable noise limits based on activity and zoning.

Table 9-2 FEA-Free Field External Noise Limits for Community Noise

Receptor Areas	Allowable Limits of Noise (dbA)	
	Day (7am -8pm)	Evening (8pm-7am)
Residential Areas with Light Traffic	40-50	30-40
Residential Areas in Downtown	45-55	35-45
Residential Areas with some workshops & Commercial or near highways	50-60	40-50
Commercial areas & Downtown	55-65	45-55
Industrial Areas (Heavy Industry)	60-70	50-60

9.4.2 Lender Requirements

The projects lenders are expected to require compliance with the IFC Performance Standards and IFC EHS Guidelines. The IFC EHS General Guidelines (2007) reference the World Health Organisation (WHO) noise standards that indicate the maximum allowable noise levels to be received at nearby receptors, which depends on receptor classification.

It is stated within the WHO noise standards that noise impacts should not exceed the levels which are presented in the table below or result in a maximum increase in background levels of 3dB at the nearest off-site point of reception.

Table 9-3 WHO Noise Standards (At off-site receptors)

Receptor	One Hour Leq (dB(A))	
	Daytime 07:00 – 22:00	Night time 22:00 – 07:00
Residential, Institutional, Educational	55	45
Industrial, Commercial	70	70

Furthermore, the following requirements have also been specified in the IFC EHS noise guidelines:

- No employee should be exposed to a noise level greater than 85 dB (A) for duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).
- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB (A), the peak sound level reaches 140 dB(C), or the average maximum sound level reaches 110 dB (A). Hearing protective devices provided should be capable of reducing sound level at the ear to at least 85 dB (A).
- For every 3 dB(A) increase in sound levels, the allowed exposure period or duration should be reduced by 50%.
- Where feasible, use of acoustic insulating materials isolations of the noise source and other engineering controls should be investigated and implemented prior to the issuance of hearing protection devices as the final control mechanism.
- Medical hearing checks on workers exposed to high noise levels should be performed periodically.

9.4.3 FEWA Requirements

In addition to the above regulations, FEWA provides more guidelines for guaranteed maximum noise pressure levels as shown in the table below.

Table 9-4 Guaranteed Maximum Noise Pressure Levels

Description	Unit	Limit
At 1-meter outside the RO plant fence during the operation of all equipment	dB(A)	60
At 1-meter distance of open air installation	dB(A)	85
Within the RO Plant control room	dB(A)	50
Within other machine rooms, RO membrane hall and workshops	dB(A)	85

9.5 Proposed Assessment Requirements for EIA

In accordance with the outlined potential impacts, the table below details those impacts that may require further assessment at the EIA stage.

Table 9-5 Noise & Vibration Impacts for Further Assessment at the EIA Stage

Potential Impact	Justification
Construction	
Construction Site Noise	Construction noise may not be discernible to the identified receptors which are in close proximity to the works and laydown area.
Construction Access Road Noise	The increase in vehicle traffic due to the construction phase may be noticeable at locations adjacent to the access road. Impacts upon such receptors are expected to be negligible and managed via a robust CEMP.
Vibration	Vibration impacts are not expected to be discernible at the sensitive receptors.
Operation	
Operational Noise	Operational noise will be minimal and largely attenuated by the SWRO housing and pump housing. Impacts will unlikely be discernible above existing noise locally.
Vibration	Impacts related to vibration are not expected during operational activities.

Table 9-6 Noise & Vibration Impacts Assessment Methodology at the EIA Stage

Potential Impact	EIA Assessment Methodology
Construction Phase	
Construction Site Noise	<u>Baseline Study:</u> In order to determine a representative baseline for existing noise levels at the sensitive receptors a noise monitoring survey will be undertaken with a noise meter compliant with Class 1 specification, as set out in BS EN 60804:2001. It is proposed that up to four (4) locations will be monitored and will be located at the Proposed project site, wastewater treatment plant and at the Ras Al Khaimah Tourism Development Authority. The survey will monitor ambient noise levels for 30-minute periods to provide measurements of Leq(A) readings for daytime periods. As night time construction works may be required, night-time noise surveys are to be carried out. 30-minute periods are considered representative as there are few sporadic noise sources locally, with primary noise sources being the continuous highway noise from the E11 highway. As such, noise monitoring will be undertaken at during both peak traffic and inter-peak traffic periods. The ESIA baseline noise section will include: • GPS coordinates, photographic record and map of the monitoring locations. • Presentation of monitoring results. • Comparison of results to applicable standards and requirements.

Figure 9-1 Baseline Noise Monitoring Locations

<u>Assessment of Impact Significance:</u>

Assessment of impact significance will be made by considering the existing baseline condition in combination with the potential additional construction phase noise impacts from construction sources.

The determination of impact magnitude will be made based upon a prediction of construction noise using BS5228-1:2009 *'Code of Practice for Noise and Vibration Control on construction and Open Sites'*. A basic model for the calculation of noise propagation will be used to predict the expected additional impact of the works at the receptors.

The potential impacts will be based upon the degree of change in decibels at the receptor location and compliance to regulatory noise standards.

The EIA will include best practice mitigation and management measures to reduce the potential for any associated effects upon noise and vibration. The intention will be for these best practice measures to be included into the OESMP and operational phase ESMS for effective management and implementation on-site. The same is relevant for potential impacts identified during the construction phase, whereby best practice mitigation and management measures will be included to the EIA for incorporation to the CESMP and construction phase ESMS.

10 Waste and Wastewater Management

10.1 Observation and Baseline Condition

Waste is an undesired by-product of every development, contributing to a number of environmental problems, for example, emissions of greenhouse gases, heavy metals and other environmentally hazardous chemicals. With proper management, a large amount of materials discarded can be recovered and either reused directly or disassembled and their components reutilised.

10.1.1 Project Site

NO existing structures or facilities that will require demolition during the construction phase were identified during the site visit within the project boundaries, with the exception of the rock armour at the beach. The project site was observed to be generally clean apart from the presence of general waste such as empty bottles, plastic wrappers and waste from previous geo-technical survey.

Plates 10-1General Waste Observed at the Project Site

10.2 Potential Impacts

10.2.1 Construction Phase

Waste

The construction phase can often be the most environmentally damaging phase of a project, particularly in regard to the volumes of waste that are generated, if not properly managed. Such impacts relate to the management of such wastes, particularly hazardous streams.

A robust CEMP for the project should outline the requirements for a waste management plan for the construction phase that incorporates the waste hierarchy as identified in the figure below.

Wastewater

The project will require on-site sanitation facilities for the construction workers (expected to be toilets with collection septic tanks). These facilities will require regular emptying and removal from the project site for disposal.

Liquid wastes generated during the construction phase will be trucked away for disposal off-site.

The commissioning phase of construction will likely require the hydro-testing, steam cleaning and perhaps chemical cleaning of plant components such as tanks and pipework. These commissioning activities will generate large volumes of wastewater that may contain residual heavy metals, as well as oils and greases.

Under all rainfall conditions pollutants from polluted construction surfaces can potentially runoff from the site and lead to a transfer of pollutants externally from the project into the receiving environment.

10.2.2 Operational Phase

Waste

Solid waste is not expected in significant quantities during the operational phase of the SWRO, besides maintenance for RO membranes and general day to day maintenance activities.

Disposal of material from operations can contribute to wastes directed to landfill resulting in subsequent risk of damage to local hydrological systems and emissions associated with necessary transport.

A robust CEMP for the project should outline the requirements for a waste management plan for the operational phase that incorporates the waste hierarchy as shown in the figure below.

Wastewater

When in operation, the project will use seawater to generate potable water. In order to generate potable water, the reverse osmosis process will separate the saltwater component, hence resulting in a residual volume of brine wastewater.

Brine wastewater will be discharged directly to the Arabian Gulf where it will mix and dilute with seawater to background concentrations within the projects mixing zone. Given that the brine wastewater is more dense than ambient seawater, it will likely sink through the water column as mixing takes place. As described in the relevant section of this scoping report, such impacts of brine will be assessed in the marine environment section of the EIA.

Other wastewater will be generated from sanitary systems on site and from general operational building (e.g. kitchen's, office buildings etc.). Wastewater will be treated at on-site treatment facilities prior to being reused for landscaping and industrial purposes within the site

10.3 Standards and Regulation Requirements

The UAE's commitment to the prevention of pollution associated with waste management is well established within the principal objectives of Feral Law No. (24) of 1999 for the Protection and Development of the Environment, namely:

- Protection and conservation of the quality and natural balance of the environment.
- Control of all forms of pollution and avoidance of any immediate or long-term harmful effects resulting from developments.

International financial institutions will require adherence to IFC General EHS Guidelines. These guidelines require that projects undertaken:

- Establish waste management priorities at the outset of activities.
- Identify EHS risks and impacts with regards to waste generation and its consequences.
- Establish a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes.
- Avoid or minimize the generation waste materials, as far as practicable.
- Identify where waste generation cannot be avoided but can be minimized or where opportunities exist for, recovering and reusing waste.
- Where waste cannot be recovered or reused, identify means of treating, destroying, and disposing of it in an environmentally sound manner.

Additional Technical Guidelines are likely to be considered in the EIA.

10.4 Proposed Consideration for Project EIA

10.4.1 Waste

Should any evidence of contaminated materials be identified from the site soil quality investigation (as outlined in the soils, geology and groundwater chapter), the EIA will consider appropriate disposal routes and potential acceptance criteria for any contaminated materials. This may include a requirement for additional analysis to provide a robust hazard classification.

The mitigation section of the EIA will consider the requirements established by Good International Industry Practice (GIIP) for general waste, hazardous waste and construction/demolition waste.

The outcomes of the contaminated land assessment undertaken as part of the EIA will need to consider appropriate disposal routes and potential acceptance criteria for any contaminated materials. This may include a requirement for sufficient analysis to provide a robust hazard classification.

Also, in preparation of the environmental management plans for the construction and operational phases, a principle component should be application of the waste hierarchy as shown in the figure below.

Figure 10-1 Waste Hierarchy

The waste hierarchy illustrates best practice for waste management considerations by ensuring consideration of the most sustainable available application for waste management in preference of disposal and eventual contribution to adverse environmental and economic impacts associated with landfill.

The waste hierarchy should form a key element of any waste management plan and if implemented effectively will achieve maximum reductions in waste generation. Application also has the potential to reduce costs associated with material procurement, handling, transportation and disposal.

The Construction & Operational Environmental Management Plans (CEMP & OEMP) for the project should include a requirement for a Waste Management Plan to outline the projects waste strategy in accordance with the waste hierarchy.

10.4.2 Wastewater

The EIA will inventory all wastewater streams and indicate the pathway and receptor of each stream. Any mitigation and control requirements for treatment will be fully outlined in the EIA.

11 TRAFFIC & TRANSPORTATION

11.1 Observation and Baseline Condition

The proposed project site will be accessed through the E11 highway which is directed to both north and south. The E11 highway is a key arterial route throughout the UAE and links Abu Dhabi to Ras Al Khaimah. Near to the site location, it splits to a separate 2-way carriageways (with hard shoulders) that flow north and south bound respectively. Even though the traffic flow along this section is not constant and busy there is a regular flow of vehicles (including passenger cars, HGVs and LDVs) though traffic congestion is highly unlikely near the project site.

During the site visit, street lights and road signage were observed as well as evidence of vehicle tracks on and off the project site used by vehicles connecting to the E11 highway at the eastern and western extents of the project site.

The proximity of the proposed project site to the E11hiighway will ease the transportation of supplies and materials into the project site. However, an access road will need to be constructed into the site.

Figure 11-1 Access Routes to the Proposed Project Site (E11 highway)

Plates 11-1 E11 Highway Passing Through the Proposed Project Site

11.2 Potential Impacts

11.2.1 Construction Phase

The key reason for vehicle use during construction will be the delivery of materials and equipment for construction activities as well as for the transportation of labourers.

The volume of traffic will vary over the course of construction, in accordance to the phases of construction and the demand for materials, removals and construction personnel on site. The main factors that will affect the number of vehicles on the roads will be related material usage manpower needs and waste generation.

Impacts due to additional vehicular transportation are not expected to be significant due to the existing high traffic flows and capacity of the E11 highway, but may be noticeable.

During the construction phase of the project, tunnelling will be required through the E11 highway for the laying of intake and outfall pipes. This and other construction works may lead to traffic management on one or both the carriageways which may include temporary lane closures and reduced speed limits. This may result in reduced speed of vehicles going past the site though it is not expected to result into congestion.

11.2.2 Operational Phase

In general transportation impacts during operations are not expected to be significant, as the operation of the SWRO will not require continuous delivery of materials, or other equipment in order to operate.

Occasional deliveries and waste removals are not expected to result in noticeable increases in vehicle traffic along the E11 due to the existing flows of vehicles and its capacity.

Staff movements will also contribute to a minimal additional vehicle flows on the E11 highway and internal site road.

11.3 Proposed Assessment Requirements for EIA

It is not expected that the project will result in additional traffic that will contribute to noticeable impacts along the E11 highway, or may result in congestion.

The EIA will however qualitatively assess the current levels of traffic in the area (if secondary data is available) and compare this against the anticipated levels of vehicle movements for the proposed project.

The assessment will determine the potential significance impact from associated plant traffic during construction and operation. Vehicle related secondary impacts on air quality, noise, and local infrastructure will be assessed in those specific sections of the EIA. The evaluation will also take into consideration any future plans for road expansions in the local area and assess any elevated risk in the vicinity of the sensitive receptors identified.

Where appropriate, mitigation measures relevant to the identified impacts will be recommended to reduce or eliminate these potential issues. It is anticipated that such items will be incorporated in the CEMP & OEMP.

12 ARCHAEOLOGY & CULTURAL HERITAGE

12.1 Observation and Baseline Condition

12.1.1 Archaeological Sites in the UAE

An examination of existing literature on archeologically and historically relevant sites in the UAE shows a selection of significant sites, which include ancient forts, trading camps, fishing villages and more. Archaeological artefacts have also been found within these sites.

12.1.2 International Cultural Heritage Sites in the UAE

Al Ain (Hafit, Hili, Bidaa Bint Saud and Oases Areas) is the only UNESCO World Heritage site in UAE since 2011.

The Cultural Sites of Al Ain (Hafit, Hili, Bidaa Bint Saud and Oases Areas) testifies to sedentary human occupation of a desert region since the Neolithic period with vestiges of many prehistoric cultures. Remarkable vestiges in the site include circular stone tombs (ca 2500 B.C.), wells and a wide range of adobe constructions: residential buildings, towers, palaces and administrative buildings. This site features one of the oldest examples of the sophisticated aflaj irrigation system, which dates back to the Iron Age. The site provides important testimony to the transition of cultures in the region from hunting and gathering to sedentarisation.

The site is approximately 200 km from the proposed project site and will therefore not be impacted by any of the project activities.

12.1.3 Cultural Sites in Umm Al Quwain

There are numerous sites of archaeological and cultural importance in the UAE and preservation and protection of such resources is vital. Sites of cultural and archaeological importance include ancient forts, trading camps, fishing villages, cemeteries and tombs. Some of these sites are found in Umm Al Quwain and are briefly discussed below.

Ed-Dur Site

Ed-Dur is one of the largest archaeological sites in the UAE. The periods of human settlement on the site include: Obeid, the Bronze Age, Stone Age, Iron Age, and Pre-Islamic periods. Site excavations revealed a square Fort, large number of funeral configurations and local stones residential buildings and a rectangle temple.

Alakaab Island site

This site dates back to the Neolithic period dating back to 5000 B.C. The archaeological excavations showed the presence of a patch of land which turned out to have been used for the slaughter of Dugongs.

12.1.4 Project Site

During the site visit no features of potential archaeological importance were identified on the proposed project site apart from a boundary marker between Umm Al Quwain and Ras Al Khaimah which is approximately 20 m from the proposed project site boundary and may be considered of cultural significance.

Plates 12-1 Boundary Marker between Umm Al Quwain & Ras Al Khaimah

12.2 Sensitive Receptors

As the proposed project site is generally not known to be of importance archaeologically or culturally, the only expected receptors relate to potential unknown buried artefacts within the project footprint. However, the boundary marker between Umm All Quwain and Ras Al Khaimah may be considered of cultural significance to the two Emirates.

12.3 Potential Impacts

12.3.1 Construction Phase

Excavation and earthwork activities can potentially result in the damage and destruction of undiscovered archaeological artefacts. Given the absence of cultural heritage features and lack of evidence of previous land use, the presence of archaeological features within the project footprint is likely to be low.

The EIA will ensure that a chance find procedure is incorporated within the project CEMP such that in the unlikely event any items of archaeological significance are uncovered, these can be appropriately identified and preserved. The EIA will also include management provisions in order to minimise any damage to the boundary marker between Um Al Quwain and Ras Al Khaimah.

12.3.2 Operational Phase

The operational phase will not result in further impacts to cultural heritage, as the site will be static and excavations will not be required.

12.4 Standards and Regulatory Requirements

The UAE passed into law the Federal Law No 11 of 2017 on Antiquities with an aim to:

- Protect monuments and artefacts from sale, damage and being defaced.
- Promote national identity and preserve cultural heritage for the purpose of enriching the national heritage of the country.

Where applicable this law will be considered during the EIA process.

12.5 Proposed Assessment Requirements for EIA

In accordance with the described potential impacts, the following table details those impacts that may require detailed assessment at the EIA stage.

Table 12-1Cultural Heritage & Archaeological Impacts for further Assessment at the EIA Stage

Potential Impact	Justification
Construction	
Damage to Unknown Buried Archaeology	Impacts are generally not expected due to the lack of cultural or known archaeological features at the project site. However, due to the heritage of the UAE as identified in the baseline, the impacts on archaeological features will be assessed in the EIA.

In order to provide a representative assessment of the significance of potential impacts, the following methods have been proposed to enable further assessment in the EIA

Table 12-2 Cultural Heritage & Archaeology Impact Assessment Methodology at the EIA Stage

Potential Impact	EIA Assessment Methodology
Construction Phase	
Damage to Unknown Buried Archaeology	<u>Baseline Study:</u> During the EIA process, A brief examination of the available literature on archaeological and historically relevant sites in Umm Al Quwain will be conducted, as will consultation with the relevant heritage authority in Umm Al Quwain. A walkthrough of the project site will be conducted to identify and locate any surface signs or features of archaeology, or sites of cultural heritage. A photographic record, GPS coordinates and map showing the presence of any archaeological/cultural sensitive areas will be undertaken. The EIA will not include further survey work such as archaeological digs or other investigations. The EIA will include best practice mitigation measures for the construction phase. The intention is to include these mitigation measures into the respective CEMP for effective management and implementation on-site. This will include a chance finds procedure.
	<u>Assessment of Impact Significance:</u> Where there is a risk of unknown buried archaeology being uncovered, the EIA will base the assessment of significance on a high potential value of the unknown artefacts but assess this with respect to the likelihood of an encounter.

13 SOCIO-ECONOMICS

13.1 Observation and Baseline Condition

13.1.1 Land Ownership and Land Use

The land ownership has been transferred by the Emir of Umm Al Quwain to FEWA which will allow FEWA to grant lease over the site to the Project Company.

The proposed site is undeveloped and there is no evidence of any historical use. During the site visit, evidence of vehicle tyre tracks were identified on and off the project site used by vehicles connecting to the E11 highway located at the eastern and western extents of the project site. In addition, there was evidence that animals go through the site through the observation of faeces and a camel skeleton. However, the site is located in the middle of the E11 highway and is unlikely to be used as a grazing site.

13.1.2 Population

Umm Al Quwain is the smallest and the least populated emirate in the UAE. According to the UAE government census in 2005, Umm Al Quwain has a population of 49,159 people. The Federal Competitiveness and Statistics Authority estimated the population of Umm Al Quwain nationals at 17, 482 people in 2010 with 8,671 males and 8, 811 females. Umm Al Quwain is the only emirates where the female population outnumber the male. Based on the population growth rate of + 3.35% between 1995-2005, the current population is estimated to be around 75, 441 people.

13.1.3 Economy

Fishing is considered to be a key economic contributor in Umm Al Quwain with export of seafoods to Europe and the Middle East. Efforts towards the diversification of the economy have led to the construction of the Ahmed Bin Rashid Port and the Free Trade Zone which are supposed to expand the commercial and investment base of Umm Al Quwain.

In addition to this, the economy is also based on tourism, agriculture and breeding of livestock. The emirate has rich coastal mangroves along the Arabian Gulf and islands that lie to the east of the mainland. The biggest of the islands, Al Seniah, is home to the Arabian gazelles, falcons and turtles.

13.2 Potential Impacts

13.2.1 Construction Phase

Land Use Change and Restriction on Access

Examination of the site indicates no evidence that development of the project will give rise to any involuntary resettlement of local population or direct displacement of economic activity.

There are no ethnic minorities, indigenous peoples or internally displaced people in the project area, or nearby. Therefore, the potential negative social impacts of the project are likely to be relatively limited.

13.2.2 Operational Phase

At a strategic level the operation of the SWRO Plant offers potential to support the continued growth of the local and national economies, through the ability to provide an important source of potable water to the FEWA network.

As with the construction phase, a significant economic impact during operation will result from any local employment created by the project. Whilst the size of the required workforce is significantly smaller, the type of work and the increased time-scales involved offer an opportunity for greater dissemination of skills. A targeted system of local recruitment and investment in the human capital of the local workforce will enhance this process and consequently increase the benefit to the local economy.

With regards to the impacts to the nearby community areas, the operational activities of the SWRO will likely have long term negative impacts, due to the reduction in amenity value of these receptors.

13.3 Proposed Assessment Requirements for EIA

In accordance with the described potential impacts, the following table details those impacts that may require detailed assessment at the EIA stage.

Table 13-1Socio-Economic Impacts for Further Assessment in the EIA

Potential Impact	Justification
Construction & Operation	
Land Use Change & Restrictions on Access	Although there was evidence of animals using the site through the observation of faeces and a camel skeleton, the project site is located in the middle of the E11 highway and is unlikely to be used as a grazing site. In addition, the vehicles that use the project site and the surrounding areas to connect to the E11 on the western and

Potential Impact	Justification
	eastern extent can use the existing roundabout approximately 400 m from the project site.
Employment & Economics	Positive impacts relating to the employment and economics of Umm Al Quwain as a whole are expected as a result of the project.

In order to provide a representative assessment of the significance of potential impacts at the EIA stage, the following methods have been proposed for further assessment.

Table 13-2 Socio-Economic Impact Assessment Methodology for the EIA Stage

Potential Impact	EIA Assessment Methodology
Construction & Operational Phase	
Land Use Change & Restrictions on Access	It will be necessary for the EIA to identify any informal land users and the rights of these land users, to determine what (and if any) mitigation measures will be appropriate. During the EIA, consultation is proposed with FEWA with respect to the current use of the proposed project site.

14 LANDSCAPE & VISUAL IMPACTS

14.1 Observation and Baseline Conditions

Landscape character could be defined as "a distinct, recognisable and consistent pattern of elements, be it natural (soil, landform) and/or human (for example settlement and development) in the landscape that makes one landscape different from another, rather than better or worse" (Natural England, 2014).

Due to the varied nature of developments being undertaken in the local project area, several landscape character types have been established or are natural features. These include the following:

- The Desert;
- The Coastline;
- The Open Sea;
- E11 highway;
- Marjan Island
- Ras Al Khaimah Tourism Authority;
- Rixos Bab Al Bahr resort;
- Umm Al Quwain public beach
- Wastewater treatment plant

14.2 Sensitive Receptors

The local landscape and visual sensitive receptors can be considered those bulleted above.

14.3 Potential Impacts

14.3.1 Construction Phase

One of the first stages of construction activities will result in the levelling, grading and preparation of the site, before the commencement of construction. The proliferation of such activities throughout the construction period and across the site will eventually result in land use changes, with the subsequent construction of small buildings and the construction of the SWRO Plant.

The movement of heavy construction vehicles and earthworks on sandy surfaces are also likely to result in dust generation and the resulting haze may disturb the visual envelopes of sensitive receptors, especially those using E11 highway.

Impacts to landscape character and the visual envelope of surrounding receptors will also occur at night where the addition of lighting during construction will illuminate this area that has previously been free of any light sources. The addition of light and eventual widespread use of lighting across the project construction site will result in a night time light haze being emitted in the air above the general site area. Potential impacts due to light may impact upon local receptor at night including the fauna in the area.

14.3.2 Operational Phase

The operational phase of the project will result into the loss of the view of the sand dunes as they will be replaced by the SWRO plant. However, this is unlikely to have a significant impact on the wider view of the landscape due to the existing infrastructure near the site.

It is envisioned that only minimal lighting will be required at night-time for security purposes. This is expected to result in minimal changes to the night time views given the current existing street lights and lighting from Marjan islands.

14.4 Standards and Regulatory Requirements

Specific Umm Al Quwain or UAE legislation in regard to landscape and visual conditions does not exist.

14.5 Proposed Assessment Requirements for EIA

In accordance with the described potential impacts, the following table details those impacts that may require detailed assessment at the EIA stage.

Table 14-1 Potential Landscape and Visual Impacts for Further Assessment at the EIA Stage

Potential Impact	Justification
Construction and Operation	
Change in Landscape Character	Given the anticipated change in landscape condition and associated visual impacts. It is proposed for the EIA to include a section for Landscape and Visual Impact Assessment in accordance with the guidelines set by the UK Landscape Institute "Guidelines for Landscape and Visual Impact Assessment, 3rd Edition, 2013".
Reduction in Visual Amenity	

The EIA will however include best practice mitigation measures so that any potential impacts can be reduced. The intention is to include these mitigation measures into the respective CEMP & OEMP's for effective management and implementation on-site.

The EIA should consider whether the project has been designed to be as visibly and environmentally discreet as possible and ensure that the setting of the project is sympathetic to its surroundings and consistent with the design of existing buildings in the area.

REFERENCES

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التاريخ : ١٠/١٠/٢٠١٨ Date:

الرقم : ٣٤٨٨/٢٠١٨ No. :

لمــن يهمــه الأمــر

يشهد قسم الصحة العامة ببلدية أم القيوين أن السادة/ **الهيئة الاتحادية للكهرباء والماء** قد قام بتسليم دراسة تقييم الأثر البيئي من شركة **فايف كابيتال للاستثمارات البيئية والادارية** التي تعد احدى الشركات الاستشارية المعتمدة .

وعليه حررت له هذه الشهادة بناءًا على طلبه دون أدنى مسئولية على البلدية تجاه الغير.

وتفضلوا بقبول فائق الاحترام

مدير ادارة الصحة العامة والبيئة
غانم علي سعيد

APPENDIX B – STAKEHOLDER CONSULTATION LETTERS

18th June 2019

Mr. Hussain Al Banna
Director of Traffic Department
Road and Transport Authority
PO Box 118899
Dubai, UAE

Attention: Director of Road and Transport Authority (RTA)

Project: FEWA 150 MIGD SWRO Independent Water Project Umm Al Quwain, UAE

Subject: Stakeholder Consultation for the Environmental Impact Assessment (EIA)

Dear Mr. Al Banna,

The Federal Electricity and Water Authority (FEWA) is proposing to develop a Sea Water Reverse Osmosis (SWRO) desalination plant in the Emirate of Um Al Quwain near Marjan Island, south of the border with the Emirate of Ras Al Khaimah. FEWA awarded the project to ACWA Power who will hold forty percent (40%) share of the project equity while Mubadala Investment Company PJSC and FEWA will own forty percent (40%) and twenty percent (20%) shares respectively. The Project is an Independent Water Project (IWP) and is expected to be commercially operational in the 2nd quarter of 2022.

The Project will be located on land in Umm Al Quwain with intake and outfall facilities extending into the marine environment. The land-based section of the project will be approximately 23.5 hectares in area on two plots of land adjacent to E11 carriageways (see attached location map). The initial scope of works as per the 2018 bid (Tender 39EW/2016) included the installation of the plant along with the associated intake & outfall facilities to produce 45 MIGD (204,500 m³/day) of desalinated water. However, in March 2019 FEWA invited ACWA Power & Mubadala under Tender 39E/2016 to submit a proposal for the best technical and commercial discounted proposal to upgrade the IWP 45 MIGD to 150 MIGD (681,900 m³/day) SWRO desalination plant. After the submission of the proposal by ACWA Power and Mubadala and its review by FEWA, the revised project agreement was signed on 30th May 2019.

According to the Federal Law No. 24 of 1999, ACWA Power is required to obtain a license from the Umm Al Quwain Public Health and Environment Department (PHED) prior to the commencement of the project. Therefore, as part of the Environmental Impact Assessment (EIA) ACWA Power is consulting with Road and Transport Authority to request any data or comments that will be relevant to the preparation of the project EIA, including any conditions that are required during the construction and operational phase of the IWP.

We welcome any comments or feedback you may have in regard to the proposed Project to be addressed to Ken Wade-Director of Environmental Planning at 5 Capitals Environmental & Management Consulting who are the registered Environmental Consultants (Email: ken.wade@5capitals-group.com Tel: +971 50 653 8468).

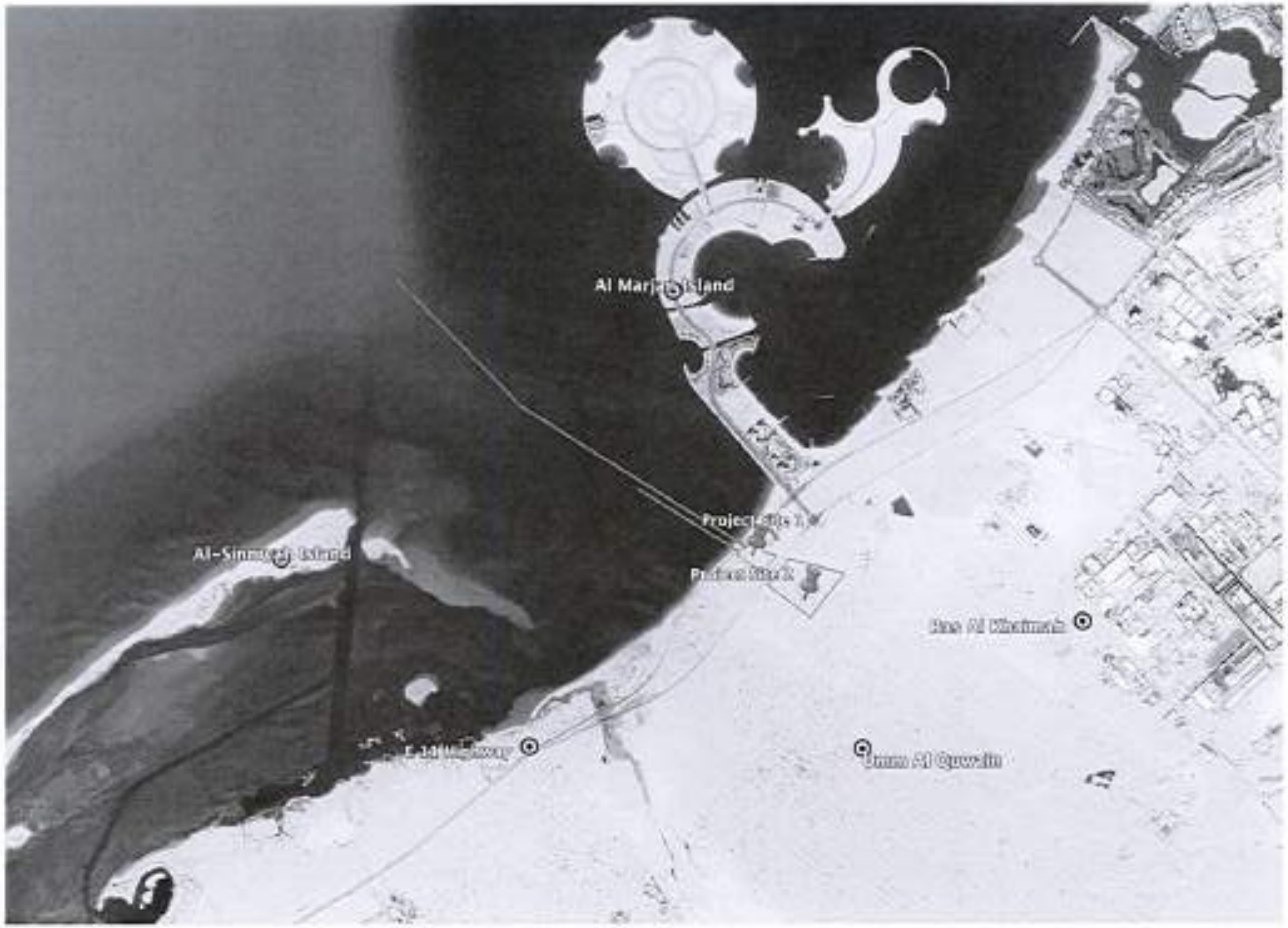
Thank you very much for your assistance and we look forward to your response.

Yours sincerely,

Signed Udyanlch Position EXECUTIVE DIRECTOR-BD

For and on behalf of International Company for Water and Power Projects **("ACWA Power")** and MDC Power Holding Company LLC **("MUBADALA")**

Figure 1-1 Location of the Proposed Project



18th June 2019

Dr. Saif Mohammed Al Ghais
Chief Executive Officer
Environmental Protection and Development Authority (EPDA)
Ras Al Khaimah Municipality
Al Nahdha Street
RAK, UAE

Attention: Chief Executive Officer, EPDA

Project: FEWA 150 MIGD SWRO Independent Water Project Umm Al Quwain, UAE

Subject: Stakeholder Consultation for the Environmental Impact Assessment (EIA)

The Federal Electricity and Water Authority (FEWA) is proposing to develop a Sea Water Reverse Osmosis (SWRO) desalination plant in the Emirate of Um Al Quwain near Marjan Island, south of the border with the Emirate of Ras Al Khaimah. FEWA awarded the project to ACWA Power who will hold forty percent (40%) share of the project equity while Mubadala Investment Company PJSC and FEWA will own forty percent (40%) and twenty percent (20%) shares respectively. The Project is an Independent Water Project (IWP) and is expected to be commercially operational in the 2nd quarter of 2022.

The Project will be located on land in Umm Al Quwain with intake and outfall facilities extending into the marine environment. The land-based section of the project will be approximately 23.5 hectares in area on two plots of land adjacent to E11 carriageways (see attached location map). The initial scope of works as per the 2018 bid (Tender 39EW/2016) included the installation of the plant along with the associated intake & outfall facilities to produce 45 MIGD (204,500 m^3/day) of desalinated water. However, in March 2019 FEWA invited ACWA Power & Mubadala under Tender 39E/2016 to submit a proposal for the best technical and commercial discounted proposal to upgrade the IWP 45 MIGD to 150 MIGD (681,900 m^3/day) SWRO desalination plant. After the submission of the proposal by ACWA Power and Mubadala and its review by FEWA, the revised project agreement was signed on 30th May 2019.

According to the Federal Law No. 24 of 1999, ACWA Power is required to obtain a license from the Umm Al Quwain Public Health and Environment Department (PHED) prior to the commencement of the project. Therefore, as part of the Environmental Impact Assessment (EIA) ACWA Power is consulting with EPDA to request any data or comments that will be relevant to the preparation of the project EIA, including any conditions that are required during the construction and operational phase of the IWP.

We welcome any comments or feedback you may have in regard to the proposed Project to be addressed to Ken Wade-Director of Environmental Planning at 5 Capitals Environmental & Management Consulting who are the registered Environmental Consultants (Email: ken.wade@5capitals-group.com Tel: +971 50 653 8468).

Thank you very much for your assistance and we look forward to your response.

Yours sincerely,

Signed Udyandeh Position EXECUTIVE DIRECTOR - BD

For and on behalf of International Company for Water and Power Projects (**"ACWA Power"**) and MDC Power Holding Company LLC (**"MUBADALA"**).

Figure 1-1 Location of the Proposed Project

ACWA POWER كــوا بــاور

MUBADALA

18th June 2019

Haitham Mattar
Chief Executive Officer
Ras Al Khaimah Tourism Development Authority
Government of Ras Al Khaimah
Street 11, Al Marjan Island
RAK, UAE

Attention: Chief Executive Officer, RAQ Tourism Development Authority

Project: FEWA 150 MIGD SWRO Independent Water Project Umm Al Quwain, UAE

Subject: Stakeholder Consultation for the Environmental Impact Assessment (EIA)

Dear Mr. Mattar,

The Federal Electricity and Water Authority (FEWA) is proposing to develop a Sea Water Reverse Osmosis (SWRO) desalination plant in the Emirate of Um Al Quwain near Marjan Island, south of the border with the Emirate of Ras Al Khaimah. FEWA awarded the project to ACWA Power who will hold forty percent (40%) share of the project equity while Mubadala Investment Company PJSC and FEWA will own forty percent (40%) and twenty percent (20%) shares respectively. The Project is an Independent Water Project (IWP) and is expected to be commercially operational in the 2nd quarter of 2022.

The Project will be located on land in Umm Al Quwain with intake and outfall facilities extending into the marine environment. The land-based section of the project will be approximately 23.5 hectares in area on two plots of land adjacent to E11 carriageways (see attached location map). The initial scope of works as per the 2018 bid (Tender 39EW/2016) included the installation of the plant along with the associated intake & outfall facilities to produce 45 MIGD (204,500 m^3/day) of desalinated water. However, in March 2019 FEWA invited ACWA Power & Mubadala under Tender 39E/2016 to submit a proposal for the best technical and commercial discounted proposal to upgrade the IWP 45 MIGD to 150 MIGD (681,900 m^3/day) SWRO desalination plant. After the submission of the proposal by ACWA Power and Mubadala and its review by FEWA, the revised project agreement was signed on 30th May 2019.

According to the Federal Law No. 24 of 1999, ACWA Power is required to obtain a license from the Umm Al Quwain Public Health and Environment Department (PHED) prior to the commencement of the project. Therefore, as part of the Environmental Impact Assessment (EIA) ACWA Power is consulting with RAQ Tourism Authority to request any data or comments that will be relevant to the preparation of the project EIA, including any conditions that are required during the construction and operational phase of the IWP.

We welcome any comments or feedback you may have in regard to the proposed Project to be addressed to Ken Wade- Director of Environmental Planning at 5 Capitals Environmental & Management Consulting who are the registered Environmental Consultants (Email: ken.wade@5capitals-group.com Tel: +971 50 653 8468).

Thank you very much for your assistance and we look forward to your response.

Yours sincerely,

Signed Udayanbulu Position EXECUTIVE DIRECTOR - BD

For and on behalf of International Company for Water and Power Projects **("ACWA Power")** and MDC Power Holding Company LLC **("MUBADALA")**

Figure 1-1 Location of the Proposed Project

ACWA POWER
كوا باور

MUBADALA

18th June 2019

HE Obaid Sultan Taiwirh
General Director
Department of Planning and Survey, Umm Al Quwain
P.O Box 2900
UAQ, UAE

Attention: General Director, UAQ

Project: FEWA 150 MIGD SWRO Independent Water Project Umm Al Quwain, UAE

Subject: Stakeholder Consultation for the Environmental Impact Assessment (ESIA)

Dear HE Taiwirh,

The Federal Electricity and Water Authority (FEWA) is proposing to develop a Sea Water Reverse Osmosis (SWRO) desalination plant in the Emirate of Um Al Quwain near Marjan island, south of the border with the Emirate of Ras Al Khaimah. FEWA awarded the project to ACWA Power who will hold forty percent (40%) share of the project equity while Mubadala Investment Company PJSC and FEWA will own forty percent (40%) and twenty percent (20%) shares respectively. The Project is an Independent Water Project (IWP) and is expected to be commercially operational in the 2nd quarter of 2022.

The Project will be located on land in Umm Al Quwain with intake and outfall facilities extending into the marine environment. The land-based section of the project will be approximately 23.5 hectares in area on two plots of land adjacent to E11 carriageways (see attached location map). The initial scope of works as per the 2018 bid (Tender 39EW/2016) included the installation of the plant along with the associated intake & outfall facilities to produce 45 MIGD (204,500 m^3/day) of desalinated water. However, in March 2019 FEWA invited ACWA Power & Mubadala under Tender 39E/2016 to submit a proposal for the best technical and commercial discounted proposal to upgrade the IWP 45 MIGD to 150 MIGD (681,900 m^3/day) SWRO desalination plant. After the submission of the proposal by ACWA Power and Mubadala and its review by FEWA, the revised project agreement was signed on 30th May 2019.

According to the Federal Law No. 24 of 1999, ACWA Power is required to obtain a license from the Umm Al Quwain Public Health and Environment Department (PHED) prior to the commencement of the project. Therefore, as part of the Environmental Impact Assessment (EIA) ACWA Power is consulting with Department of Planning and Survey to request any data or comments that will be relevant to the preparation of the project EIA, including any conditions that are required during the construction and operational phase of the IWP.

We welcome any comments or feedback you may have in regard to the proposed Project to be addressed to Ken Wade-Director of Environmental Planning at 5 Capitals Environmental & Management Consulting who are the registered Environmental Consultants (Email: ken.wade@5capitals-group.com Tel: +971 50 653 8468).

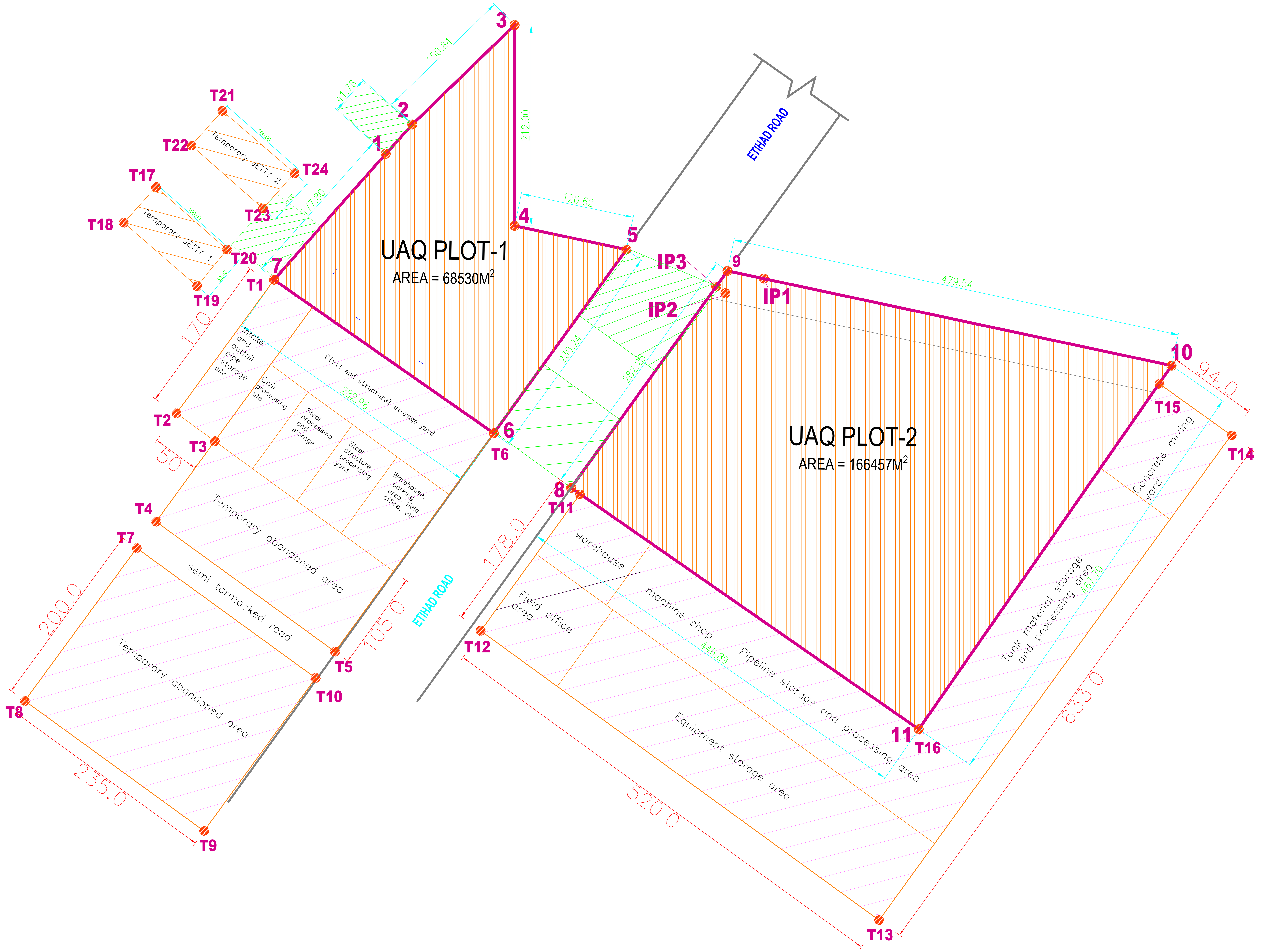
Thank you very much for your assistance and we look forward to your response.

Yours sincerely,

Signed: Udyanlal Position: EXECUTIVE DIRECTOR - BD

For and on behalf of International Company for Water and Power Projects (**"ACWA Power"**) and MDC Power Holding Company LLC (**"MUBADALA"**)

APPENDIX C – LAYOUT OF THE PROJECT SITE AND LAYDOWN AREAS



NOTE:	
1	The location of Temporary Jetty 1 & 2 maybe changed due to the undetermined arrangement of intake
2	The tier limit of spoil is considered for 6 metre.

COORDINATES

No.	NORTH (Y) m	EAST (X) m
T1	2838052	374081
T2	2837911	373978
T3	2837883	374017
T4	2837799	373958
T5	2837660	374145
T6	2837890	374313
T7	2837769	373936
T8	2837608	373817
T9	2837470	374007
T10	2837632	374125
T11	2837826	374404
T12	2837682	374299
T13	2837376	374719
T14	2837888	375091
T15	2837943	375015
T16	2837578	374761
T17	2838150	373956
T18	2838113	373922
T19	2838045	373999
T20	2838084	374031
T21	2838231	374026
T22	2838194	373993
T23	2838128	374069
T24	2838165	374102

TEMPORARY FACILITY AREA

PERMANENT FACILITY AREA

APPENDIX D – MARINE WATER AND SEDIMENT ANALYSIS (2017 & 2018)

Marine Water and Sediment Analysis 2017

Reference: SGS Gulf Limited (2017). Environmental Impact Assessment for 2x45 MIGD SWRO Desalination Plant for Umm Al Quwain report as provided by Federal Electricity and Water Authority (FEWA) to prospective bidders.

ANNEXURE-8

MARINE WATER ANALYSIS REPORTS

AMENDMENT ANALYTICAL REPORT

DB17-12118 R01

Default Project

Prepared for

FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)

SGS E-Data
Understanding your Environment
https://edata.sgs.com

SGS - ENGAGE
JUST IN TIME INFO ON YOUR RESULTS AVAILABLE ON THE WEB
https://engage.sgs.com

AMENDMENT ANALYTICAL REPORT

DB17-12118 R01

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)	Manager	Smitha Abraham
		Laboratory	SGS Dubai Environmental Laboratory
Address	P.O. Box no: 1672, Dubai	Address	Blue Shed Warehouse TC-3 P.O.Box: 18556, Dubai, Jebel Ali Free Zone, UAE
Contact	Director of Supply of the Authority	Telephone	+971-4-887-01-77 Ext. 114
Telephone	971 4 2315555	Facsimile	+971-4-887-63-76
Facsimile	971 4 2809977	Email	smitha.abraham@sgs.com
Email	shaikha.rashid@fewa.gov.ae	SGS Reference	DB17-12118
Project	Default Project	Received	19/10/2017
Order Number	Morning Sampling 17.10.17	Approved	20/11/2017
Samples	Marine Water(23)	Analysis started	02/11/2017
		Analysis completed	20/11/2017
		Report Number	DB17-12118 R01
		Date Reported	21/11/2017

COMMENTS

This Report/Certificate cancels and supersedes the Report No.:
DB17-12118 R0
issued by:
SGS Dubai Environmental Laboratory
Whilst SGS laboratories conform to ISO/IEC 17025 standards, results of analysis in this report fall outside of the current scope accreditation

SIGNATORIES

Smitha Abraham
Laboratory Manager

SGS 13 P.O.Box 18556, JAFZA, Dubai SGS GULF LIMITED (JAFZA BR.)

AMENDMENT ANALYTICAL REPORT

TABLE OF CONTENTS

AMENDMENT ANALYTICAL REPORT

CASE NARRATIVE

The following samples were not physically received in the lab, only in situ analysis of pH and temperature were done on the samples and included in the lab report as per client request: DB17-12118.019. DB17-12118.020, DB17-12118.021, DB17-12118.022 and DB17-12118.023.

AMENDMENT ANALYTICAL REPORT

RESULTS

		Sample n°	DB17-12118.001	DB17-12118.002	DB17-12118.003	DB17-12118.004	DB17-12118.005
		Sample Name	MW 1 SURFACE	MW 2 SURFACE	MW 3 SURFACE	MW 4 SURFACE	MW 5 SURFACE
		Sample Location	0 M	0 M	0 M	0 M	0 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	57850	57483	57286	57184	57185
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	43000	42700	42200	41800	42100
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	130	126	130	126	126
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	158	154	158	154	154
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium	mg/L	1	481	481	401	481	401
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	6.34	5.88	6.24	7.79	6.59
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Potassium	mg/L	0.02	575	499	503	508	582
Sodium	mg/L	0.05	11330	10550	10700	10800	10900
Strontium	mg/L	0.005	8.74	8.07	8.76	8.42	9.02
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.22	0.21	0.21	0.21	0.22
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	2.6	2.6	0.9	2.1	2.6

AMENDMENT ANALYTICAL REPORT

RESULTS

		Sample n°	DB17-12118.001	DB17-12118.002	DB17-12118.003	DB17-12118.004	DB17-12118.005
		Sample Name	MW 1 SURFACE	MW 2 SURFACE	MW 3 SURFACE	MW 4 SURFACE	MW 5 SURFACE
		Sample Location	0 M	0 M	0 M	0 M	0 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Forms of Carbon [APHA 5310 C, 21st Edition 2005] continued							
Total Organic Carbon	mg/L	0.5	3.5	2.9	1.6	3.3	3.9
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1507	1507	1458	1458	1458
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	20820.5	20907.0	20589.0	20397.8	20634.9
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3146.6	3175.3	3084.5	3080.7	3096.1
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7400	7400	7000	7200	7000
[ATP-Method]							
^ Extra polymer substances	μg/L	-	0.01	0.01	0.01	0.01	0.00

AMENDMENT ANALYTICAL REPORT

DB17-12118 R01

RESULTS

		Sample n°	DB17-12118.006	DB17-12118.007	DB17-12118.008	DB17-12118.009	DB17-12118.010
		Sample Name	MW 6 SURFACE	MW 1	MW 2	MW 3	MW 4
		Sample Location	0 M	1.5 M	1.5 M	1.5 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	8.3	8.3	8.3	8.3
Temperature - APHA 4500HB	°C	0.1	-	31.5	31.6	31.6	31.7
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	57203	57900	57843	57642	57198
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	42100	42500	41900	42600	42600
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	126	126	130	126	130
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	154	154	158	154	158
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium	mg/L	1	481	481	481	481	401
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	6.20	5.86	5.95	6.01	6.16
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Potassium	mg/L	0.02	522	477	599	503	610
Sodium	mg/L	0.05	10420	10150	11330	10060	11600
Strontium	mg/L	0.005	8.46	8.05	8.10	8.18	8.33
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.21	0.21	0.22	0.21	0.21

Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]

RESULTS

Parameter	Units	RL	DB17-12118.006	DB17-12118.007	DB17-12118.008	DB17-12118.009	DB17-12118.010
Sample Name			MW 6 SURFACE	MW 1	MW 2	MW 3	MW 4
Sample Location			0 M	1.5 M	1.5 M	1.5 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
			Result	Result	Result	Result	Result
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005] continued							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	0.3	3.4	4.0	2.9	2.1
Total Organic Carbon	mg/L	0.5	1.9	3.5	5.0	3.0	4.0
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1458	1507	1458	1409	1458
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	20101.0	20302.5	21491.4	20737.5	20747.5
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3052.9	3057.9	3140.2	3139.6	3104.3
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7200	7400	7200	7000	7000
[ATP-Method]							
^ Extra polymer substances	µg/L	-	0.02	0.00	0.00	0.01	0.01

AMENDMENT ANALYTICAL REPORT

RESULTS

Sample n°	DB17-12118.011	DB17-12118.012	DB17-12118.013	DB17-12118.014	DB17-12118.015
Sample Name	MW 5	MW 6	MW 1	MW 2	MW 3
Sample Location	1.5 M	1.5 M	3 M	3 M	3 M
Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By	SGS	SGS	SGS	SGS	SGS
Sample Date	17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017

Parameter	Units	RL	Result	Result	Result	Result	Result
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	8.3	8.3	-	-	-
Temperature - APHA 4500HB	°C	0.1	31.6	31.6	-	-	-
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	57050	57420	58028	58009	57918
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	42300	41800	42400	42400	42500
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	122	126	122	126	126
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	149	154	149	154	154
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium	mg/L	1	481	481	481	481	481
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	5.91	6.04	5.94	5.94	5.82
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Potassium	mg/L	0.02	513	510	479	556	588
Sodium	mg/L	0.05	10580	10670	10460	10720	12100
Strontium	mg/L	0.005	8.15	8.26	8.13	8.24	8.08
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.21	0.21	0.21	0.20	0.21

Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]

AMENDMENT ANALYTICAL REPORT

RESULTS

Sample n°			DB17-12118.011	DB17-12118.012	DB17-12118.013	DB17-12118.014	DB17-12118.015
Sample Name			MW 5	MW 6	MW 1	MW 2	MW 3
Sample Location			1.5 M	1.5 M	3 M	3 M	3 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005] continued							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	2.0	2.1	0.7	1.1	1.2
Total Organic Carbon	mg/L	0.5	3.0	4.1	1.0	1.7	1.6
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1409	1409	1458	1409	1458
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	22050.8	20773.6	21138.9	20879.3	22787.2
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3196.6	3138.3	3142.8	3103.5	3208.2
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7000	7200	7000	7200	7000
[ATP-Method]							
^ Extra polymer substances	μg/L	-	0.00	0.00	0.02	0.01	0.00

AMENDMENT ANALYTICAL REPORT

RESULTS

		Sample n°	DB17-12118.016	DB17-12118.017	DB17-12118.018	DB17-12118.019	DB17-12118.020
		Sample Name	MW 4	MW 5	MW 6	MW 7	MW 8
		Sample Location	3 M	3 M	3 M	1.5 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By		SGS	SGS	SGS	SGS
		Sample Date	17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	-	-	8.3	8.3
Temperature - APHA 4500HB	°C	0.1	-	-	-	31.5	31.6
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	58155	58210	58150	-	-
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	-	-
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	42700	42100	41600	-	-
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	-	-
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	126	126	122	-	-
Carbonate	mg/L	1	<1	<1	<1	-	-
Bicarbonate	mg/L	1	154	154	149	-	-
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium	mg/L	1	481	481	481	-	-
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	-	-
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	-	-
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Boron	mg/L	0.05	5.89	5.87	5.82	-	-
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	-	-
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Potassium	mg/L	0.02	563	504	561	-	-
Sodium	mg/L	0.05	10760	10540	10930	-	-
Strontium	mg/L	0.005	8.12	8.13	8.02	-	-
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	-	-
Zinc	mg/L	0.01	0.21	0.20	0.20	-	-

Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]

AMENDMENT ANALYTICAL REPORT

RESULTS

		Sample n°	DB17-12118.016	DB17-12118.017	DB17-12118.018	DB17-12118.019	DB17-12118.020
		Sample Name	MW 4	MW 5	MW 6	MW 7	MW 8
		Sample Location	3 M	3 M	3 M	1.5 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By		SGS	SGS	SGS	SGS
		Sample Date	17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005] continued							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	-	-
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	1.2	2.2	2.2	-	-
Total Organic Carbon	mg/L	0.5	1.4	2.2	2.6	-	-
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	-	-
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1409	1458	1409	-	-
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Sulphide [APHA 4500-S²- F, 21st Edition 2005]							
Sulphide (S²-)	mg/L	0.5	<0.50	<0.50	<0.50	-	-
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	-	-
Chloride	mg/L	0.2	20994.0	20950.4	21215.5	-	-
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	-	-
Sulphate	mg/L	0.2	3177.3	3122.1	3150.5	-	-
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7000	7200	7000	-	-
[ATP-Method]							
^ Extra polymer substances	µg/L	-	0.01	0.01	0.00	-	-

AMENDMENT ANALYTICAL REPORT

RESULTS

		Sample n°	DB17-12118.021	DB17-12118.022	DB17-12118.023
		Sample Name	MW 9	MW 10	MW 11
		Sample Location	1.5 M	1.5 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS
		Sample Date	17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**
On-Site Analysis					
pH - APHA 4500HB	pH unit	0.1	8.3	8.3	8.3
Temperature - APHA 4500HB	°C	0.1	31.7	31.7	31.5

AMENDMENT ANALYTICAL REPORT

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1728818

Conductivity [APHA 2510 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Electrical Conductivity	LB1728818	µS/cm	1.0	<1	0%	100%

LB1728819

Turbidity [APHA 2130 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Turbidity	LB1728819	NTU	1.0	<1	0%	98%

LB1728820

Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids	LB1728820	mg/L	5.0	<5	0 - 3%	93 - 98%

LB1728821

Total Suspended Solids [APHA 2540 D, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Suspended Solids	LB1728821	mg/L	5.0	<5	0%

LB1728822

Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Alkalinity	LB1728822	mg CaCO	1.0	<1	0 - 3%
Carbonate	LB1728822	mg/L	1.0	<1	0%
Bicarbonate	LB1728822	mg/L	1.0	<1	0 - 3%

LB1728823

Free Oil [APHA5520B, 21st Edition 2005 Modified]

Parameter	QC Reference	Units	RL	DUP %RPD
Free Oil	LB1728823	mg/L	20	0%

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1728824

Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Calcium	LB1728824	mg/L	1.0	<1	0%

LB1728825

Forms of Carbon [APHA 5310 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Dissolved Organic Carbon	LB1728825	mg/L	0.10	<0.1	1 - 7%
Total Organic Carbon	LB1728825	mg/L	0.50	<0.5	0 - 5%

LB1728826

Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Phosphorus	LB1728826	mg/L	0.50	<0.5	0%	102 - 110%

LB1728828

Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
NH4	LB1728828	mg/L	0.50	0%	114%

LB1728829

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Aluminium	LB1728829	mg/L	0.010		92%
			0.050	0%	
Arsenic	LB1728829	mg/L	0.020		97%
			0.10	0%	
Barium	LB1728829	mg/L	0.0050		97%
			0.0250	0%	
Cadmium	LB1728829	mg/L	0.0050		98%
			0.0250	0%	
Chromium	LB1728829	mg/L	0.0050		98%
			0.0250	0%	
Copper	LB1728829	mg/L	0.010		95%
			0.050	0%	

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001] (continued)

				DUP %RPD	LCS %Recovery
Lead	LB1728829	mg/L	0.020		92%
			0.10	0%	
Nickel	LB1728829	mg/L	0.010		100%
			0.050	0%	
Potassium	LB1728829	mg/L	0.020		95%
			0.10	0%	
Sodium	LB1728829	mg/L	0.050		95%
			0.250	1%	
Strontium	LB1728829	mg/L	0.0050		97%
			0.0250	0%	
Vanadium	LB1728829	mg/L	0.0050		103%
			0.0250	0%	
Zinc	LB1728829	mg/L	0.010		99%
			0.050	3%	

LB1728831

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Mercury	LB1728831	mg/L	0.0050	0%	93%

LB1728832

Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Magnesium	LB1728832	mg/L	1.0	<1	0 - 3%

LB1728833

Total Silica [APHA 4500-SiO2 (Modify)]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Silica	LB1728833	mg/L	0.50	<0.5	0%	96 - 107%

LB1728845

Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Sulphide (S^{2-})	LB1728845	mg/L	0.50	<0.50	0%

AMENDMENT ANALYTICAL REPORT

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1729125

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Fluoride	LB1729125	mg/L	0.040	<0.04		95%
			20		0%	
Bromide	LB1729125	mg/L	0.150	<0.15		96%
			75		0%	
Chloride	LB1729125	mg/L	0.20	<0.2		94%
			100		0%	
Nitrite	LB1729125	mg/L	0.040	<0.04		102%
			20		0%	
Nitrate	LB1729125	mg/L	0.040	<0.04		97%
			20		0%	
Phosphate	LB1729125	mg/L	0.10	<0.10		110%
			50		0%	
Sulphate	LB1729125	mg/L	0.20	<0.2		95%
			100		4%	

LB1729126

Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Hardness as CaCO3	LB1729126	mg/L	1.0	<1	3%

LB1729204

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Boron	LB1729204	mg/L	0.050		99%
			0.250	1%	

AMENDMENT ANALYTICAL REPORT

LEGEND

FOOTNOTES

^	Performed by external SGS laboratory.	IS	Insufficient sample for analysis.
^^	Performed by outside laboratory.	LNR	Sample listed, but not received.
RL	Reporting Limit	NA	The sample was not analysed for this analyte
↑	Raised Limit of Reporting	NVL	Result to be validated
↓	Lowered Limit of Reporting	TBA	Parameter not yet analysed

Sampling not accredited as per ISO 17025.
Samples analysed as received.
Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request

--- End of the analytical report ---

AMENDMENT ANALYTICAL REPORT

DB17-12117 R02

Default Project

Prepared for

FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)

SGS E-Data
Understanding your Environment
https://edata.sgs.com

SGS - ENGAGE

JUST IN TIME INFO ON YOUR RESULTS AVAILABLE ON THE WEB
https://engage.sgs.com

AMENDMENT ANALYTICAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)	Manager	Smitha Abraham
		Laboratory	SGS Dubai Environmental Laboratory
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Email	shaikha.rashid@fewa.gov.ae	SGS Reference	DB17-12117
Project	Default Project	Received	19/10/2017
Order Number	Evening Sampling 17.10.17	Approved	19/11/2017
Samples	Marine Water(18)	Analysis started	01/11/2017
		Analysis completed	19/11/2017
		Report Number	DB17-12117 R02
		Date Reported	21/11/2017

COMMENTS

This Report/Certificate cancels and supersedes the Report No.:
DB17-12117 R1
issued by:
SGS Dubai Environmental Laboratory
Whilst SGS laboratories conform to ISO/IEC 17025 standards, results of analysis in this report fall outside of the current scope accreditation

SIGNATORIES

Smitha Abraham
Laboratory Manager

AMENDMENT ANALYTICAL REPORT

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AMENDMENT ANALYTICAL REPORT

CASE NARRATIVE

The following samples were not physically received in the lab, only in situ analysis of pH and temperature were done on the samples and included in the lab report as per client request: DB17-12117.014. DB17-12117.015, DB17-12117.016, DB17-12117.017 and DB17-12117.018.

AMENDMENT ANALYTICAL REPORT

RESULTS

Sample n°			DB17-12117.001	DB17-12117.002	DB17-12117.003	DB17-12117.004	DB17-12117.005
Sample Name			MW 1 SURFACE	MW 2 SURFACE	MW 3 SURFACE	MW 4 SURFACE	MW 5 SURFACE
Sample Location			0 M	0 M	0 M	0 M	0 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	58870	60585	56561	58940	58365
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	42300	42100	43100	42600	43500
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5.0	<5.0	<5.0	<5.0	<5.0
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	124	130	122	130	126
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	151	158	149	158	154
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7255	6863	7255	6863	7059
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	1176	1176	1176
Calcium	mg/L	1	472	472	472	472	472
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1477	1382	1477	1382	1429
Free Oil [APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	0.7	<0.5	<0.5	<0.5	<0.5
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	2.0	1.6	2.4	2.0	1.6
Total Organic Carbon	mg/L	0.5	2.5	2.1	2.8	2.6	1.0

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

AMENDMENT ANALYTICAL REPORT

RESULTS

Sample n°			DB17-12117.001	DB17-12117.002	DB17-12117.003	DB17-12117.004	DB17-12117.005
Sample Name			MW 1 SURFACE	MW 2 SURFACE	MW 3 SURFACE	MW 4 SURFACE	MW 5 SURFACE
Sample Location			0 M	0 M	0 M	0 M	0 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005] continued

Parameter	Units	RL	DB17-12117.001	DB17-12117.002	DB17-12117.003	DB17-12117.004	DB17-12117.005
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	20828.8	19502.0	19839.8	21219.6	21117.0
Nitrite	mg/L	0.04	80.30	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	38.50	<20.00↑	<20.00↑	102	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3240.3	2976.4	3014.6	3181.7	3194.4

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	DB17-12117.001	DB17-12117.002	DB17-12117.003	DB17-12117.004	DB17-12117.005
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	6.35	5.68	5.70	5.89	5.77
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Potassium	mg/L	0.02	1084	477	485	524	515
Sodium	mg/L	0.05	11570	10270	10410	10990	11040
Strontium	mg/L	0.005	8.96	7.90	8.15	8.17	8.05
Vanadium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Zinc	mg/L	0.01	0.24	0.23	0.22	0.22	0.21

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	DB17-12117.001	DB17-12117.002	DB17-12117.003	DB17-12117.004	DB17-12117.005
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

[ATP-Method]

Parameter	Units	RL	DB17-12117.001	DB17-12117.002	DB17-12117.003	DB17-12117.004	DB17-12117.005
^ Extra polymer substances	-	-	0.0031	0.0044	0.0062	0.0058	0.0069

AMENDMENT ANALYTICAL REPORT

RESULTS

Parameter	Units	RL	Result	Result	Result	Result	Result
Sample n°			DB17-12117.006	DB17-12117.007	DB17-12117.008	DB17-12117.009	DB17-12117.010
Sample Name			MW 6 SURFACE	MW 1	MW 2	MW 3	MW 4
Sample Location			0 M	1.5 M	1.5 M	1.5 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	8.3	8.3	8.3	8.3
Temperature - APHA 4500HB	°C	0.1	-	30.8	30.8	30.9	30.8
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	57950	57480	62146	58310	59009
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	43600	43400	42500	40800	43000
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5.0	<5.0	<5.0	<5.0	<5.0
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	126	130	130	126	130
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	154	158	158	154	158
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	6863	7059	7059	7255	7059
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	1176	1176	1373
Calcium	mg/L	1	472	472	472	472	550
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1382	1429	1429	1477	1382
Free Oil [APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	1.1	<0.5	<0.5	<0.5
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							

AMENDMENT

ANALYTICAL

REPORT

DB17-12117 R02

RESULTS

Sample n°			DB17-12117.006	DB17-12117.007	DB17-12117.008	DB17-12117.009	DB17-12117.010
Sample Name			MW 6 SURFACE	MW 1	MW 2	MW 3	MW 4
Sample Location			0 M	1.5 M	1.5 M	1.5 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**

Forms of Carbon [APHA 5310 C, 21st Edition 2005] continued

Parameter	Units	RL	Result	Result	Result	Result	Result
Dissolved Organic Carbon	mg/L	0.1	2.3	2.2	4.3	4.9	2.0
Total Organic Carbon	mg/L	0.5	2.5	3.0	4.3	6.1	2.1

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

Parameter	Units	RL	Result	Result	Result	Result	Result
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	19959.6	21951.5	20870.3	19817.3	20880.1
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3049.6	3310.0	3058.5	3013.2	3273.9

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	Result	Result	Result	Result	Result
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	5.94	5.88	6.21	6.13	6.44
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Potassium	mg/L	0.02	483	530	625	472	544
Sodium	mg/L	0.05	10520	11410	11350	10260	10940
Strontium	mg/L	0.005	8.24	8.24	8.10	8.48	8.89
Vanadium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Zinc	mg/L	0.01	0.21	0.22	0.22	0.21	0.22

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	Result	Result	Result	Result	Result
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

[ATP-Method]

Parameter	Units	RL	Result	Result	Result	Result	Result
^ Extra polymer substances	-	-	0.0076	0.0026	0.0208	0.0037	0.007

AMENDMENT ANALYTICAL REPORT

RESULTS

		Sample n°	DB17-12117.011	DB17-12117.012	DB17-12117.013	DB17-12117.014	DB17-12117.015
		Sample Name	MW 5	MW 6	MW 1	MW 7	MW 8
		Sample Location	1.5 M	1.5 M	3 M	1.5 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	8.3	8.3	-	8.3	8.3
Temperature - APHA 4500HB	°C	0.1	30.6	30.8	-	30.4	30.5
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	59048	63140	60150	-	-
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	-	-
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	42200	42900	42500	-	-
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5.0	<5.0	<5.0	-	-
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	122	122	130	-	-
Carbonate	mg/L	1	<1	<1	<1	-	-
Bicarbonate	mg/L	1	149	149	158	-	-
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7059	7059	7255	-	-
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	1176	-	-
Calcium	mg/L	1	472	472	472	-	-
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1429	1429	1477	-	-
Free Oil [APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	-	-
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	-	-
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Sulphide [APHA 4500-S²- F, 21st Edition 2005]							
Sulphide (S²-)	mg/L	0.5	<0.50	<0.50	<0.50	-	-
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							

AMENDMENT ANALYTICAL REPORT

RESULTS

Parameter	Units	RL	DB17-12117.011	DB17-12117.012	DB17-12117.013	DB17-12117.014	DB17-12117.015
Sample Name			MW 5	MW 6	MW 1	MW 7	MW 8
Sample Location			1.5 M	1.5 M	3 M	1.5 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
			Result	Result	Result	Result	Result
Forms of Carbon [APHA 5310 C, 21st Edition 2005] continued							
Dissolved Organic Carbon	mg/L	0.1	3.6	2.9	1.6	-	-
Total Organic Carbon	mg/L	0.5	4.1	3.0	2.0	-	-
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	-	-
Chloride	mg/L	0.2	21825.3	20585.0	21171.8	-	-
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Nitrate	mg/L	0.04	56.50	<20.00↑	22.78	-	-
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	-	-
Sulphate	mg/L	0.2	3474.8	3134.7	3222.4	-	-
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	-	-
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Boron	mg/L	0.05	5.89	6.18	6.42	-	-
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	-	-
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Potassium	mg/L	0.02	587	504	548	-	-
Sodium	mg/L	0.05	11680	10650	11040	-	-
Strontium	mg/L	0.005	8.18	8.57	8.78	-	-
Vanadium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Zinc	mg/L	0.01	0.21	0.24	0.22	-	-
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	-	-
[ATP-Method]							
^ Extra polymer substances	-	-	0.0055	0.0078	0.0035	-	-

AMENDMENT ANALYTICAL REPORT

RESULTS

Sample n°			DB17-12117.016	DB17-12117.017	DB17-12117.018
Sample Name			MW 9	MW 10	MW 11
Sample Location			1.5 M	1.5 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS
Sample Date			17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**
On-Site Analysis					
pH - APHA 4500HB	pH unit	0.1	8.3	8.3	8.3
Temperature - APHA 4500HB	°C	0.1	30.7	30.5	30.6

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1728818

Conductivity [APHA 2510 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Electrical Conductivity	LB1728818	µS/cm	1.0	<1	0%	100%

LB1728819

Turbidity [APHA 2130 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Turbidity	LB1728819	NTU	1.0	<1	0%	98%

LB1728820

Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids	LB1728820	mg/L	5.0	<5	0 - 3%	93 - 98%

LB1728821

Total Suspended Solids [APHA 2540 D, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Suspended Solids	LB1728821	mg/L	5.0	<5.0	0%

LB1728822

Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Alkalinity	LB1728822	mg CaCO	1.0	<1	0 - 3%
Carbonate	LB1728822	mg/L	1.0	<1	0%
Bicarbonate	LB1728822	mg/L	1.0	<1	0 - 3%

LB1728823

Free Oil [APHA5520B, 21st Edition 2005 Modified]

Parameter	QC Reference	Units	RL	DUP %RPD
Free Oil	LB1728823	mg/L	20	0%

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1728824

Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Calcium Hardness	LB1728824	mg/L	1.0	<1	0%
Calcium	LB1728824	mg/L	1.0	<1	0%

LB1728825

Forms of Carbon [APHA 5310 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Dissolved Organic Carbon	LB1728825	mg/L	0.10	<0.1	1 - 7%
Total Organic Carbon	LB1728825	mg/L	0.50	<0.5	0 - 5%

LB1728826

Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Phosphorus	LB1728826	mg/L	0.50	<0.5	0%	102 - 110%

LB1728828

Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
NH4	LB1728828	mg/L	0.50	0%	114%

LB1728829

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Aluminium	LB1728829	mg/L	0.010		92%
			0.050	0%	
Arsenic	LB1728829	mg/L	0.020		97%
			0.10	0%	
Barium	LB1728829	mg/L	0.0050		97%
			0.0250	0%	
Cadmium	LB1728829	mg/L	0.0050		98%
			0.0250	0%	
Chromium	LB1728829	mg/L	0.0050		98%
			0.0250	0%	
Copper	LB1728829	mg/L	0.010		95%

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001] (continued)

				DUP %RPD	LCS %Recovery
Copper	LB1728829	mg/L	0.050	0%	
Lead	LB1728829	mg/L	0.020		92%
			0.10	0%	
Nickel	LB1728829	mg/L	0.010		100%
			0.050	0%	
Potassium	LB1728829	mg/L	0.020		95%
			0.10	0%	
Sodium	LB1728829	mg/L	0.050		95%
			0.250	1%	
Strontium	LB1728829	mg/L	0.0050		97%
			0.0250	0%	
Vanadium	LB1728829	mg/L	0.0050		103%
			0.0250	0%	
Zinc	LB1728829	mg/L	0.010		99%
			0.050	3%	

LB1728831

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Mercury	LB1728831	mg/L	0.0050	0%	93%

LB1728832

Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Magnesium	LB1728832	mg/L	1.0	<1	0 - 3%

LB1728833

Total Silica [APHA 4500-SiO2 (Modify)]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Silica	LB1728833	mg/L	0.50	<0.5	0%	96 - 107%

LB1728845

Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Sulphide (S^{2-})	LB1728845	mg/L	0.50	<0.50	0%

AMENDMENT ANALYTICAL REPORT

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1729125

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Fluoride	LB1729125	mg/L	0.040	<0.04		95%
			20		0%	
Bromide	LB1729125	mg/L	0.150	<0.15		96%
			75		0%	
Chloride	LB1729125	mg/L	0.20	<0.2		94%
			100		0%	
Nitrite	LB1729125	mg/L	0.040	<0.04		102%
			20		0%	
Nitrate	LB1729125	mg/L	0.040	<0.04		97%
			20		0%	
Phosphate	LB1729125	mg/L	0.10	<0.10		110%
			50		0%	
Sulphate	LB1729125	mg/L	0.20	<0.2		95%
			100		4%	

LB1729126

Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Hardness as CaCO3	LB1729126	mg/L	1.0	<1	3%

AMENDMENT ANALYTICAL REPORT

LEGEND

FOOTNOTES

^	Performed by external SGS laboratory.	IS	Insufficient sample for analysis.
^^	Performed by outside laboratory.	LNR	Sample listed, but not received.
RL	Reporting Limit	NA	The sample was not analysed for this analyte
↑	Raised Limit of Reporting	NVL	Result to be validated
↓	Lowered Limit of Reporting	TBA	Parameter not yet analysed

Sampling not accredited as per ISO 17025.
Samples analysed as received.
Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request

--- End of the analytical report ---

ANALYTICAL REPORT

DB17-12132 R0

Default Project

Prepared for

FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)

TE-GL-ENVLAB-IT-011v2.13.5

ANALYTICAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)	Manager	Smitha Abraham
		Laboratory	SGS Dubai Environmental Laboratory
Address	P.O. Box no: 1672, Dubai	Address	Blue Shed Warehouse TC-3 P.O.Box: 18556, Dubai, Jebel Ali Free Zone. UAE
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Telephone	971 4 2315555	Facsimile	+971-4-887-63-76
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Email	shaikha.rashid@fewa.gov.ae	SGS Reference	DB17-12132
Project	Default Project	Received	25/10/2017
Order Number	Evening Sampling 24.10.17	Approved	23/11/2017
Samples	Marine Water(23)	Analysis started	09/11/2017
		Analysis completed	23/11/2017
		Report Number	DB17-12132 R0
		Date Reported	27/11/2017

COMMENTS

Whilst SGS laboratories conform to ISO/IEC 17025 standards, results of analysis in this report fall outside of the current scope accreditation

SIGNATORIES

Smitha Abraham

Laboratory Manager

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ANALYTICAL REPORT

RESULTS

Parameter	Units	RL	DB17-12132.001	DB17-12132.002	DB17-12132.003	DB17-12132.004	DB17-12132.005
Sample Name			MW 1	MW 1	MW 1	MW 2	MW 2
Sample Location			0 M	1.5 M	3 M	0 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
			Result	Result	Result	Result	Result
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	8.2	-	-	8.2
Temperature - APHA 4500HB	°C	0.1	-	31.0	-	-	31.5
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	56980	56940	56950	56880	56821
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	42300	42050	42400	42250	42400
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	122	126	126	122	118
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	149	154	154	149	144
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7255	7255	7255	7451	7451
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	980	1176	1176	980	1176
Calcium	mg/L	1	393	472	472	393	472
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1525	1477	1477	1572	1525
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	0.7	<0.5	0.7
Sulphide [APHA 4500-S²- F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50

Forms of Carbon [APHA 5310 C, 21st Edition 2005]

ANALYTICAL REPORT

RESULTS

	Units	RL	DB17-12132.001	DB17-12132.002	DB17-12132.003	DB17-12132.004	DB17-12132.005
Sample Name			MW 1	MW 1	MW 1	MW 2	MW 2
Sample Location			0 M	1.5 M	3 M	0 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Forms of Carbon [APHA 5310 C, 21st Edition 2005] continued							
Dissolved Organic Carbon	mg/L	0.1	2.1	2.2	2.0	2.1	2.0
Total Organic Carbon	mg/L	0.5	2.6	2.6	2.7	2.7	2.4
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	20087.3	21944.4	21968.3	21264.9	21945.6
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3017.9	3264.0	3256.5	3162.2	3259.0
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	6.21	5.65	6.77	6.08	6.82
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Potassium	mg/L	0.02	553	601	620	624	643
Sodium	mg/L	0.05	11230	11820	11690	11290	11930
Strontium	mg/L	0.005	8.66	7.90	9.41	8.24	9.40
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.20	0.20	0.22	0.20	0.21
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
[ATP-Method]							
^ Extra polymer substances	μg/L	-	0.0070	0.0059	0.0043	0.0048	0.0070

RESULTS

		Sample n°	DB17-12132.006	DB17-12132.007	DB17-12132.008	DB17-12132.009	DB17-12132.010
		Sample Name	MW 2	MW 3	MW 3	MW 3	MW 4
		Sample Location	3 M	0 M	1.5 M	3 M	0 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	-	8.2	-	-
Temperature - APHA 4500HB	°C	0.1	-	-	31.3	-	-
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	56890	56840	56830	56850	56760
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	42300	42150	42300	42400	42250
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	122	126	126	126	130
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	149	154	154	154	158
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7451	7451	7451	7451	7255
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	1176	1176	980
Calcium	mg/L	1	472	472	472	472	393
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1525	1525	1525	1525	1525
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	0.7	<0.5	<0.5
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							

ANALYTICAL REPORT

RESULTS

		Sample n°	DB17-12132.006	DB17-12132.007	DB17-12132.008	DB17-12132.009	DB17-12132.010
		Sample Name	MW 2	MW 3	MW 3	MW 3	MW 4
		Sample Location	3 M	0 M	1.5 M	3 M	0 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Forms of Carbon [APHA 5310 C, 21st Edition 2005] continued							
Dissolved Organic Carbon	mg/L	0.1	2.1	1.9	2.0	2.0	2.2
Total Organic Carbon	mg/L	0.5	2.9	2.2	2.4	2.4	2.7
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	20510.5	20819.2	21679.1	21075.2	21285.8
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3099.6	3116.0	3249.0	3122.6	3192.1
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	5.84	6.62	6.11	6.16	6.06
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Potassium	mg/L	0.02	576	613	603	591	583
Sodium	mg/L	0.05	11320	11530	11750	11610	11660
Strontium	mg/L	0.005	8.00	9.09	8.27	8.33	8.30
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.20	0.21	0.20	0.20	0.20
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
[ATP-Method]							
^ Extra polymer substances	µg/L	-	0.0114	0.0180	0.0053	0.0132	0.0083

RESULTS

		Sample n°	DB17-12132.011	DB17-12132.012	DB17-12132.013	DB17-12132.014	DB17-12132.015
		Sample Name	MW 4	MW 4	MW 5	MW 5	MW 5
		Sample Location	1.5 M	3 M	0 M	1.5 M	3 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	8.2	-	-	8.2	-
Temperature - APHA 4500HB	°C	0.1	31.2	-	-	30.9	-
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	56790	56805	56760	56730	56730
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	42100	44200	43700	43350	43750
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	122	126	126	126	126
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	149	154	154	154	154
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7255	7255	7451	7451	7451
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	1176	1176	1176
Calcium	mg/L	1	472	472	472	472	472
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1477	1477	1525	1525	1525
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	0.5	0.5	<0.5	0.7
Sulphide [APHA 4500-S²- F, 21st Edition 2005]							
Sulphide (S²-)	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							

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DB17-12132 R0

RESULTS

		Sample n°	DB17-12132.011	DB17-12132.012	DB17-12132.013	DB17-12132.014	DB17-12132.015
		Sample Name	MW 4	MW 4	MW 5	MW 5	MW 5
		Sample Location	1.5 M	3 M	0 M	1.5 M	3 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Forms of Carbon [APHA 5310 C, 21st Edition 2005] continued							
Dissolved Organic Carbon	mg/L	0.1	1.9	2.5	2.2	2.2	2.2
Total Organic Carbon	mg/L	0.5	2.9	3.9	2.6	2.8	2.9
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	20639.3	21015.2	21000.5	21233.6	20799.5
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3093.8	3147.7	3135.3	3160.7	3109.5
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	5.87	6.16	5.77	6.04	6.08
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Potassium	mg/L	0.02	581	590	583	613	595
Sodium	mg/L	0.05	11560	11770	11750	11850	11570
Strontium	mg/L	0.005	8.00	8.41	7.94	8.26	8.29
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.19	0.20	0.19	0.20	0.21
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
[ATP-Method]							
^ Extra polymer substances	µg/L	-	0.0078	0.0130	0.0078	0.0039	0.0074

RESULTS

		Sample n°	DB17-12132.016	DB17-12132.017	DB17-12132.018	DB17-12132.019	DB17-12132.020
		Sample Name	MW 6	MW 6	MW 6	MW 7	MW 8
		Sample Location	0 M	1.5 M	3 M	1.5 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	8.2	-	8.2	8.2
Temperature - APHA 4500HB	°C	0.1	-	31.0	-	31.1	31.1
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	56786	56775	56740	-	-
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	-	-
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	43750	43650	43450	-	-
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	-	-
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	126	126	126	-	-
Carbonate	mg/L	1	<1	<1	<1	-	-
Bicarbonate	mg/L	1	154	154	154	-	-
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7451	7451	7451	-	-
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	1176	-	-
Calcium	mg/L	1	472	472	472	-	-
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1525	1525	1525	-	-
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	-	-
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	-	-
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	1.0	<0.5	<0.5	-	-
Sulphide [APHA 4500-S²- F, 21st Edition 2005]							
Sulphide (S²-)	mg/L	0.5	<0.50	<0.50	<0.50	-	-
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							

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RESULTS

		Sample n°	DB17-12132.016	DB17-12132.017	DB17-12132.018	DB17-12132.019	DB17-12132.020
		Sample Name	MW 6	MW 6	MW 6	MW 7	MW 8
		Sample Location	0 M	1.5 M	3 M	1.5 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**

Forms of Carbon [APHA 5310 C, 21st Edition 2005] continued

Parameter	Units	RL	Result	Result	Result	Result	Result
Dissolved Organic Carbon	mg/L	0.1	2.6	1.9	2.1	-	-
Total Organic Carbon	mg/L	0.5	3.0	2.2	2.7	-	-

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

Parameter	Units	RL	Result	Result	Result	Result	Result
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	-	-
Chloride	mg/L	0.2	20830.3	20855.4	21191.0	-	-
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	-	-
Sulphate	mg/L	0.2	3097.8	3096.2	3136.8	-	-

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	Result	Result	Result	Result	Result
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	-	-
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Boron	mg/L	0.05	6.01	6.34	6.12	-	-
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	-	-
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Potassium	mg/L	0.02	589	600	603	-	-
Sodium	mg/L	0.05	11740	11640	11980	-	-
Strontium	mg/L	0.005	8.19	8.74	8.22	-	-
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	-	-
Zinc	mg/L	0.01	0.20	0.20	0.19	-	-

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	Result	Result	Result	Result	Result
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	-	-

[ATP-Method]

Parameter	Units	RL	Result	Result	Result	Result	Result
^ Extra polymer substances	µg/L	-	0.0033	0.0038	0.0084	-	-

ANALYTICAL REPORT

RESULTS

		Sample n°	DB17-12132.021	DB17-12132.022	DB17-12132.023
		Sample Name	MW 9	MW 10	MW 11
		Sample Location	1.5 M	1.5 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS
		Sample Date	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**

On-Site Analysis

Parameter	Units	RL	Result	Result	Result
pH - APHA 4500HB	pH unit	0.1	8.2	8.2	8.2
Temperature - APHA 4500HB	°C	0.1	30.8	30.6	30.4

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1728872

Conductivity [APHA 2510 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Electrical Conductivity	LB1728872	µS/cm	1.0	<1	0%	100%

LB1728873

Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids	LB1728873	mg/L	5.0	<5	0%	96%

LB1728874

Turbidity [APHA 2130 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Turbidity	LB1728874	NTU	1.0	<1	0%	94 - 99%

LB1728875

Total Suspended Solids [APHA 2540 D, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Suspended Solids	LB1728875	mg/L	5.0	<5	0%

LB1728876

Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Alkalinity	LB1728876	mg CaCO	1.0	<1 - 295	0 - 3%
Carbonate	LB1728876	mg/L	1.0	<1	0%
Bicarbonate	LB1728876	mg/L	1.0	<1 - 360	0 - 3%

LB1728877

Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Calcium Hardness	LB1728877	mg/L	1.0	<1	0%
Calcium	LB1728877	mg/L	1.0	<1	0%

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1728878

Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Hardness as CaCO3	LB1728878	mg/L	1.0	<1	0%

LB1728879

Free Oil [APHA5520B, 21st Edition 2005 Modified]

Parameter	QC Reference	Units	RL	DUP %RPD
Free Oil	LB1728879	mg/L	20	0%

LB1728880

Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Phosphorus	LB1728880	mg/L	0.50	<0.5	0%	94 - 101%

LB1728881

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Fluoride	LB1728881	mg/L	0.040	<0.04		93 - 98%
			20		0%	
Bromide	LB1728881	mg/L	0.150	<0.15		92 - 96%
			75		0%	
Chloride	LB1728881	mg/L	0.20	<0.2		92 - 93%
			100		0 - 1%	
Nitrite	LB1728881	mg/L	0.040	<0.04		97 - 99%
			20		0%	
Nitrate	LB1728881	mg/L	0.040	<0.04		91 - 94%
			20		0%	
Phosphate	LB1728881	mg/L	0.10	<0.10		103 - 105%
			50		0%	
Sulphate	LB1728881	mg/L	0.20	<0.2		93 - 94%
			100		0 - 1%	

LB1728882

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001] (continued)

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Aluminium	LB1728882	mg/L	0.010		94%
			0.050	0%	
Arsenic	LB1728882	mg/L	0.020		100%
			0.10	0%	
Barium	LB1728882	mg/L	0.0050		101%
			0.0250	0%	
Boron	LB1728882	mg/L	0.050		103%
			0.250	0 - 6%	
Cadmium	LB1728882	mg/L	0.0050		100%
			0.0250	0%	
Chromium	LB1728882	mg/L	0.0050		95%
			0.0250	0%	
Copper	LB1728882	mg/L	0.010		96%
			0.050	0%	
Lead	LB1728882	mg/L	0.020		100%
			0.10	0%	
Nickel	LB1728882	mg/L	0.010		102%
			0.050	0%	
Potassium	LB1728882	mg/L	0.020		95%
			0.10	1 - 3%	
Sodium	LB1728882	mg/L	0.050		94%
			0.250	2%	
Strontium	LB1728882	mg/L	0.0050		101%
			0.0250	0 - 1%	
Vanadium	LB1728882	mg/L	0.0050		106%
			0.0250	0%	
Zinc	LB1728882	mg/L	0.010		103%
			0.050	2 - 5%	

LB1728883

Forms of Carbon [APHA 5310 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Dissolved Organic Carbon	LB1728883	mg/L	0.10	<0.1	0 - 3%
Total Organic Carbon	LB1728883	mg/L	0.50	<0.5	0 - 2%

LB1728884

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Mercury	LB1728884	mg/L	0.0050	0%	97 - 101%

LB1728885

Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005] (continued)

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
NH4	LB1728885	mg/L	0.50	0%	108%

LB1728886

Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Magnesium	LB1728886	mg/L	1.0	<1	0%

LB1728887

Total Silica [APHA 4500-SiO2 (Modify)]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Silica	LB1728887	mg/L	0.50	<0.5	0 - 1%	95 - 98%

LB1728888

Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Sulphide (S^{2-})	LB1728888	mg/L	0.50	<0.50	0%

LEGEND

FOOTNOTES

^	Performed by external SGS laboratory.	IS	Insufficient sample for analysis.
^^	Performed by outside laboratory.	LNR	Sample listed, but not received.
RL	Reporting Limit	NA	The sample was not analysed for this analyte
↑	Raised Limit of Reporting	NVL	Result to be validated
↓	Lowered Limit of Reporting	TBA	Parameter not yet analysed

Sampling not accredited as per ISO 17025.
Samples analysed as received.
Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request

--- End of the analytical report ---

SGS

ANALYTICAL REPORT

DB17-12133 R0

Default Project

Prepared for

FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)

ANALYTICAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)	Manager	Smitha Abraham
		Laboratory	SGS Dubai Environmental Laboratory
Address	P.O. Box no: 1672, Dubai	Address	Blue Shed Warehouse TC-3 P.O.Box: 18556, Dubai, Jebel Ali Free Zone, UAE
Contact	Director of Supply of the Authority	Telephone	+971-4-887-01-77 Ext. 114
Telephone	971 4 2315555	Facsimile	+971-4-887-63-76
Facsimile	971 4 2809977	Email	smitha.abraham@sgs.com
Email	shaikha.rashid@fewa.gov.ae	SGS Reference	DB17-12133
Project	Default Project	Received	25/10/2017
Order Number	Morning Sampling 24.10.17	Approved	23/11/2017
Samples	Marine Water(23)	Analysis started	09/11/2017
		Analysis completed	23/11/2017
		Report Number	DB17-12133 R0
		Date Reported	27/11/2017

COMMENTS

Whilst SGS laboratories conform to ISO/IEC 17025 standards, results of analysis in this report fall outside of the current scope accreditation

SIGNATORIES

Smitha Abraham
Laboratory Manager

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ANALYTICAL REPORT

DB17-12133 R0

RESULTS

Parameter	Units	RL	DB17-12133.001	DB17-12133.002	DB17-12133.003	DB17-12133.004	DB17-12133.005
Sample Name			MW 1	MW 1	MW 1	MW 2	MW 2
Sample Location			0 M	1.5 M	3 M	0 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	8.2	-	-	8.2
Temperature - APHA 4500HB	°C	0.1	-	30.2	-	-	30.2
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	58240	58630	58660	58730	58860
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	44150	44050	44300	44250	44100
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	122	122	126	134	126
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	149	149	154	163	154
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7255	7255	7255	7647	7843
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	1176	1176	1176
Calcium	mg/L	1	472	472	472	472	472
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1477	1477	1477	1572	1620
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	0.5
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50

Forms of Carbon [APHA 5310 C, 21st Edition 2005]

RESULTS

Sample n°			DB17-12133.001	DB17-12133.002	DB17-12133.003	DB17-12133.004	DB17-12133.005
Sample Name			MW 1	MW 1	MW 1	MW 2	MW 2
Sample Location			0 M	1.5 M	3 M	0 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Forms of Carbon [APHA 5310 C, 21st Edition 2005] continued							
Dissolved Organic Carbon	mg/L	0.1	2.0	1.9	2.0	1.9	2.0
Total Organic Carbon	mg/L	0.5	2.3	2.0	2.6	2.1	2.0
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	21293.4	20551.2	21463.5	21013.0	22009.0
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3137.3	3091.3	3197.0	3173.0	3258.5
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	5.74	5.74	6.20	6.04	6.08
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Potassium	mg/L	0.02	555	533	564	545	573
Sodium	mg/L	0.05	10790	10590	10910	10800	11310
Strontium	mg/L	0.005	8.02	7.93	8.48	8.25	8.35
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.22	0.20	0.21	0.20	0.20
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
[ATP-Method]							
^ Extra polymer substances	µg/L	-	0.0305	0.0103	0.0107	0.0129	0.0063

RESULTS

Parameter	Units	RL	Result	Result	Result	Result	Result
Sample n°			DB17-12133.006	DB17-12133.007	DB17-12133.008	DB17-12133.009	DB17-12133.010
Sample Name			MW 2	MW 3	MW 3	MW 3	MW 4
Sample Location			3 M	0 M	1.5 M	3 M	0 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	-	8.2	-	-
Temperature - APHA 4500HB	°C	0.1	-	-	30.2	-	-
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	58680	58640	58650	58410	58240
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	44000	44200	44450	44600	44750
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	126	138	126	122	118
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	154	168	154	149	144
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7843	7255	7255	7255	7647
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	1176	1176	1176
Calcium	mg/L	1	472	472	472	472	472
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1620	1477	1477	1477	1572
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	0.6	<0.5	<0.5	0.5	<0.5
Sulphide [APHA 4500-S²- F, 21st Edition 2005]							
Sulphide (S²-)	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50

Forms of Carbon [APHA 5310 C, 21st Edition 2005]

ANALYTICAL REPORT

RESULTS

		Sample n°	DB17-12133.006	DB17-12133.007	DB17-12133.008	DB17-12133.009	DB17-12133.010
		Sample Name	MW 2	MW 3	MW 3	MW 3	MW 4
		Sample Location	3 M	0 M	1.5 M	3 M	0 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Forms of Carbon [APHA 5310 C, 21st Edition 2005] continued							
Dissolved Organic Carbon	mg/L	0.1	2.7	1.9	1.9	2.3	1.9
Total Organic Carbon	mg/L	0.5	3.3	2.0	2.1	2.9	2.0
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	21565.1	21237.6	21126.4	20440.9	22621.6
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3203.5	3173.4	3118.1	2995.5	3306.6
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	6.06	6.90	5.95	6.11	6.25
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Potassium	mg/L	0.02	555	556	544	516	590
Sodium	mg/L	0.05	10790	10860	10740	10290	11420
Strontium	mg/L	0.005	8.28	9.46	8.27	8.35	8.46
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.21	0.21	0.20	0.20	0.20
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
[ATP-Method]							
^ Extra polymer substances	µg/L	-	0.0059	0.0102	0.0102	0.0073	0.0069

RESULTS

Parameter	Units	RL	Result	Result	Result	Result	Result
Sample n°			DB17-12133.011	DB17-12133.012	DB17-12133.013	DB17-12133.014	DB17-12133.015
Sample Name			MW 4	MW 4	MW 5	MW 5	MW 5
Sample Location			1.5 M	3 M	0 M	1.5 M	3 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	8.2	-	-	8.2	-
Temperature - APHA 4500HB	°C	0.1	30.7	-	-	30.9	-
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	58330	58240	58330	58200	58320
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	44850	44800	45400	45300	44950
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	122	130	134	118	126
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	149	158	163	144	154
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7647	7647	7451	7647	7647
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	1176	1176	1176
Calcium	mg/L	1	472	472	472	472	472
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1572	1572	1525	1572	1572
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphide [APHA 4500-S²- F, 21st Edition 2005]							
Sulphide (S²-)	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50

Forms of Carbon [APHA 5310 C, 21st Edition 2005]

RESULTS

Sample n°			DB17-12133.011	DB17-12133.012	DB17-12133.013	DB17-12133.014	DB17-12133.015
Sample Name			MW 4	MW 4	MW 5	MW 5	MW 5
Sample Location			1.5 M	3 M	0 M	1.5 M	3 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Forms of Carbon [APHA 5310 C, 21st Edition 2005] continued							
Dissolved Organic Carbon	mg/L	0.1	1.6	2.3	2.1	2.5	2.0
Total Organic Carbon	mg/L	0.5	1.8	2.7	2.6	3.0	2.3
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	20673.2	21456.0	21701.2	21116.1	21033.7
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3053.3	3156.8	3170.2	3134.7	3111.9
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	6.24	6.06	6.40	6.30	6.02
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Potassium	mg/L	0.02	530	550	569	558	547
Sodium	mg/L	0.05	10390	10690	10800	10840	10570
Strontium	mg/L	0.005	8.39	8.46	8.71	8.57	8.19
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.20	0.20	0.21	0.20	0.20
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
[ATP-Method]							
^ Extra polymer substances	µg/L	-	0.0029	0.0060	0.0026	0.0039	0.0018

RESULTS

		Sample n°	DB17-12133.016	DB17-12133.017	DB17-12133.018	DB17-12133.019	DB17-12133.020
		Sample Name	MW 6	MW 6	MW 6	MW 7	MW 8
		Sample Location	0 M	1.5 M	3 M	1.5 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	8.2	-	8.2	8.2
Temperature - APHA 4500HB	°C	0.1	-	30.8	-	30.7	31.2
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	58230	58180	58110	-	-
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	-	-
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	45150	44800	44850	-	-
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	-	-
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	134	118	122	-	-
Carbonate	mg/L	1	<1	<1	<1	-	-
Bicarbonate	mg/L	1	163	144	149	-	-
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7255	7451	7255	-	-
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	980	1176	-	-
Calcium	mg/L	1	472	393	472	-	-
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1477	1572	1477	-	-
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	-	-
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	-	-
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	0.5	-	-
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	-	-

Forms of Carbon [APHA 5310 C, 21st Edition 2005]

ANALYTICAL REPORT

DB17-12133 R0

RESULTS

Sample n°	DB17-12133.016	DB17-12133.017	DB17-12133.018	DB17-12133.019	DB17-12133.020
Sample Name	MW 6	MW 6	MW 6	MW 7	MW 8
Sample Location	0 M	1.5 M	3 M	1.5 M	1.5 M
Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By	SGS	SGS	SGS	SGS	SGS
Sample Date	24/10/2017	24/10/2017	24/10/2017	24/10/2017	24/10/2017

Forms of Carbon [APHA 5310 C, 21st Edition 2005] continued

Parameter	Units	RL	Result	Result	Result	Result	Result
Dissolved Organic Carbon	mg/L	0.1	2.0	1.5	2.1	-	-
Total Organic Carbon	mg/L	0.5	2.1	1.7	2.4	-	-

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

Parameter	Units	RL	Result	Result	Result	Result	Result
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	-	-
Chloride	mg/L	0.2	21343.0	21406.7	22042.9	-	-
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	-	-
Sulphate	mg/L	0.2	3192.7	3160.7	3255.9	-	-

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	Result	Result	Result	Result	Result
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	-	-
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Boron	mg/L	0.05	5.94	6.25	6.42	-	-
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	-	-
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Potassium	mg/L	0.02	562	566	577	-	-
Sodium	mg/L	0.05	10880	10950	11230	-	-
Strontium	mg/L	0.005	7.98	8.39	8.80	-	-
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	-	-
Zinc	mg/L	0.01	0.20	0.22	0.22	-	-

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	Result	Result	Result	Result	Result
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	-	-

[ATP-Method]

Parameter	Units	RL	Result	Result	Result	Result	Result
^ Extra polymer substances	µg/L	-	0.0044	0.0073	0.0084	-	-

RESULTS

Sample n°			DB17-12133.021	DB17-12133.022	DB17-12133.023
Sample Name			MW 9	MW 10	MW 11
Sample Location			1.5 M	1.5 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS
Sample Date			24/10/2017	24/10/2017	24/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**
On-Site Analysis					
pH - APHA 4500HB	pH unit	0.1	8.2	8.2	8.2
Temperature - APHA 4500HB	°C	0.1	31.3	31.3	31.2

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1728872

Conductivity [APHA 2510 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Electrical Conductivity	LB1728872	µS/cm	1.0	<1	0%	100%

LB1728873

Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids	LB1728873	mg/L	5.0	<5	0%	96%

LB1728874

Turbidity [APHA 2130 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Turbidity	LB1728874	NTU	1.0	<1	0%	94 - 99%

LB1728875

Total Suspended Solids [APHA 2540 D, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Suspended Solids	LB1728875	mg/L	5.0	<5	0%

LB1728876

Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Alkalinity	LB1728876	mg CaCO	1.0	<1 - 295	0 - 3%
Carbonate	LB1728876	mg/L	1.0	<1	0%
Bicarbonate	LB1728876	mg/L	1.0	<1 - 360	0 - 3%

LB1728877

Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Calcium Hardness	LB1728877	mg/L	1.0	<1	0%
Calcium	LB1728877	mg/L	1.0	<1	0%

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1728878

Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Hardness as CaCO3	LB1728878	mg/L	1.0	<1	0%

LB1728879

Free Oil [APHA5520B, 21st Edition 2005 Modified]

Parameter	QC Reference	Units	RL	DUP %RPD
Free Oil	LB1728879	mg/L	20	0%

LB1728880

Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Phosphorus	LB1728880	mg/L	0.50	<0.5	0%	94 - 101%

LB1728881

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Fluoride	LB1728881	mg/L	0.040	<0.04		93 - 98%
			20		0%	
Bromide	LB1728881	mg/L	0.150	<0.15		92 - 96%
			75		0%	
Chloride	LB1728881	mg/L	0.20	<0.2		92 - 93%
			100		0 - 1%	
Nitrite	LB1728881	mg/L	0.040	<0.04		97 - 99%
			20		0%	
Nitrate	LB1728881	mg/L	0.040	<0.04		91 - 94%
			20		0%	
Phosphate	LB1728881	mg/L	0.10	<0.10		103 - 105%
			50		0%	
Sulphate	LB1728881	mg/L	0.20	<0.2		93 - 94%
			100		0 - 1%	

LB1728882

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001] (continued)

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Aluminium	LB1728882	mg/L	0.010		94%
			0.050	0%	
Arsenic	LB1728882	mg/L	0.020		100%
			0.10	0%	
Barium	LB1728882	mg/L	0.0050		101%
			0.0250	0%	
Boron	LB1728882	mg/L	0.050		103%
			0.250	0 - 6%	
Cadmium	LB1728882	mg/L	0.0050		100%
			0.0250	0%	
Chromium	LB1728882	mg/L	0.0050		95%
			0.0250	0%	
Copper	LB1728882	mg/L	0.010		96%
			0.050	0%	
Lead	LB1728882	mg/L	0.020		100%
			0.10	0%	
Nickel	LB1728882	mg/L	0.010		102%
			0.050	0%	
Potassium	LB1728882	mg/L	0.020		95%
			0.10	1 - 3%	
Sodium	LB1728882	mg/L	0.050		94%
			0.250	2%	
Strontium	LB1728882	mg/L	0.0050		101%
			0.0250	0 - 1%	
Vanadium	LB1728882	mg/L	0.0050		106%
			0.0250	0%	
Zinc	LB1728882	mg/L	0.010		103%
			0.050	2 - 5%	

LB1728883

Forms of Carbon [APHA 5310 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Dissolved Organic Carbon	LB1728883	mg/L	0.10	<0.1	0 - 3%
Total Organic Carbon	LB1728883	mg/L	0.50	<0.5	0 - 2%

LB1728884

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Mercury	LB1728884	mg/L	0.0050	0%	97 - 101%

LB1728885

Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005] (continued)

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
NH4	LB1728885	mg/L	0.50	0%	108%

LB1728886

Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Magnesium	LB1728886	mg/L	1.0	<1	0%

LB1728887

Total Silica [APHA 4500-SiO2 (Modify)]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Silica	LB1728887	mg/L	0.50	<0.5	0 - 1%	95 - 98%

LB1728888

Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Sulphide (S^{2-})	LB1728888	mg/L	0.50	<0.50	0%

LEGEND

FOOTNOTES

^	Performed by external SGS laboratory.	IS	Insufficient sample for analysis.
^^	Performed by outside laboratory.	LNR	Sample listed, but not received.
RL	Reporting Limit	NA	The sample was not analysed for this analyte
↑	Raised Limit of Reporting	NVL	Result to be validated
↓	Lowered Limit of Reporting	TBA	Parameter not yet analysed

Sampling not accredited as per ISO 17025.
Samples analysed as received.
Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request

--- End of the analytical report ---

ANALYTICAL REPORT

DB17-12170 R0

Default Project

Prepared for

FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)

ANALYTICAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)	Manager	Smitha Abraham
		Laboratory	SGS Dubai Environmental Laboratory
Address	P.O. Box no: 1672, Dubai	Address	Blue Shed Warehouse TC-3 P.O.Box: 18556, Dubai, Jebel Ali Free Zone. UAE
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Email	shaikha.rashid@fewa.gov.ae	SGS Reference	DB17-12170
Project	Default Project	Received	04/11/2017
Order Number	Morning Sampling 1.11.17	Approved	05/12/2017
Samples	Marine Water(23)	Analysis started	21/11/2017
		Analysis completed	05/12/2017
		Report Number	DB17-12170 R0
		Date Reported	05/12/2017

COMMENTS

Whilst SGS laboratories conform to ISO/IEC 17025 standards, results of analysis in this report fall outside of the current scope accreditation

SIGNATORIES

Smitha Abraham

Laboratory Manager

TABLE OF CONTENTS

RESULTS

		Sample n°	DB17-12170.001	DB17-12170.002	DB17-12170.003	DB17-12170.004	DB17-12170.005
		Sample Name	MW 1	MW 1	MW 1	MW 2	MW 2
		Sample Location	0 M	1.5 M	3 M	0 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	8.1	-	-	8.2
Temperature - APHA 4500HB	°C	0.1	-	29.7	-	-	29.6
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	56700	56300	56600	56400	56800
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	40950	41250	41350	41150	41500
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	134	130	134	126	122
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	163	158	163	154	149
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	6863	7059	7255	7059	6863
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	1176	980	1176
Calcium	mg/L	1	472	472	472	393	472
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1382	1429	1477	1477	1382
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	1.9	2.0	2.4	1.9	2.0
Total Organic Carbon	mg/L	0.5	2.0	2.1	2.9	2.1	2.2

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

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Sample n°			DB17-12170.001	DB17-12170.002	DB17-12170.003	DB17-12170.004	DB17-12170.005
Sample Name			MW 1	MW 1	MW 1	MW 2	MW 2
Sample Location			0 M	1.5 M	3 M	0 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005] continued

Parameter	Units	RL	Result	Result	Result	Result	Result
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	21140.2	21017.0	21214.0	21108.1	20813.0
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3122.0	3111.4	3112.9	3133.0	3087.9

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	Result	Result	Result	Result	Result
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	5.76	5.45	5.54	5.51	5.81
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Strontium	mg/L	0.005	7.94	7.50	7.62	7.54	7.76
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.18	0.17	0.18	0.18	0.19

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	Result	Result	Result	Result	Result
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]

Parameter	Units	RL	Result	Result	Result	Result	Result
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05

[ATP-Method]

Parameter	Units	RL	Result	Result	Result	Result	Result
^ Extra polymer substances	µg/L	-	0.0066	0.0020	0.0078	0.0055	0.0044

Sodium [APHA 3500-Na B, 21st Edition 2005]

Parameter	Units	RL	Result	Result	Result	Result	Result
Sodium	mg/L	1	12250	12200	12200	12300	12200

Potassium [APHA 3500-K B, 21st Edition 2005]

Parameter	Units	RL	Result	Result	Result	Result	Result
Potassium	mg/L	1	420	415	420	415	420

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DB17-12170 R0

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Parameter	Units	RL	Result	Result	Result	Result	Result
Sample n°			DB17-12170.006	DB17-12170.007	DB17-12170.008	DB17-12170.009	DB17-12170.010
Sample Name			MW 2	MW 3	MW 3	MW 3	MW 4
Sample Location			3 M	0 M	1.5 M	3 M	0 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	-	8.2	-	-
Temperature - APHA 4500HB	°C	0.1	-	-	30.0	-	-
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	56900	57500	57900	57400	57500
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	41700	41350	41600	41850	41750
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	134	122	126	118	126
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	163	149	154	144	154
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7059	7059	7255	7451	6863
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	980	1176	1176	980	980
Calcium	mg/L	1	393	472	472	393	393
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1477	1429	1477	1572	1429
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphide [APHA 4500-S²- F, 21st Edition 2005]							
Sulphide (S²-)	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	2.1	2.2	2.2	2.0	1.6
Total Organic Carbon	mg/L	0.5	2.5	2.6	2.2	2.1	1.8

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

RESULTS

Sample n°			DB17-12170.006	DB17-12170.007	DB17-12170.008	DB17-12170.009	DB17-12170.010
Sample Name			MW 2	MW 3	MW 3	MW 3	MW 4
Sample Location			3 M	0 M	1.5 M	3 M	0 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005] continued

Parameter	Units	RL	Result	Result	Result	Result	Result
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	20694.3	20785.5	20678.7	20292.4	19513.7
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3088.0	3099.7	3054.8	2995.2	2921.9

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	Result	Result	Result	Result	Result
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	5.22	5.40	5.58	5.45	5.42
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Strontium	mg/L	0.005	7.16	7.34	7.69	7.47	7.39
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.18	0.18	0.19	0.18	0.18

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	Result	Result	Result	Result	Result
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]

Parameter	Units	RL	Result	Result	Result	Result	Result
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05

[ATP-Method]

Parameter	Units	RL	Result	Result	Result	Result	Result
^ Extra polymer substances	µg/L	-	0.0092	0.0095	0.0041	0.0085	0.0028

Sodium [APHA 3500-Na B, 21st Edition 2005]

Parameter	Units	RL	Result	Result	Result	Result	Result
Sodium	mg/L	1	12250	12250	12200	12250	11700

Potassium [APHA 3500-K B, 21st Edition 2005]

Parameter	Units	RL	Result	Result	Result	Result	Result
Potassium	mg/L	1	415	420	420	415	420

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		Sample n°	DB17-12170.011	DB17-12170.012	DB17-12170.013	DB17-12170.014	DB17-12170.015
		Sample Name	MW 4	MW 4	MW 5	MW 5	MW 5
		Sample Location	1.5 M	3 M	0 M	1.5 M	3 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	8.2	-	-	8.2	-
Temperature - APHA 4500HB	°C	0.1	29.8	-	-	29.9	-
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	57800	57500	57600	57600	57600
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	41400	41400	42250	42050	41600
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	126	118	130	126	134
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	154	144	158	154	163
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7059	7255	7255	7059	7255
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	980	980	1176	980
Calcium	mg/L	1	472	393	393	472	393
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1429	1525	1525	1429	1525
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	1.7	2.7	1.6	2.0	2.0
Total Organic Carbon	mg/L	0.5	2.0	2.9	1.9	2.2	2.2

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

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Sample n°			DB17-12170.011	DB17-12170.012	DB17-12170.013	DB17-12170.014	DB17-12170.015
Sample Name			MW 4	MW 4	MW 5	MW 5	MW 5
Sample Location			1.5 M	3 M	0 M	1.5 M	3 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005] continued							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	21016.3	21125.1	20914.0	21661.1	21046.9
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3113.7	3128.0	3129.9	3218.4	3133.3
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	5.58	5.73	5.39	5.76	5.53
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Strontium	mg/L	0.005	7.61	7.85	7.35	7.86	7.64
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.19	0.18	0.18	0.18	0.19
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
[ATP-Method]							
^ Extra polymer substances	µg/L	-	0.0033	0.0050	0.0049	0.0050	0.0027
Sodium [APHA 3500-Na B, 21st Edition 2005]							
Sodium	mg/L	1	12200	12250	12200	12250	12300
Potassium [APHA 3500-K B, 21st Edition 2005]							
Potassium	mg/L	1	420	420	425	425	420

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Parameter	Units	RL	DB17-12170.016	DB17-12170.017	DB17-12170.018	DB17-12170.019	DB17-12170.020
Sample Name			MW 6	MW 6	MW 6	MW 7	MW 8
Sample Location			0 M	1.5 M	3 M	1.5 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
			Result	Result	Result	Result	Result
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	8.2	-	8.2	8.1
Temperature - APHA 4500HB	°C	0.1	-	30.4	-	29.9	30.2
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	57700	57700	57800	-	-
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	-	-
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	41950	42550	42800	-	-
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	-	-
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	122	126	130	-	-
Carbonate	mg/L	1	<1	<1	<1	-	-
Bicarbonate	mg/L	1	149	154	158	-	-
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7059	7255	7059	-	-
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	980	1176	980	-	-
Calcium	mg/L	1	393	472	393	-	-
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1477	1477	1477	-	-
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	-	-
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	-	-
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	2.0	3.1	2.1	-	-
Total Organic Carbon	mg/L	0.5	2.0	4.3	2.3	-	-

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

RESULTS

		Sample n°	DB17-12170.016	DB17-12170.017	DB17-12170.018	DB17-12170.019	DB17-12170.020
		Sample Name	MW 6	MW 6	MW 6	MW 7	MW 8
		Sample Location	0 M	1.5 M	3 M	1.5 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005] continued

Parameter	Units	RL	DB17-12170.016	DB17-12170.017	DB17-12170.018	DB17-12170.019	DB17-12170.020
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	-	-
Chloride	mg/L	0.2	21531.8	20974.0	20527.4	-	-
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	-	-
Sulphate	mg/L	0.2	3216.4	3177.1	3068.0	-	-

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	DB17-12170.016	DB17-12170.017	DB17-12170.018	DB17-12170.019	DB17-12170.020
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	-	-
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Boron	mg/L	0.05	5.57	5.83	5.68	-	-
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	-	-
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Strontium	mg/L	0.005	7.54	8.03	7.80	-	-
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	-	-
Zinc	mg/L	0.01	0.17	0.18	0.18	-	-

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

Parameter	Units	RL	DB17-12170.016	DB17-12170.017	DB17-12170.018	DB17-12170.019	DB17-12170.020
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	-	-

Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]

Parameter	Units	RL	DB17-12170.016	DB17-12170.017	DB17-12170.018	DB17-12170.019	DB17-12170.020
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	-	-

[ATP-Method]

Parameter	Units	RL	DB17-12170.016	DB17-12170.017	DB17-12170.018	DB17-12170.019	DB17-12170.020
^ Extra polymer substances	µg/L	-	0.0036	0.0052	0.0040	-	-

Sodium [APHA 3500-Na B, 21st Edition 2005]

Parameter	Units	RL	DB17-12170.016	DB17-12170.017	DB17-12170.018	DB17-12170.019	DB17-12170.020
Sodium	mg/L	1	12300	12300	12250	-	-

Potassium [APHA 3500-K B, 21st Edition 2005]

Parameter	Units	RL	DB17-12170.016	DB17-12170.017	DB17-12170.018	DB17-12170.019	DB17-12170.020
Potassium	mg/L	1	425	420	425	-	-

RESULTS

		Sample n°	DB17-12170.021	DB17-12170.022	DB17-12170.023
		Sample Name	MW 9	MW 10	MW 11
		Sample Location	1.5 M	1.5 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS
		Sample Date	01/11/2017	01/11/2017	01/11/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**
On-Site Analysis					
pH - APHA 4500HB	pH unit	0.1	8.2	8.2	8.2
Temperature - APHA 4500HB	°C	0.1	29.8	30.4	30.9

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1729130

Total Suspended Solids [APHA 2540 D, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Suspended Solids	LB1729130	mg/L	5.0	<5	0%

LB1729133

Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Hardness as CaCO3	LB1729133	mg/L	1.0	<1	0%

LB1729139

Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB
Calcium Hardness	LB1729139	mg/L	1.0	<1
Calcium	LB1729139	mg/L	1.0	<1

LB1729140

Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Calcium Hardness	LB1729140	mg/L	1.0	<1	0%
Calcium	LB1729140	mg/L	1.0	<1	0%

LB1729142

Conductivity [APHA 2510 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Electrical Conductivity	LB1729142	μS/cm	1.0	<1	0%	100%

LB1729145

Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Magnesium	LB1729145	mg/L	1.0	<1	0%

ANALYTICAL REPORT

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1729148

Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Alkalinity	LB1729148	mg CaCO	1.0	<1	0 - 3%
Carbonate	LB1729148	mg/L	1.0	<1	0%
Bicarbonate	LB1729148	mg/L	1.0	<1	0 - 3%

LB1729149

Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids	LB1729149	mg/L	5.0	<5	0%	98%

LB1729151

Turbidity [APHA 2130 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Turbidity	LB1729151	NTU	1.0	<1	0%	93 - 96%

LB1729168

Free Oil [APHA5520B, 21st Edition 2005 Modified]

Parameter	QC Reference	Units	RL	DUP %RPD
Free Oil	LB1729168	mg/L	20	0%

LB1729169

Forms of Carbon [APHA 5310 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Dissolved Organic Carbon	LB1729169	mg/L	0.10	<0.1	1 - 4%
Total Organic Carbon	LB1729169	mg/L	0.50	<0.5	1 - 2%

LB1729173

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005] (continued)

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Fluoride	LB1729173	mg/L	0.040	<0.04		87 - 100%
			20		0%	
Bromide	LB1729173	mg/L	0.150	<0.15		91 - 96%
			75		0%	
Chloride	LB1729173	mg/L	0.20	<0.2		93 - 99%
			100		0 - 1%	
Nitrite	LB1729173	mg/L	0.040	<0.04		91 - 109%
			20		0%	
Nitrate	LB1729173	mg/L	0.040	<0.04		89 - 102%
			20		0%	
Phosphate	LB1729173	mg/L	0.10	<0.10		96 - 107%
			50		0%	
Sulphate	LB1729173	mg/L	0.20	<0.2		89 - 96%
			100		0 - 2%	

LB1729174

Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Sulphide (S^{2-})	LB1729174	mg/L	0.50	<0.50	0%

LB1729175

Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
NH4	LB1729175	mg/L	0.50	0%	110%

LB1729176

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Aluminium	LB1729176	mg/L	0.010		95%
			0.050	0%	
Arsenic	LB1729176	mg/L	0.020		102%
			0.10	0%	
Barium	LB1729176	mg/L	0.0050		103%
			0.0250	0%	
Boron	LB1729176	mg/L	0.050		105%
			0.250	0%	
Cadmium	LB1729176	mg/L	0.0050		102%
			0.0250	0%	
Chromium	LB1729176	mg/L	0.0050		95%

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001] (continued)

				DUP %RPD	LCS %Recovery
Chromium	LB1729176	mg/L	0.0250	0%	
Copper	LB1729176	mg/L	0.010		98%
			0.050	0%	
Lead	LB1729176	mg/L	0.020		101%
			0.10	0%	
Nickel	LB1729176	mg/L	0.010		106%
			0.050	0%	
Strontium	LB1729176	mg/L	0.0050		103%
			0.0250	0%	
Vanadium	LB1729176	mg/L	0.0050		108%
			0.0250	0%	
Zinc	LB1729176	mg/L	0.010		104%
			0.050	1%	

LB1729177

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Mercury	LB1729177	mg/L	0.0050	0%	94%

LB1729181

Total Silica [APHA 4500-SiO2 (Modify)]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Silica	LB1729181	mg/L	0.50	<0.5 - 10.0	0%	109 - 110%

LB1729635

Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Phosphorus	LB1729635	mg/L	0.50	<0.5	0%	88 - 105%

ANALYTICAL REPORT

LEGEND

FOOTNOTES

^	Performed by external SGS laboratory.	IS	Insufficient sample for analysis.
^^	Performed by outside laboratory.	LNR	Sample listed, but not received.
RL	Reporting Limit	NA	The sample was not analysed for this analyte
↑	Raised Limit of Reporting	NVL	Result to be validated
↓	Lowered Limit of Reporting	TBA	Parameter not yet analysed

Sampling not accredited as per ISO 17025.
Samples analysed as received.
Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request

--- End of the analytical report ---

SGS

ANALYTICAL REPORT

DB17-12171 R0

Default Project

Prepared for

FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)

ANALYTICAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)	Manager	Smitha Abraham
		Laboratory	SGS Dubai Environmental Laboratory
Address	P.O. Box no: 1672, Dubai	Address	Blue Shed Warehouse TC-3 P.O.Box: 18556, Dubai, Jebel Ali Free Zone. UAE
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Email	shaikha.rashid@fewa.gov.ae	SGS Reference	DB17-12171
Project	Default Project	Received	04/11/2017
Order Number	Evening Sampling 1.11.17	Approved	05/12/2017
Samples	Marine Water(23)	Analysis started	21/11/2017
		Analysis completed	05/12/2017
		Report Number	DB17-12171 R0
		Date Reported	05/12/2017

COMMENTS

Whilst SGS laboratories conform to ISO/IEC 17025 standards, results of analysis in this report fall outside of the current scope accreditation

SIGNATORIES

Smitha Abraham
Laboratory Manager

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ANALYTICAL REPORT

RESULTS

Parameter	Units	RL	Result	Result	Result	Result	Result
Sample n°			DB17-12171.001	DB17-12171.002	DB17-12171.003	DB17-12171.004	DB17-12171.005
Sample Name			MW 1	MW 1	MW 1	MW 2	MW 2
Sample Location			0 M	1.5 M	3 M	0 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	8.1	-	-	8.1
Temperature - APHA 4500HB	°C	0.1	-	29.2	-	-	29.1
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	59000	58200	56400	56400	56400
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	40800	41700	41450	41200	41550
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7255	6667	6863	7059	6863
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	130	126	126	122	118
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	158	154	154	149	144
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	1176	980	1176
Calcium	mg/L	1	472	472	472	393	472
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1477	1334	1382	1477	1429
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	2.1	1.9	1.8	1.8	2.7
Total Organic Carbon	mg/L	0.5	2.3	2.0	1.9	1.8	2.9

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

ANALYTICAL REPORT

DB17-12171 R0

RESULTS

Sample n°			DB17-12171.001	DB17-12171.002	DB17-12171.003	DB17-12171.004	DB17-12171.005
Sample Name			MW 1	MW 1	MW 1	MW 2	MW 2
Sample Location			0 M	1.5 M	3 M	0 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005] continued							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	21360.9	21396.0	21370.8	20913.1	21444.6
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3169.2	3190.9	3163.9	3142.1	3197.3
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	5.41	5.42	5.51	5.44	5.36
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Strontium	mg/L	0.005	7.51	7.49	7.59	7.42	7.38
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.18	0.18	0.18	0.18	0.21
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
[ATP-Method]							
^ Extra polymer substances	µg/L	-	0.0042	0.0023	0.0030	0.0060	0.0038
Sodium [APHA 3500-Na B, 21st Edition 2005]							
Sodium	mg/L	1	12350	12400	12350	12300	12350
Potassium [APHA 3500-K B, 21st Edition 2005]							
Potassium	mg/L	1	410	410	415	420	415

RESULTS

Parameter	Units	RL	DB17-12171.006	DB17-12171.007	DB17-12171.008	DB17-12171.009	DB17-12171.010
Sample Name			MW 2	MW 3	MW 3	MW 3	MW 4
Sample Location			3 M	0 M	1.5 M	3 M	0 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			30/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
			Result	Result	Result	Result	Result
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	-	8.2	-	-
Temperature - APHA 4500HB	°C	0.1	-	-	29.5	-	-
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	μS/cm	1	56500	56600	56700	56100	56600
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	41800	42450	42100	41850	41600
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7255	7059	7255	7059	7059
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	126	122	126	122	130
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	154	149	154	149	158
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	980	1176	980
Calcium	mg/L	1	472	472	393	472	393
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1477	1429	1525	1429	1477
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	1.7	2.0	2.2	2.8	3.1
Total Organic Carbon	mg/L	0.5	2.0	2.1	2.5	3.0	3.8

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

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Sample n°			DB17-12171.006	DB17-12171.007	DB17-12171.008	DB17-12171.009	DB17-12171.010
Sample Name			MW 2	MW 3	MW 3	MW 3	MW 4
Sample Location			3 M	0 M	1.5 M	3 M	0 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			30/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005] continued							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	20005.2	19436.3	21032.0	21133.0	21199.3
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	2987.1	2931.7	3132.0	3173.0	3171.9
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	5.27	5.41	5.31	5.27	5.20
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Strontium	mg/L	0.005	7.18	7.42	7.26	7.34	7.21
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.18	0.20	0.18	0.18	0.18
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
[ATP-Method]							
^ Extra polymer substances	µg/L	-	0.0033	0.0022	0.0035	0.0026	0.0030
Sodium [APHA 3500-Na B, 21st Edition 2005]							
Sodium	mg/L	1	12350	12300	12350	12300	12200
Potassium [APHA 3500-K B, 21st Edition 2005]							
Potassium	mg/L	1	420	415	415	415	420

RESULTS

Parameter	Units	RL	DB17-12171.011	DB17-12171.012	DB17-12171.013	DB17-12171.014	DB17-12171.015
Sample Name			MW 4	MW 4	MW 5	MW 5	MW 5
Sample Location			1.5 M	3 M	0 M	1.5 M	3 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
			Result	Result	Result	Result	Result
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	8.2	-	-	8.1	-
Temperature - APHA 4500HB	°C	0.1	29.9	-	-	29.2	-
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	56600	56600	56900	56500	56800
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	<1	<1
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	41950	40200	41800	41500	42050
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	<5	<5
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7255	7059	6863	7059	7255
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	126	122	126	118	126
Carbonate	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	154	149	154	144	154
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	980	980	1176	980
Calcium	mg/L	1	472	393	393	472	393
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1477	1477	1429	1429	1525
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	<20.00	<20.00
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	2.6	2.4	2.1	2.0	2.8
Total Organic Carbon	mg/L	0.5	2.8	3.0	2.3	2.1	3.0

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

RESULTS

Sample n°			DB17-12171.011	DB17-12171.012	DB17-12171.013	DB17-12171.014	DB17-12171.015
Sample Name			MW 4	MW 4	MW 5	MW 5	MW 5
Sample Location			1.5 M	3 M	0 M	1.5 M	3 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005] continued							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	<75.00↑	<75.00↑
Chloride	mg/L	0.2	21086.9	20973.5	21340.8	21682.4	21851.7
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	<20.00↑	<20.00↑
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	<50.00↑	<50.00↑
Sulphate	mg/L	0.2	3154.1	3136.0	3205.6	3225.7	3239.1
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Boron	mg/L	0.05	5.54	5.24	5.21	5.60	5.55
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑	<0.0250↑
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	<0.10↑	<0.10↑
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	<0.05↑	<0.05↑
Strontium	mg/L	0.005	7.58	7.25	7.17	7.64	7.60
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	<0.03↑	<0.03↑
Zinc	mg/L	0.01	0.18	0.18	0.18	0.19	0.18
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
[ATP-Method]							
^ Extra polymer substances	µg/L	-	0.0040	0.0029	0.0044	0.0049	0.0042
Sodium [APHA 3500-Na B, 21st Edition 2005]							
Sodium	mg/L	1	12200	12200	12200	12250	12200
Potassium [APHA 3500-K B, 21st Edition 2005]							
Potassium	mg/L	1	415	420	430	425	425

RESULTS

Parameter	Units	RL	Result	Result	Result	Result	Result
Sample n°			DB17-12171.016	DB17-12171.017	DB17-12171.018	DB17-12171.019	DB17-12171.020
Sample Name			MW 6	MW 6	MW 6	MW 7	MW 8
Sample Location			0 M	1.5 M	3 M	1.5 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
Sampled By			SGS	SGS	SGS		
Sample Date			01/11/2017	01/11/2017	01/11/2017		
On-Site Analysis							
pH - APHA 4500HB	pH unit	0.1	-	8.2	-	8.2	8.1
Temperature - APHA 4500HB	°C	0.1	-	29.6	-	29.1	29.4
Conductivity [APHA 2510 B, 21st Edition 2005]							
Electrical Conductivity	µS/cm	1	56800	56600	56800	-	-
Turbidity [APHA 2130 B, 21st Edition 2005]							
Turbidity	NTU	1	<1	<1	<1	-	-
Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]							
Total Dissolved Solids	mg/L	5	40800	41200	41350	-	-
Total Suspended Solids [APHA 2540 D, 21st Edition 2005]							
Total Suspended Solids	mg/L	5	<5	<5	<5	-	-
Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]							
Total Hardness as CaCO3	mg/L	1	7059	6667	7255	-	-
Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]							
Alkalinity	mg CaCO3/L	1	122	118	126	-	-
Carbonate	mg/L	1	<1	<1	<1	-	-
Bicarbonate	mg/L	1	149	144	154	-	-
Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]							
Calcium Hardness	mg/L	1	1176	1176	980	-	-
Calcium	mg/L	1	472	472	393	-	-
Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]							
Magnesium	mg/L	1	1429	1334	1525	-	-
[APHA5520B, 21st Edition 2005 Modified]							
Free Oil	mg/L	20	<20.00	<20.00	<20.00	-	-
Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]							
Total Phosphorus	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Total Silica [APHA 4500-SiO2 (Modify)]							
Total Silica	mg/L	0.5	<0.5	<0.5	<0.5	-	-
Sulphide [APHA 4500-S^{2-} F, 21st Edition 2005]							
Sulphide (S^{2-})	mg/L	0.5	<0.50	<0.50	<0.50	-	-
Forms of Carbon [APHA 5310 C, 21st Edition 2005]							
Dissolved Organic Carbon	mg/L	0.1	2.6	3.1	2.0	-	-
Total Organic Carbon	mg/L	0.5	2.8	3.5	2.2	-	-

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

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RESULTS

		Sample n°	DB17-12171.016	DB17-12171.017	DB17-12171.018	DB17-12171.019	DB17-12171.020
		Sample Name	MW 6	MW 6	MW 6	MW 7	MW 8
		Sample Location	0 M	1.5 M	3 M	1.5 M	1.5 M
		Sample Matrix	Marine Water	Marine Water	Marine Water	Marine Water	Marine Water
		Sampled By	SGS	SGS	SGS		
		Sample Date	01/11/2017	01/11/2017	01/11/2017		
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005] continued							
Fluoride	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Bromide	mg/L	0.15	<75.00↑	<75.00↑	<75.00↑	-	-
Chloride	mg/L	0.2	21714.7	21481.1	21057.9	-	-
Nitrite	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Nitrate	mg/L	0.04	<20.00↑	<20.00↑	<20.00↑	-	-
Phosphate	mg/L	0.1	<50.00↑	<50.00↑	<50.00↑	-	-
Sulphate	mg/L	0.2	3258.2	3241.9	3185.6	-	-
Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]							
Aluminium	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Arsenic	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	-	-
Barium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Boron	mg/L	0.05	5.38	5.34	5.61	-	-
Cadmium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Chromium	mg/L	0.005	<0.0250↑	<0.0250↑	<0.0250↑	-	-
Copper	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Lead	mg/L	0.02	<0.10↑	<0.10↑	<0.10↑	-	-
Nickel	mg/L	0.01	<0.05↑	<0.05↑	<0.05↑	-	-
Strontium	mg/L	0.005	7.34	7.28	7.65	-	-
Vanadium	mg/L	0.005	<0.03↑	<0.03↑	<0.03↑	-	-
Zinc	mg/L	0.01	0.18	0.19	0.19	-	-
Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]							
Mercury	mg/L	0.005	<0.0050	<0.0050	<0.0050	-	-
Total Cyanide [Total Cyanide, APHA 4500-CN C & E , 22st Edition 2005]							
^ Total Cyanide	mg/L	0.05	<0.05	<0.05	<0.05	-	-
[ATP-Method]							
^ Extra polymer substances	µg/L	-	0.0055	0.0043	0.0026	-	-
Sodium [APHA 3500-Na B, 21st Edition 2005]							
Sodium	mg/L	1	12300	12250	12250	-	-
Potassium [APHA 3500-K B, 21st Edition 2005]							
Potassium	mg/L	1	430	430	430	-	-

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Parameter	Units	RL	DB17-12171.021	DB17-12171.022	DB17-12171.023
Sample Name			MW 9	MW 10	MW 11
Sample Location			1.5 M	1.5 M	1.5 M
Sample Matrix			Marine Water	Marine Water	Marine Water
			Result	Result	Result
On-Site Analysis					
pH - APHA 4500HB	pH unit	0.1	8.2	8.2	8.2
Temperature - APHA 4500HB	°C	0.1	29.5	29.8	29.6

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1729130

Total Suspended Solids [APHA 2540 D, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Suspended Solids	LB1729130	mg/L	5.0	<5	0%

LB1729133

Total Hardness as CaCO3 [APHA 2340 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Hardness as CaCO3	LB1729133	mg/L	1.0	<1	0%

LB1729140

Calcium Hardness [APHA 3500-Ca B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Calcium Hardness	LB1729140	mg/L	1.0	<1	0%
Calcium	LB1729140	mg/L	1.0	<1	0%

LB1729142

Conductivity [APHA 2510 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Electrical Conductivity	LB1729142	µS/cm	1.0	<1	0%	100%

LB1729145

Magnesium Hardness [APHA 3500-Mg B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Magnesium	LB1729145	mg/L	1.0	<1	0%

LB1729148

Alkalinity [APHA 2320 B, 21st Edition 2005+ calculation]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Alkalinity	LB1729148	mg CaCO	1.0	<1	0 - 3%
Carbonate	LB1729148	mg/L	1.0	<1	0%
Bicarbonate	LB1729148	mg/L	1.0	<1	0 - 3%

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1729149

Total Dissolved Solids [APHA 2540 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids	LB1729149	mg/L	5.0	<5	0%	98%

LB1729151

Turbidity [APHA 2130 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Turbidity	LB1729151	NTU	1.0	<1	0%	93 - 96%

LB1729168

Free Oil [APHA5520B, 21st Edition 2005 Modified]

Parameter	QC Reference	Units	RL	DUP %RPD
Free Oil	LB1729168	mg/L	20	0%

LB1729169

Forms of Carbon [APHA 5310 C, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Dissolved Organic Carbon	LB1729169	mg/L	0.10	<0.1	1 - 4%
Total Organic Carbon	LB1729169	mg/L	0.50	<0.5	1 - 2%

LB1729173

Anions by Ion Chromatography [APHA 4110 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Fluoride	LB1729173	mg/L	0.040	<0.04		87 - 100%
			20		0%	
Bromide	LB1729173	mg/L	0.150	<0.15		91 - 96%
			75		0%	
Chloride	LB1729173	mg/L	0.20	<0.2		93 - 99%
			100		0 - 1%	
Nitrite	LB1729173	mg/L	0.040	<0.04		91 - 109%
			20		0%	
Nitrate	LB1729173	mg/L	0.040	<0.04		89 - 102%
			20		0%	
Phosphate	LB1729173	mg/L	0.10	<0.10		96 - 107%
			50		0%	
Sulphate	LB1729173	mg/L	0.20	<0.2		89 - 96%
			100		0 - 2%	

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1729174

Sulphide [APHA 4500-S²- F, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Sulphide (S^{2-})	LB1729174	mg/L	0.50	<0.50	0%

LB1729175

Ammonia as NH4 [APHA 4500-NH4 , 21st Edition 2005]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
NH4	LB1729175	mg/L	0.50	0%	110%

LB1729176

Metals in Water [Direct Analysis + Metals by ICP-OES,EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Aluminium	LB1729176	mg/L	0.010		95%
			0.050	0%	
Arsenic	LB1729176	mg/L	0.020		102%
			0.10	0%	
Barium	LB1729176	mg/L	0.0050		103%
			0.0250	0%	
Boron	LB1729176	mg/L	0.050		105%
			0.250	0%	
Cadmium	LB1729176	mg/L	0.0050		102%
			0.0250	0%	
Chromium	LB1729176	mg/L	0.0050		95%
			0.0250	0%	
Copper	LB1729176	mg/L	0.010		98%
			0.050	0%	
Lead	LB1729176	mg/L	0.020		101%
			0.10	0%	
Nickel	LB1729176	mg/L	0.010		106%
			0.050	0%	
Strontium	LB1729176	mg/L	0.0050		103%
			0.0250	0%	
Vanadium	LB1729176	mg/L	0.0050		108%
			0.0250	0%	
Zinc	LB1729176	mg/L	0.010		104%
			0.050	1%	

LB1729177

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001]

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Mercury in Water [Hydrate + ICP-OES, EPA200.7 Rev 05, January 2001] (continued)

Parameter	QC Reference	Units	RL	DUP %RPD	LCS %Recovery
Mercury	LB1729177	mg/L	0.0050	0%	94%

LB1729181

Total Silica [APHA 4500-SiO2 (Modify)]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Silica	LB1729181	mg/L	0.50	<0.5 - 10.0	0%	109 - 110%

LB1729635

Total Phosphorus [APHA 4500-P B & E , 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Phosphorus	LB1729635	mg/L	0.50	<0.5	0%	88 - 105%

LEGEND

FOOTNOTES

^	Performed by external SGS laboratory.	IS	Insufficient sample for analysis.
^^	Performed by outside laboratory.	LNR	Sample listed, but not received.
RL	Reporting Limit	NA	The sample was not analysed for this analyte
↑	Raised Limit of Reporting	NVL	Result to be validated
↓	Lowered Limit of Reporting	TBA	Parameter not yet analysed

Sampling not accredited as per ISO 17025.
Samples analysed as received.
Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request

--- End of the analytical report ---

ANNEXURE-9

MARINE SEDIMENT ANALYSIS REPORT

ANALYTICAL REPORT

DB17-12116 R0

Default Project

Prepared for

FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)

ANALYTICAL REPORT

DB17-12116 R0

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CLIENT DETAILS		LABORATORY DETAILS	
Client	FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)	Manager	Smitha Abraham
		Laboratory	SGS Dubai Environmental Laboratory
Address	P.O. Box no: 1672, Dubai	Address	Blue Shed Warehouse TC-3 P.O.Box: 18556, Dubai, Jebel Ali Free Zone. UAE
Contact		Telephone	+971-4-887-01-77 Ext. 114
Telephone		Facsimile	+971-4-887-63-76
Facsimile		Email	smitha.abraham@sgs.com
Email		SGS Reference	DB17-12116
Project	Default Project	Received	19/10/2017
Order Number	(Not specified)	Approved	08/11/2017
Samples	Sediment(6)	Analysis started	06/11/2017
		Analysis completed	08/11/2017
		Report Number	DB17-12116 R0
		Date Reported	08/11/2017

COMMENTS

Whilst SGS laboratories conform to ISO/IEC 17025 standards, results of analysis in this report fall outside of the current scope accreditation

SIGNATORIES

Smitha Abraham
Laboratory Manager

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		Sample n°	DB17-12116.001	DB17-12116.002	DB17-12116.003	DB17-12116.004	DB17-12116.005
		Sample Name	MS-1	MS-2	MS-3	MS-4	MS-5
		Sample Location	UMM AL QUWAIN	UMM AL QUWAIN	UMM AL QUWAIN	UMM AL QUWAIN	UMM AL QUWAIN
		Sample Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
		Sampled By	SGS	SGS	SGS	SGS	SGS
		Sample Date	17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**
pH (1:5 soil:water extract) [APHA 4500-H+ B]							
pH	pH unit	0.1	8.1	8.3	7.8	8.1	7.7
Metals in Soil and Sediments [Digestion + EPA200.7 Rev 05, January 2001]							
Aluminium	mg/kg	4	1594.0	2919.0	461.3	1503.0	802.4
Cadmium	mg/kg	2	<2.0	<2.0	<2.0	<2.0	<2.0
Chromium	mg/kg	2	8.4	14.3	2.6	9.7	5.4
Cobalt	mg/kg	2	<2.0	<2.0	<2.0	<2.0	<2.0
Copper	mg/kg	2	<2.0	<2.0	<2.0	<2.0	<2.0
Iron	mg/kg	4	1868.0	3608.0	546.9	1835.0	878.8
Lead	mg/kg	4	<4.0	<4.0	<4.0	<4.0	<4.0
Manganese	mg/kg	2	100.5	168.5	20.2	111.1	35.3
Nickel	mg/kg	2	9.5	17.1	3.2	7.3	4.5
Vanadium	mg/kg	2	6.5	10.6	2.5	7.0	4.0
Zinc	mg/kg	2	11.2	13.9	8.9	11.1	9.7
Mercury in Soil and Sediments [Digestion + EPA200.7 Rev 05, January 2001]							
Mercury	mg/kg	0.25	<0.2500	<0.2500	<0.2500	<0.2500	<0.2500
Soluble Anions by Ion Chromatography in Sediment [APHA 4110 B, 21st Edition 2005]							
Chloride	mg/kg	1	7698	7994	5963	5944	7148
Nitrate	mg/kg	0.2	0.6	2.3	1.0	<0.2	<0.2
Phosphate	mg/kg	0.5	5.6	9.4	6.7	1.3	1.4
Sulphate	mg/L	1	1058	1005	761	900	939
Total Petroleum Hydrocarbons [TPH, EPA 8015, 8260]							
Total Petroleum Hydrocarbons(GRO,DRO&HF)	mg/kg	20	<20	<20	<20	<20	<20
Magnesium in saturated extract [USDA, NRCS 2004]							
Magnesium	mg/kg	1	568	614	466	384	479
Calcium in Saturated extract [USDA, NRCS 2004]							
Calcium	mg/kg	5	130	276	240	253	163
[APHA 4500-P B&E]							
Total Phosphorus	mg/kg	2.5	111	57	103	118	126
n-Hexane extractable material(HEM) [EPA 9071 B]							
Total PHC/n-hexane extractable material (dry weight)	mg/kg	5	<5	<5	<5	<5	<5
Ammonia as NH4 in soil (1:5 water extract) [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/kg	2.5	32.9	43.9	79.8	29.2	67.5
C by Walkley-Black [Walkley-Black]							
Total Organic Carbon	% weight	1	<1.00	<1.00	<1.00	<1.00	<1.00

RESULTS

Sample n°	DB17-12116.006
Sample Name	MS-6
Sample Location	UMM AL QUWAIN
Sample Matrix	Sediment
Sampled By	SGS
Sample Date	17/10/2017

Parameter	Units	RL	Result
pH (1:5 soil:water extract) [APHA 4500-H+ B]			
pH	pH unit	0.1	7.4
Metals in Soil and Sediments [Digestion + EPA200.7 Rev 05, January 2001]			
Aluminium	mg/kg	4	691.9
Cadmium	mg/kg	2	<2.0
Chromium	mg/kg	2	4.7
Cobalt	mg/kg	2	<2.0
Copper	mg/kg	2	<2.0
Iron	mg/kg	4	778.7
Lead	mg/kg	4	<4.0
Manganese	mg/kg	2	35.2
Nickel	mg/kg	2	4.2
Vanadium	mg/kg	2	3.3
Zinc	mg/kg	2	10.5
Mercury in Soil and Sediments [Digestion + EPA200.7 Rev 05, January 2001]			
Mercury	mg/kg	0.25	<0.2500
Soluble Anions by Ion Chromatography in Sediment [APHA 4110 B, 21st Edition 2005]			
Chloride	mg/kg	1	7274
Nitrate	mg/kg	0.2	1.2
Phosphate	mg/kg	0.5	13.2
Sulphate	mg/L	1	1031
Total Petroleum Hydrocarbons [TPH, EPA 8015, 8260]			
Total Petroleum Hydrocarbons(GRO,DRO&HF)	mg/kg	20	<20
Magnesium in saturated extract [USDA, NRCS 2004]			
Magnesium	mg/kg	1	627
Calcium in Saturated extract [USDA, NRCS 2004]			
Calcium	mg/kg	5	163
[APHA 4500-P B&E]			
Total Phosphorus	mg/kg	2.5	153
n-Hexane extractable material(HEM) [EPA 9071 B]			
Total PHC/n-hexane extractable material (dry weight)	mg/kg	5	<5
Ammonia as NH4 in soil (1:5 water extract) [APHA 4500-NH4 , 21st Edition 2005]			
NH4	mg/kg	2.5	61.4
C by Walkley-Black [Walkley-Black]			
Total Organic Carbon	% weight	1	<1.00

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1728773

pH (1:5 soil:water extract) [APHA 4500-H+ B]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
pH	LB1728773	pH unit	0.10	6.6	0%	99%

LB1728775

Magnesium in saturated extract [USDA, NRCS 2004]

Parameter	QC Reference	Units	RL	MB
Magnesium	LB1728775	mg/kg	1.0	<1

LB1728777

Soluble Anions by Ion Chromatography in Sediment [APHA 4110 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Chloride	LB1728777	mg/kg	1.0	<1	0%	104%
Nitrate	LB1728777	mg/kg	0.20	<0.2	0%	101%
Phosphate	LB1728777	mg/kg	0.50	<0.5	3%	110%
Sulphate	LB1728777	mg/L	1.0	<1	0%	100%

LB1728778

Metals in Soil and Sediments [Digestion + EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD
Aluminium	LB1728778	mg/kg	4.0	1%
Cadmium	LB1728778	mg/kg	2.0	0%
Chromium	LB1728778	mg/kg	2.0	1%
Cobalt	LB1728778	mg/kg	2.0	0%
Copper	LB1728778	mg/kg	2.0	0%
Iron	LB1728778	mg/kg	4.0	2%
Lead	LB1728778	mg/kg	4.0	0%
Manganese	LB1728778	mg/kg	2.0	0%
Nickel	LB1728778	mg/kg	2.0	0%
Vanadium	LB1728778	mg/kg	2.0	1%
Zinc	LB1728778	mg/kg	2.0	2%

LB1728779

Mercury in Soil and Sediments [Digestion + EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD
Mercury	LB1728779	mg/kg	0.250	0%

ANALYTICAL REPORT

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1728780

Total Phosphorus [APHA 4500-P B&E]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Phosphorus	LB1728780	mg/kg	2.50	<3	8%

LB1728781

Total Petroleum Hydrocarbons [TPH, EPA 8015, 8260]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Petroleum Hydrocarbons(GRO,DR	LB1728781	mg/kg	20	<20	0%	99%

LB1728783

Ammonia as NH4
in soil (1:5 water extract) [APHA 4500-NH4
, 21st Edition 2005]

Parameter	QC Reference	Units	RL	DUP %RPD
NH4	LB1728783	mg/kg	2.50	0%

ANALYTICAL REPORT

LEGEND

FOOTNOTES

^	Performed by external SGS laboratory.	IS	Insufficient sample for analysis.
^^	Performed by outside laboratory.	LNR	Sample listed, but not received.
RL	Reporting Limit	NA	The sample was not analysed for this analyte
↑	Raised Limit of Reporting	NVL	Result to be validated
↓	Lowered Limit of Reporting	TBA	Parameter not yet analysed

Sampling not accredited as per ISO 17025.
Samples analysed as received.
Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request

--- End of the analytical report ---

ANNEXURE-9

MARINE SEDIMENT ANALYSIS REPORT

ANALYTICAL REPORT

DB17-12116 R0

Default Project

Prepared for

FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)

ANALYTICAL REPORT

DB17-12116 R0

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	FEDERAL ELECTRICITY AND WATER AUTHORITY (FEWA)	Manager	Smitha Abraham
		Laboratory	SGS Dubai Environmental Laboratory
Address	P.O. Box no: 1672, Dubai	Address	Blue Shed Warehouse TC-3 P.O.Box: 18556, Dubai, Jebel Ali Free Zone. UAE
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Email		SGS Reference	DB17-12116
Project	Default Project	Received	19/10/2017
Order Number	(Not specified)	Approved	08/11/2017
Samples	Sediment(6)	Analysis started	06/11/2017
		Analysis completed	08/11/2017
		Report Number	DB17-12116 R0
		Date Reported	08/11/2017

COMMENTS

Whilst SGS laboratories conform to ISO/IEC 17025 standards, results of analysis in this report fall outside of the current scope accreditation

SIGNATORIES

Smitha Abraham

Laboratory Manager

ANALYTICAL REPORT

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SGS

ANALYTICAL REPORT

RESULTS

Parameter	Units	RL	Result	Result	Result	Result	Result
Sample n°			DB17-12116.001	DB17-12116.002	DB17-12116.003	DB17-12116.004	DB17-12116.005
Sample Name			MS-1	MS-2	MS-3	MS-4	MS-5
Sample Location			UMM AL QUWAIN	UMM AL QUWAIN	UMM AL QUWAIN	UMM AL QUWAIN	UMM AL QUWAIN
Sample Matrix			Sediment	Sediment	Sediment	Sediment	Sediment
Sampled By			SGS	SGS	SGS	SGS	SGS
Sample Date			17/10/2017	17/10/2017	17/10/2017	17/10/2017	17/10/2017
pH (1:5 soil:water extract) [APHA 4500-H+ B]							
pH	pH unit	0.1	8.1	8.3	7.8	8.1	7.7
Metals in Soil and Sediments [Digestion + EPA200.7 Rev 05, January 2001]							
Aluminium	mg/kg	4	1594.0	2919.0	461.3	1503.0	802.4
Cadmium	mg/kg	2	<2.0	<2.0	<2.0	<2.0	<2.0
Chromium	mg/kg	2	8.4	14.3	2.6	9.7	5.4
Cobalt	mg/kg	2	<2.0	<2.0	<2.0	<2.0	<2.0
Copper	mg/kg	2	<2.0	<2.0	<2.0	<2.0	<2.0
Iron	mg/kg	4	1868.0	3608.0	546.9	1835.0	878.8
Lead	mg/kg	4	<4.0	<4.0	<4.0	<4.0	<4.0
Manganese	mg/kg	2	100.5	168.5	20.2	111.1	35.3
Nickel	mg/kg	2	9.5	17.1	3.2	7.3	4.5
Vanadium	mg/kg	2	6.5	10.6	2.5	7.0	4.0
Zinc	mg/kg	2	11.2	13.9	8.9	11.1	9.7
Mercury in Soil and Sediments [Digestion + EPA200.7 Rev 05, January 2001]							
Mercury	mg/kg	0.25	<0.2500	<0.2500	<0.2500	<0.2500	<0.2500
Soluble Anions by Ion Chromatography in Sediment [APHA 4110 B, 21st Edition 2005]							
Chloride	mg/kg	1	7698	7994	5963	5944	7148
Nitrate	mg/kg	0.2	0.6	2.3	1.0	<0.2	<0.2
Phosphate	mg/kg	0.5	5.6	9.4	6.7	1.3	1.4
Sulphate	mg/L	1	1058	1005	761	900	939
Total Petroleum Hydrocarbons [TPH, EPA 8015, 8260]							
Total Petroleum Hydrocarbons(GRO,DRO&HF)	mg/kg	20	<20	<20	<20	<20	<20
Magnesium in saturated extract [USDA, NRCS 2004]							
Magnesium	mg/kg	1	568	614	466	384	479
Calcium in Saturated extract [USDA, NRCS 2004]							
Calcium	mg/kg	5	130	276	240	253	163
[APHA 4500-P B&E]							
Total Phosphorus	mg/kg	2.5	111	57	103	118	126
n-Hexane extractable material(HEM) [EPA 9071 B]							
Total PHC/n-hexane extractable material (dry weight)	mg/kg	5	<5	<5	<5	<5	<5
Ammonia as NH4 in soil (1:5 water extract) [APHA 4500-NH4 , 21st Edition 2005]							
NH4	mg/kg	2.5	32.9	43.9	79.8	29.2	67.5
C by Walkley-Black [Walkley-Black]							
Total Organic Carbon	% weight	1	<1.00	<1.00	<1.00	<1.00	<1.00

ANALYTICAL REPORT

RESULTS

Sample n°	DB17-12116.006
Sample Name	MS-6
Sample Location	UMM AL QUWAIN
Sample Matrix	Sediment
Sampled By	SGS
Sample Date	17/10/2017

Parameter	Units	RL	Result
pH (1:5 soil:water extract) [APHA 4500-H+ B]			
pH	pH unit	0.1	7.4
Metals in Soil and Sediments [Digestion + EPA200.7 Rev 05, January 2001]			
Aluminium	mg/kg	4	691.9
Cadmium	mg/kg	2	<2.0
Chromium	mg/kg	2	4.7
Cobalt	mg/kg	2	<2.0
Copper	mg/kg	2	<2.0
Iron	mg/kg	4	778.7
Lead	mg/kg	4	<4.0
Manganese	mg/kg	2	35.2
Nickel	mg/kg	2	4.2
Vanadium	mg/kg	2	3.3
Zinc	mg/kg	2	10.5
Mercury in Soil and Sediments [Digestion + EPA200.7 Rev 05, January 2001]			
Mercury	mg/kg	0.25	<0.2500
Soluble Anions by Ion Chromatography in Sediment [APHA 4110 B, 21st Edition 2005]			
Chloride	mg/kg	1	7274
Nitrate	mg/kg	0.2	1.2
Phosphate	mg/kg	0.5	13.2
Sulphate	mg/L	1	1031
Total Petroleum Hydrocarbons [TPH, EPA 8015, 8260]			
Total Petroleum Hydrocarbons(GRO,DRO&HF)	mg/kg	20	<20
Magnesium in saturated extract [USDA, NRCS 2004]			
Magnesium	mg/kg	1	627
Calcium in Saturated extract [USDA, NRCS 2004]			
Calcium	mg/kg	5	163
[APHA 4500-P B&E]			
Total Phosphorus	mg/kg	2.5	153
n-Hexane extractable material(HEM) [EPA 9071 B]			
Total PHC/n-hexane extractable material (dry weight)	mg/kg	5	<5
Ammonia as NH4 in soil (1:5 water extract) [APHA 4500-NH4 , 21st Edition 2005]			
NH4	mg/kg	2.5	61.4
C by Walkley-Black [Walkley-Black]			
Total Organic Carbon	% weight	1	<1.00

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1728773

pH (1:5 soil:water extract) [APHA 4500-H+ B]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
pH	LB1728773	pH unit	0.10	6.6	0%	99%

LB1728775

Magnesium in saturated extract [USDA, NRCS 2004]

Parameter	QC Reference	Units	RL	MB
Magnesium	LB1728775	mg/kg	1.0	<1

LB1728777

Soluble Anions by Ion Chromatography in Sediment [APHA 4110 B, 21st Edition 2005]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Chloride	LB1728777	mg/kg	1.0	<1	0%	104%
Nitrate	LB1728777	mg/kg	0.20	<0.2	0%	101%
Phosphate	LB1728777	mg/kg	0.50	<0.5	3%	110%
Sulphate	LB1728777	mg/L	1.0	<1	0%	100%

LB1728778

Metals in Soil and Sediments [Digestion + EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD
Aluminium	LB1728778	mg/kg	4.0	1%
Cadmium	LB1728778	mg/kg	2.0	0%
Chromium	LB1728778	mg/kg	2.0	1%
Cobalt	LB1728778	mg/kg	2.0	0%
Copper	LB1728778	mg/kg	2.0	0%
Iron	LB1728778	mg/kg	4.0	2%
Lead	LB1728778	mg/kg	4.0	0%
Manganese	LB1728778	mg/kg	2.0	0%
Nickel	LB1728778	mg/kg	2.0	0%
Vanadium	LB1728778	mg/kg	2.0	1%
Zinc	LB1728778	mg/kg	2.0	2%

LB1728779

Mercury in Soil and Sediments [Digestion + EPA200.7 Rev 05, January 2001]

Parameter	QC Reference	Units	RL	DUP %RPD
Mercury	LB1728779	mg/kg	0.250	0%

QC SUMMARY

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

LB1728780

Total Phosphorus [APHA 4500-P B&E]

Parameter	QC Reference	Units	RL	MB	DUP %RPD
Total Phosphorus	LB1728780	mg/kg	2.50	<3	8%

LB1728781

Total Petroleum Hydrocarbons [TPH, EPA 8015, 8260]

Parameter	QC Reference	Units	RL	MB	DUP %RPD	LCS %Recovery
Total Petroleum Hydrocarbons(GRO,DR	LB1728781	mg/kg	20	<20	0%	99%

LB1728783

Ammonia as NH4 in soil (1:5 water extract) [APHA 4500-NH4 , 21st Edition 2005]

Parameter	QC Reference	Units	RL	DUP %RPD
NH4	LB1728783	mg/kg	2.50	0%

ANALYTICAL REPORT

LEGEND

FOOTNOTES

^	Performed by external SGS laboratory.	IS	Insufficient sample for analysis.
^^	Performed by outside laboratory.	LNR	Sample listed, but not received.
RL	Reporting Limit	NA	The sample was not analysed for this analyte
↑	Raised Limit of Reporting	NVL	Result to be validated
↓	Lowered Limit of Reporting	TBA	Parameter not yet analysed

Sampling not accredited as per ISO 17025.
Samples analysed as received.
Solid samples expressed on a dry weight basis.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request

--- End of the analytical report ---

Marine Water and Sediment Analysis 2018

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Analytical Report

Job Ref. No. :	63178
Report No :	88657
Date Reported :	09/12/2018

Client:	Five Capital Environmental and Management Consultancies P.O. Box: 119899, Suite 203 Sheikha Sana Building Sheikh Zayed Road DUBAI, United Arab Emirates
Attn:	Harry George
Project ID:	Sea Water
Project Name:	Five Capital Environmental and Managemen
Project Location:	N/A
Tel. No:	+971 54 4325601

Approved by:

P Wilson

Paul Wilson

Laboratory Manager – Chemistry

Sample ID		63178-1	63178-2	63178-3	
Date Received		22/11/2018	22/11/2018	22/11/2018	
Sampled By		Five Capital Rep.	Five Capital Rep.	Five Capital Rep.	
Sampling Date		22/11/2018	22/11/2018	22/11/2018	
Sampling Time		Not Given	Not Given	Not Given	
Sample Sub Matrix		Water	Water	Water	
Sampling Location		Not Given	Not Given	Not Given	
Client Sample ID		WQ - 01 / Sea Water	WQ - 02 / Sea Water	WQ - 03 / Sea Water	
Analyte	**Units**	**Results**	**Results**	**Results**	**Method Limit of Detection**
Anions					
Nitrate	mg/L	<0.04	<0.04	<0.04	0.04
Nitrite	mg/L	<0.016	<0.016	<0.016	0.016
Sulphate	mg/L	2930	2970	2930	5
Chloride	mg/L	22300	22700	22300	2
Chemical Analysis					
Biochemical Oxygen Demand	mg/L	<2	<2	<2	2
Chemical Oxygen Demand	mg/L	<5	<5	<5	5
Total Organic Carbon	mg/L	1.4	1.6	1.5	1.0
Inorganic Parameters					
Turbidity	NTU	1.2	1.0	1.3	0.1
Salinity	ppt	42.0	42.7	42.1	1
Total Suspended Solids	mg/L	<5.0	<5.0	<5.0	5
Sulphide	mg/L	<0.1	<0.1	<0.1	0.1
Residual Chlorine	mg/L	<0.02	<0.02	<0.02	0.02
Bicarbonate	mg/L	146	149	151	1
Carbonate	mg/L	5	5	5	1
Total Alkalinity	mg/L	128	130	132	1
Nitrogen Kjeldhal	mg/L	<1.00	<1.00	<1.00	1
Dissolved Oxygen	mg/L	7.7	7.6	7.7	1
pH Value @ 20°C	pH units	8.2	8.2	8.2	-
Nitrogen (Ammonia)	mg/L	<0.05	<0.05	<0.05	0.05
Ammonia	mg/L	<0.06	<0.06	<0.06	0.06

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Analytical Report

Job Ref. No.	:	63178
Report No	:	88657
Date Reported :		09/12/2018

Client:	Five Capital Environmental and Management Consultancies P.O. Box: 119899, Suite 203 Sheikha Sana Building Sheikh Zayed Road DUBAI, United Arab Emirates
Attn:	Harry George
Project ID:	Sea Water
Project Name:	Five Capital Environmental and Managemen
Project Location:	N/A
Tel. No:	+971 54 4325601

Approved by:

Paul Wilson
Laboratory Manager – Chemistry

Sample ID	63178-1	63178-2	63178-3
Date Received	22/11/2018	22/11/2018	22/11/2018
Sampled By	Five Capital Rep.	Five Capital Rep.	Five Capital Rep.
Sampling Date	22/11/2018	22/11/2018	22/11/2018
Sampling Time	Not Given	Not Given	Not Given
Sample Sub Matrix	Water	Water	Water
Sampling Location	Not Given	Not Given	Not Given
Client Sample ID	WQ - 01 / Sea Water	WQ - 02 / Sea Water	WQ - 03 / Sea Water

Analyte	**Units**	**Results**	**Results**	**Results**	**Method Limit of Detection**
Inorganic Parameters - Continued					
Ammonium	mg/L	<0.064	<0.064	<0.064	0.064
Metals					
Chromium (VI)	mg/L	<0.05	<0.05	<0.05	0.05
Aluminium (Al)	mg/L	<0.030	<0.030	<0.030	0.030
Antimony (Sb)	mg/L	0.009	<0.005	<0.005	0.005
Arsenic (As)	mg/L	<0.01	<0.01	<0.01	0.010
Barium (Ba)	mg/L	0.01	0.011	0.011	0.005
Beryllium (Be)	mg/L	<0.001	<0.001	<0.001	0.001
Boron (B)	mg/L	5.15	5.37	5.29	0.005
Cadmium (Cd)	mg/L	<0.001	<0.001	<0.001	0.001
Chromium (Cr)	mg/L	<0.003	<0.003	<0.003	0.003
Cobalt (Co)	mg/L	<0.003	<0.003	<0.003	0.003
Copper (Cu)	mg/L	<0.003	<0.003	<0.003	0.003
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	0.030
Lead (Pb)	mg/L	0.01	<0.01	<0.01	0.01
Manganese (Mn)	mg/L	<0.005	<0.005	<0.005	0.005
Nickel (Ni)	mg/L	<0.003	<0.003	<0.003	0.003
Phosphorus (P)	mg/L	<0.030	0.058	<0.030	0.030
Selenium (Se)	mg/L	<0.030	<0.030	<0.030	0.030
Silver (Ag)	mg/L	<0.005	<0.005	<0.005	0.005
Sodium (Na)	mg/L	11900	12200	12100	1000
Zinc (Zn)	mg/L	<0.010	<0.010	0.072	0.010
Vanadium (V)	mg/L	<0.005	<0.005	<0.005	0.005

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Analytical Report

Job Ref. No.	:	63178
Report No	:	88657
Date Reported	:	09/12/2018

Client:	Five Capital Environmental and Management Consultancies P.O. Box: 119899, Suite 203 Sheikha Sana Building Sheikh Zayed Road DUBAI, United Arab Emirates
Attn:	Harry George
Project ID:	Sea Water
Project Name:	Five Capital Environmental and Managemen
Project Location:	N/A
Tel. No:	+971 54 4325601

Approved by:

P Wilson

Paul Wilson

Laboratory Manager – Chemistry

Sample ID		63178-1	63178-2	63178-3	
Date Received		22/11/2018	22/11/2018	22/11/2018	
Sampled By		Five Capital Rep.	Five Capital Rep.	Five Capital Rep.	
Sampling Date		22/11/2018	22/11/2018	22/11/2018	
Sampling Time		Not Given	Not Given	Not Given	
Sample Sub Matrix		Water	Water	Water	
Sampling Location		Not Given	Not Given	Not Given	
Client Sample ID		WQ - 01 / Sea Water	WQ - 02 / Sea Water	WQ - 03 / Sea Water	
Analyte	**Units**	**Results**	**Results**	**Results**	**Method Limit of Detection**
Metals - Continued					
Mercury	µg/L	<0.300	<0.300	<0.300	0.300

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Analytical Report

Job Ref. No.	:	63178
Report No	:	88657
Date Reported :		09/12/2018

Client:	Five Capital Environmental and Management Consultancies P.O. Box: 119899, Suite 203 Sheikha Sana Building Sheikh Zayed Road DUBAI, United Arab Emirates
Attn:	Harry George
Project ID:	Sea Water
Project Name:	Five Capital Environmental and Managemen
Project Location:	N/A
Tel. No:	+971 54 4325601

Approved by:

P Wilson

Paul Wilson

Laboratory Manager – Chemistry

Sample ID	63178-4	63178-5	63178-6
Date Received	22/11/2018	22/11/2018	22/11/2018
Sampled By	Five Capital Rep.	Five Capital Rep.	Five Capital Rep.
Sampling Date	22/11/2018	22/11/2018	22/11/2018
Sampling Time	Not Given	Not Given	Not Given
Sample Sub Matrix	Water	Water	Water
Sampling Location	Not Given	Not Given	Not Given
Client Sample ID	WQ - 04 / Sea Water	WQ - 05 / Sea Water	WQ - 06 / Sea Water

Analyte	Units	Results	Results	Results	Method Limit of Detection
Anions					
Nitrate	mg/L	<0.04	<0.04	<0.04	0.04
Nitrite	mg/L	<0.016	<0.016	<0.016	0.016
Sulphate	mg/L	2930	2970	2950	5
Chloride	mg/L	22300	22700	22300	2
Chemical Analysis					
Biochemical Oxygen Demand	mg/L	<2	<2	<2	2
Chemical Oxygen Demand	mg/L	<5	<5	<5	5
Total Organic Carbon	mg/L	1.5	1.6	1.4	1.0
Inorganic Parameters					
Turbidity	NTU	1.3	1.1	0.7	0.1
Salinity	ppt	42.2	42.4	42.3	1
Total Suspended Solids	mg/L	<5.0	<5.0	<5.0	5
Sulphide	mg/L	<0.1	<0.1	<0.1	0.1
Residual Chlorine	mg/L	<0.02	<0.02	<0.02	0.02
Bicarbonate	mg/L	149	151	151	1
Carbonate	mg/L	5	5	5	1
Total Alkalinity	mg/L	130	132	132	1
Nitrogen Kjeldhal	mg/L	<1.00	<1.00	<1.00	1
Dissolved Oxygen	mg/L	7.6	7.7	7.7	1
pH Value @ 20°C	pH units	8.2	8.2	8.2	-
Nitrogen (Ammonia)	mg/L	<0.05	<0.05	<0.05	0.05
Ammonia	mg/L	<0.06	<0.06	<0.06	0.06

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Analytical Report

Job Ref. No.	:	63178
Report No	:	88657
Date Reported	:	09/12/2018

Client:	Five Capital Environmental and Management Consultancies P.O. Box: 119899, Suite 203 Sheikha Sana Building Sheikh Zayed Road DUBAI, United Arab Emirates
Attn:	Harry George
Project ID:	Sea Water
Project Name:	Five Capital Environmental and Managemen
Project Location:	N/A
Tel. No:	+971 54 4325601

Approved by:

P Wilson

Paul Wilson
Laboratory Manager – Chemistry

Sample ID	63178-4	63178-5	63178-6
Date Received	22/11/2018	22/11/2018	22/11/2018
Sampled By	Five Capital Rep.	Five Capital Rep.	Five Capital Rep.
Sampling Date	22/11/2018	22/11/2018	22/11/2018
Sampling Time	Not Given	Not Given	Not Given
Sample Sub Matrix	Water	Water	Water
Sampling Location	Not Given	Not Given	Not Given
Client Sample ID	WQ - 04 / Sea Water	WQ - 05 / Sea Water	WQ - 06 / Sea Water

Analyte	Units	Results	Results	Results	Method Limit of Detection
Inorganic Parameters - Continued					
Ammonium	mg/L	<0.064	<0.064	<0.064	0.064
Metals					
Chromium (VI)	mg/L	<0.05	<0.05	<0.05	0.05
Aluminium (Al)	mg/L	<0.030	<0.030	<0.030	0.030
Antimony (Sb)	mg/L	<0.005	0.014	0.008	0.005
Arsenic (As)	mg/L	<0.01	<0.01	<0.01	0.010
Barium (Ba)	mg/L	0.012	0.013	0.013	0.005
Beryllium (Be)	mg/L	<0.001	<0.001	<0.001	0.001
Boron (B)	mg/L	5.28	5.28	5.30	0.005
Cadmium (Cd)	mg/L	<0.001	<0.001	<0.001	0.001
Chromium (Cr)	mg/L	<0.003	<0.003	<0.003	0.003
Cobalt (Co)	mg/L	<0.003	<0.003	<0.003	0.003
Copper (Cu)	mg/L	<0.003	<0.003	<0.003	0.003
Iron (Fe)	mg/L	<0.030	<0.030	<0.030	0.030
Lead (Pb)	mg/L	<0.01	<0.01	<0.01	0.01
Manganese (Mn)	mg/L	<0.005	<0.005	<0.005	0.005
Nickel (Ni)	mg/L	<0.003	<0.003	<0.003	0.003
Phosphorus (P)	mg/L	<0.030	0.039	0.038	0.030
Selenium (Se)	mg/L	<0.030	<0.030	<0.030	0.030
Silver (Ag)	mg/L	<0.005	<0.005	<0.005	0.005
Sodium (Na)	mg/L	12100	11900	11900	1000
Zinc (Zn)	mg/L	<0.010	0.013	<0.010	0.010
Vanadium (V)	mg/L	<0.005	<0.005	<0.005	0.005

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Analytical Report

Job Ref. No. : 63178
Report No : 88657
Date Reported : 09/12/2018

Client:	Five Capital Environmental and Management Consultancies P.O. Box: 119899, Suite 203 Sheikha Sana Building Sheikh Zayed Road DUBAI, United Arab Emirates
Attn:	Harry George
Project ID:	Sea Water
Project Name:	Five Capital Environmental and Managemen
Project Location:	N/A
Tel. No:	+971 54 4325601

Approved by:

Paul Wilson
Laboratory Manager – Chemistry

Sample ID	63178-4	63178-5	63178-6
Date Received	22/11/2018	22/11/2018	22/11/2018
Sampled By	Five Capital Rep.	Five Capital Rep.	Five Capital Rep.
Sampling Date	22/11/2018	22/11/2018	22/11/2018
Sampling Time	Not Given	Not Given	Not Given
Sample Sub Matrix	Water	Water	Water
Sampling Location	Not Given	Not Given	Not Given
Client Sample ID	WQ - 04 / Sea Water	WQ - 05 / Sea Water	WQ - 06 / Sea Water

Analyte	Units	Results	Results	Results	Method Limit of Detection
Metals - Continued					
Mercury	µg/L	<0.300	<0.300	<0.300	0.300

Method of Analysis

Method Name	Reference
Alkalinity [APHA 2320 B]-DXB	APHA [2320 B]
Biochemical Oxygen Demand [APHA 5210 B]Water-DXB$	APHA [5210 B]
Chemical Oxygen Demand [APHA 5220 B]Water-DXB$	APHA [5220 B]
Chloride [APHA 4500 Cl- B]-DXB	APHA [4500 Cl- B]
Chlorine (Total Residual) [HACH 8167]-DXB	HACH [8167]
Chromium (Hexavalent) [HACH 8023] Water-DXB	HACH [8023]
Mercury by PSA [EPA 245.7] SW-DXB$	EPA [245.7]
Metals ICP OES [APHA 3120 B] SW-DXB$	APHA [3120 B]
Nitrate [HACH 8039]-DXB	HACH [8039]
Nitrite [HACH 8507]-DXB	HACH [8507]
Nitrogen (Ammonia) [HACH 8155]-DXB	HACH [8155]
Nitrogen Kjeldhal [APHA 4500 Norg B]-DXB	APHA [4500 Norg B]
Oxygen (Dissolved) [APHA 4500 O G]-DXB	APHA [4500 O G]
pH [APHA 4500 H+ B]Water-DXB$	APHA [4500 H+ B]
	APHA [4500 H+ B]
Salinity [APHA 2520 B]-DXB	APHA [2520 B]
Solids (Total Suspended) [APHA 2540 D]Water-DXB$	APHA [2540 D]
Sulphate [APHA 4500 SO42- C]-DXB	APHA [4500 SO42- C]
Sulphide [APHA 4500 S2- F]-DXB	APHA [4500 S2- F]
Total Organic Carbon (TOC) [APHA 5310 B]-DXB	APHA [5310 B]
Turbidity [APHA 2130 B]-DXB	APHA [2130 B]

* Reference Method Modified

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Analytical Report

Job Ref. No.	:	63178
Report No	:	88657
Date Reported :		09/12/2018

Client:	Five Capital Environmental and Management Consultancies P.O. Box: 119899, Suite 203 Sheikha Sana Building Sheikh Zayed Road DUBAI, United Arab Emirates
Attn:	Harry George
Project ID:	Sea Water
Project Name:	Five Capital Environmental and Managemen
Project Location:	N/A
Tel. No:	+971 54 4325601

Approved by:

P Wilson

Paul Wilson

Laboratory Manager – Chemistry

Comments:

· Tested By : AAP, DCE, JCH, SGE, SMO
· Date Tested: 22/11/2018 to 09/12/2018

. Please note that if the sample has to be diluted due to the matrix, the reported Limit of Detection (LOD) value will increase from the method LOD.

. Any APHA methods stated herein are documented in-house procedures, referenced to 22nd edition.

- Test methods marked with $ are EIAC (formerly DAC) accredited.

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Analytical Report

Job Ref. No.	:	63179
Report No	:	88726
Date Reported	:	17/12/2018

Client: Five Capital Environmental and Management Consultancies
P.O. Box: 119899, Suite 203
Sheikha Sana Building Sheikh Zayed Road
DUBAI, United Arab Emirates

Attn: Harry George
Project ID: Sediment
Project Name: Five Capital Environmental and Managemen
Project Location: N/A
Tel. No: +971 54 4325601

Approved by:

Saji SK
Asst. Laboratory Manager–Chemistry & Microbiology

Sample ID	63179-1	63179-2	63179-3
Date Received	22/11/2018	22/11/2018	22/11/2018
Sampled By	Five Capital Rep.	Five Capital Rep.	Five Capital Rep.
Sampling Date	22/11/2018	22/11/2018	22/11/2018
Sampling Time	Not Given	Not Given	Not Given
Sample Sub Matrix	Sediment	Sediment	Sediment
Sampling Location	Not Given	Not Given	Not Given
Client Sample ID	WQ - 01 / Sediment	WQ - 02 / Sediment	WQ - 03 / Sediment

Analyte	Units	Results	Results	Results	Method Limit of Detection
Anions					
Sulphate (Acid Soluble)	%	0.24	0.23	0.26	0.01
Chemical Analysis					
Total Organic Carbon	%	0.2	0.2	0.2	0.1
Hydrocarbons					
VPH C5-C10	mg/kg	<0.05	<0.05	<0.05	0.05
EPH C10-C40	mg/kg	<50	<50	<50	50
Inorganic Parameters					
Carbonate	%	27.0	27.0	29.0	0.01
Sulphide	mg/kg	<5	<5	<5	5
Total Nitrogen	mg/kg	225	264	308	5
Redox Potential	mV	66	52	32	
Metals					
Cadmium (Cd)	mg/kg	<0.5	<0.5	<0.5	0.5
Aluminium (Al)	mg/kg	2110	2410	2370	130
Arsenic (As)	mg/kg	1.7	2.7	2.5	1.0
Barium (Ba)	mg/kg	12.2	12.9	13.1	3.0
Chromium (Cr)	mg/kg	13.4	15.5	14.5	1.0
Cobalt (Co)	mg/kg	1.5	1.9	1.5	1.0
Copper (Cu)	mg/kg	<3.0	<3.0	<3.0	3.0
Iron (Fe)	mg/kg	2530	2980	2770	70
Manganese (Mn)	mg/kg	147	169	149	3.0
Nickel (Ni)	mg/kg	11.0	14.8	12.1	1.0

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Analytical Report

Job Ref. No. :	63179
Report No :	88726
Date Reported :	17/12/2018

Client:	Five Capital Environmental and Management Consultancies P.O. Box: 119899, Suite 203 Sheikha Sana Building Sheikh Zayed Road DUBAI, United Arab Emirates
Attn:	Harry George
Project ID:	Sediment
Project Name:	Five Capital Environmental and Managemen
Project Location:	N/A
Tel. No:	+971 54 4325601

Approved by:

Saji SK

Asst. Laboratory Manager–Chemistry & Microbiology

Sample ID	63179-1	63179-2	63179-3
Date Received	22/11/2018	22/11/2018	22/11/2018
Sampled By	Five Capital Rep.	Five Capital Rep.	Five Capital Rep.
Sampling Date	22/11/2018	22/11/2018	22/11/2018
Sampling Time	Not Given	Not Given	Not Given
Sample Sub Matrix	Sediment	Sediment	Sediment
Sampling Location	Not Given	Not Given	Not Given
Client Sample ID	WQ - 01 / Sediment	WQ - 02 / Sediment	WQ - 03 / Sediment

Analyte	Units	Results	Results	Results	Method Limit of Detection
Metals - Continued					
Phosphorus (P)	mg/kg	333	318	349	50
Selenium (Se)	mg/kg	<3.0	<3.0	<3.0	3.0
Silver (Ag)	mg/kg	<10	<10	<10	10
Vanadium (V)	mg/kg	7.5	8.9	8.6	1.0
Zinc (Zn)	mg/kg	6.3	7.5	7.4	3.0
Chromium (VI)	mg/kg	<0.4	<0.4	<0.4	0.4
Antimony (Sb)	mg/kg	1.3	1.0	<1.0	1.0
Beryllium (Be)	mg/kg	<1.0	<1.0	<1.0	1.0
Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	0.010

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Analytical Report

Job Ref. No.	:	63179
Report No	:	88726
Date Reported :		17/12/2018

Client:	Five Capital Environmental and Management Consultancies P.O. Box: 119899, Suite 203 Sheikha Sana Building Sheikh Zayed Road DUBAI, United Arab Emirates
Attn:	Harry George
Project ID:	Sediment
Project Name:	Five Capital Environmental and Managemen
Project Location:	N/A
Tel. No:	+971 54 4325601

Approved by:

Saji SK

Asst. Laboratory Manager–Chemistry & Microbiology

Sample ID	63179-4	63179-5	63179-6
Date Received	22/11/2018	22/11/2018	22/11/2018
Sampled By	Five Capital Rep.	Five Capital Rep.	Five Capital Rep.
Sampling Date	22/11/2018	22/11/2018	22/11/2018
Sampling Time	Not Given	Not Given	Not Given
Sample Sub Matrix	Sediment	Sediment	Sediment
Sampling Location	Not Given	Not Given	Not Given
Client Sample ID	WQ - 04 / Sediment	WQ - 05 / Sediment	WQ - 06 / Sediment

Analyte	Units	Results	Results	Results	Method Limit of Detection
Anions					
Sulphate (Acid Soluble)	%	0.30	0.25	0.33	0.01
Chemical Analysis					
Total Organic Carbon	%	0.6	0.2	0.2	0.1
Hydrocarbons					
VPH C5-C10	mg/kg	<0.05	<0.05	<0.05	0.05
EPH C10-C40	mg/kg	<50	<50	<50	50
Inorganic Parameters					
Carbonate	%	27.0	27.0	30.0	0.01
Sulphide	mg/kg	<5	<5	<5	5
Total Nitrogen	mg/kg	452	396	281	5
Redox Potential	mV	32	30	87	
Metals					
Cadmium (Cd)	mg/kg	<0.5	<0.5	<0.5	0.5
Aluminium (Al)	mg/kg	3080	2550	1930	130
Arsenic (As)	mg/kg	3.1	2.5	3.3	1.0
Barium (Ba)	mg/kg	15.9	14.1	13.0	3.0
Chromium (Cr)	mg/kg	18.3	15.9	13.8	1.0
Cobalt (Co)	mg/kg	2.1	1.9	1.2	1.0
Copper (Cu)	mg/kg	3.9	<3.0	<3.0	3.0
Iron (Fe)	mg/kg	3630	3130	2500	70
Manganese (Mn)	mg/kg	155	166	142	3.0
Nickel (Ni)	mg/kg	21.5	13.4	10.1	1.0

Al Futtaim Element Materials Technology Dubai L.L.C
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Date Received		22/11/2018	22/11/2018	22/11/2018	
Sampled By		Five Capital Rep.	Five Capital Rep.	Five Capital Rep.	
Sampling Date		22/11/2018	22/11/2018	22/11/2018	
Sampling Time		Not Given	Not Given	Not Given	
Sample Sub Matrix		Sediment	Sediment	Sediment	
Sampling Location		Not Given	Not Given	Not Given	
Client Sample ID		WQ - 04 / Sediment	WQ - 05 / Sediment	WQ - 06 / Sediment	
Analyte	**Units**	**Results**	**Results**	**Results**	**Method Limit of Detection**
Metals - Continued					
Phosphorus (P)	mg/kg	405	353	400	50
Selenium (Se)	mg/kg	<3.0	<3.0	<3.0	3.0
Silver (Ag)	mg/kg	<10	<10	<10	10
Vanadium (V)	mg/kg	10.5	9.5	7.9	1.0
Zinc (Zn)	mg/kg	10.7	8.4	6.3	3.0
Chromium (VI)	mg/kg	<0.4	<0.4	<0.4	0.4
Antimony (Sb)	mg/kg	1.1	1.1	1.0	1.0
Beryllium (Be)	mg/kg	<1.0	<1.0	<1.0	1.0
Mercury (Hg)	mg/kg	<0.010	0.011	<0.010	0.010

Method of Analysis

Method Name	Reference
Carbonate [BS 1377-3] Soil-DXB$	BS [1377-3:1990]
Chromium (Hexavalent) [HACH 8023] Solids-DXB	HACH [8023]
EPH C10-C40 by GC-FID [EPA 8015B] SSS-DXB$	EPA [8015B]
Mercury by PSA [EPA 245.7] SSS-DXB$	EPA [245.7]
Metals ICP OES [APHA 3120 B] SSS-DXB$	APHA [3120 B]
Nitrogen (Total) [APHA 4500 Norg B]-DXB	APHA [4500 Norg B]
Redox [APHA 2580]-DXB	APHA [2580]
Sulphate (Acid Soluble)[BS 1377-3] Soil-DXB$	BS [1377-3:1990]
Sulphide [In-house]-DXB	In-house []
Total Organic Carbon [MOOPAM IV.4]-DXB	MOOPAM [IV.4]
VPH C5-C10 by GC-FID [EPA 8015B]-SSS-DXB$	EPA [8015B]

* Reference Method Modified

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Approved by:

Saji SK
Asst. Laboratory Manager–Chemistry & Microbiology

Comments:

· Tested By : AAP, DCE, EMA, JCH, SAU, SKR, SMO
· Date Tested: 25/11/2018 to 17/12/2018

. Please note that if the sample has to be diluted due to the matrix, the reported Limit of Detection (LOD) value will increase from the method LOD.

. Any APHA methods stated herein are documented in-house procedures, referenced to 22nd edition.

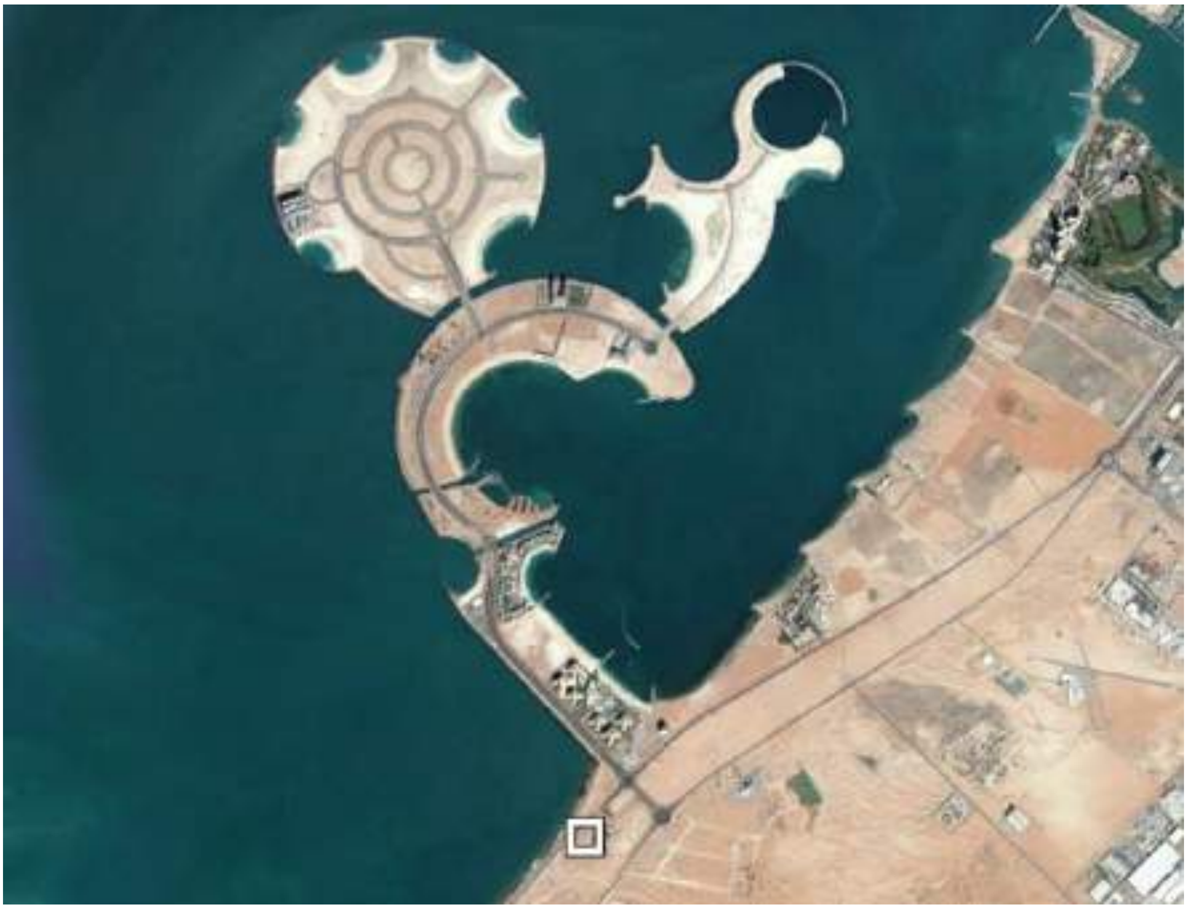
- Test methods marked with $ are EIAC (formerly DAC) accredited.

APPENDIX E – MARINE ECOLOGY SURVEY REPORT

Reference: SGS Gulf Limited (2017). Environmental Impact Assessment for 2x45 MIGD SWRO Desalination Plant for Umm Al Quwain report as provided by Federal Electricity and Water Authority (FEWA) to prospective bidders.

RO Plant Umm Al Quwain
Water & Sediment Quality Survey
Field and Analytical Report

NEA Reference: N551-1117-1.0 dated November 2017



NAUTICA Environmental Associates LLC

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Front cover: Google satellite image of Al Marjan Island and RO Plant Location (white outlined square). All photographs ©NEA, 2017, except where otherwise stated.

Document Issue and Revision

Issue Date	Author(s)	Checked	Approved	Issue №	Comment
02/11/2017	VP/RP/JO/AK/MA	RP/HC	VP	1.0	First Issue

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Abbreviations used in Report

CMRECS	Coastal and Marine Resources and Ecosystem Classification System
EAD	Environment Agency - Abu Dhabi
GIS	(ArcGIS) Geographic Information System
HAB	Harmful Algal Bacteria
ISO	International Standards Organisation
Km	Kilometre
m	Metre
MOOPAM	Manual of Oceanographic Observations and Pollutants Analysis Methods
NEA	Nautica Environmental Associates LLC
%	Percent
SGS	SGS Gulf Limited
UAE	United Arab Emirates

1.0 Project Background and Objectives

1.1 Background and Objectives

The emirate of Umm Al Quwain has plans to develop a Reverse Osmosis plant on its border with Ras Al Khaimah. SGS Gulf Limited, Dubai (SGS), has been awarded a contract which includes field data collections of environmental data as part of the regulatory process requirements.

This document has been prepared by Nautica Environmental Associates LLC (NEA), on behalf of SGS, under SGS LPO № 101702784 dated 15/10/2017, and provides a report detailing the results of the drop-down video survey and plankton sampling and analysis undertaken on 24/10/2017.

1.2 Site Investigation Locations

The site investigation locations are shown in Figure 1, below.

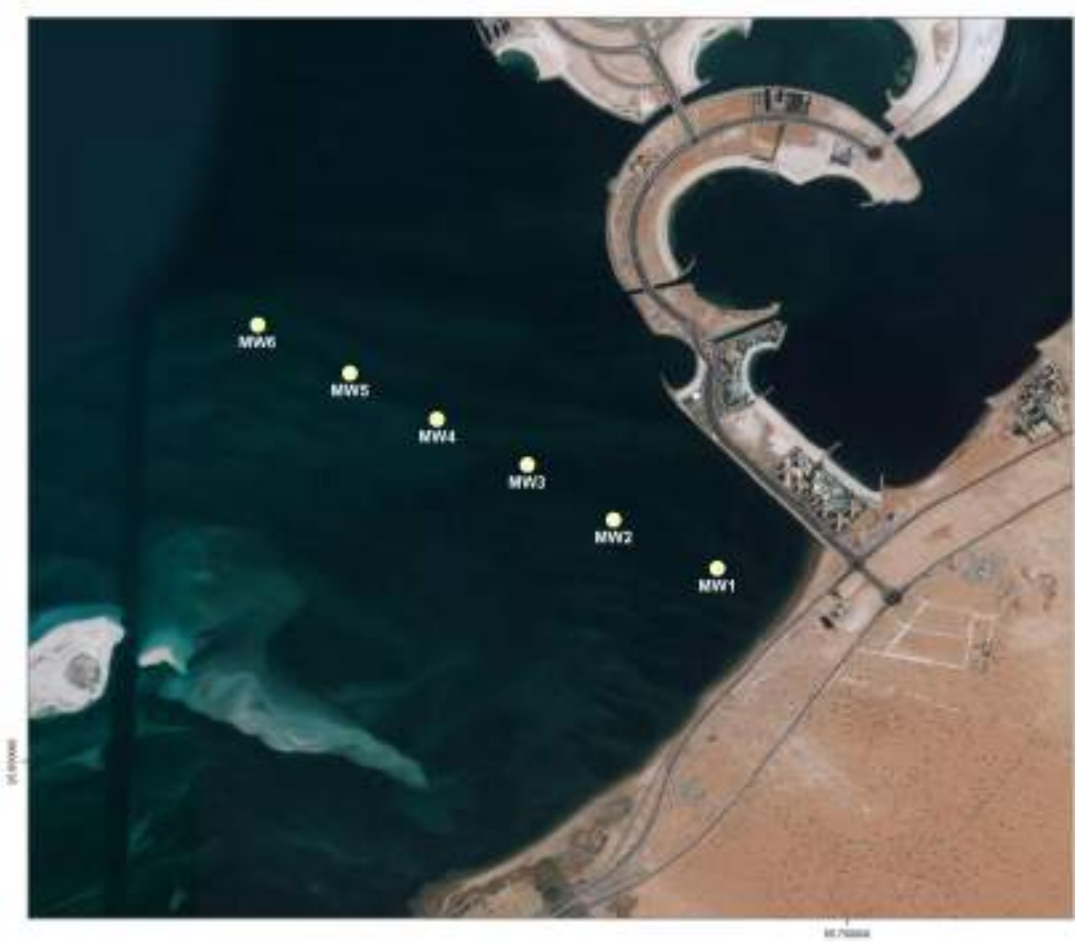


Figure 1: Site investigation locations

2.0 Scope of Work and Deliverables

2.1 Scope of Work

The scope of work has been defined as follows, from an email received on October 11th at 11:40:

Marine ecology survey will be conducted by marine expert at the six locations in the study area as shown in the map below. The study will cover the following components.

- Marine fauna and flora of the study area;
- Identification of epibenthic species;
- Phytoplankton and zooplankton; and
- Photographs of underwater species using drop-down cameras.

Location ID	Coordinates
MW1	25°39'34.52"N, 55°44'36.78"E
MW2	25°39'43.23"N, 55°44'18.20"E
MW3	25°39'53.08"N, 55°44'2.73"E
MW4	25°40'1.26"N, 55°43'46.65"E
MW5	25°40'9.53"N, 55°43'31.02"E
MW6	25°40'18.17"N, 55°43'14.48"E

2.2 Deliverables

Deliverables are understood to include provision of a Field report, once survey and subsequent analysis is completed.

3.0 Consultant Profile and Experience

3.1 Overview of Services

Nautica Environmental Associates LLC, is a UAE-based environmental consultancy, with offices in Abu Dhabi.

The company has considerable experience and capability in the management and conduct of marine and terrestrial environmental baseline surveys in the UAE and region, for both public and private sectors of the economy, including the Oil and Gas sector and construction industries.

NEA facilities include a laboratory for biological analysis, set up specifically for the identification of biological specimens, including terrestrial and marine flora and fauna, infauna, zooplankton and phytoplankton.

3.2 Quality Control and Assurance

NEA operates an integrated Quality and Environmental Management System (QEMS), designed to ensure the maintenance of service quality standards at all stages from initial client reception to completion of projects in line with ISO 9001:2015, 14001:2015 and OHSAS 18001:2007 to which NEA is accredited (see Annex B).

NEA methodologies for collection and analysis of samples are designed to meet specific project requirements and conform to regional and international 'best practices'.

3.3 Project-related Experience

NEA has considerable experience in undertaking marine environmental baseline and data collection (sampling) studies, having completed over 550 surveys in the Arabian Gulf and wider region over the past 17+ years.

NEA scientists are therefore very familiar with both the environment and the logistical and technical requirements needed to conduct such a survey.

4.0 Sampling Methodology

4.1 Sampling Locations

Sampling locations are shown in Table 1 overleaf, with details of elements conducted at each.

4.2 Ecological Evaluation Method Guidelines

Sampling was conducted in accordance with the following international and regional 'best practice' methods where applicable.

The following is a (non-exhaustive) list of references to guidelines used:

(1) The Manual of Oceanographic Observations and Pollutants Analysis Methods (MOOPAM). Forming part of the Regional Organisation for the Protection of the Marine Environment (ROPME).

(2) Abu Dhabi EHSMS Regulatory Framework (AD EHSMS RF), EHS Regulatory Instrument (ES RI) Code of Practice; COP 31.0 for Working On, Over or Adjacent to Water; Version 2.0, February 2012.

(3) Abu Dhabi EHSMS Regulatory Framework (AD EHSMS RF), EHS Regulatory Instrument (ES RI) Code of Practice; COP 45.0 for Underwater Activities; Version 2.0, February 2012.

4.3 Drop-down Video Survey

4.3.1 Sampling Protocols, Storage and Transferral

Sampling was undertaken at pre-selected stations, with in-field sampling procedures following protocols provided by the Manual of Oceanographic Observations and Pollutants Analysis Methods (MOOPAM), forming part of the Regional Organisation for the Protection of the Marine Environment (ROPME).

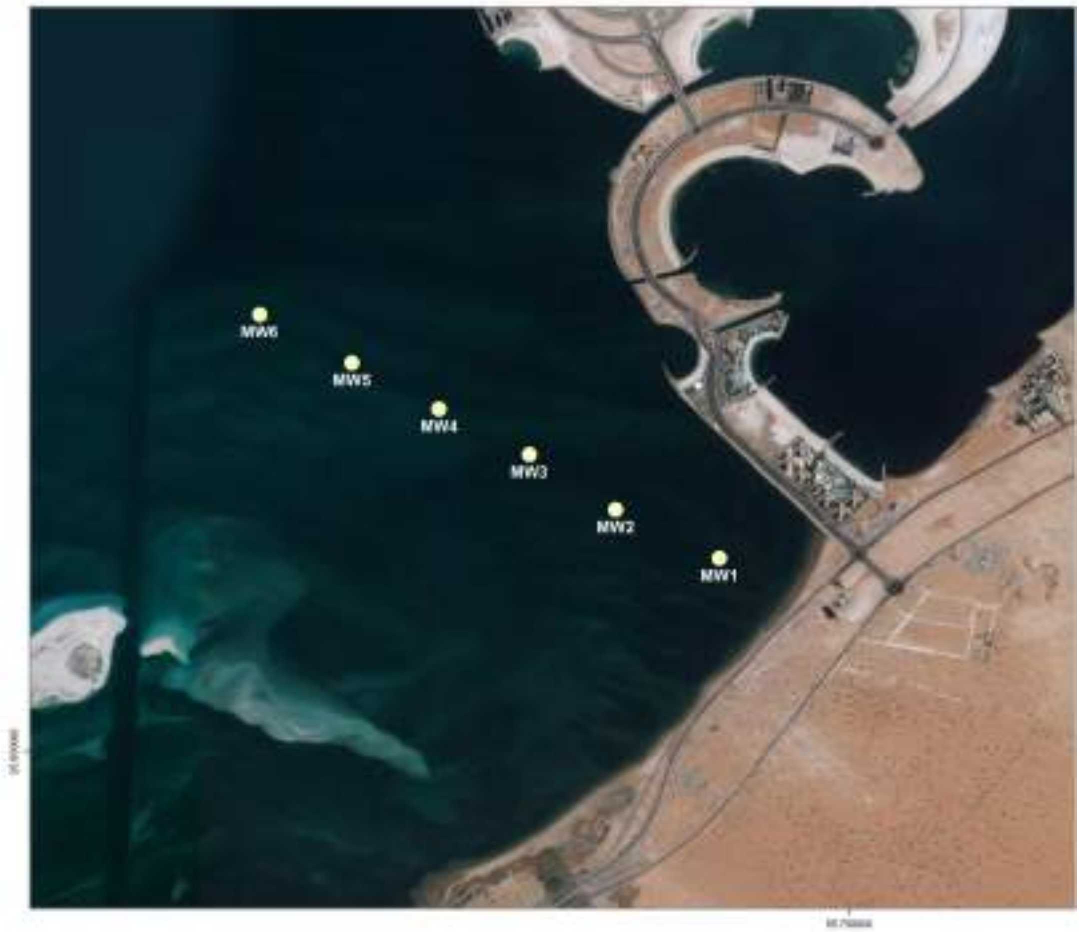
Collected samples for both sediment and seawater were stored in appropriate containers (pre-prepared by the analytical laboratory, RAKLab) and conditions (cool storage at ~4^{o}C) on board the support vessel, prior to delivery to the analytical laboratory, with Chain of Custody documentation in place.

4.3.2 In-situ Water Quality Measurements

Salinity, turbidity, temperature, pH, conductivity and dissolved oxygen were measured in situ at each of the selected survey locations, from sub-surface (-1m), mid-water and seabed (+1m) depths. Measurements were recorded using a YSI Pro DSS Multiparameter probe, lowered and raised through the water column, with the results used to provide an indication of both spatial distribution and stratification of characteristic. See Annex B for unit specifications.

Table 1: Site locations and elements investigated

Site Location Map



Site details and Elements Conducted

Site ID	Latitude	Longitude	DDV	ZP	PP
MW1	25.65959	55.74355	x	x	x
MW2	25.66201	55.73838889	x	x	x
MW3	25.66474	55.73409167	x	x	x
MW4	25.66702	55.729625	x	x	x
MW5	25.66931	55.72528333	x	x	x
MW6	25.67171	55.72068889	x	x	x

Table Key:

Coordinates in WGS64 Decimal Degrees / x = element investigated

PR = Seawater in-situ probe measurements (3 depths - surface -1m, mid-water and seabed =1m);

ZP = Zooplankton trawl (discrete horizontal trawl 2 minutes at 2kts; using bongo trawl array);

PP = Phytoplankton vertical trawl (in duplicate per station);

4.4 Plankton Sampling for Analysis

Plankton samples were collected at selected survey stations within the study area in order to characterize community structure.

Phytoplankton samples were collected at each station, using a vertical haul plankton net with an appropriate mesh size (see Annex B for specifications), which is subsequently combined into a single composite sample.

Zooplankton samples were collected at the same selected stations, using a standard zooplankton trawl Bongo-net array towed behind the vessel for a 1 x 2 minute tow (see Annex B for specifications).

Samples were preserved in a buffered solution of four percent formaldehyde and retained in cool, dark storage before being shipped for analysis at the NEA laboratory. Samples were subject to standard sub-sampling methodology; and conformed to the APHA Standard Method for counting techniques: Chapter 10200 F, with identifications made to the lowest taxonomic level, where feasible. Determinations were made with reference to Rajan & Al Abdessalam (2008) and the results included information on relative abundance to allow a quantitative assessment of community structure.

Identifications were made to the lowest taxonomic level feasible, by the following team of experienced NEA analytical scientists (subject to availability at time of award of contract):

- NEA Analysts and Taxonomists:
  - ✓ Dr. Richard Hornby (Zoologist and Principal Taxonomist)
  - ✓ Julian Johnson (Marine Biologist)
  - ✓ Jem Iskender (Marine Biologist)
  - ✓ Marisela Rodriguez (Marine Scientist)
  - ✓ Justin Olortegui (Environmental Scientist)

Standard NEA laboratory safety procedures applied, with all preservative handling undertaken within a designated and well ventilated fume room, with appropriate Personal Protective Equipment (PPE) worn.

4.5 Marine Mammals and Reptiles

Incidental observations of marine mammals and reptiles were recorded during the in-field period.

5.0 Field Management & Reporting

5.1 Management

The project scope and deliverables were managed and conducted by the following NEA project team.

- NEA Project Manager: Veryan Pappin (+971 50 613 4583)
- NEA Team Members: Ross Pappin (Field Team Leader)
  Julian Johnson (Marine Biologist)
  Suresh Varghese (Environmental Technician)

Annex B provides provisional details of equipment used.

5.3 Conduct

The survey was undertaken on one occasion and Table 2 provides the field survey schedule for the event.

The in-field survey comprised a team of 3 NEA staff on-site, including one qualified marine scientist, with in-field activities conducted during daylight hours only and in safe sea conditions (up to Beaufort scale 3/4). NEA had planned to use their vessel SR-2 but an engine issue on-site meant that a locally supplied vessel was used.

NEA PM/FTL reviewed weather forecasts prior to commencement of the sampling phase and informed AMI of changes to proposed phase elements in a timely manner, prior to their occurrence.

Daily communications were maintained between the in-field team and NEA management and logs of activities were maintained and are provided at Annex B.

Table 2: Field Survey Schedule

Date	Day	Event	NEA Field Team	Vessel/Vehicle
23/10/17	Mon	Preparation and mobilisation to site	RP/JJ/SV	Vehicle + SR2
24/09/17	Tue	Site investigations/sampling	RP/JJ/SV	Vehicle + SR2
25/09/17	Wed	Return to Abu Dhabi	RP/JJ/SV	Vehicle + SR2
Schedule Conditions:				
On-site vessel used in place of NEA vessel				

6.0 Results

6.1 Marine Habitats and Species

6.1.1 Drop-down Video Survey

The benthic ecology of the area was reviewed by a series of drop-down videos conducted at the six locations. The results are shown in Table 3 overleaf. It should be noted that the visibility at seabed depths was generally poor, which limited the identification and record of benthic species.

6.1.2 Marine Habitats and Species

In general, the marine habitats along the line of the proposed intake/outfall can broadly be categorised under one habitat type; that of unconsolidated sediments - a high percentile of soft sediment cover to the substrate.

Floral diversity was poor at all locations , although seagrass was recorded (*Halodule uninervis* dominant) at 3 sites, but only in very low densities. Floral and faunal communities one would normally associate with seagrass meadows were also almost non-existent and very limited in diversity and abundance. Gastropods, sponges, ascidians, hydroids were only very rarely recorded, as were fish species.

A plausible explanation is that the recent spate of coastal developments in the area has impacted the local hydrodynamics, resulting in a depositional regime in this particular location, which has covered any existing near-shore habitat. Most locations consisted of a 100% medium to fine sediment cover, of indeterminate depth, over the substrate.

6.1.3 Other Marine Fauna

One turtle was sighted, which, given the relatively limited in-field duration, would tend to suggest the species moves within the area on a potentially regular basis, as we would expect species of dolphin. It is unlikely that dugong would venture this far north, with the scarcity of their preferred food source, seagrass, although this does not necessarily preclude their presence from time to time.

Birds over open water were recorded as very infrequent and at distance, with no identifications made, although terns and gulls are a possibility.

6.1.4 Conclusions

In conclusion, the site is not considered to be of high significance and ecological value in its current state, in terms of the very low diversity and abundance of species recorded.

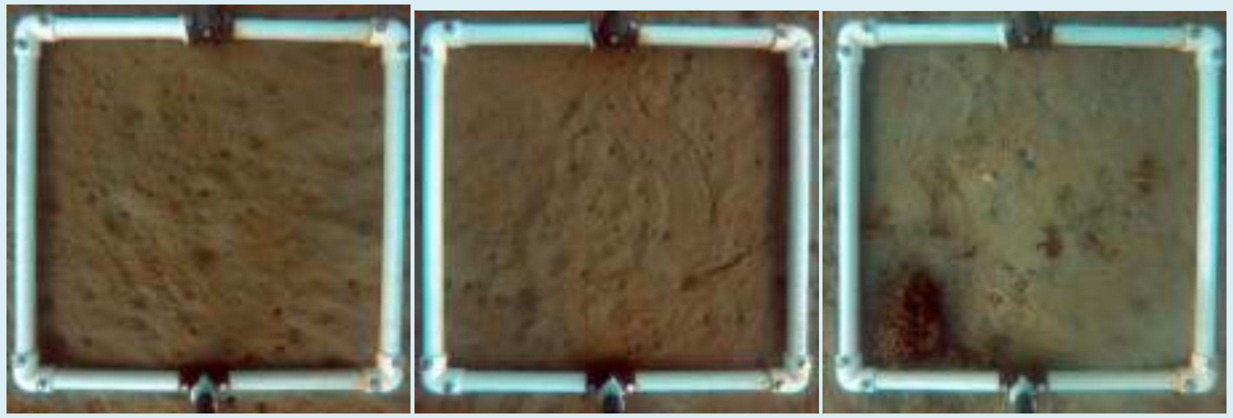
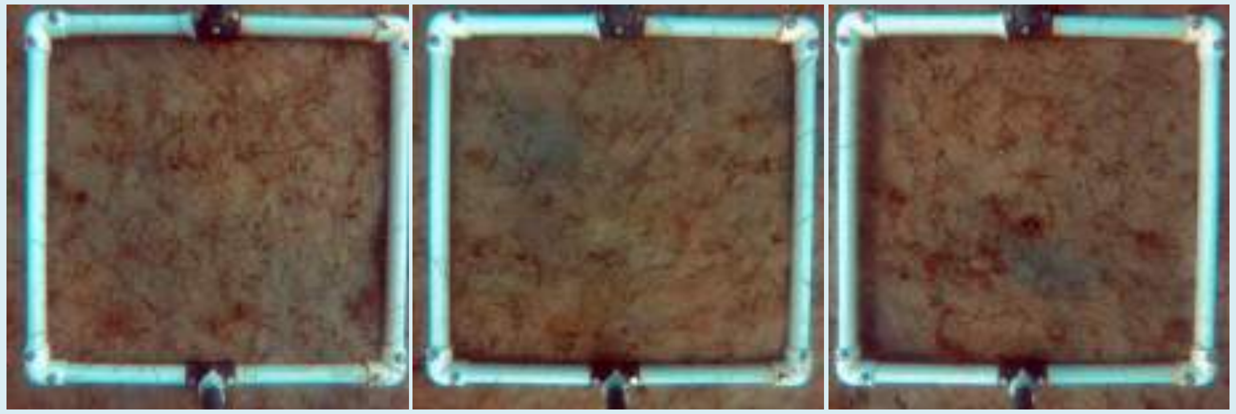
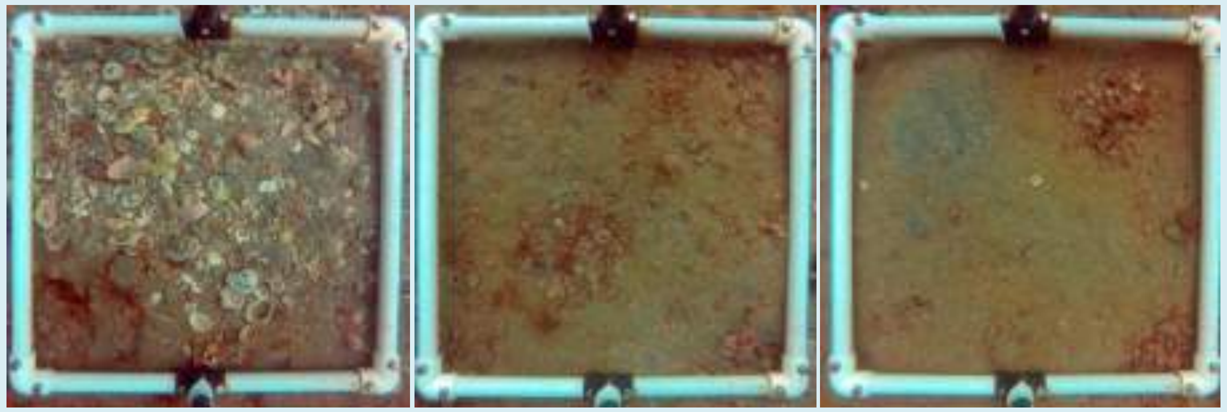
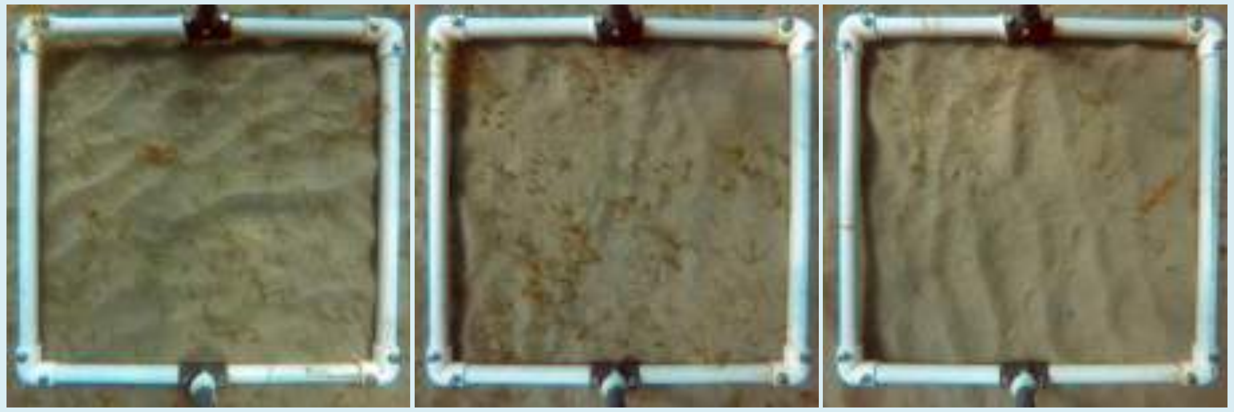
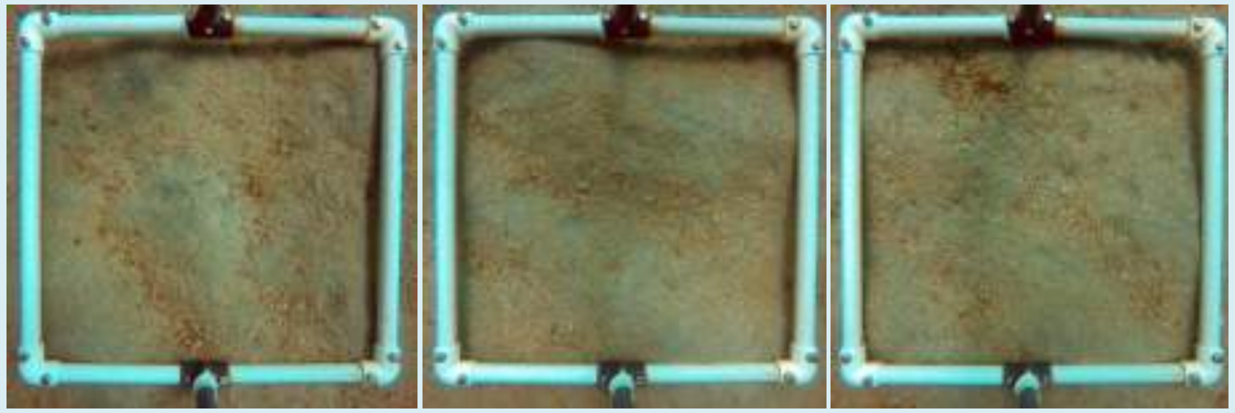
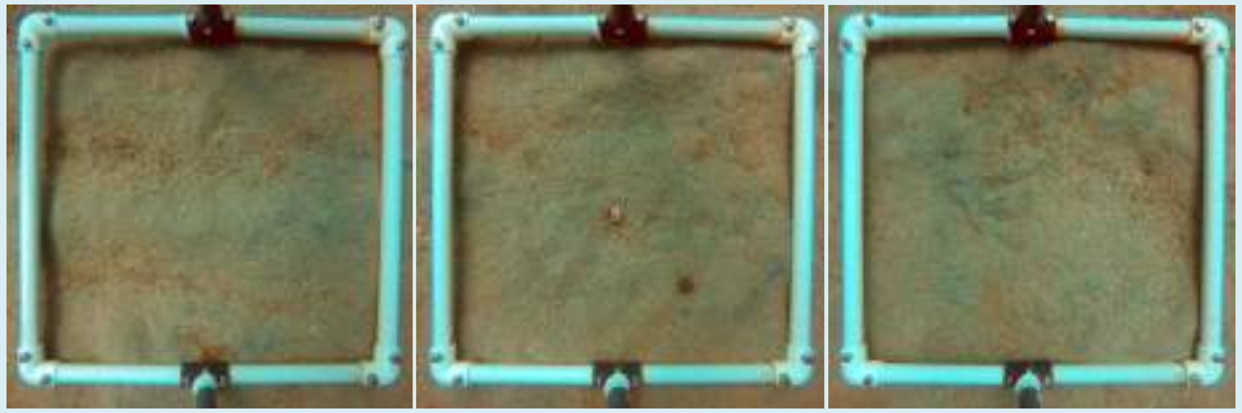
Table 3: Site Views and ecological status			
Site	**Lateral View over Seabed**	**Photo-quadrat Plates**	**Site Information**
MW1			Depth: 3.8m Visibility: Poor; Habitat Type: Unconsolidated; Sediment Type: Medium to fine; Rugosity/Slope: 0/0; Epiflora: V. low density seagrass with turf algae over rubble surfaces; Epifauna: Occasional small cerithids; Fish/MMR: Few fish; no MMR; Status: Impacted/not sensitive;
MW2			Depth: 4.8m; Visibility: Poor; Habitat Type: Unconsolidated; Sediment Type: Medium to fine; Rugosity/Slope: 0/0; Flora: V. low density seagrass; Fauna: None recorded; Fish/MMR: Few fish; no MMR sightings; Status: Impacted/not sensitive;
MW3			Depth: 6.1m; Visibility: Poor; Habitat Type: Unconsolidated; Sediment Type: Coarse to fine; Rugosity/Slope: 0/0; Flora: None recorded; Fauna: Occasional hermit crabs Fish/MMR: Few fish; no MMR sightings; Status: Impacted/low sensitivity;

Table 3: Site Views and ecological status

Site	Lateral View over Seabed	Photo-quadrat Plates	Site Information
MW4			Depth: 4.0m; Visibility: Poor; Habitat Type: Unconsolidated; Sediment Type: Medium to fine; Rugosity/Slope: 0/0; Flora: V. low density seagrass; Fauna: None recorded; Fish/MMR: Few fish; no MMR sightings; Status: Impacted/low sensitivity;
MW5			Depth: 5.5m; Visibility: Poor; Habitat Type: Unconsolidated; Sediment Type: Medium to fine; Rugosity/Slope: 0/0; Flora: None recorded; Fauna: None recorded; Fish/MMR: Few fish; no MMR sightings; Status: Impacted/low sensitivity;
MW6			Depth: 5.4m; Visibility: Poor; Habitat Type: Unconsolidated; Sediment Type: Medium to fine; Rugosity/Slope: 0/0; Flora: None recorded; Fauna: Sea anemones and bivalves (rare); Fish/MMR: Few fish; no MMR sightings; Status: Impacted/low sensitivity;

6.2 Zooplankton Analysis

6.2.1 Background

Zooplankton are one of the most important components of the marine ecosystem, containing a diverse array of species and playing a crucial role in energy transfer between the phytoplankton and the vast assemblages of marine food webs. Including both unicellular and multicellular organisms, zooplankton can range in size from the microscopic (as small as 2µm) to organisms visible to the naked eye. Traditionally, definitions of plankton or zooplankton implied organisms that simply drift with water currents, but some zooplanktonic animals are very able swimmers, capable of complex feeding and evasive manoeuvres (Johnson and Allen, 2005).

The distribution of zooplankton is influenced by factors acting on many different scales. Geographic ranges are primarily determined by water temperatures, a function of both latitude and major ocean currents. Within a given temperature range, salinity is usually the largest factor affecting distribution, with nearshore habitats ranging from lower salinity (brackish) water to hypersaline (lagoonal) areas. Many species show preferences for specific habitats or hydrographic conditions. Differences in depth, current velocity, wave energy and turbidity affect local distributions. There are also many environmental variables that can affect zooplankton assemblages, including water temperature, nutrient concentrations and salinity. Higher nutrient concentrations typically result in increased primary production leading to a greater abundance of zooplankton (Francis *et al*., 1998).

Zooplankton contains representatives of almost all major phyla found in the sea and contributes a significant and vital component to the biodiversity of the oceans. Countless organisms fundamental to other marine habitats, including many commercially important fish species, start their lives as zooplankton as eggs or larvae in the (meroplankton), while others species, such as copepods spend their entire life as zooplankton (holoplankton). Many species feed on phytoplankton and consequently form an essential link in the food chain by converting plant material into animal tissue. They, in turn, may be the basic food for higher animals including fish, as well as other types of zooplankton. The occurrence and distribution of zooplankton can therefore directly influence pelagic fishing potentials. Breeding and spawning areas tend to occur where there is a high density of plankton so that larval fish can obtain sufficient food, critical for survival and growth.

Due to their life histories, Zooplankton often very small turnover periods, with life, spawn and death cycles occurring several times within a span of only a week. This is seen as a universal adaptation common to all holoplankton species, enabling community structure to adapt quickly to changing environmental conditions, favourable or otherwise. Zooplankton community structure is dynamic in this regard, and both biotic and abiotic factors influence species dominance within the community.

6.2.2 Results

A total of 6 samples were analyzed. **Error! Reference source not found.** show a broad taxonomic breakdown of the results.

Zooplankton samples analysed comprised 33 taxa in 10 phyla. These comprised Ctenophora, Cnidaria, Brachiopoda, Nematoda, Platyhelminthes Chaetognatha, Mollusca, Annelida, Arthropoda and Chordata. Chordata represented the greatest majority of the zooplankton (68.2%) followed by Arthropoda (25.8%). The phylum Platyhelminthes was the least numerous at 0.065% of the total.

Figure provides a visual representation of the abundance encountered for each sample, each colour representing a phylum.

The most abundant sample was MW 5 with a total density of 208 organisms per m^3. The least abundant sample was MW 1 with a total density of 47 organisms per m^3.

With regards to biodiversity, sample MW 5 had the most recorded taxa at 22. In comparison samples MW 4 and MW 6 were the least diverse, with only 12 different taxa recorded.

Table 4: Taxonomic breakdown of zooplankton results

Phylum/sub-phylum	№ Taxa	Relative abundance (%)
Ctenophora	1	0.1
Cnidaria	2	4.1
Brachiopoda	1	0.07
Nematoda	1	0.07
Platyhelminthes	1	0.06
Chaetognatha	1	0.1
Mollusca	3	1
Annelida	3	0.5
Arthropoda	17	25.8
Chordata	3	68.2
Totals	**33**	**100**

6.2.3 Discussion

The results indicate that the zooplankton in the study area show an average level of diversity with 33 taxa. The real number of species is likely to be significantly higher than this, as not all individuals could be identified to species level. Figure 3.3 shows a graphical representation of the recorded abundances for each sample, separated by phyla and **Error! Reference source not found.** presents the percentage of each phylum encountered within the samples.

The phylum Chordata was the most abundant with three different taxa recorded, making up 68.2% of the total. Within Chordata, the taxon, Oikopleuridae, accounted for nearly all of the organisms present within the phylum, making up 99.1% of the total.

Oikopleuridae are distinct due to their elongated tail extending from an amorphous head that possesses a gelatinous "house" containing unique filters utilized for collecting and processing food, particularly phytoplankton and bacterioplankton in the nano/pico range. These houses are disposable and become detritus, which is an essential component of the food webs in marine ecological systems. Their fine mucus filters allow larvacea to take advantage of a food source not available to many other members of the zooplankton community, giving larvaceans a competitive advantage over organisms of a comparable size, such as carnivorous copepods and the nauplii of suspension-feeding copepods, which lack a filter fine enough to capture bacterioplankton (King et al, 1980).

Oikopleuridae play significantly important roles within marine ecosystems, as their filter-feeding habits can transfer energy found in bacteria and nanoplankton to higher trophic levels. This trait is shared by the two most abundant taxa of copepods encountered within the samples, described further on in this report. Plate 1 depicts an individual okiopleurid larvacean. The main body is located to the right of the image, where the mucus housing is produced. The long tail produces the current in which the organism uses pull seawater through its mucus filter.

Plate 1: Okiopleurid larvacean

Arthropoda was the second dominant phylum with 17 different taxa. Within the phylum the order Copepoda was the most dominant, making 59.4% of the phylum. The samples contained seven copepod taxa, the most numerous being the order Cyclopoida making up 54.9% of the recorded copepods. The second most numerous was Calanoida at 43.8%. Copepods were present in all the samples.

Copepods are a very diverse group with more than 200 families and 10,000 marine species and are often the most abundant animals in zooplankton collections, commonly outnumbering all other animals combined (Johnson and Allen, 2005). The plasticity of both copepod morphology and life histories enable them to fulfil varied levels and roles throughout zooplanktonic food webs, resulting in their presence being common in zooplankton communities. A study of 4,000 globally sampled plankton samples over five years derived a comprehensive global description of zooplankton community structure in modern oceans: this shows that copepods form about 50% of the biomass of all plankton, ranging from 70% in polar to 35% in tropical seas (Longhurst, 1985).

It is important to note that these results are averaged over a five year time span, and reflect long term zooplanktonic community structure. Due to their life histories, zooplankton have very small turnover periods, with life, spawn and death cycles occurring several times within a span of only a week. This is seen as a universal adaptation common to all zooplankton species, enabling community structure to adapt quickly to changing environmental conditions, favourable or otherwise. Zooplankton community structure is dynamic in this regard, where both biotic and abiotic factors influence species dominance within the community.

The ratio between the copepod orders differs from a typical distribution, where calanoid copepods are dominant in the plankton in many parts of the world's oceans, making up 55–95% of plankton samples (Mauchline, 1998). This increase in cyclopoid to calanoid ratio can be dependent upon many factors.

The dominance of cyclopoida within the copepod assemblage may be due to their alternate feeding strategy. Cyclopoid copepods are classed as small copepod species, and are often dwarfed by their larger calanoid cousins when reaching maturity. Nonetheless their numerical abundance and/or biomass can often dominate over those of calanoid copepods (Turner, 2004). Research done on the cyclopoid *Oithona similis*, described as a ubiquitous cyclopoid species found globally indicate that *O.similis* can feed on particles smaller then 10µm (Nakamura and Turner, 1997). Food particles below this size range are inefficiently grazed on by larger calanoid copepods, giving the smaller cyclopoid species an advantage in such conditions. Having an ability to feed upon organism within the nano range is a trait also shared with Oikopleuridae. Plate 2 depicts a female individual *Oithona* sp., with the two egg sacks visible.

Plate 2: *Oithona* sp.

Plate 3: Monstrilloid copepod

The species *Acarthia fossae* was the second most abundant, making up 30.8% of all the recorded copepods, followed by *Temora turbinata* at 14.3%. Copepod identification is highly dependent upon the morphology of the fifth swimming leg, which is modified in the males to facilitate sexual reproduction.

Plate 4 displays the telson of a female *Acarthia fossae,* with the two genital pores visible. The finger like caudal ramus is a defining morphological feature for the identification of this species.

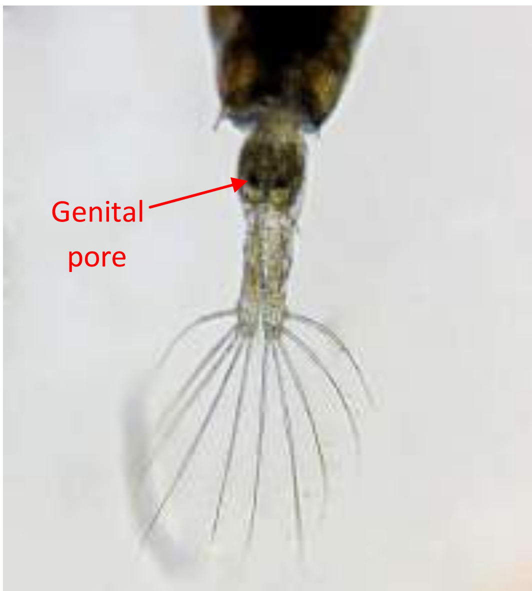


Plate 4: Telson of female *Acarthia fossae*

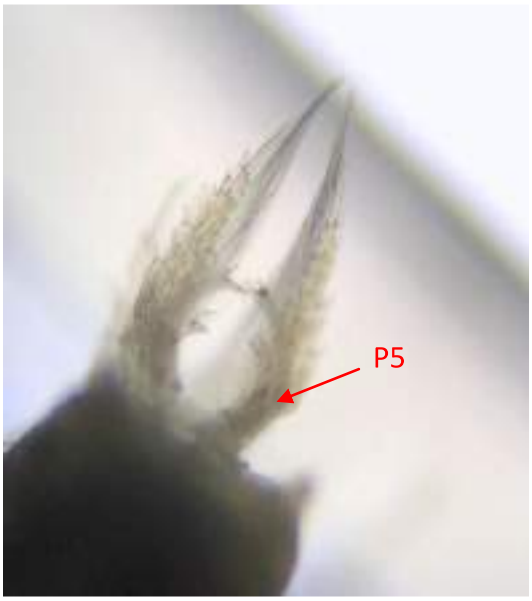


Plate 5: Left-hand Fifth swimming leg of a male *Pontellopsis herdmani*

The species *Pontellopsis herdmani* is a first for Nautica Environmental Associates. Plate 5 displays the posterior of a male example of the species, with the claw like fifth swimming appendages which are used to clasp onto the female to facilitate the transfer of spermatophores.

The order Monstrilloida was only encountered MW 05, with a recorded density of 0.5 organisms m^{-3}. Plate 3 depicts an adult monstrilloid copepod. This family of copepods spends most of its juvenile stages as parasites of gastropods and polycheates. The adult form is planktonic, where its sole function is the finding of a mate and the brooding of their eggs. The feeding appendages are atrophied at this stage, and the organism survives solely on its reserves gained during its parasitic juvenile stage (Cristina de Oliveira Dias, 1996).

Plate 6: *Lucifer hanseni* mysis stage 1

Plate 7: *Lucifer hanseni* protozoea

Plate 6 and Plate 7 depict two life stages undertaken by the species *Lucifer hanseni* as it develops into an adult form. As the organism develops from a protozoa into a mysis stage and subsequent adult, it further resembles the bizarre appearance its adult form takes, from which the family name, Luciferidae is derived from.

The Brachiopod taxon *Lingula* sp. was recorded in sample MW-1. The phylum as a whole is rather rare within infaunal samples and less so within zooplanktonic samples, as their dominance was during the Palaeozoic era 541 million years ago. Plate 8 depicts the pre-settlement larval form of *Lingula* sp., the pedicle clearly visible protruding from the main body, and most probably used in locomotion within the water column. The lophophore (feeding tentacles) have not developed in the individual, which hints at lecithotrophic development during this stage of its lifecycle.

Plate 8: *Lingula* sp. pre-settlement larvae

Plate 9: Fish excrement

Plate 9 depicts fish excrement. All samples contained fish excrement, which had an average a diameter of 1mm. This would give us an idea to the diameter of the anus, which would indicate a small sized progenitor of the excrea.

6.2.4 Conclusions

The samples were dominated by Chordata, which was driven by oikopleurid larvaceans. Their nano-pico scale filter feeding strategy is shared by the taxon *Oithona* sp., which was the most abundant Arthropod taxon. The dominance of these two taxa potentially indicate a healthy bacterioplanktonic community within the sample area.

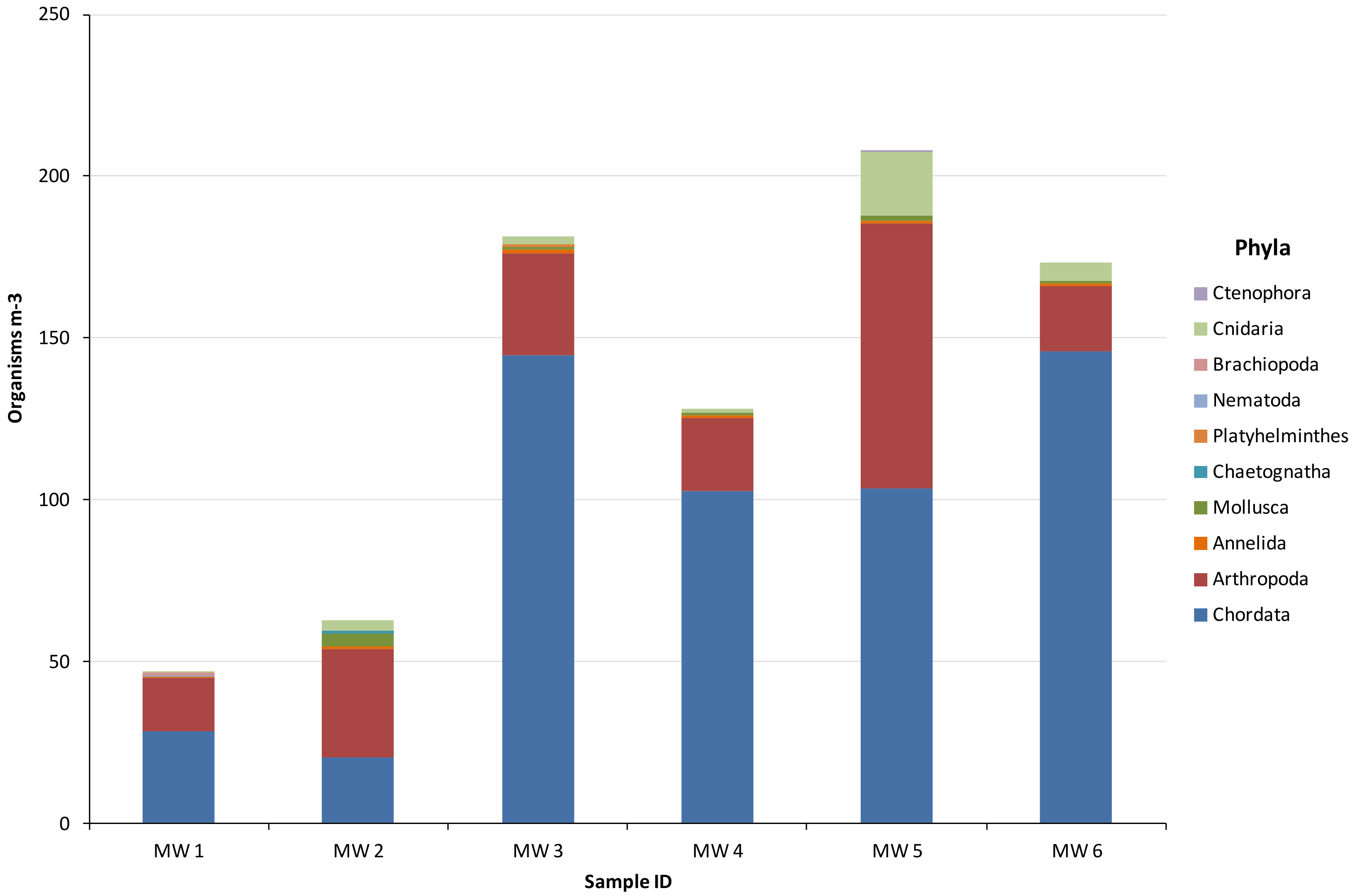


Figure 2: Graphical representation of the recorded abundances for each sample, separated by phyla

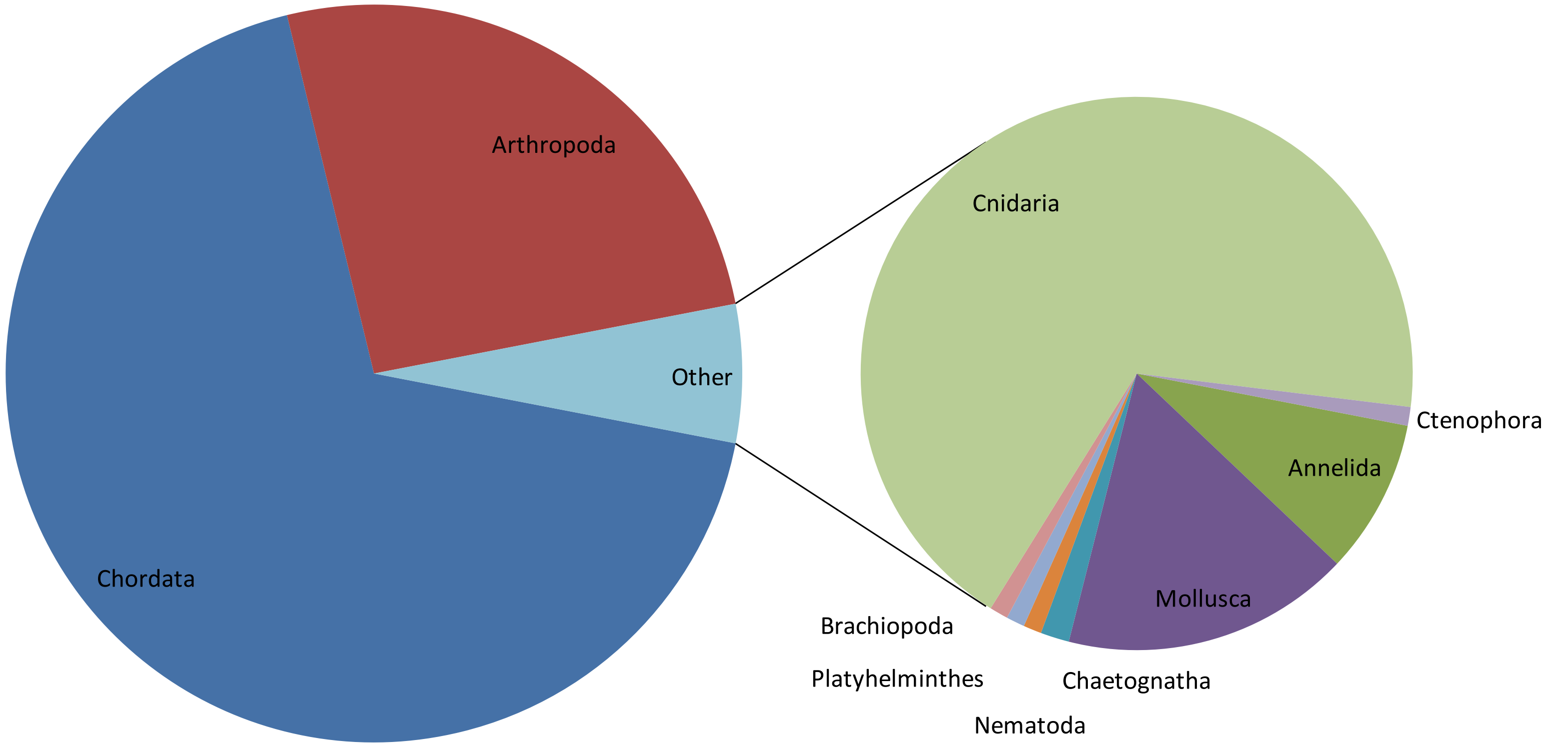


Figure 3: Zooplankton composition by phylum

6.3 Phytoplankton and Harmful Algal Bloom (HAB) Analysis

6.3.1 Background

Phytoplankton are characterized by short life spans and fast turn over periods. This enables phytoplankton communities to take advantage of favourable conditions within the environment, reaching community densities where they are described as a bloom. These blooms are dynamic, appearing suddenly and generally lasting a few days or weeks. The community structure within a bloom shifts according to changes within the environment, resulting in changes to the dominant phytoplankton species. While not all phytoplankton blooms (sometimes termed 'red tides') are harmful, the type of phytoplankton in dominance and the nature of the environment may result in the formation of a Harmful Algal Bloom (HAB). Some phytoplankton produce toxins implicated in the deaths of fish and marine mammals, where bioaccumulation causes the toxins to increase in concentration as they move up the food chain, posing a threat to humans.

Non-toxic blooms can be detrimental to their environment, either in direct mechanical damage to sensitive components of local organisms such as fish gills, to the formation of hypoxic or anoxic conditions caused by a depletion of dissolved oxygen within the water column.

6.3.2 Results and Conclusions

The samples were composed of three phytoplankton classes; Bacillariophyceae, Dinophyceae and Haptophyta. A total of 48 taxa were identified. Figure 10 presents the phytoplankton density by phylum for each sample. A full taxonomic breakdown of the results is provided in Annex A. Many of the recorded species were classed as non-toxic on the IOC-UNESCO HAB database (IOC-UNESCO HAB, 2017). However, Table 5 details species encountered within the samples listed as being potentially and indirectly harmful.

Indirectly harmful species were classified as such, as they do not produce toxins, but can have significant detrimental effects on other organisms or ecosystems either in the production of suffocating mucus or in directly damaging the gill membranes of fish with spines. Figure 11 presents the percentages of toxic, harmful and non-toxic phytoplankton species. Toxic species made up only 0.3% of all the phytoplankton encountered within the samples.

The World Health Organisation guidance values for probability of acute health risks during recreational exposure to HAB species state that cell concentration values greater than 100,000 cells per ml pose a high level of risk to human health (WHO, 1998). All toxic and potentially harmful taxa recorded within each of the samples all contained concentrations below the threshold set by the WHO.

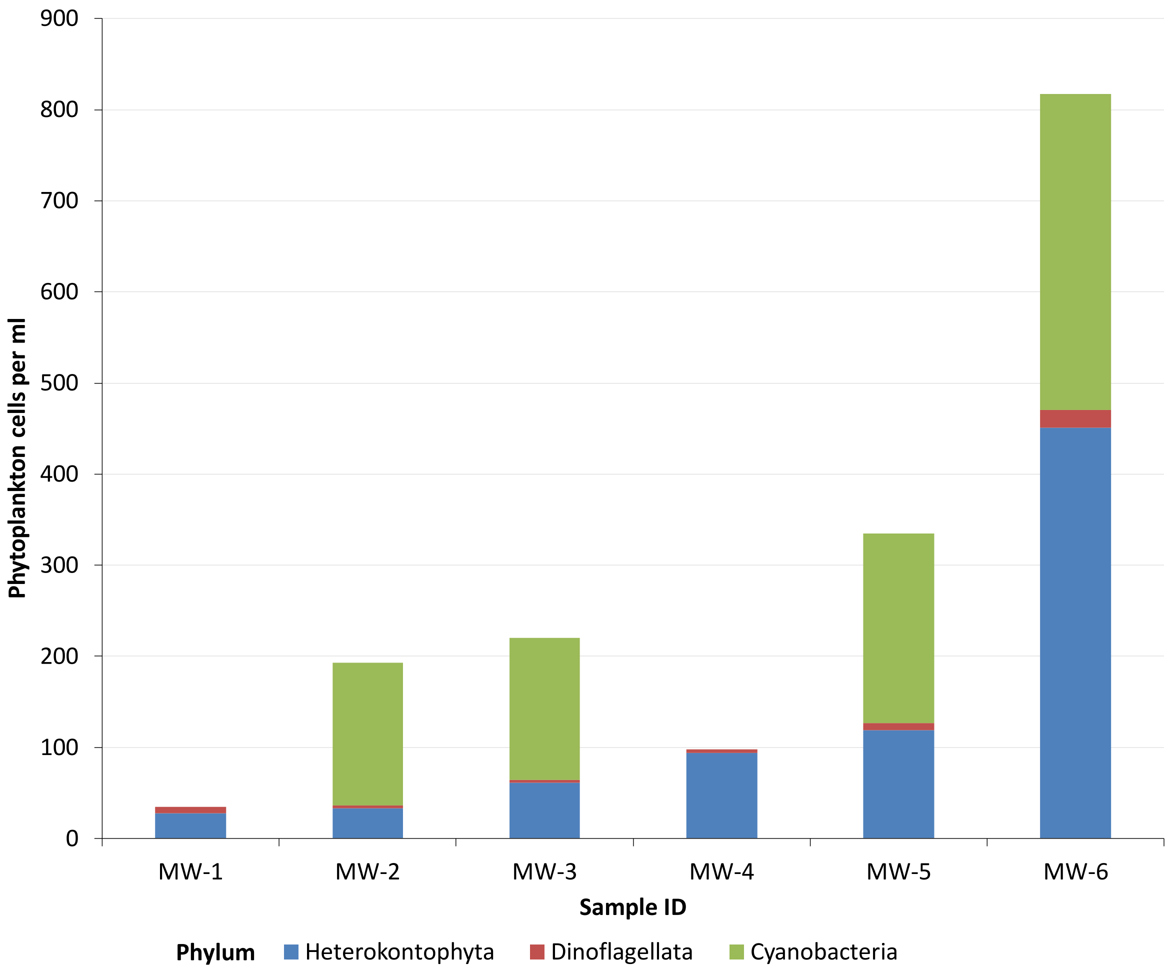


Figure 4: Phytoplankton density by phylum for each sample

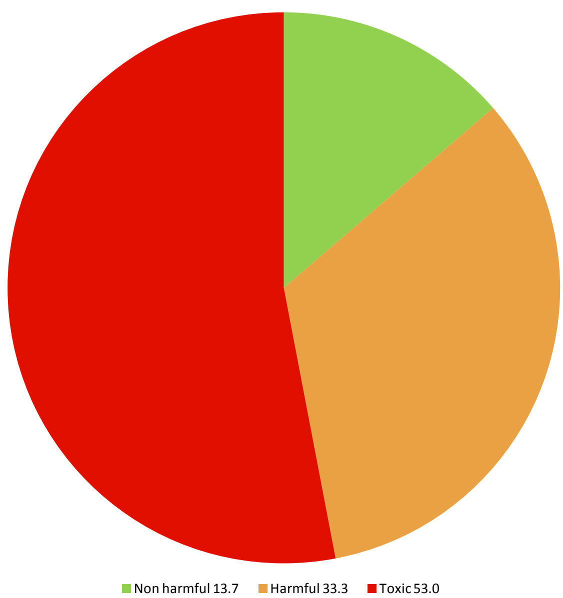


Figure 5: % harmful / toxic / non-toxic species recorded in samples

Table 5: Harmful and toxic phytoplanktonic species encountered within the samples

Species	Toxicity	Effect	Density (cells ml^{-1})
Skeletonema costatum	Non-toxic	Can create Hypoxic or Anoxic conditions when in bloom.	1,017
Chaetoceros sp.	Non-toxic	Spines can get caught in animal gills and when in bloom can affect animals' respiratory systems.	578,800
Pseudo-nitzschia multiseries	Toxic	Produces domoic acid.	57
Cylindrotheca closterium	Non-toxic	Can form blooms and produce mucus, When in large numbers they can effect ecosystems and animals respiratory systems.	4,153
Prorocentrum sp.	Toxic	Produces the toxin responsible for Ciguatera fish poisoning.	333
Prorocentrum micans	Non-toxic	Reports on it being a (PSP) producer are unconfimed. Recent incidents involving shellfish mortality have been linked to oxygen depletion.	47
Prorocentrum sigmoides	Non-toxic	Harmful to organisms due to oxygen depletion at high cell concentration.	33
Ceratium furca	Non-toxic	Spines can get caught in animal gills and when in bloom can affect animals' respiratory systems.	137
Ceratium fusus	Non-toxic	Spines can get caught in animal gills and when in bloom can affect animals' respiratory systems.	50
Ostreopsis lenticularis	Toxic	Produces Ostreotoxin.	160
Gonyaulax sp.	Toxic	Known to produce yessotoxins, That causes similar toxilogical effects to the toxins responsible for Paralytic shellfish poisoning (PSP).	943
Gonyaulax polygramma	Toxic	Known to produce yessotoxins, That causes similar toxilogical effects to the toxins responsible for Paralytic shellfish poisoning (PSP).	10
Gonyaulax diegensis	Toxic	Known to produce yessotoxins, That causes similar toxilogical effects to the toxins responsible for Paralytic shellfish poisoning (PSP).	3

Table 5: Harmful and toxic phytoplanktonic species encountered within the samples

Species	Toxicity	Effect	Density (cells ml^{-1})
Gonyaulax spinifera	Toxic	Known to produce yessotoxins, That causes similar toxilogical effects to the toxins responsible for Paralytic shellfish poisoning (PSP).	10
Scrippsiella trochoidea	Non-toxic	Harmful to marine organisms due to oxygen depletion at high cell concentration.	13
Protoperidinium sp.	Toxic	Known to produce the toxin Azaspiracid.	100
Protoperidinium divergens	Toxic	Known to produce the toxin Azaspiracid.	23
Protoperidinium depressum	Toxic	Known to produce the toxin Azaspiracid.	113
Protoperidinium conicum	Toxic	Known to produce the toxin Azaspiracid.	40
Akashiwo sanguinea	Toxic	One isolate of this species has been shown to be potentially toxic; however, the toxin principles have yet to be elucidated.	30

Plates 10 to 15: From top left to bottom right: *Chaetoceros* sp., *Prorocentrum* sp., *Cylindrotheca closterium*, Coccolithophore, *Gonyaulax spinifera, Navicula* sp.. All photographs ©NEA, 2017, except where otherwise stated

7.0 References

Sampling Methodology and Safety

(1) The Manual of Oceanographic Observations and Pollutants Analysis Methods (MOOPAM). Forming part of the Regional Organisation for the Protection of the Marine Environment (ROPME).

(2) Abu Dhabi EHSMS Regulatory Framework (AD EHSMS RF), EHS Regulatory Instrument (ES RI) Code of Practice; COP 31.0 for Working On, Over or Adjacent to Water; Version 2.0, February 2012.

(3) Abu Dhabi EHSMS Regulatory Framework (AD EHSMS RF), EHS Regulatory Instrument (ES RI) Code of Practice; COP 45.0 for Underwater Activities; Version 2.0, February 2012.

Zooplankton, Phytoplankton (HAB) and Cysts

(1) Johnson, W.S. and Allen, D.M., (2005). Zooplankton of the Atlantic and Gulf Coasts: A guide to their identification and ecology. The Johns Hopkins University Press, Baltimore and London.

(2) King, K.R., Hollibaugh, J.T., Azam, F., (1980). Predator-prey interactions between the larvacean Oikopleura dioica and bacterioplankton in enclosed water columns. Marine Biology. 56, 49-57.

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(11) Matsuoka, K., Fukuyo, Y., 2000. Technical Guide for Modern Dinoflagellate cyst study. WESTPACHAB/ WESTPAC/IOC.

(12) Subba-Rao, D.V., Al-Yamani, F., 1998. Phytoplankton ecology in the water between Shatt Al-Arab and the Straits of Hormuz,Arabian Gulf: a review. Plank. Biol. Ecol. 45, 101–116.

RO Plant Umm Al Quwain
Water & Sediment Quality and Benthic Survey
Field and Analytical Report

NEA Reference: N551-1117-1.0 dated November 2017

ANNEX A
Site Data Sheets and
Raw Data Spreadsheets

Contents:

Site ID: MW1										
Date / Time	Location (WGS84 DD)	WD	DV	BN	SC	SW	SD	ZP	PP	IN
24.10.17/08:26	N25.65958,E55.74355	3.8	✓	-	-	-	-	✓	✓	-

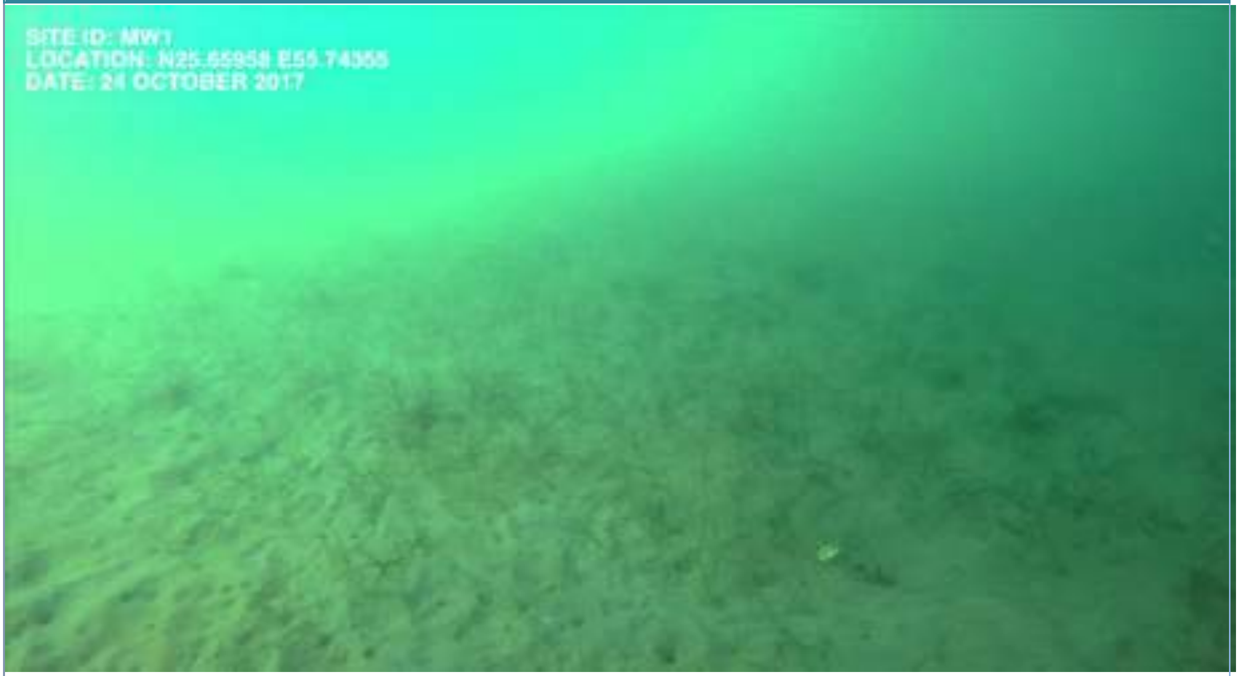
DD = Decimal degrees / WD = Site Water Depth (metres) / DV = Drop-down Video / BN = Benthic (SCUBA) / SC = Seawater Characteristics (Probe)
SW = Seawater Laboratory Analysis / SD = Sediment Laboratory Analysis / ZP = Zooplankton / PP = Phytoplankton / IN = Infauna

Location Map

Habitat Type / Rugosity & Slope / Description

Type	Unconsolidated habitat
Rugosity / Slope	0/0
Description (dominant floral and faunal communities)	500m from the shoreline and RO plant footprint; 100% cover of bare rippled sediment, with very limited benthic development; Very low density seagrass, *Halodule uninervis*, *H. stipulacea* and *Halophila ovalis* and occasional bivalves on small rubble mounds.

Seabed Views (Lateral and Photo-quadrat)



Site Notes + Additional Observations

Unconsolidated sediment cover with sparse seagrass (*Halodule uninervis*) and bivalve assemblages, and occasional rubble mounds with turf algal species cover.

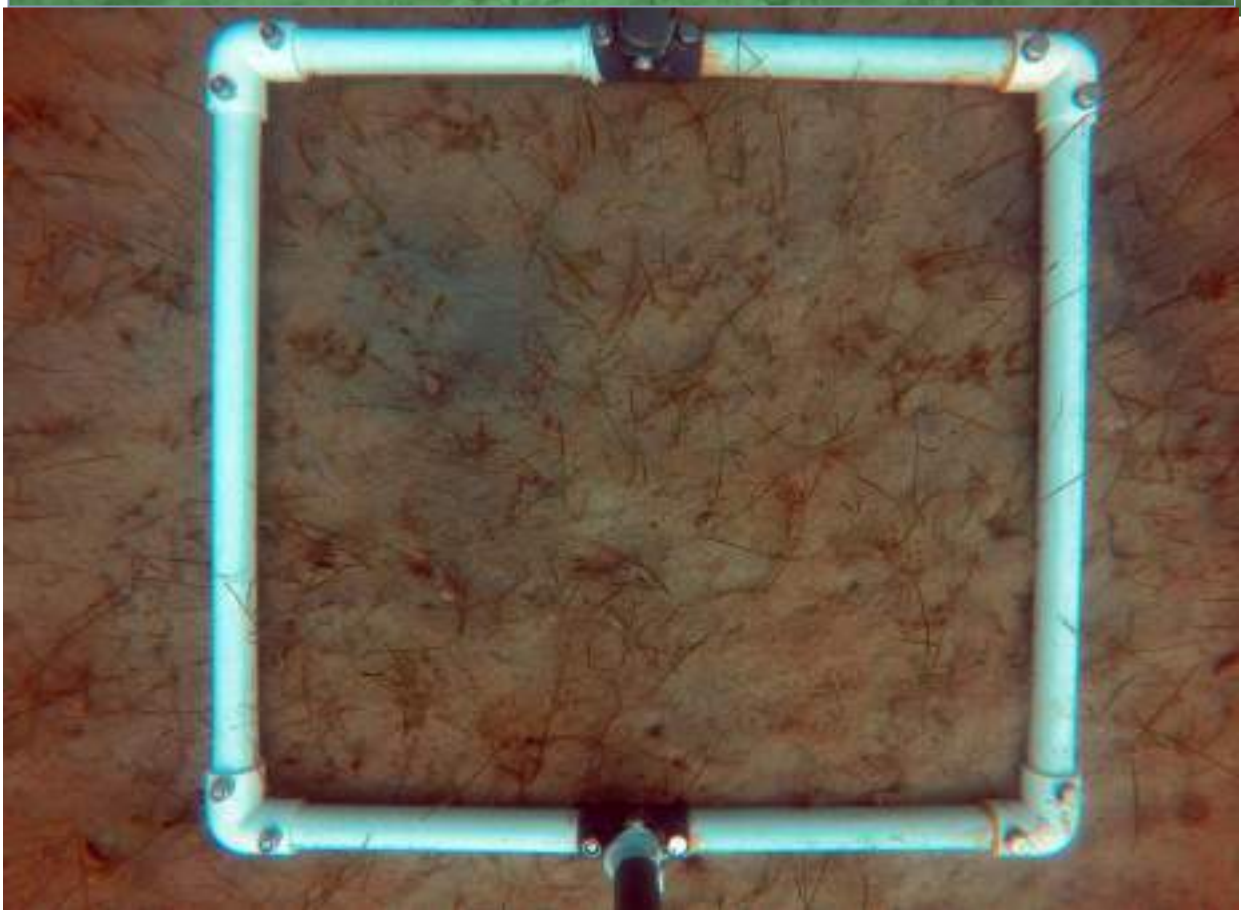
Site ID: MW2										
Date / Time	Location (WGS84 DD)	WD	DV	BN	SC	SW	SD	ZP	PP	IN
24.10.17/09:04	N25.66200,E55.738388	4.8	✓	-	-	-	-	✓	✓	-
DD = Decimal degrees / WD = Site Water Depth (metres) / DV = Drop-down Video / BN = Benthic (SCUBA) / SC = Seawater Characteristics (Probe) SW = Seawater Laboratory Analysis / SD = Sediment Laboratory Analysis / ZP = Zooplankton / PP = Phytoplankton / IN = Infauna										

Location Map

Habitat Type / Rugosity & Slope / Description

Type	Unconsolidated
Rugosity / Slope	0/0
Description (dominant floral and faunal communities)	1km from the shoreline and RO plant footprint; 100% cover of bare rippled sediment, with very limited benthic development; Very low density seagrass, *Halodule uninervis* dominant, but with *H. stipulacea* and *Halophila ovalis* and occasional small bivalves and grazing gastropods observed.

Seabed Views

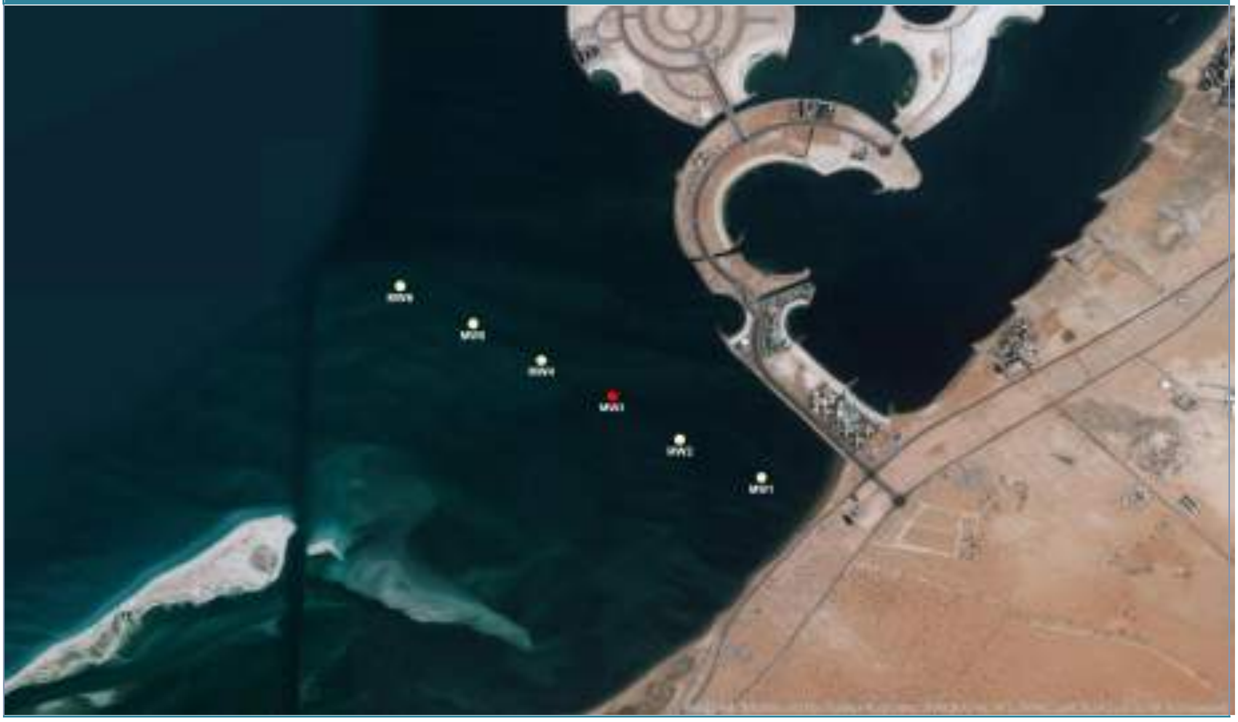


Site Notes + Additional Observations

MW2 with very sparse *Halodule uninervis* over unconsolidated soft sediments and occasional bivalve and gastropod activity (tracks and holes). Otherwise a generally depauperate site, low in both diversity and abundance.

Site ID: MW3										
Date / Time	Location (WGS84 DD)	WD	DV	BN	SC	SW	SD	ZP	PP	IN
24.10.17/09:30	N25.66474,E55.73409	6.1	✓	-	-	-	-	✓	✓	-
DD = Decimal degrees / D = Site Water Depth (metres) / DV = Drop-down Video / BN = Benthic (SCUBA) / SC = Seawater Characteristics (Probe) SW = Seawater Laboratory Analysis / SD = Sediment Laboratory Analysis / ZP = Zooplankton / PP = Phytoplankton / IN = Infauna										

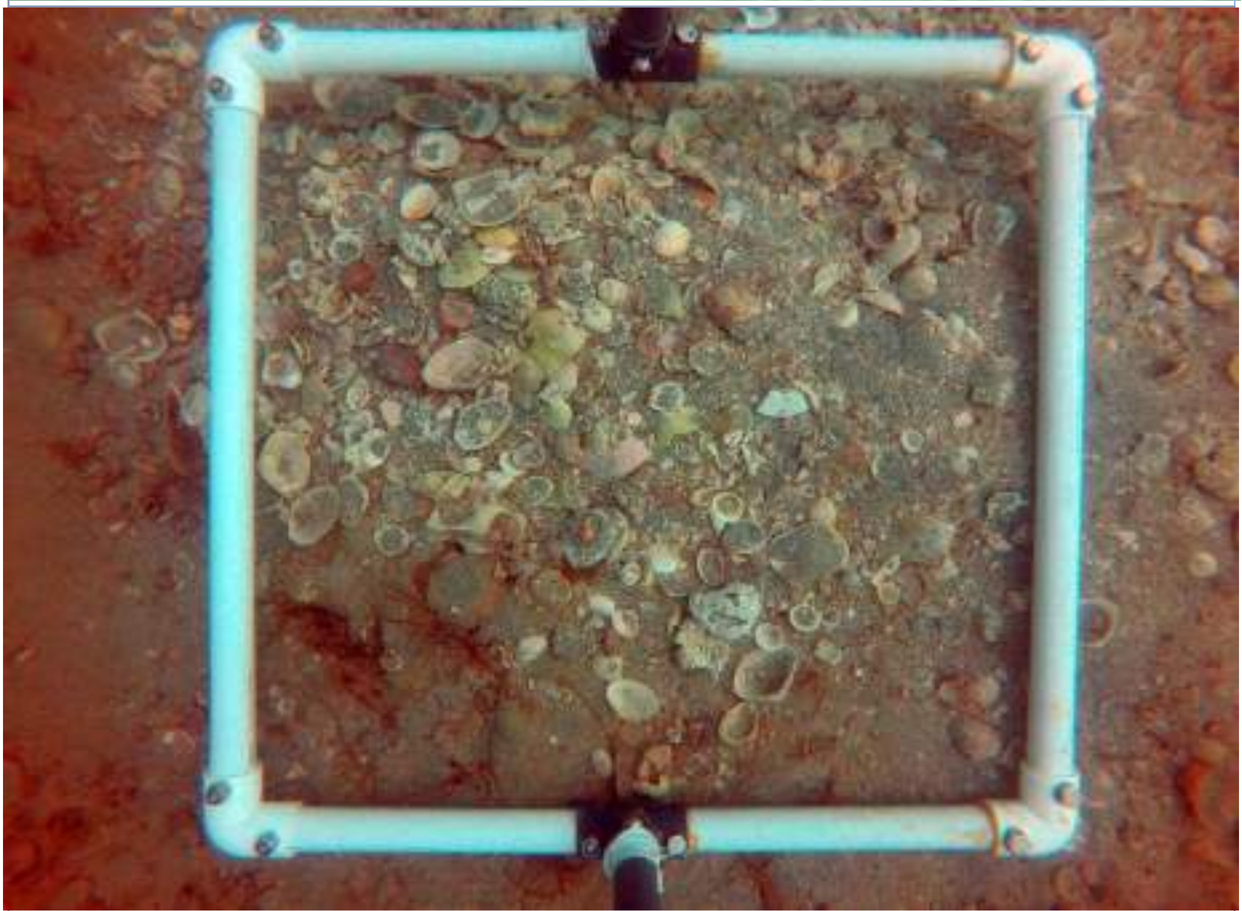
Location Map



Habitat Type / Rugosity & Slope / Description

Type	Unconsolidated sediments
Rugosity / Slope	0/0
Description (dominant floral and faunal communities)	1.5 km from the shoreline and RO plant footprint; 100% cover of bare rippled sediment and shell debris mix, with very limited benthic development;

Seabed Views



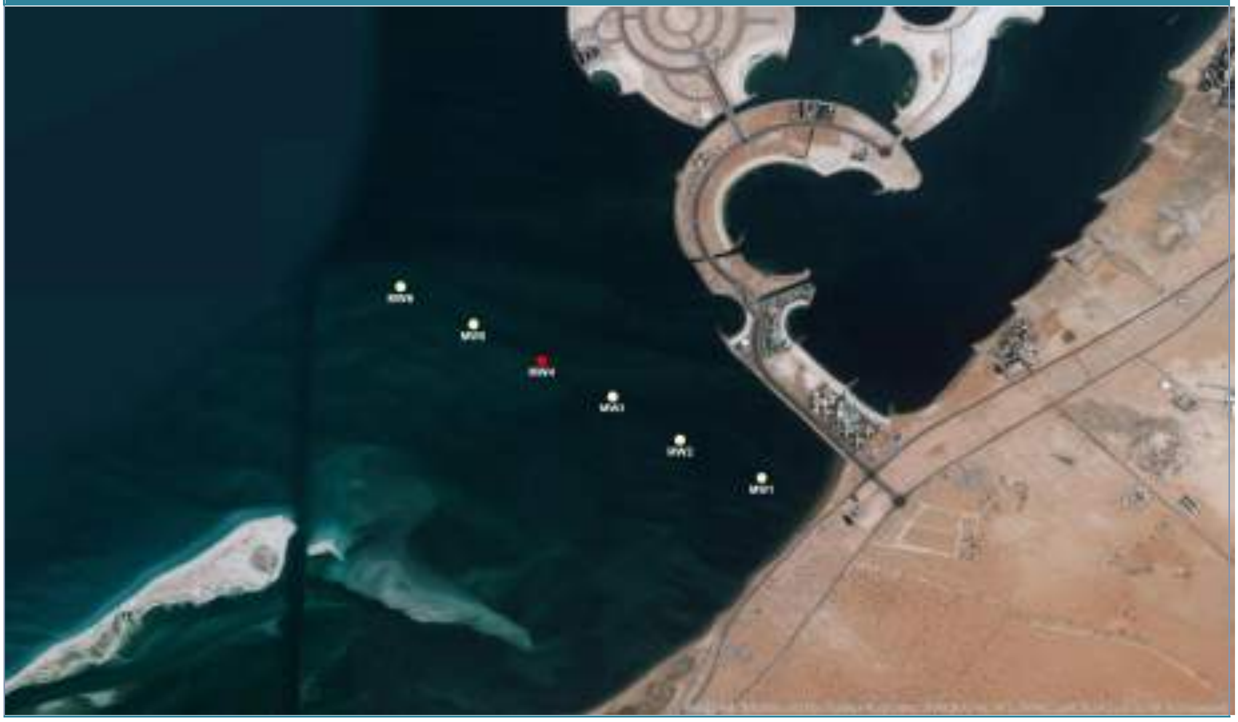
Site Notes + Additional Observations

Unconsolidated habitat of fine to medium sediment and shell debris mix (as shown in the photo-quadrat plate above).

Site ID: MW4										
Date / Time	Location (WGS84 DD)	WD	DV	BN	SC	SW	SD	ZP	PP	IN
24.10.17/10:00	N25.66701, E55.72962	4.0	✓	-	-	-	-	✓	✓	-

DD = Decimal degrees / D = Site Water Depth (metres) / DV = Drop-down Video / BN = Benthic (SCUBA) / SC = Seawater Characteristics (Probe)
SW = Seawater Laboratory Analysis / SD = Sediment Laboratory Analysis / ZP = Zooplankton / PP = Phytoplankton / IN = Infauna

Location Map



Habitat Type / Rugosity & Slope / Description

Type	Seagrass with soft sediments
Rugosity / Slope	0/0
Description (dominant floral and faunal communities)	2 km from the shoreline and RO plant footprint; 100% cover of bare rippled sediment, with very sparse seagrass, *H.uninervis*, but with otherwise depauperate floral and faunal development;

Seabed Views

Site Notes + Additional Observations

Generally depauperate site; *Halodule uninervis* recorded as very sparse and low in density. Occasional gastropods and sea-anemones recorded.

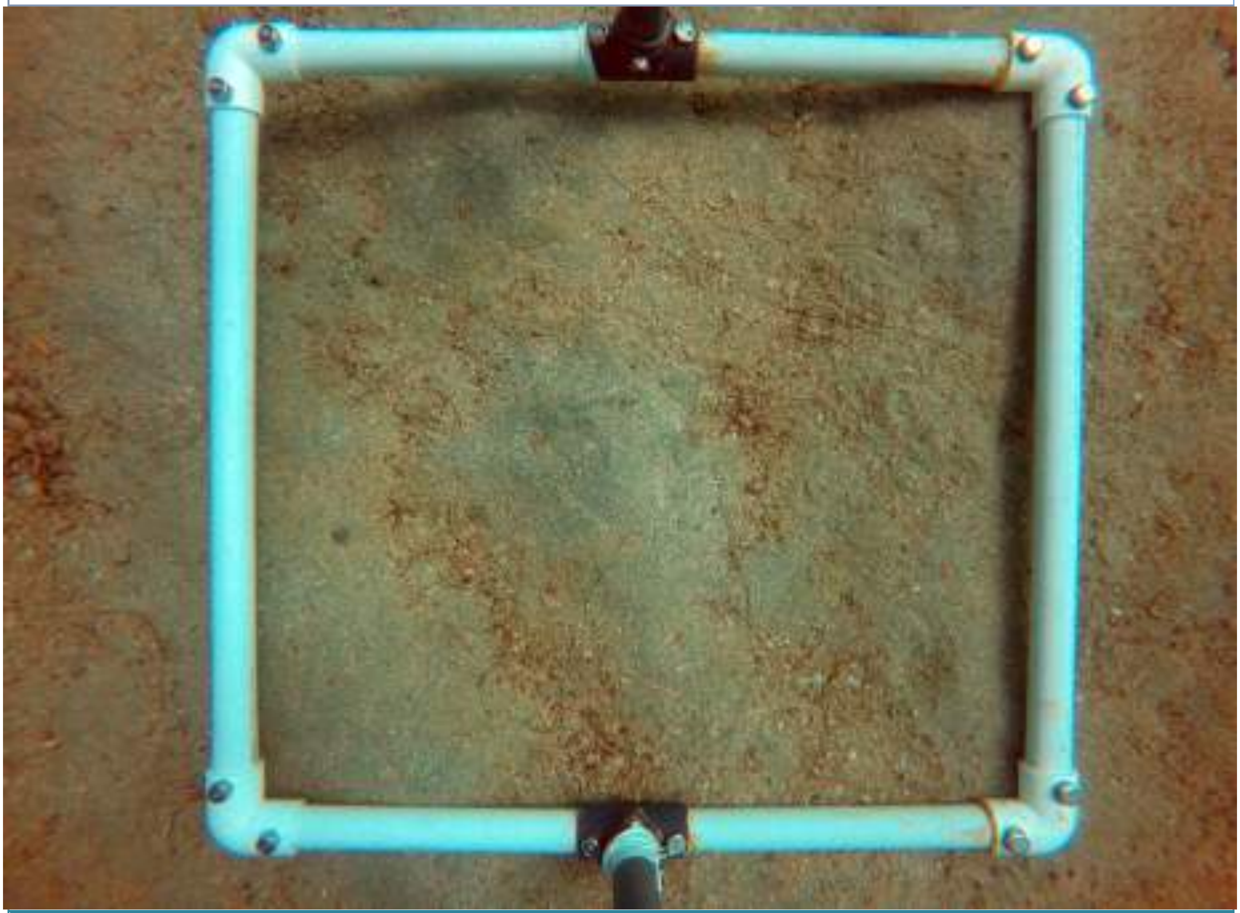
Site ID: MW5										
Date / Time	Location (WGS84 DD)	WD	DV	BN	SC	SW	SD	ZP	PP	IN
24.10.17/10:33	N25.66931,E55.72528	5.5	✓	-	-	-	-	✓	✓	-
DD = Decimal degrees / WD = Site Water Depth (metres) / DV = Drop-down Video / BN = Benthic (SCUBA) / SC = Seawater Characteristics (Probe) SW = Seawater Laboratory Analysis / SD = Sediment Laboratory Analysis / ZP = Zooplankton / PP = Phytoplankton / IN = Infauna										

Location Map

Habitat Type / Rugosity & Slope / Description

Type	Consolidated bottom
Rugosity / Slope	0/0
Description (dominant floral and faunal communities)	2.5 km from the shoreline and RO plant footprint; 100% cover of bare rippled sediment and shell debris mix, with no benthic species recorded;

Seabed Views



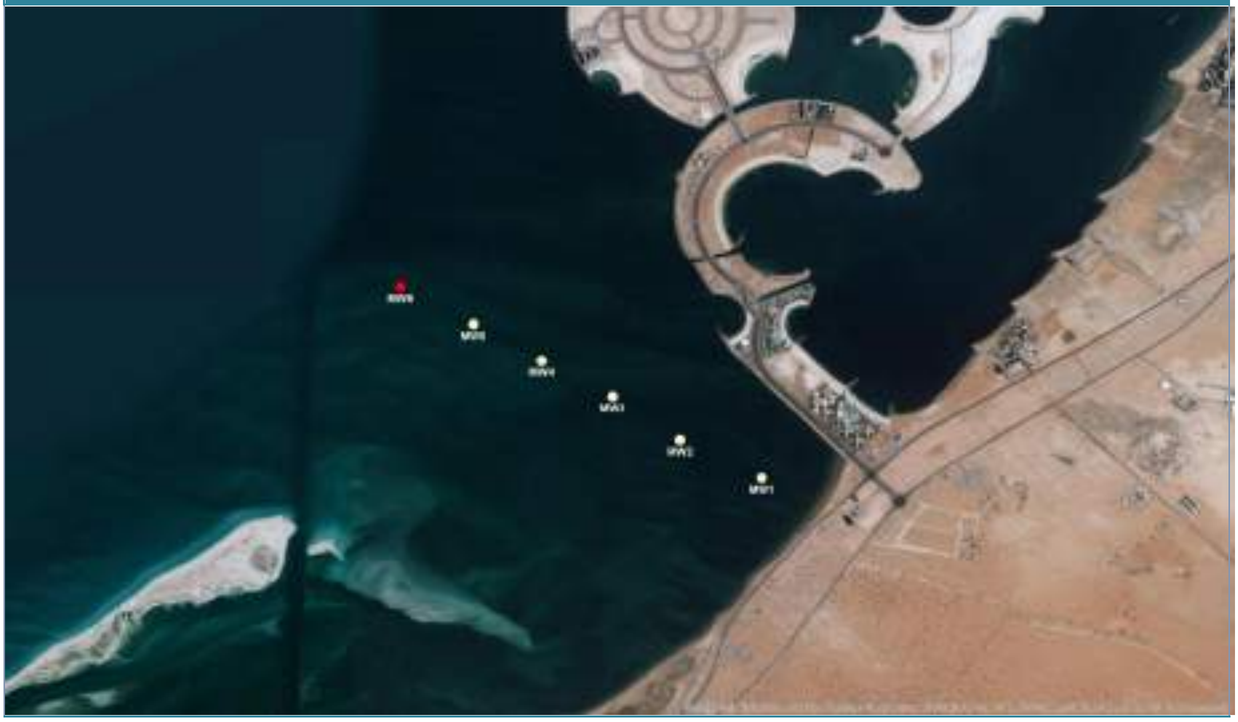
Site Notes + Additional Observations

No benthic species recorded, with the exception of gastropod tracks in the fine sediment. The site is characterized with fine to medium sediments making the area unfit for the development of sessile species.

Site ID: MW6										
Date / Time	Location (WGS84 DD)	WD	DV	BN	SC	SW	SD	ZP	PP	IN
24.10.17/10:59	N25.67171,E55.72068	5.4	✓	-	-	-	-	✓	✓	-

DD = Decimal degrees / D = Site Water Depth (metres) / DV = Drop-down Video / BN = Benthic (SCUBA) / SC = Seawater Characteristics (Probe)
SW = Seawater Laboratory Analysis / SD = Sediment Laboratory Analysis / ZP = Zooplankton / PP = Phytoplankton / IN = Infauna

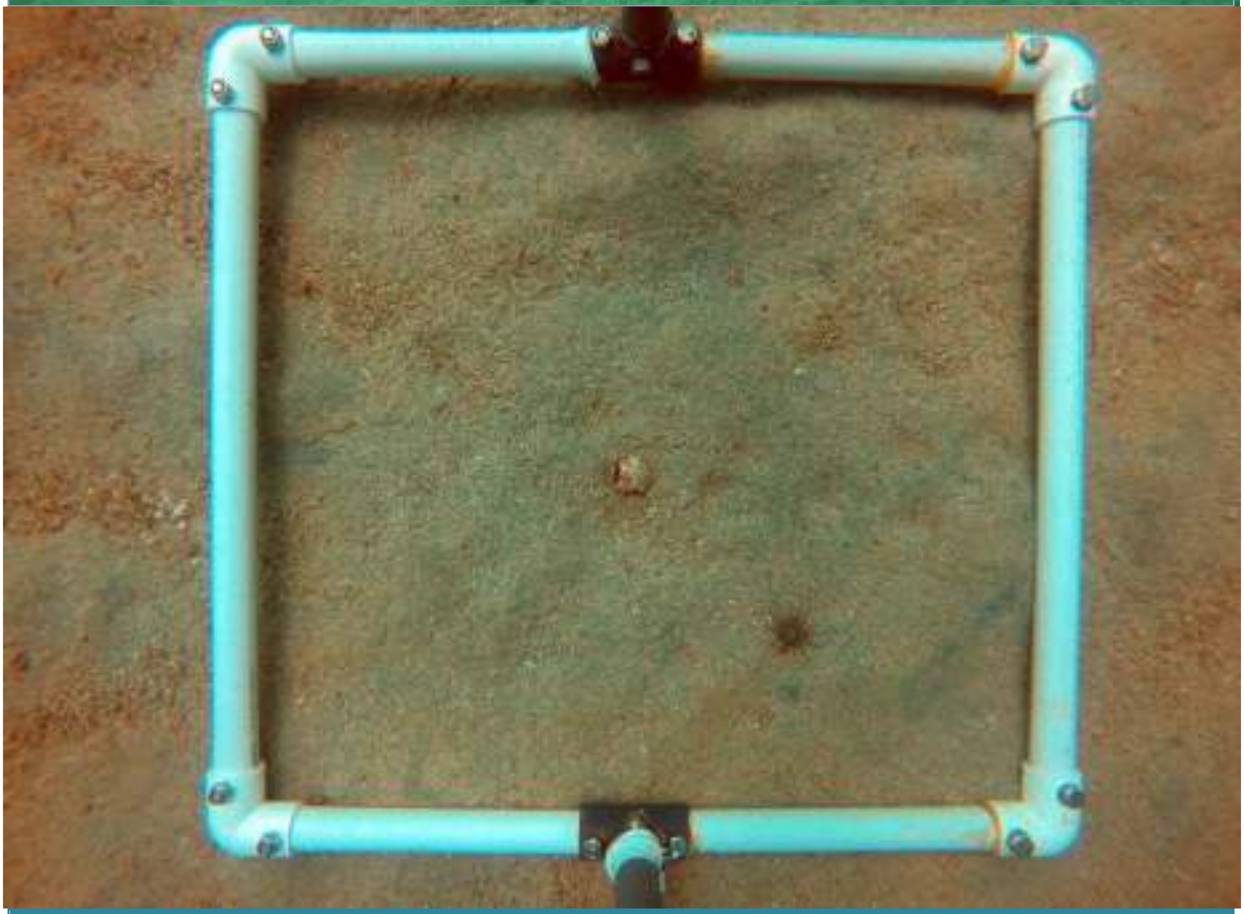
Location Map



Habitat Type / Rugosity & Slope / Description

Type	Unconsolidated habitat
Rugosity / Slope	0/0
Description (dominant floral and faunal communities)	3km from the shoreline and RO plant footprint. 100% cover of bare rippled sediment, with very depauperate benthic development, save the occasional sea anemone, bivalve and small gastropod;

Seabed Views



Site Notes + Additional Observations

Site MW6 exhibited similar characteristics as MW5 with the presence of unconsolidated, medium to fine sediments that supported minimal benthic life, with the occasional bivalve and sea-anemone, as shown in the photo-quadrat above.

Table A1: Zooplankton Results per Sample

Taxon	Individual organisms per sample						Total	%
	MW1	MW2	MW3	MW4	MW5	MW6		
Beroe sp.	0	0	0	0	16	0	16	0.06
Eirene viridula	0	128	48	32	288	128	624	2.44
Obelia sp.	16	0	32	0	304	96	448	1.75
Presettlement larvae	16	0	0	0	0	0	16	0.06
Nematoda	16	0	0	0	0	0	16	0.06
Presettlement larvae	0	0	16	0	0	0	16	0.06
Sagitta sp.	0	32	0	0	0	0	32	0.12
Atlanta sp.	0	64	0	0	0	0	64	0.25
Gastropod veliger larvae	0	96	16	16	48	32	208	0.81
Gastropod presettlement larvae	0	0	16	0	0	0	16	0.06
Polycheate trochophore larvae	16	32	32	0	16	0	96	0.37
Polycheate late stage trochophore larvae	0	0	0	0	0	32	32	0.12
Terebellid presettlement larvae	0	0	0	16	0	0	16	0.06
Monstrilloida	0	0	0	0	16	0	16	0.06
Microsetella sp.	0	0	16	0	0	0	16	0.06
Acartia fossae	32	160	48	16	752	128	1,136	4.43
Pontellopsis herdmani	0	0	0	0	16	0	16	0.06
Temora turbinata	288	192	16	48	16	0	560	2.19
Corycaeus amazonicus	0	0	16	0	0	0	16	0.06
Oithona sp.	16	544	528	160	576	384	2,208	8.62
Cirripedian naupli	48	0	16	0	144	0	208	0.81
Alima larvae	0	0	0	0	16	0	16	0.06

Table A1: Zooplankton Results per Sample

Taxon	Individual organisms per sample						Total	%
	MW1	MW2	MW3	MW4	MW5	MW6		
Protozoea	32	32	128	96	368	64	720	2.81
Mysis stage 1	0	0	0	16	144	32	192	0.75
Mysis stage 2	0	0	0	0	64	0	64	0.25
Adult	0	0	0	0	32	0	32	0.12
(Naupli)*	32	160	112	64	80	160	608	2.37
(Zoea) *	16	32	16	80	144	0	288	1.12
Portunid zoea	32	192	80	48	32	32	416	1.62
Porcelinid zoea	0	0	0	0	64	0	64	0.25
Oikopleuridae	848	736	4480	2400	3040	5760	17,264	67.40
Fish egg	16	32	0	0	64	32	144	0.56
Fish larvae	0	32	0	0	0	0	32	0.12
Total individuals in each sample	**1,424**	**2,464**	**5,616**	**2,992**	**6,240**	**6,880**	**25,616**	**100**
Total no of taxa in each sample	**14**	**15**	**17**	**12**	**22**	**12**		
% of Total	**5.6**	**9.6**	**22**	**12**	**24**	**26.9**		
Flow metre start value	**58919**	**59425**	**60079**	**60595**	**60984**	**61484**		
Flow metre stop value	**59425**	**60079**	**60595**	**60984**	**61484**	**62145**		
Flow metre value difference	**506**	**654**	**516**	**389**	**500**	**661**		
Net aperture area (m^2)	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**		
Impeller pitch	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**		
Distance	**151.8**	**196.2**	**154.8**	**116.7**	**150**	**198.3**		
Volume of water (m^3)	**30.36**	**39.24**	**30.96**	**23.34**	**30**	**39.66**		

Table A2: Zooplankton Taxonomy

Phylum	Class / Subclass	Order (Super)	Sub-order / Family (Super)	Genus / Species	Taxon
Ctenophora	Nuda	Beroida	Beroidae	*Beroe* sp.	*Beroe* sp.
Cnidaria	Hydrozoa	Leptothecata	Eirenidae	*Eirene viridula*	*Eirene viridula*
			Campanulariidae	*Obelia* sp.	*Obelia sp.*
Brachiopoda	Lingulata	Lingulida	Lingulidae	*Lingula* sp.	Presettlement larvae
Nematoda				indet.	Nematoda
Platyhelminthes				indet.	Presettlement larvae
Chaetognatha	Sagittoidea	Aphragmophora	Sagittidae	*Sagitta* sp.	*Sagitta* sp.
Nemertea				indet.	Pilidinium Larvae
Mollusca	Gastropoda	Littorinimorpha	Atlantidae	*Atlanta* sp.	*Atlanta* sp.
				indet.	Gastropod veliger larvae
				indet.	Gastropod presettlement larvae
Annelida	Polychaeta			indet.	Polychaete trochophore larvae
				indet.	Polychaete late stage trochophore larvae
		Terebellida	Terebellidae	indet.	Terebellid presettlement larvae
Arthropoda	Copepoda	Monstrilloida	Monstrillidae	indet.	Monstrilloida
		Harpacticoida	Miraciidae	*Microsetella* sp.	*Microsetella* sp.
		Calanoida	Acartiidae	*Acartia fossae*	*Acartia fossae*
			Pontellidae	*Pontellopsis herdmani*	*Pontellopsis herdmani*
			Temoridae	*Temora turbinata*	*Temora turbinata*
		Cyclopoida	Corycaeidae	*Corycaeus amazonicus*	*Corycaeus amazonicus*
			Oithonidae	*Oithona* sp.	*Oithona* sp.
	Thecostraca	Cirripedia		indet.	Cirripedian naupli
	Malacostraca	Stomatopoda		indet.	Alima larvae
		Brachyura	Luciferidae	*Lucifer hanseni*	Protozoea
					Mysis stage 1
					Mysis stage 2

Table A2: Zooplankton Taxonomy

Phylum	Class / Subclass	Order (Super)	Sub-order / Family (Super)	Genus / Species	Taxon
					Adult
				indet.	(Naupli)*
				indet.	(Zoea) *
			Portunidae	*Portunus pelagicus*	Portunid zoea
		Anomura	Porcellanidae	indet.	Porcelinid zoea
Chordata	Larvacea	Copelata	Oikopleuridae	indet.	Oikopleuridae
	Osteichthyes			indet.	Fish larvae
				indet.	Fish egg

Table A3: Phytoplankton Results per Sample

Family	Genus / Species	Phytoplankton cells per ml						Total
		MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	
Oscillatoriaceae	Spirulina	0	1	0	0	0	0	1
	Oscillatoria	0	156	156	0	208	347	867
Coscinodiscales	*Coscinodiscus* sp.	7	4	5	11	8	13	48
Rhizosoleniales	*Pseudosolenia calcar-avis*	0	1	0	0	0	0	1
Cheatoceratales	*Chaetoceros* sp.	0	21	42	69	96	277	505
Thalassiophysales	*Thalassionema* sp.	0	1	4	13	12	153	183
Naviculales	*Navicula* sp.	0	1	0	0	1	0	2
	Pleurosigma sp.	0	0	0	1	0	0	1
	Pleurosigma directum	7	0	0	0	0	0	7
	Pleurosigma formosum	0	0	1	0	0	0	1
	Plagiotropis lepidoptera	7	0	0	0	0	0	7
	Diploneis smithii	0	0	0	0	1	7	8
	Meuniera membranacea	7	0	0	0	0	0	7
	Gyrosigma balticum	0	2	2	0	0	0	4
Cymbellales	*Cymbella* sp.	0	0	2	0	1	0	3
Bacillariales	*Nitzschia macilenta*	0	0	4	0	0	0	4
	Pseudo-nitzschia multiseries	0	1	0	0	0	0	1
	Cylindrotheca closterium	0	2	1	0	0	0	3
Dionphysiales	*Dinophysis* sp.	0	0	1	2	1	7	11
Gonyaulacales	*Ceratium furca*	0	0	1	1	1	7	10
	Pyrophacus horologicum	0	1	1	0	1	0	3

Table A3: Phytoplankton Results per Sample

Family	Genus / Species	Phytoplankton cells per ml						Total
		MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	
Peridiniales	*Protoperidinium* sp.	0	0	0	0	0	7	7
	Protoperidinium divergens	0	2	0	1	0	0	3
	Protoperidinium oceanium	7	0	0	0	2	0	9
	Protoperidinium steini	0	0	0	0	3	0	3
Total number of taxa in each sample		5	12	12	7	12	8	1,699
Total amount of phytoplankton		35	193	220	98	335	818	
Sample percentage per total		2	11	13	6	20	48	

Table A4: Phytoplankton Taxonomy

Phylum	Class / Subclass	Order / Suborder	Family	Genus / Species
Heterokontophyta	Bacillariophyceae	Centrales	Coscinodiscales	*Hemidiscus cuneiformis*
			Thalassiosirales	*Thalassiosira eccentrica*
				Thalassiosira sp.
				Skeletonema costatum
			Leptocylindrales	*Leptocylindrus danicus*
			Rhizosoleniales	*Rhizosolenia* sp.
				Proboscia alata
				Guinardia flaccida
			Cheatoceratales	*Chaetoceros* sp.
				Bacteriastrum delicatulum
			Triceratiaceae	*Odontella aurita*
		Pennales	Fragilariales	*Synedra crystallina*
			Thalassiophysales	*Amphora crassa*
				Amphora turgida
			Naviculales	*Navicula* sp.
				Pleurosigma sp.
				Pleurosigma formosum
				Pleurosigma angulatum
				Plagiotropis lepidoptera
				Diploneis weissflogii
				Meuniera membranacea
			Surirellales	*Entomoneis* sp.
				Entomoneis alata
			Climacospheniales	*Climacosphenia moniligera*
			Bacillariales	*Nitzschia macilenta*
				Nitzschia panduriformis

Table A4: Phytoplankton Taxonomy

Phylum	Class / Subclass	Order / Suborder	Family	Genus / Species
				Pseudo-nitzschia multiseries
				Cylindrotheca closterium
Dinoflagellata	Dinokaryota	Armored	Prorocentrales	*Prorocentrum* sp.
				Prorocentrum micans
				Prorocentrum sigmoides
			Gonyaulacales	*Ceratium furca*
				Ceratium fusus
				Ostreopsis lenticularis
				Pyrophacus horologicum
				Gonyaulax sp.
				Gonyaulax polygramma
				Gonyaulax diegensis
				Gonyaulax spinifera
				Scrippsiella trochoidea
			Peridiniales	*Protoperidinium* sp.
				Protoperidinium divergens
				Protoperidinium depressum
				Protoperidinium conicum
				Protoperidinium steini
		Unarmored	Gymnodiniales	*Amphidinium klebsii*
				Akashiwo sanguinea
Haptophyta				Coccolithophore indet.

ANNEX B

Quaity Control Documentation

Contents:

Part 1: Field Documentation

Table B1, below, details field and dive logs, together with tidal predictions, provided on subsequent pages.

Table B1: Field Documentation

Figure №	Description	Usage
Figure B1	NEA Field Log	Daily log of activities
Figure B2	Tides 12/09/2017	Tidal predictions

Figure B1: Field Log 12/09/2017

NEA Field Activity Log			
Project № & Client:	N551 SGS	**Date/Day:**	24/10/17
Site Team:	RP, SV, JJ	**PM/FTL:**	RP
Vessel(s)/Vehicle(s):	SGS vessel	**Visitors:**	None
Weather:	Calm	**W/Source:**	W/Guru
Tides (Time/Height):	HT: LT:	**Sea States:**	BS: 2

Time	ID	D	Activities / Notes
08:16	-	-	Board SGS vessel, depart for site
08:26	MW1	3.8	DDV, ZP, PP
09:04	MW2	4.8	DDV, ZP, PP
09:30	MW3	6.1	DDV, ZP, PP
10:00	MW4	4	DDV, ZP, PP
10:33	MW5	5.5	DDV, ZP, PP
10:59	MW6	5.4	DDV, ZP, PP
11;30	-	-	Return vessel

Change of Plans:	None
EQ/PE issues:	None
Incidents/PIR №:	None

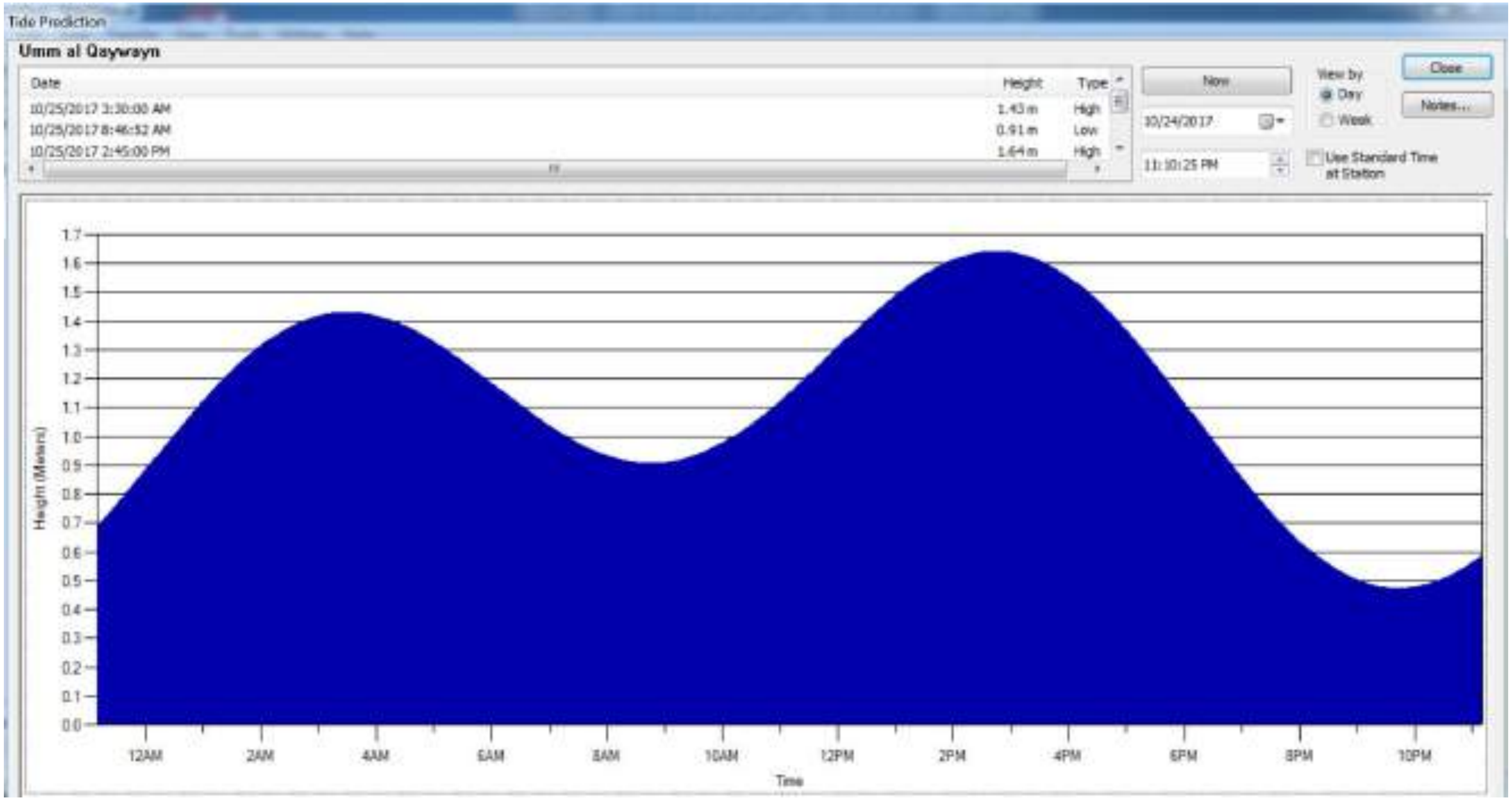
Key to Abbreviations: AR = Arrival / DP = Departure / ID = Site ID / D(M) = Depth (metres) / EQ = Equipment / PE = Personnel / DV = Dive team (initials) BN = Benthic investigation / PQ = Photoquadrats / DDV = Drop Down Video IN = Infauna / SW = Seawater sample / SD Sediment sample / PR = Seawater Probe DT = Deployment / RL = Retrieval / PP = Phytoplankton / ZP = Zooplankton

FTL Sign-off Signature: Ross

PM Approval Signature + Stamp:

NAUTICA ENVIRONMENTAL ASSOCIATES LLC POB 44790 ABU DHABI UAE

Figure B2: Tidal Prediction (UAQ 25/10/2017)



Part 2: NEA Licenses and Accreditations

Table B2, below, provides a list NEA licenses and accreditations, provided on subsequent pages

Table B2: NEA Licenses and Accreditations

Figure №	Description	Usage
Figure B3	NEA Trade License	-
Figure B4	NEA EAD Registration	-
Figure B5	NEA Quality Assurance Accreditation	-

Figure B3: NEA Trade License

مركـــز أبـوظـبي للأعـمـــال
Abu Dhabi Business Center

دائـرة الـتـنـمـيـة الاقـتـصـاديـة
DEPARTMENT OF ECONOMIC DEVELOPMENT

Professional License

خصة مهنية

License No	:	CN-1006375	:	لم الرخصة
Unified ID for ADCCI	:	228824	:	الرقم الموحد لعضوية الغرفة
Legal Form	:	Limited Liability Company / شركة ذات مسؤولية محدودة	:	شكل القانوني
Trade Name	:	Nautica Environmental Associates - Llc / نوتيكا للزمالة البيئية ذ م م	:	سم التجاري
Establishment Date	:	09/05/2007	:	يخ تاسيس المنشاة
Issue Date	:	13/02/2017	:	يخ الإصدار
Expiry Date	:	12/02/2018	:	يخ الانتهاء

نوع الشراكة Partner	الجنسية Nationality	الوصف Description	الرمز No.
شريك Partner	الإمارات العربية المتحدة United Arab Emirates	بيتر ارثر هيلير - PETER ARTHUR HELLYER	41208281
شريك Partner	المملكة المتحدة United Kingdom	فيريان جوى هنرى باين - VERYAN GUY HENRY	20029756
شريك Partner	المملكة المتحدة United Kingdom	ريشارد جون حورنبي - - RICHARD JOHN HORNBY	20029757

Commercial Activities : : الشطة التجارية
Onshore And Offshore Oil And Gas Fields And Facilities Services — مات حقول ومنشآت النفط والغاز البرية والبحرية
Environmental Consultancy And Studies And Researches — ستشارات والدراسات والبحوث البيئية

Address : : جزيرة أبوظبي, شارع الفلاح - شرق3-18 - ق146C - طMb - م22, وحدة, المالك السيد عبدالله بن حمد العامري عنوان

تشهد غرفة أبوظبي بموجب القانون رقم 27 لعام 2005 بان المنشاة المذكورة أعلاه قد سجلت لدينا
Abu Dhabi Chamber certifies that the above mentioned establishment has been registered in accordance with the law No.27 of 2005

وثيقة معتمدة وصادرة بدون توقيع أو ختم من دائرة التنمية الإقتصادية - أبوظبي. للتحقق من صحة البيانات الواردة في الرخصة برجاء زيارة الموقع http://www.ded.abudhabi.ae
Approved document issued without signature or stamp by the Department of Economic Development - Abu Dhabi. To verify the license kindly visit http://www.ded.abudhabi.ae

This Document is Considered As Commercial Register — بر هذه الوثيقة بمثابة سجل تجاري

غرفة أبوظبي
ABU DHABI CHAMBER

http://ded.abudhabi.ae

Figure B4: NEA EAD Registration

هيئة البيئة - أبوظبي
Environment Agency - ABU DHABI

EC-	58/06	رقم المكتب
ECR-	455/17	رقم التوصية
Date of Issue	24/7/2017	تاريخ الإصدار
Date of Expiry	18/5/2018	تاريخ الإنتهاء

إعتماد مكتب استشاري في مجال البيئة

* فئة (أ)

Registration of Environmental Consultancy

* Class A

Office Name:	Nautica Environmental Associates LLC	نوتيكا الزميلة البيئية	المكتب:
Type of Office:	Local (100 %)	محلي (100%)	نوع المكتب:
Address:	Office 22, Al Hilal Bank Bldg Al Falah Street, Abu Dhabi	ابوظبي- شارع الفلاح - سرق 3-18 القطعة 146	العنوان:

Environment Agency–Abu Dhabi
Environmental Quality Sector

هيئة البيئة-ابوظبي
قطاع الجودة البيئية

Figure B5: NEA ISO/OHSAS Accreditation

Lloyd's Register
LRQA

CERTIFICATE OF APPROVAL

This is to certify that the Management System of:

Nautica Environmental Associates LLC
Block C-146 – Al Falah Street
Abu Dhabi
United Arab Emirates

has been approved by Lloyd's Register Quality Assurance to the following Management System Standards:

ISO 9001:2015
ISO 14001:2015
OHSAS 18001:2007

The Management System is applicable to:

1. **Provision of environmental consultancy services typically covering:**
   - **Baseline surveys (marine and terrestrial)**
   - **Environmental Impact Assessments**
   - **Sampling and monitoring studies (air, land, sediments, marine)**
   - **Identification and statistical evaluation of biological specimens**
2. **Provision of First-Aid training**

Approval
Certificate No: MEA6011598

Original QMS/EMS Approval:	13 June 2011
Original SMS Approval:	6 May 2017
Current Certificate:	6 May 2017
Certificate Expiry:	29 April 2020

Issued by: Lloyd's Register Quality Assurance Limited

UKAS
MANAGEMENT SYSTEMS
001

LRQA Ltd – Dubai, Festival Office Tower, Suite 2001, Dubai Festival City, Dubai
For and on behalf of LRQA Ltd, 1 Trinity Park, Bickenhill Lane, Birmingham, B37 7ES, United Kingdom
This approval is carried out in accordance with the LRQA assessment and certification procedures and monitored by LRQA.
The use of the UKAS Accreditation Mark indicates Accreditation in respect of those activities covered by the Accreditation Certificate Number 001

Part 3: Support Equipment Specifications

Table B3, below, provides a list of key equipment used for the survey programme, with specifications provided on subsequent pages.

Table B3: Proposed survey equipment requirements

Figure №	Description	Usage
Figure B6	YSI Pro DSS Multiparameter probe	In-situ seawater measurements
Figure B7	YSI Pro DSS Calibration sheet	In-situ seawater measurements
Figure B8	Seawater Samplers	Remote seawater sampling
Figure B9	Sediment Grabs	Remote sediment sampling
Figure B10	Zooplankton sampling array	Remote zooplankton sampling
Figure B11	Phytoplankton net	Remote phytoplankton sampling

Figure B6: YSI Pro DSS Multiparameter Seawater Probe

a xylem brand

Parameters:
Dissolved Oxygen (Optical)
Turbidity
pH
ORP/Redox
Conductivity
Specific Conductance
Salinity
Total Dissolved Solids (TDS)
Resistivity
Seawater Density
Total Suspended Solids (TSS)
Depth
Ammonium
Ammonia
Chloride
Nitrate
Temperature

SPECIFICATIONS

DOCUMENT #W83

YSI ProDSS Multiparameter Sampling Instrument

Portable digital sampling system for the measurement of pH, ORP, dissolved oxygen (optical-based sensor), conductivity, turbidity, temperature, depth and more.

Designed for use in applications such as surface water, groundwater, coastal waters, and aquaculture, the rugged and reliable ProDSS allows for measurement of up to 17 parameters. The ProDSS features user-replaceable digital smart sensors that are automatically recognized by the instrument when connected. A backlit color display, large memory, convenient calibration procedures, rechargeable battery, and powerful PC data management program (KorDSS) make the ProDSS user friendly. The optional GPS function, wide range of sensors, and varying cable lengths allow for complete customization of the ProDSS. Mil-spec (military spec) connectors and a waterproof (IP-67), rubber over-molded case ensures durability to provide years of sampling even in the harshest field conditions.

- Single cable design features universal ports which can accept any 4 sensors plus depth
- Long-life rechargeable lithium-ion battery to power handheld and sensors
- Color display and backlit keypad allow for sampling in all lighting conditions
- Digital smart sensors are automatically recognized by the instrument and store calibration data
- User-replaceable cables and sensors provide versatility, reduce down time and reduce overall cost of ownership
- Large memory (> 100,000 data sets) with extensive site list and Data ID tag capabilities
- KorDSS, a powerful data management software with geo-mapping capability, is included with the instrument
- USB On-The-Go connector for PC connection, recharging/powering the ProDSS and connecting directly to a USB stick
- Global Positioning System (GPS) (optional)
- Cable lengths up to 100 meters available with or without a depth sensor
- Rugged, waterproof case (IP-67 rated) with rubber over-mold and metal, military-spec (MS) cable connectors as well as rugged titanium sensors
- Multiple languages in handheld and KorDSS: English, Spanish, Portuguese, French, German, Italian, Japanese, Norwegian, and Chinese (simplified and traditional)
- Warranty: 3-year instrument; 2-year cable assembly and sensors; 1-year pH and pH/ORP sensor modules; 6-months ammonium, nitrate and chloride sensor modules.

YSI.com/ProDSS

ProDSS General Specifications

Size	8.3 cm width x 21.6 cm length x 5.6 cm depth (3.25 in. x 8.5 in. x 2.21 in.)
Weight with batteries	567 grams (1.25 lbs)
Power	Rechargeable lithium-ion battery pack providing ~48 hours of battery life (instrument only with backlight off)
Instrument operating temperature	0 to 50 °C (32 to 122 °F)
Instrument storage temperature	0 to 45 °C (32 to 113 °F) with battery installed; 0 to 60 °C (32 to 140 °F) without battery installed
Display	Color, LCD graphic display
USB port	Built-in micro USB On-The-Go port for PC connection, recharging/powering the ProDSS and connecting directly to a USB stick
Cables	Available with or without depth sensor in 1, 4, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100-meters
Sensor ports	4 universal sensor ports on each cable; can accept any ProDSS sensor
Warranty	3-year instrument; 2-year bulkhead, cable assembly, and sensors; 1-year pH and pH/ORP sensor modules, ODO sensor caps, and Li-ion battery pack; 6-months ammonium, nitrate, and chloride sensor modules
Memory	> 100000 data sets
Logging modes	Single point or continuous with autostable feature
GLP compliance	Yes; 400 detailed GLP records can be stored and are available to view, download, and print.
Languages	English, Spanish, Portuguese, French, German, Italian, Japanese, Norwegian, Simplified Chinese, Traditional Chinese
Certifications	CE; RoHS; IP-67; WEEE; FCC; UN Part III, Section 38.3, Test methods for lithium-ion batteries (Class 9)
GPS	Optional internal GPS; coordinates are stored with measurement data and site lists
Sites and data ID	100 user-defined sites and 100 user-defined data ID tags

ProDSS System Specifications (Instrument, Sensor, and Cable)

Sensor/Parameter	Range	Accuracy	Resolution	Units
Temperature	-5 to 70 °C (temperature compensation range for DO mg/L measurement: -5 to 50 °C)	±0.2 °C	0.1 °C or 0.1 °F (user selectable)	°C, °F, K
pH	0 to 14 pH units	±0.2 pH units	0.01 pH units	pH, pH mV
ORP	-1999 to 1999 mV	±20 mV	0.1 mV	mV
Dissolved Oxygen	0 to 500%, 0 to 50 mg/L	0 to 200%: ±1% of reading or 1% saturation, whichever is greater 200 to 500%: ±8% of reading 0 to 20 mg/L: ±0.1 mg/L or 1% of reading, whichever is greater 20 to 50 mg/L: ±8% of reading	0.01 mg/L and 0.1%, or 0.1 mg/L and 1% (user selectable)	% saturation, % saturation local, mg/L, ppm
Barometer	375 to 825 mmHg	±1.5 mmHg from 0 to 50 °C	0.1 mmHg	mmHg, inHg, mbar, psi, kPa, atm
Conductivity	0 to 200 mS/cm	0 - 100 mS/cm: ±0.5% of reading or .001 mS/cm, whichever is greater 100 - 200 mS/cm: ±1.0% of reading	0.001, 0.01 or 0.1 µS/cm (range dependent)	µS/cm, mS/cm
Specific Conductance*	0 to 200 mS/cm	0 - 100 mS/cm: ±0.5% of reading or .001 mS/cm, whichever is greater 100 - 200 mS/cm: ±1.0% of reading. User selectable reference temperature (15 to 25 °C; default 25 °C) and compensation coefficient (0 to 4%/°C; default 1.91%)	0.001, 0.01, 0.1 mS/cm	µS/cm or mS/cm
Salinity*	0 to 70 ppt	±1.0% of reading or ±0.1 ppt, whichever is greater	0.01 ppt	ppt or PSU
Total Dissolved Solids (TDS)*	0 to 100 g/L	Calculated from specific conductance and a user-selectable TDS multiplier (0.30 to 1.00; default 0.65)	0.001, 0.01, 0.1 g/L	mg/L, g/L, kg/L
Resistivity*	0 to 2 Mohms	±0.1% Full Scale	0.001, 0.01, 0.1 ohms	ohm-cm, kohm-cm, Mohm-cm
Seawater Density*	0.0 to 50.0 sigma, sigma T	-	0.1 sigma or sigma T	Sigma, Sigma T
Turbidity	0 to 4000 FNU	0 to 999 FNU: 0.3 FNU or ±2% of reading, whichever is greater 1000 to 4000 FNU: ±5% of reading	0.1 FNU	FNU, NTU
Total Suspended Solids (TSS)*	0 to 30000 mg/L	User correlated from turbidity field measurements and lab TSS measurements from grab samples	0.01, 0.1 mg/L	mg/L
Ammonium**	0 to 200 mg/L NH_4-N	±10% of reading or 2 mg/L, whichever is greater	0.01 mg/L	NH_4-N mg/L, NH_4-N mV
Ammonia*	0 to 200 mg/L NH_3-N	-	0.01 mg/L	NH_3-N mg/L
Chloride**	0 to 18000 mg/L Cl	±15% of reading or 5 mg/L, whichever is greater	0.01 mg/L	Cl mg/L, Cl mV
Nitrate**	0 to 200 mg/L NO_3-N	±10% of reading or 2 mg/L, whichever is greater	0.01 mg/L	NO_3-N mg/L, NO_3-N mV
Depth	0 to 328 feet (0 to 100 m)	±0.013 ft (±0.004 m) for 1, 4, and 10 m cables ±0.13 ft (±0.04 m) for cables 20 m and longer	0.001 m or 0.01 ft	m, ft

*Derived/calculated parameter **ISEs for freshwater only; 20 meter maximum depth

ProDSS System Specifications (Instrument, Sensor, and Cable)

Sensor/Parameter	Sensor Type/Measurement Method	Calibration	Maximum Depth	Warranty
Temperature	Thermistor, installed on conductivity sensor	Not available	100 m	2 years for conductivity/temperature sensor
pH	Combination glass bulb electrode, Ag/AgCl reference electrode with gelled electrolyte	1, 2, or 3 point	100 m	2 years for pH and pH/ORP sensors 1 year for pH and pH/ORP sensor modules
ORP	Platinum button with Ag/AgCl reference	1 point	100 m	2 years for pH/ORP sensor 1 year for pH/ORP sensor module
Dissolved Oxygen	Optical luminescence - lifetime method	1 or 2 point	100 m	2 years for optical DO sensor 1 year for optical DO sensor cap
Barometer	-	1 point	-	3 years, integrated into ProDSS handheld
Conductivity	Four nickel electrode cell	1 point	100 m	2 years for conductivity/temperature sensor
Specific Conductance*	Calculated from conductivity and temperature	1 point	-	-
Salinity*	Calculated from conductivity and temperature	1 point	-	-
Total Dissolved Solids (TDS)*	Calculated from specific conductance and a user-selectable TDS multiplier (0.30 to 1.00; default 0.65)	-	-	-
Resistivity*	Calculated from conductivity and temperature	-	-	-
Seawater Density*	Sigma is calculated from salinity, temperature, and pressure (depth) Sigma T is calculated from salinity and temperature	-	-	-
Turbidity	Nephelometric - Optical, 90° scatter	1, 2, or 3 point	-	2 years for turbidity sensor
Total Suspended Solids (TSS)*	User correlated from turbidity field measurements and lab TSS measurements from grab samples	-	-	-
Ammonium**	Ion selective electrode	1, 2, or 3 point	20 m	2 years for ammonium sensor 6 months for ammonium sensor module
Ammonia*	Calculated from ammonium, temperature, salinity, and pH	-	-	-
Chloride**	Ion selective electrode	1, 2, or 3 point	20 m	2 years for chloride sensor 6 months for chloride sensor module
Nitrate**	Ion selective electrode	1, 2, or 3 point	20 m	2 years for nitrate sensor 6 months for nitrate sensor module
Depth	Pressure transducer	1 point	-	2 years, integrated into cable assembly

*Derived/calculated parameter
**ISEs for freshwater only ; 20 meter maximum depth

Figure B7: YSI Probe Calibration Certificate

NEA Probe Calibration					
Model №:	Pro DSS		Serial №:	-	
Technician:	RP		Job ref:	N551	
Test Date/Time:	17/09/2017 (09:00)		Job Name:	UAQ RO Plant Survey	
• *Rinse cup with standard prior to calibration* • *Wait for readings to stabilise and allow 3-5 minutes to reach temperature equilibrium* • *Fill in all blue-shaded fields of the worksheet*					
Depth Sensor model:					
• *Put guard on sonde and place upright on the floor (i.e. not in water)* • *Calibrate to 0m*					
Depth:	0m	Pre-cal:	0	Calibrated:	0
Conductivity Sensor model:					
• *Dry inside sensor and dry cup. Put sensor in cup and calibrate to 0ms cm^{-1}* • *Rinse cup with calibration standard (50ms cm^{-1}) then calibrate*					
Conductivity:	0ms cm^{-1}	Pre-cal:	-	Calibrated:	-
	50 ms cm^{-1}	Pre-cal:	49.154	Calibrated:	50.00
pH Sensor model:					
• *Rinse cup and sensor with pH 7, allow temperature to reach equilibrium then calibrate. Repeat using pH 10*					
pH:	7	Pre-cal:	6.97	Calibrated:	7.00
	10	Pre-cal:	9.98	Calibrated:	10.00
Turbidity Sensor model:					
• *Run cleaning cycle and check wiper rotates* • *Dry out the sensor, rinse with standard then fill calibration cup. Allow readings to stabilise and temperature* • *2-point calibration - 0NTU then 20NTU. Second point may vary if expecting particularly turbid water*					
Turbidity:	0NTU	Pre-cal:	0.0	Calibrated:	0.0
	20NTU	Pre-cal:	19.97	Calibrated:	20.0
Dissolved Oxygen Sensor model:					
• *Allow water to reach O_2 equilibrium with air by leaving in an open container for 24 hrs. Shake vigorously in a bottle for 2 mins to fully aerate prior to calibration* • *Position the sonde with sensors facing up, remove calibration cup lid and pour in aerated water* • *Screw lid on slowly to allow air pressure to escape* • *Enter barometric pressure; check on internet (e.g. weather.adac.ae & convert to mmHg) or use 748-750* • *Calibrate to 100%*					
DO:	100%	Pre-cal:	100.02	Calibrated:	100.0
Temperature check Sensor model:					
Temperature:		Traceable thermometer:	Yes	Probe:	Yes
Test Pass/Fail:	Pass				
Comments:	-				
Signature of Evaluating Technician(s):					

Figure B8: Box Corer and Van Veen Sediment Grab Specifications

Box-corer Description:

This patented device is designed to take larger samples in harder bottoms more easily and safely than spring-powered grabs. The sole driving force is the box corer’s weight, which can total 49 kg (108 lbs).

The body itself weighs about 14 kg (31 lbs) and is augmented by up to 12 extra weights, each weighing 4 kg (9 lbs), securely fastened in two side bins. The heavy duty linkage and scoops dig as deep as the weight will allow. The inside of the box is smooth and free of projections, allowing an acrylic liner to easily slip in and out.

Specifications:

- Box size: 150 x 150 x 230 mm (6 x 6 x 9”)
- All 316 stainless steel with 18-8 fasteners
- Centre pivot scoops
- Self-releasing pinch-pin™ for safety
- Stainless steel construction
- Scoops overlap to reduce sample loss
- 36 lbs weight (excl. removable lead wts)
- Acrylic box liner

Van Veen Grab Description:

This patented device is designed by KC Denmark, based on the Van Veen design, to take small samples in soft bottom habitats. Constructed of AISI 316 stainless steel, the surface is electro polished, with a heavy duty construction designed for all kinds of environments.The body itself weighs about <10 kg.

Specifications:

- Sample area: 250 cm^2;
- Sample volume: 3.14 litres;
- Manufacture: AISI 316 stainless steel, 3 mm;
- Finish: Electro polish;
- Lids: 4 pcs, each 60 x 70 mm;
- Weights: 4 lead weights, each 0.65 kg;
- Dimensions: 20 x 20 x 70 cm.

Figure B9: Zooplankton Net Array

Close-up view of the 'Bongo' net assembly with flow-meters in place (NEA File photo);

Lateral view of the 'Bongo' net assembly in operation, showing float attachment and discrete sampling depth (NEA File photo);

The NEA bongo net assembly, comprising two conical plankton nets attached parallel to one another within a bongo net frame. The assembly is made to the following specifications:

1. Bongo net frame, paired 50cm diameter stainless steel net rings, 5/8" rod stock, polyethylene towing yoke, snap-shackle weight attachment and quick-link cable attachment.
2. Plankton nets, 50cm x 150cm x 333 micron (conical) made from heavy duty 330µm Nitex mesh with 11cm diameter cod end aperture (grometted, reinforced and triple stitched.
3. 2 x PVC cod end assembly with detachable lower section and line (333 microns) cod end attachments to each net.

Figure B10: Phytoplankton Sampling Net Array

efe-gb (NHBS) phytoplankton net

- Frame diameter: 250mm
- Net length: 500mm
- Frame material: Stainless steel
- Towing line length: 7m
- Mesh size: 30µm

The nets have a 30µm mesh size bag, which is made from nylon precision mesh and have a screw-on filter cap with the same mesh size as the main body of the net. The nets are suitable for trawling or vertical hauling from a vessel.

Part 4: Chain of Custody Documentation

Table B4, below, details the chain of custody documentation, provided on subsequent pages.

Table B4: Chain of Custody Documentation

Figure №	Description	Usage
Figure B11	NEA Zooplankton/Phytoplankton sample COC	Sample QC

Figure B11: NEA Zooplankton/Phytoplankton Chain of Custody Documentation

ANALYTICAL CHAIN OF CUSTODY RECORD

Client:	SGS	Project:	UAQ RO	Laboratory Use	NAUTICA Environmental Associates LLC
Address:		Reference:	N551	Job No:	P.O. Box 44780, Abu Dhabi, United Arab Emirates
		Contact:		Contact:	Tel: +9712 6731250 / Fax: +9712 6731054
		Tel No:		Quote Ref:	Email: [illegible]
Tel No:		Collected By:		Invoice To:	

Date Collected	Sample ID	Container Type	Size	Sample Type	Preservation Method(s)	Analytical Requirements
24/10/17	MW1	Plastic	1L	Zooplankton	Lugols	
✓	MW2			✓	✓	
✓	MW3			✓	✓	
✓	MW4			✓	✓	
✓	MW5			✓	✓	
✓	MW6			✓	✓	
✓	MW1			Phytoplankton	✓	
✓	MW2			✓	✓	
✓	MW3			✓	✓	
✓	MW4			✓	✓	
✓	MW5			✓	✓	
✓	MW6			✓	✓	

Total No samples delivered:

Date Sent/Collected: 24/10/17

Sender Name:

Method of Delivery:

Airway Bill No:

Received by: Julian Johnson

Date/Time: 25/10/17

NAUTICA ENVIRONMENTAL ASSOCIATES LLC POB 44780 ABU DHABI UAE

APPENDIX F – HR WALLINGFORD MARINE MODELLING

HR Wallingford
Working with water

Umm Al Quwain 150 MIGD desalination plant

Dispersion modelling

DEM8371-RT001-R03-00

July 2019

Document information

Document permissions	Confidential - client
Project number	DEM8371
Project name	Umm Al Quwain 150 MIGD desalination plant
Report title	Dispersion modelling
Report number	RT001
Release number	R03-00
Report date	July 2019
Client	ACWA Global
Client representative	Udyan Seth
Project manager	Elfed Jones
Project director	Matthew Wood

Document history

Date	Release	Prepared	Approved	Authorised	Notes
18 Jul 2019	03-00	TEJ	MJW	MJW	Revised following comments from 5 Capitals
03 Jul 2019	02-00	PMJ	TEJ	MJW	Shoreline intake option added
19 Feb 2019	01-00	TEJ	MJW	MJW	

Document authorisation

Prepared	Approved	Authorised

Summary

The Federal Electricity & Water Authority (FEWA) of UAE is promoting an Independent Water Project (IWP) in Umm Al Quwain (UAQ). ACWA Power (ACWA) is part of the successful consortium that will develop the plant. ACWA has appointed 5 Capitals as environmental consultant to carry out the Environmental and Social Impact Assessment (ESIA).Initially the plant was to be constructed in two phases, each delivering 45 MIGD of potable water. ACWA has now been asked to consider a single plant delivering 150 MIGD.

HR Wallingford carried out hydrodynamic and dispersion/recirculation studies to determine an outfall configuration for reject brine associated with the expanded plant, and to help determine the impacts of the seawater supply system and by-products discharge to support 5 Capitals' ESIA. This report presents the results of the modelling assessment. We carried out a similar assessment for an initial 45 MIGD plant for ACWA in 2018.

The intake will be located around 600 m from the shoreline. According to the bathymetric surveys, the bed elevation 600 m offshore results in minimum water depths of around 4 m. This is therefore a relatively shallow intake, and **the EPC contractor should confirm this design with detailed surveys and appropriate design for the intake risers**.

The end of the outfall will be located 3600 m from the shoreline. The proposed outfall location lies outside of the area surveyed data. Therefore we have estimated water depths by interpolating between the depths at the edge of the survey, and data from Admiralty Charts further offshore. Typical water depths appear to be around 6 m at this location. **The EPC contractor should confirm the exact bed elevations with detailed surveys/design.**

The most stringent of the environmental standards applied require the excess salinity to be below 5% of the naturally occurring ambient salinity at the edge of the mixing zone. We have therefore attempted to derive a diffuser design that meets the required level of dilution within the near-field area around the diffuser. However, as the seabed along the proposed outfall corridor slopes relatively gradually, water depths at the proposed outfall location are shallow. This means that the depth of water available for mixing and dilution of the brine is limited.

A concept design for the proposed outfall was derived consisting of a 1500 m-long diffuser, with 40 single-port risers, equally spaced along the pipe. The end point of the 1500 m diffuser section is located 3.6 km offshore (so the first, shoreward, port discharges at 2.1 km offshore). Port diameters are about 0.4 m and each port was assumed to be located around 1 m above the seabed. The ports were assumed to make an angle of about 30° with the seabed, and the port on each riser is orientated normal to the diffuser pipe axis, with neighbouring risers discharging in opposite directions.

This concept configuration was predicted to reduce excess salinities to within 5% of the ambient values within the near-field area, which extends about 30-40 m from the outfall. The saline layer that forms at the bed will be around 2-3 m deep at this point, which means that the spreading layer will occupy a significant proportion of the water depth.

Dispersion of the brine over the wider area, and its potential for build-up around the diffuser over successive tides was assessed using detailed 3D hydrodynamic dispersion modelling. The hydrodynamic model was validated using data from a single Acoustic Doppler Current Profiler (ADCP) deployed for 14 days. The instrument was located in very shallow water and, as result, the recorded currents were quite noisy and

difficult to interpret. **As the outfall and intake are to be located much further offshore, additional ADCP deployments at 1-2 km from the shore are recommended.** The modelling identified that local currents were sensitive to assumptions made about the bathymetry in the shallow area around the islands between the plant site and Umm al Quwain town. Little or no bathymetry data are available in this area. **Collection of additional bathymetry information in this area is recommended to reduce modelling uncertainties and give more reliable predictions.**

At the seabed, maximum excess salinities outside the near-field region are below 2 ppt, although excess salinities above 1 ppt are predicted up to around 8 km from the outfall. On average, excess salinities are predicted to exceed 1 ppt up to about 2 km from the outfall. This demonstrates that rates of dilution in the spreading layer beyond the near-field are likely to be slow.

Excess salinities of up to 0.8 ppt were predicted at the intake, with highest levels typically predicted to occur during stronger Shamal winds.

Maximum predicted excess salinities between 0.1 ppt and 1.6 ppt were predicted at nearby marine receptors. At the north-eastern corner of Al Sinniyah Island, maximum excess salinities of 0.8 ppt were predicted. However, the horizontal salinity gradient is relatively strong near this site, and only a small change in the plume position would be required to increase concentrations. It is therefore recommended that a precautionary approach is taken when determining the potential effects at this location.

An option for an intake consisting of an open channel with breakwaters has also been investigated. Generally, the results are similar to the offshore intake case in terms of excess salinity footprints and salinities at sensitive sites. Peak predicted excess salinities at the intake are increased slightly from 0.6 to 0.75 ppt (weaker wind case) and from 0.8 to 0.95 ppt (stronger wind case).

Contents

Tables

1. Introduction

The Federal Electricity & Water Authority (FEWA) of UAE is promoting an Independent Water Project (IWP) in Umm Al Quwain (UAQ). ACWA Power (ACWA) is part of the successful consortium that will develop the plant. ACWA has appointed 5 Capitals as environmental consultant to carry out the Environmental and Social Impact Assessment (ESIA). Initially the plant was to be constructed in two phases, each delivering 45 MIGD of potable water. ACWA has now been asked to consider a single plant delivering 150 MIGD.

HR Wallingford has carried out recirculation studies to determine an outfall configuration for this expanded plant, and to help determine the impacts of the seawater supply system and by-products discharge to support 5 Capitals' ESIA. This report presents the results of the modelling assessment. We carried out a similar assessment for the initial 45 MIGD plant for ACWA in 2018 (HR Wallingford, 2018a,b).

Initial modelling was carried out with an offshore intake for the proposed IWP. An alternative open intake with breakwaters was also investigated.

In this report, the horizontal coordinate system is WGS84 UTM Zone 40. The vertical datum is Mean Sea Level (MSL). In accordance with normal meteorological and oceanographic conventions, winds come from the specified direction while currents and water displacements are towards the specified direction.

2. Data and assumptions

The IWP will produce 150 MIGD (682,000 m^3/day). The operational parameters provided by ACWA are given below:

- Intake flow: 71033 m^3/hr
- Brine effluent flow: 42,620 m^3/hr
- Excess salinity in brine effluent: 29 ppt
- Effluent temperature: maximum 1°C above ambient
- Intake length: 600 m from shore
- Outfall length: To be determined by this assessment.

Water quality sampling was carried out in October 2017. The key parameters with regards to hydrodynamic and dispersion modelling are:

- Ambient TDS: 42-43 ppt.
- Seawater temperature: 31°C.
- The required mixing zones for the discharge have been defined by 5 Capitals as follows:
  - Federal standards: salinity to fall within 5% of background at the edge of the mixing zone, although the permitted size of mixing zone is not set.
  - Iranian standards: salinity to fall within 10% of background at the edge of a 200 m mixing zone.

3. Hydrodynamic modelling

We have used our established Arabian Gulf regional model to provide time- and space-varying boundary conditions for a detailed local model at UAQ. This procedure, commonly known as nesting, is a well-established technique for modelling hydrodynamics over wide areas with varying resolution.

3.1. Regional model

The regional Gulf model is built using TELEMAC, an established state-of-the-art finite element model, which is currently being used by more than 200 professional and research organisations worldwide. The TELEMAC-2D module solves the depth-averaged shallow water equations and is used to model various hydraulic phenomena such as tidal and coastal flows, storm surges, etc. The TELEMAC system is developed under a quality assured system, which includes the application of stringent validation tests. TELEMAC uses a completely flexible triangular mesh. As meshes are unstructured, they can be easily refined to represent coastlines and other important structures efficiently and accurately.

The computational mesh of the Gulf model is shown in Figure 3.1. The model covers the Arabian Gulf, the Straits of Hormuz and the Gulf of Oman, and extends out into the Arabian Sea. Currents and water levels are driven by astronomical tides and spatially-varying wind and pressure fields. Predicted water levels have been calibrated against tidal elevation data at 36 locations spread across the Arabian Gulf and Gulf of Oman.

Time- and spatially-varying currents and water levels have been extracted from the regional model and used to drive the local UAQ model for October 2017, covering the period of a recent ADCP (Acoustic Doppler Current Profiler) deployment at the site.

Figure 3.1: HR Wallingford’s regional gulf model mesh

3.2. Local flow modelling

Our existing UAQ model is built using TELEMAC-3D, which solves the equations of motion and transport in multiple layers, and includes the important effects of buoyant spreading, inhibition of vertical mixing associated with sharp density gradients, and shear of wind-driven currents. Each of these processes is vital for the accurate simulation of brine discharge dispersion and recirculation.

The computational mesh of our baseline UAQ model is shown in Figure 3.2. The unstructured triangular mesh used by TELEMAC allows us to resolve the complex coastline and reclamations with high accuracy. Additional small refinements were made to the mesh for the present study.

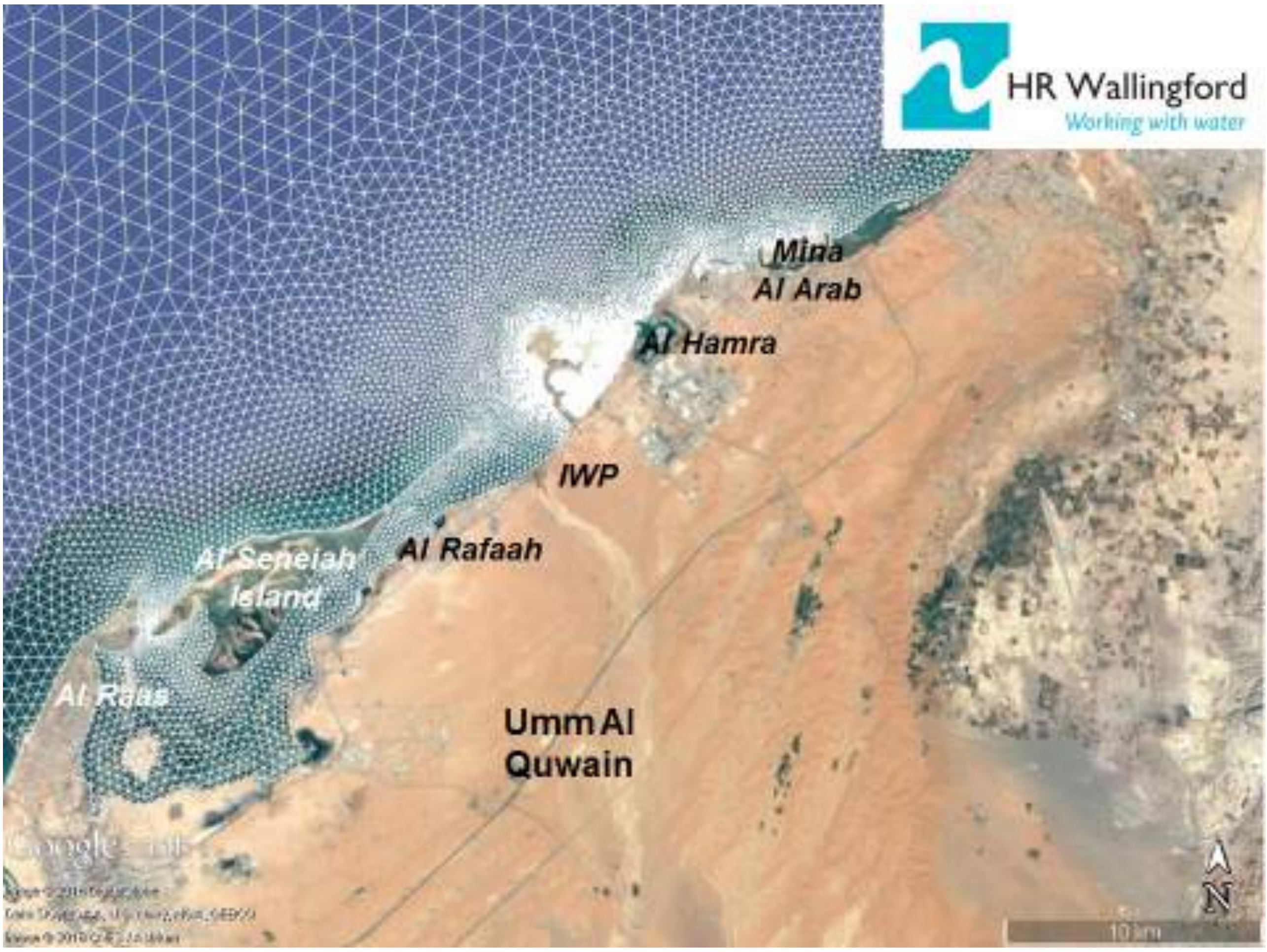


Figure 3.2: Local model mesh

The model bathymetry is based on data from international hydrographic offices and has been updated to include the survey bathymetry collected for SGS during October 2017 (Figure 3.3). No detailed data are available for the lagoon system to the west of the site between Al Rafahh and Al Raas. Therefore, depths were estimated as varying from -1.0 to +1.0 m MSL, and the navigation channels from Al Rafaah were assumed to be dredged according to information found on admiralty charts. We recommend that these assumptions are confirmed through wider data collection as part of subsequent studies.

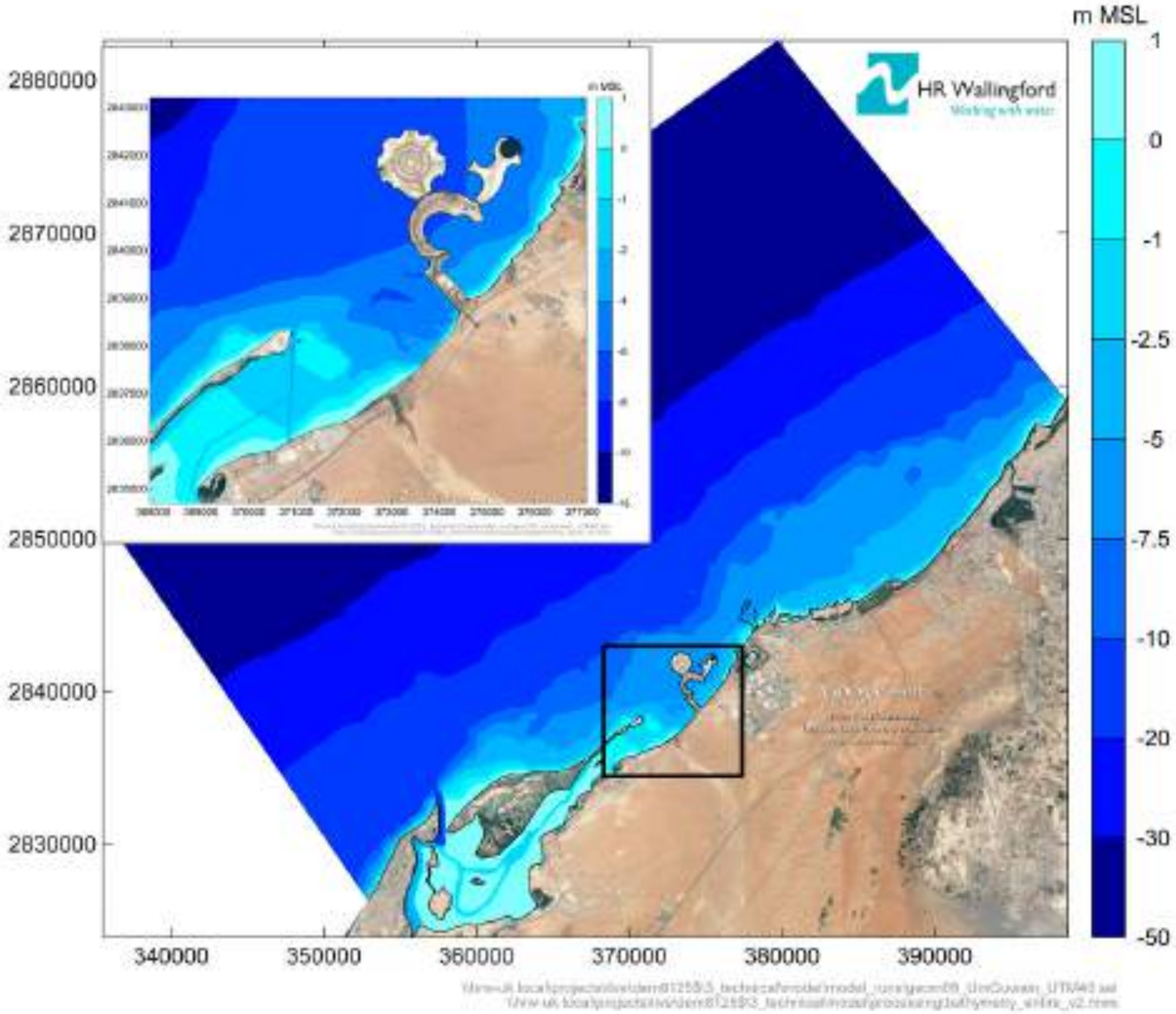


Figure 3.3: Model bathymetry

An ADCP was deployed in October 2017 by ACES to record currents, waves and water levels. The instrument was located at the initial location for the IWP intakes: 373976E, 2838239N (25°39'23.30"N, 55°44'39.96"E), which is about 180 m from the shoreline.

A high proportion of the ADCP measurement bins contained data that were unsuitable for use in the modelling assessment, due to the instrument's coarse vertical resolution and deployment in shallow water. We have applied smoothing to data from the remaining usable bins, to reduce the noise within the measurements.

The model was validated using the processed ADCP data by adjusting the model parameters to achieve the best possible agreement between the predictions and observations. Wind forcing was applied across the entire model using observed wind data from Dubai International Airport for the period of the ADCP deployment. It is recommended that local wind data are collected during future survey campaigns to provide more accurate wind conditions at the site.

The predicted and observed water levels at the ADCP are shown in Figure 3.4. The observed water levels were estimated from the ADCP pressure measurements, and data are missing at the Low Waters. Nevertheless, the model predicts the tidal phasing correctly to within just a few minutes of the observations, and High Water levels are reproduced to within a few percent of the model tidal ranges.

The observed and predicted depth-averaged currents at the ADCP location are shown in Figure 3.5 and Figure 3.6. The tidal currents at the site flow approximately towards 30°N during the ebbing (falling) tide, and approximately towards 210°N on the flooding (rising) tide. For clarity, and to highlight any imbalances in the flooding and ebbing currents, the observed and predicted currents are presented as:

- Speeds and direction relative to compass north;
- Current speeds resolved in the directions alongshore (towards 30°N) and offshore (towards 300°N);
- Scatter plots of eastward and northward components of velocity (“tidal ellipses”).

The observed currents are slow, with speeds generally below 0.1 m/s. In such environments, where the tidal components of the current are relatively weak, observed current speeds and directions are often highly variable, being affected by local wind and wave variations. These variations are more noticeable on neap tides, as the tidal currents are weaker than those on spring tides.

The model reproduces the general trends of the tidal variation in the currents, and the imbalances between the flood and ebb currents, with slightly stronger speeds on the ebbing tides. On the spring tides, the peak north-eastward speeds are under predicted by a few centimetres per second. This is likely to be due to differences in the bathymetry in the un-surveyed shallow areas to the west, which slightly changes the volume of water flowing alongshore to the northeast on the larger tides. We recommend that additional bathymetry data are collected in this region during subsequent studies. In general, this feature of the model will tend to marginally reduce the excursion of the saline plume towards the northeast, and will result in marginally higher predicted concentrations in the mid-field around the outfall and intakes than might occur in the field.

For the present study the model is deemed suitable for assessing the dispersion and recirculation of the reject brine from the plant. Further model enhancements may be performed at later stages of the project once additional survey data are available.

Examples of the predicted currents in the vicinity of the site are shown in Figure 3.7 and Figure 3.8.

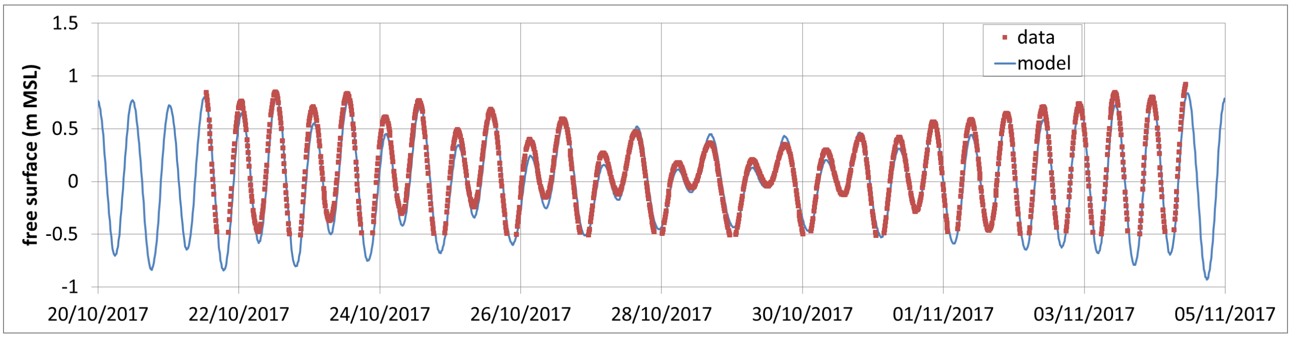


Figure 3.4: Observed and predicted free surface elevation at the ADCP location

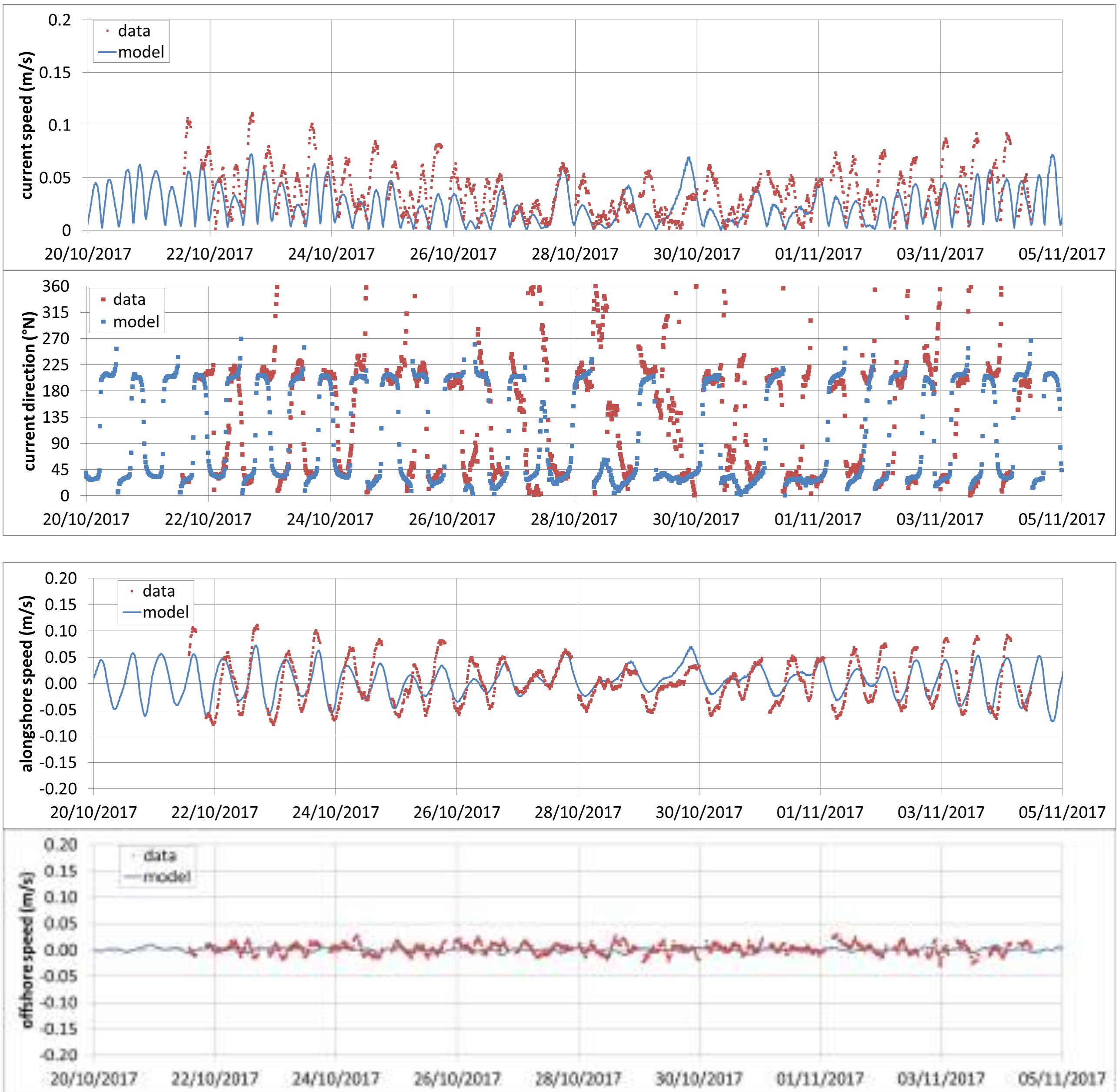


Figure 3.5: Observed and predicted currents at the ADCP location

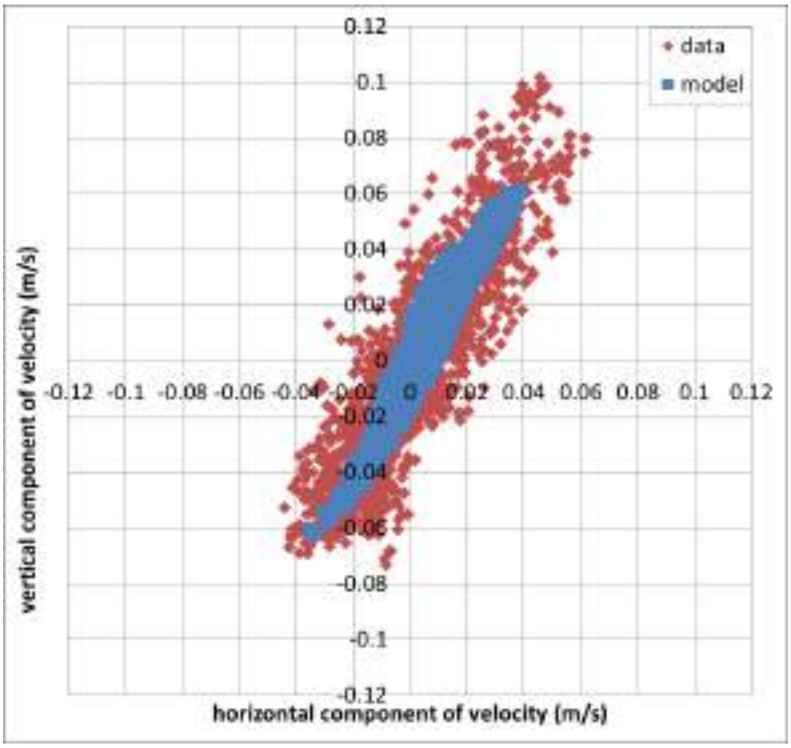


Figure 3.6: Observed and predicted current velocity components at the ADCP location

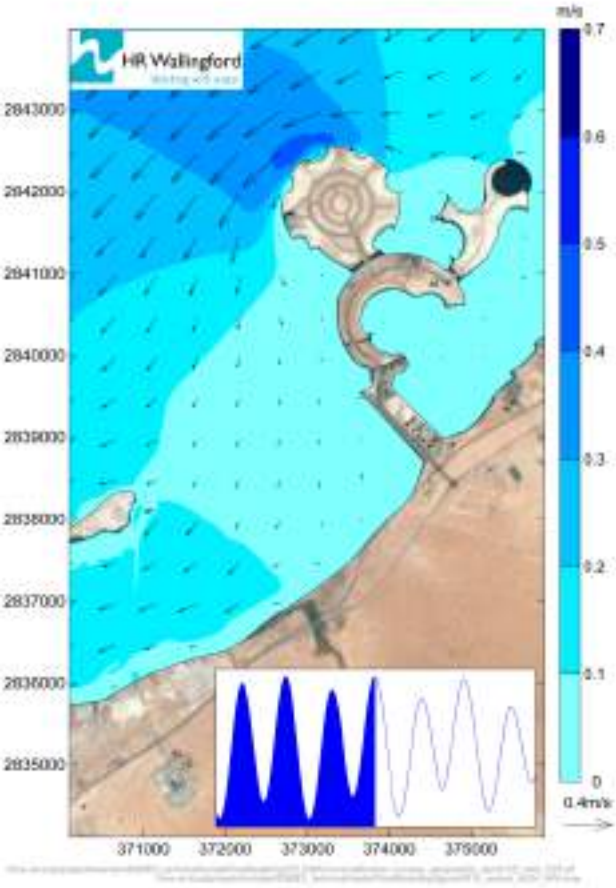


Figure 3.7 Predicted currents, high water, spring tide

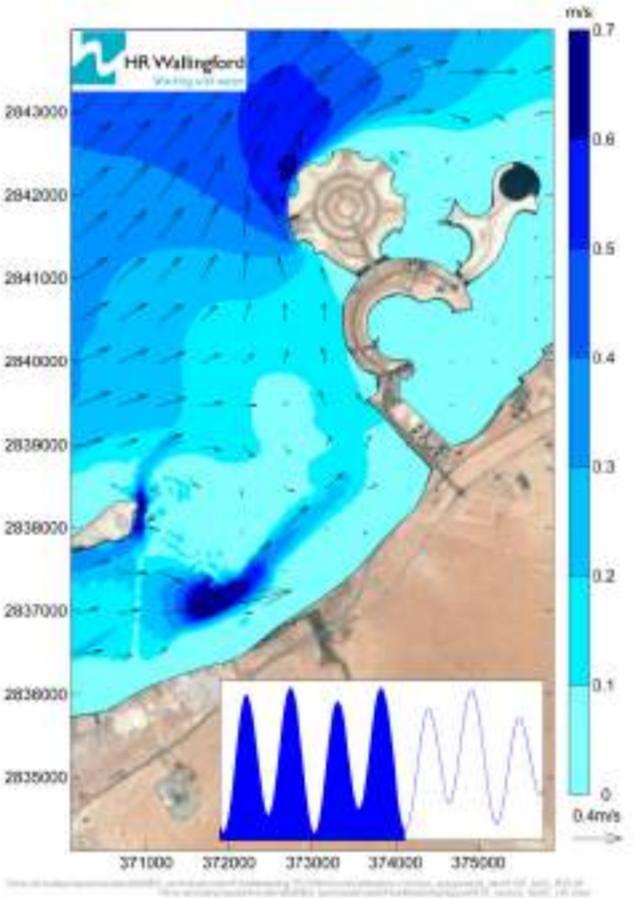


Figure 3.8: Predicted currents, low water, spring tide

Source: Background imagery from Google Earth , using data from SIO, NOAA, US Navy, NGA, GEBCO

4. Outfall configuration and near-field behaviour

The Federal environmental standards require the excess salinity to be below 5% of the background salinity, which means 2.1 ppt in this case (5% of 42 ppt), at the edge of the mixing zone. We have therefore attempted to derive a diffuser design that meets the required level of dilution within the near-field area around the diffuser. However, as the seabed along the initially proposed outfall corridor slopes relatively gradually, water depths at the proposed outfall location (2.6 km offshore) can be as shallow[1] as 5 m. This means that the depth of water available for mixing and dilution of the brine is limited.

The reject brine from the proposed IWP will be denser than the receiving seawater, which means it will tend to sink following release, forming a dense layer or gravity current at the seabed. Rates of dilution in gravity currents can be relatively slow, and so outfalls for reject brines must be designed to ensure high levels of dilution and mixing with the ambient seawater before the plume reaches the seabed.

[1] Note that the proposed outfall location lies outside of the area of a survey carried out in October 2017 by ACES, for SGS Gulf Limited and FEWA. Therefore we have estimated water depths by interpolating between the depths at the edge of the survey, and data from Admiralty Charts further offshore. The EPC contractor should confirm the exact bed elevations with detailed surveys/design.

Brine is therefore usually discharged as a series of individual jets from diffuser ports spread along a pipe. The ports are normally angled upwards so that the jets initially rise before sinking back to the seabed under their negative buoyancy. This increases the trajectories of the individual jets before they reach the seabed, maximises the potential for entrainment of ambient seawater, and reduces near-bed concentrations.

We derived a concept design for the proposed outfall using these principles. The concept consists of a 1500 m-long diffuser, with 40 single-port risers, equally spaced along the pipe. The end point of the 1500 m diffuser section is located 3.6 km offshore (so the first, shoreward, port discharges at 2.1 km offshore). Port diameters are about 0.4 m, which gives exit velocities of around 2.4 m/s. For this stage of modelling, we have assumed that the centre point of each diffuser port is located around 1 m above the seabed. This is to increase the trajectory lengths of the jets, and to minimise their interaction with both the sea surface and seabed.

The ports should make an angle of about 30° with the seabed. For the modelling, we have assumed that the port on each riser is orientated normal to the diffuser pipe axis, and neighbouring risers discharge in opposite directions.

This concept configuration is predicted to reduce excess salinities to within 2.1 ppt of the ambient values within the near-field area, which extends about 30 m from the outfall. The saline layer that forms at the bed will be around 2-3 m deep at this point, which means that the spreading layer will occupy a significant proportion of the water depth. Dispersion of the brine over the wider area, and its potential for build-up around the diffuser over successive tides cannot be included in the near-field assessment. This requires detailed 3D hydrodynamic dispersion modelling, details of which are shown in the next section.

5. Dispersion/recirculation modelling

Having validated the hydrodynamic aspects of the model, and derived a concept diffuser configuration, the IWP intakes and outfall were added to the model to investigate the dispersion of the saline plume and the potential for recirculation.

5.1. Initial outfall and intakes layout

The locations of the intake and outfall are shown in Figure 5.1. The intake will be located around 600 m from the shoreline. According to the bathymetric surveys (which were carried out in October 2017 by ACES, for SGS Gulf Limited and FEWA) the bed elevation 600 m offshore results in minimum water depths of around 4 m. This is therefore a relatively shallow intake, and the EPC contractor should confirm this design with detailed surveys and appropriate design for the intake risers. In the model, the intakes were located at 373682 E, 838528 N (25°39'23.30"N, 55°44'39.96"E). An alternative shoreline intake is discussed in Section 0.

The outfall diffuser will be located from 2100 m to 3600 m from the shoreline in water depths of around 6 m. The start and end points of the outfall diffuser as used in the model are shown in Table 5.1.

Table 5.1: Locations of start and end of outfall diffuser as used in the model

Point	Location
Start	372742 E, 2839699 N (25°40'10.4"N, 55°43'55.2"E)
End	372381 E 2840057 N (25°40'21.9"N, 55°43'42.1"E)

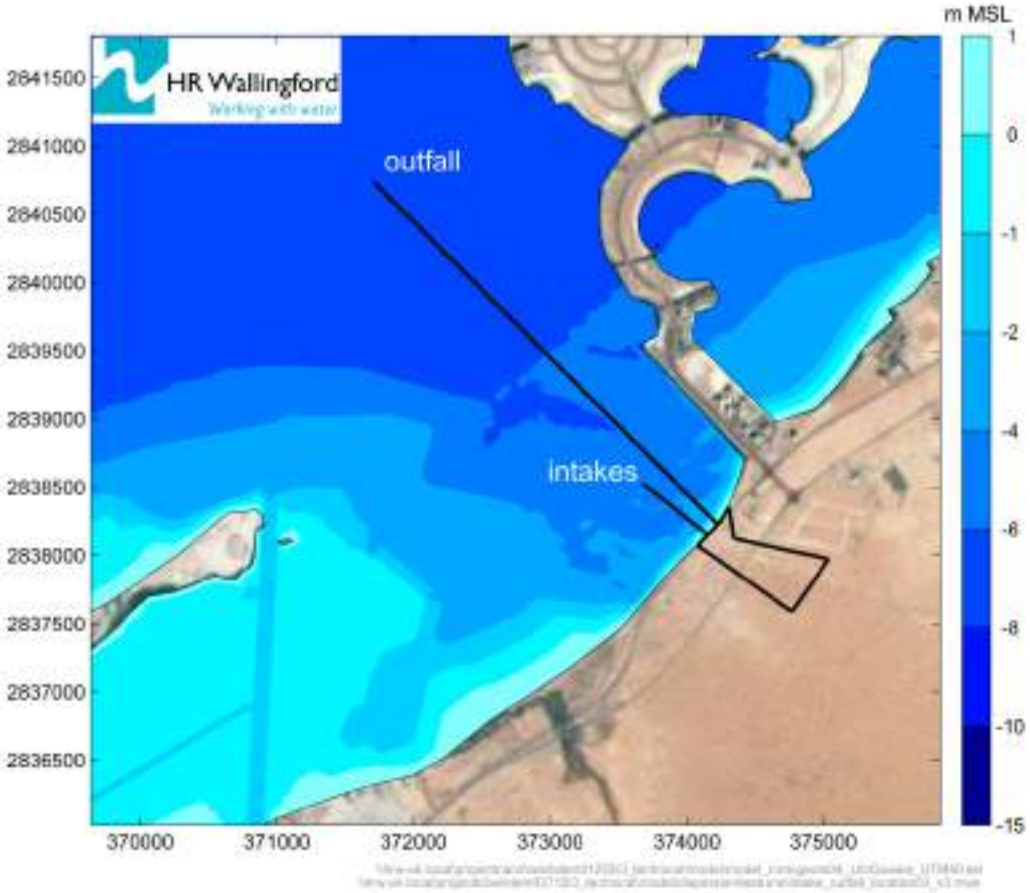


Figure 5.1: Initial intake and outfall locations

Source: Background imagery from Google Earth , using data from SIO, NOAA, US Navy, NGA, GEBCO

5.2. Wind conditions

Wind conditions at the site were simulated using data from Dubai International Airport accessed through the NOAA NCDC database. Winds at Dubai International Airport are shown in Figure 5.2. Winds from west to north-west occur frequently at speeds of around 5 m/s. Weaker winds with speeds of around 3 m/s also frequently occur from south and east.

Data for Sharjah Airport were also considered. In general the measured wind data are very similar at both airports, with similar wind events and directional distributions. The winds measured at Dubai are slightly faster than those at Sharjah, possibly because Dubai Airport is closer to the coast. Data from the nearest airport to the site (Ras al Khaimah) were not considered, as the airport is too far from the sea and too close to the mountains to be representative of winds at the coast. Therefore, Dubai Airport data were used as being most representative of winds at the coast in this region of the Gulf.

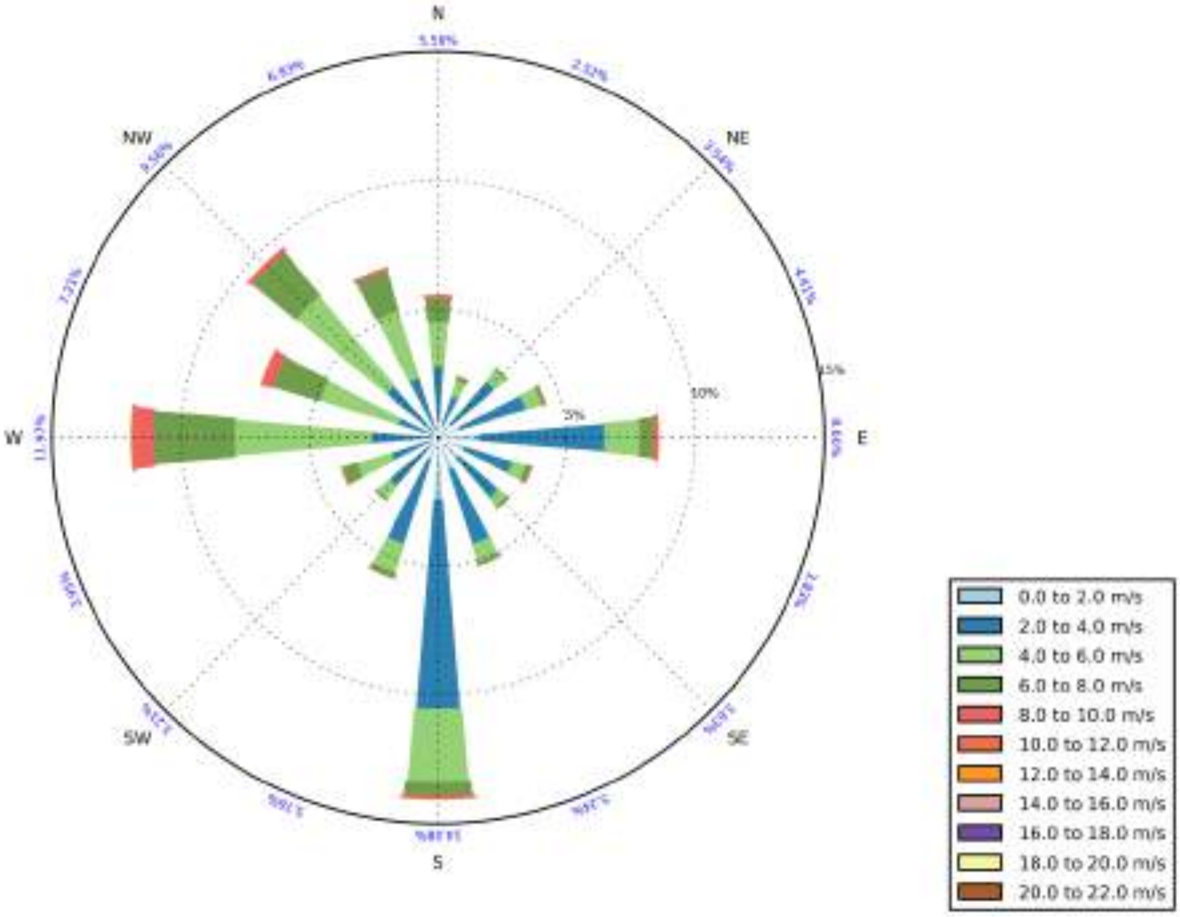


Figure 5.2: Winds at Dubai International Airport, 1983 – 2017

Source: NOAA NCDC

For the far-field dispersion assessment, winds were applied for a 17-day period from 19 October to 5 November 2017 to coincide with the ADCP deployment. Wind speeds and directions for this period are shown in Figure 5.3. Winds were generally weak (on average around 3 m/s), with daily peaks up to 6 m/s. From analysis of wind speeds at Dubai International Airport (Table 5.2), winds of around 3 m/s occur 41% of the time. A second period (5-22 December 2009) was simulated to assess the influence of stronger winds, including those from the north-west, which may increase recirculation. Wind speeds and directions for this period are shown in Figure 5.4. Peak winds around 8-10 m/s and include a sustained period of easterly winds which may be adverse in terms of brine recirculation for the simulated intake and outfall configuration. From Table 5.2, winds of greater than 8 m/s occur 2% of the time.

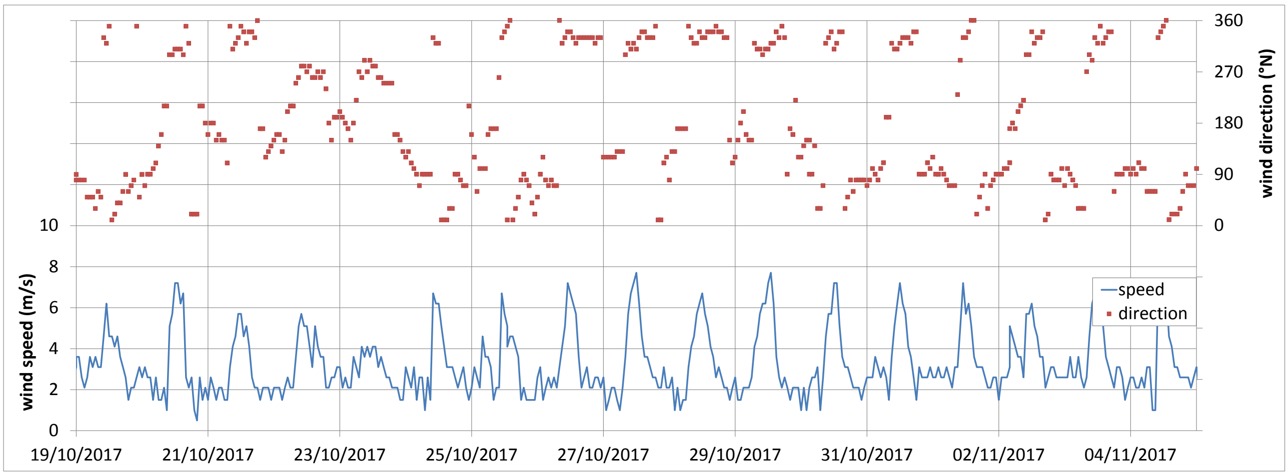


Figure 5.3: Winds at Dubai International Airport, 19/10/2017- 5/11/2017

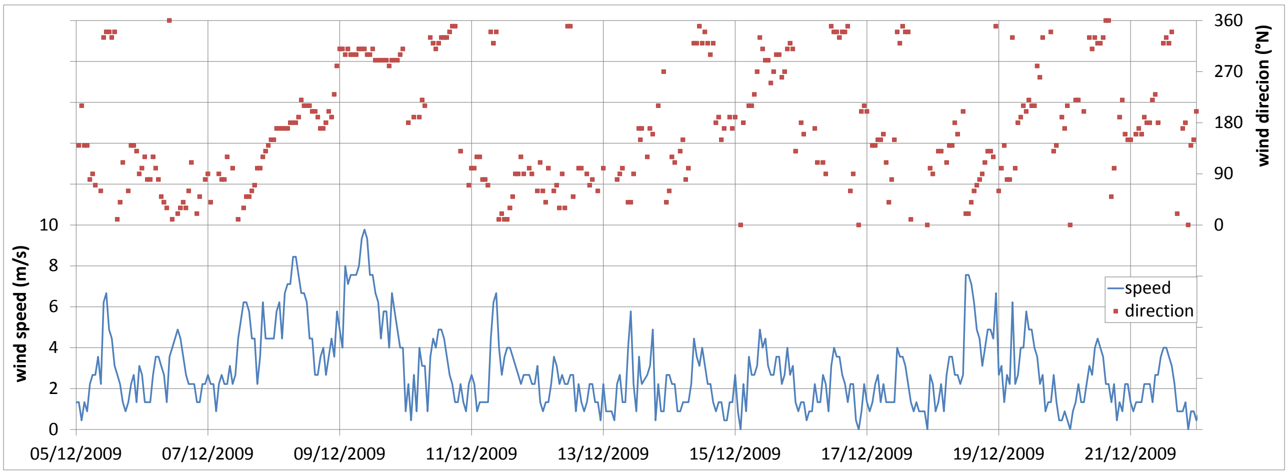


Figure 5.4: Winds at Dubai International Airport, 5/12/2009- 22/12/2009

Table 5.2: Percentage occurrence of wind speeds at Dubai International Airport, 1983 - 2017

Wind speed (m/s)	Percentage occurrence (%)
< 2	19
2 to 4	41
4 to 6	26
6 to 8	11
8 to 10	2
10 >	< 1

5.3. Far-field assessment

5.3.1. Brine dispersion patterns

Dispersion and recirculation were simulated for the two wind periods described in the previous section (referred to as “weak winds” and “stronger winds”). The stronger wind simulations were conducted for 17 days to include a full 15-day spring-neap cycle, and allowing two days’ model spin-up time (for dispersion patterns to reach a dynamic equilibrium). Weak wind simulations were conducted over two spring-neap cycles plus an additional two day period at the start to allow for model spin-up. This extended period was required as the weaker wind simulations took longer for dispersion patterns to reach an approximate dynamic equilibrium. However, we note that such long periods of weak winds are unlikely to occur in reality, and these simulations therefore represent conservative conditions.

Model predictions are presented as:

- Contour plots of average excess salinity at the sea surface and seabed;
- Contour plots of maximum excess salinity at the sea surface and seabed.

In each case, the averages and maxima were calculated over the full simulations, excluding the initial model spin-up periods.

It should be noted that the plots of maximum excess salinity show the maximum predicted values at each model node over the course of the simulation. As the maxima do not occur at the same time at each location, these plots should be thought of as overall plume “footprints”. The contour plots do not include the detail of concentrations in the near-field region around the diffuser, which typically extends 30-40 m from the diffuser.

Predicted excess salinity dispersion patterns are shown in Figure 5.5: and Figure 5.6 for the periods of weak winds and stronger winds respectively. As the brine is denser than the ambient seawater, it forms a layer at the seabed, meaning that excess salinities will generally be higher at the seabed than at the sea surface.

At the seabed, maximum excess salinities outside the near-field region are below 2 ppt, although maximum excess salinities above 1 ppt are predicted up to around 8 km to the east of the outfall, and 3.5 km to the west. On average, excess salinities are predicted to exceed 1 ppt up to 0.75 km west and up to 1.8 km east of the outfall. This demonstrates that, as identified in Section 0, rates of dilution in the spreading layer beyond the near-field are likely to be slow. The tendency for the plumes to extend further to the east is likely due to net residual currents in the vicinity of Al Marjan Island, generated by the most commonly occurring north-westerly wind conditions, and the general system of eddies that form around the nearby islands and reclamations.

Time series of the predicted excess salinities at the intake location are shown in Figure 5.7 and Figure 5.8 for the simulated weak wind and strong wind conditions respectively. Depending on the configuration of the intake, the water may effectively be drawn from the entire water column, or may be drawn selectively from the lower part of the water column. Excess salinities of up to 0.8 ppt are predicted at the seabed, and are highest around days 3 of the “stronger wind” condition, which coincides with stronger Shamal winds. At the sea surface and for the depth average the excess salinity is predicted to be similar, which indicates a well-mixed water column at this location. This is to be expected given the shallow water depths at the proposed intake.

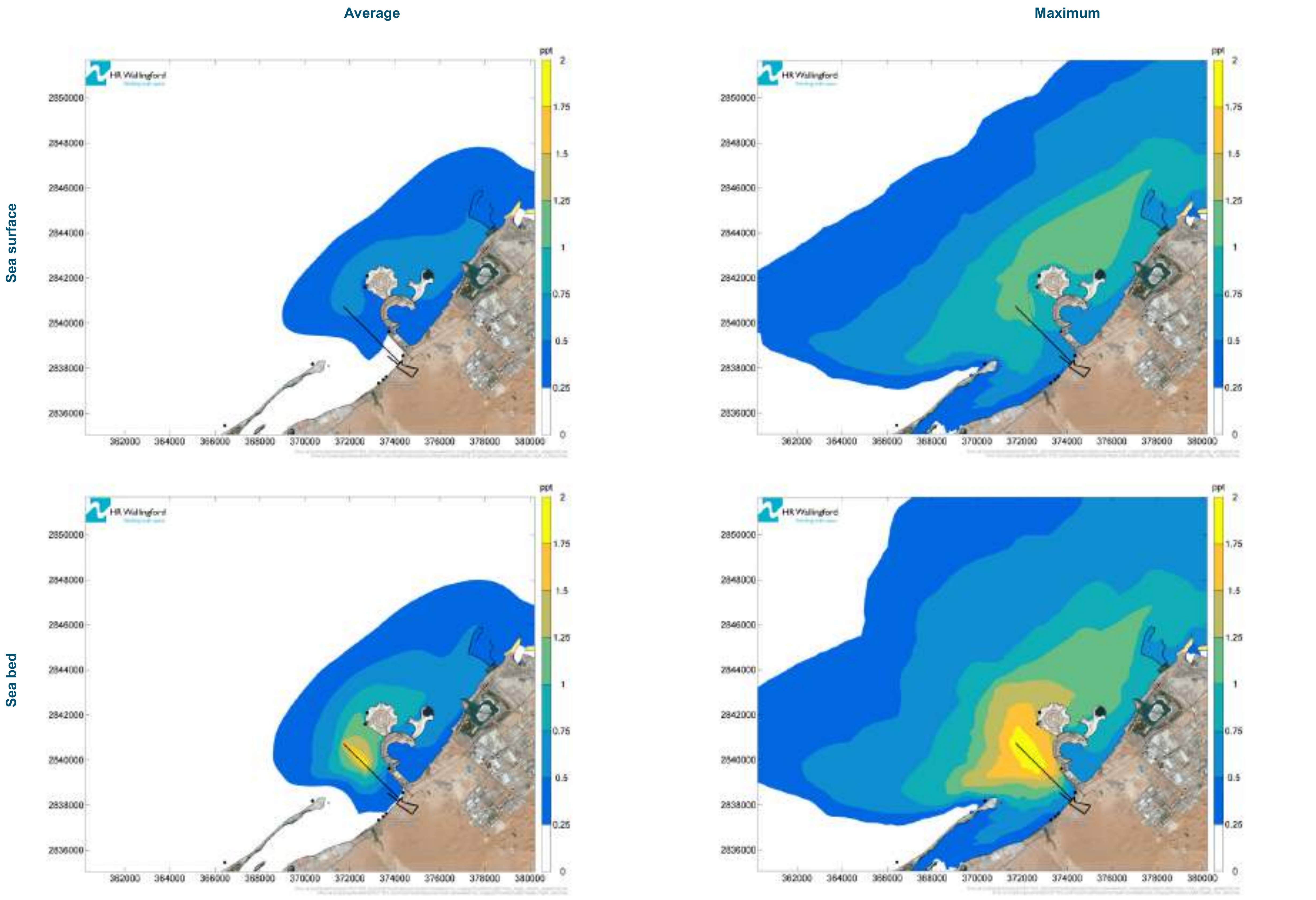


Figure 5.5: Predicted maximum and average excess salinity, weak winds

Source: Background imagery from Google Earth , using data from SIO, NOAA, US Navy, NGA, GEBCO

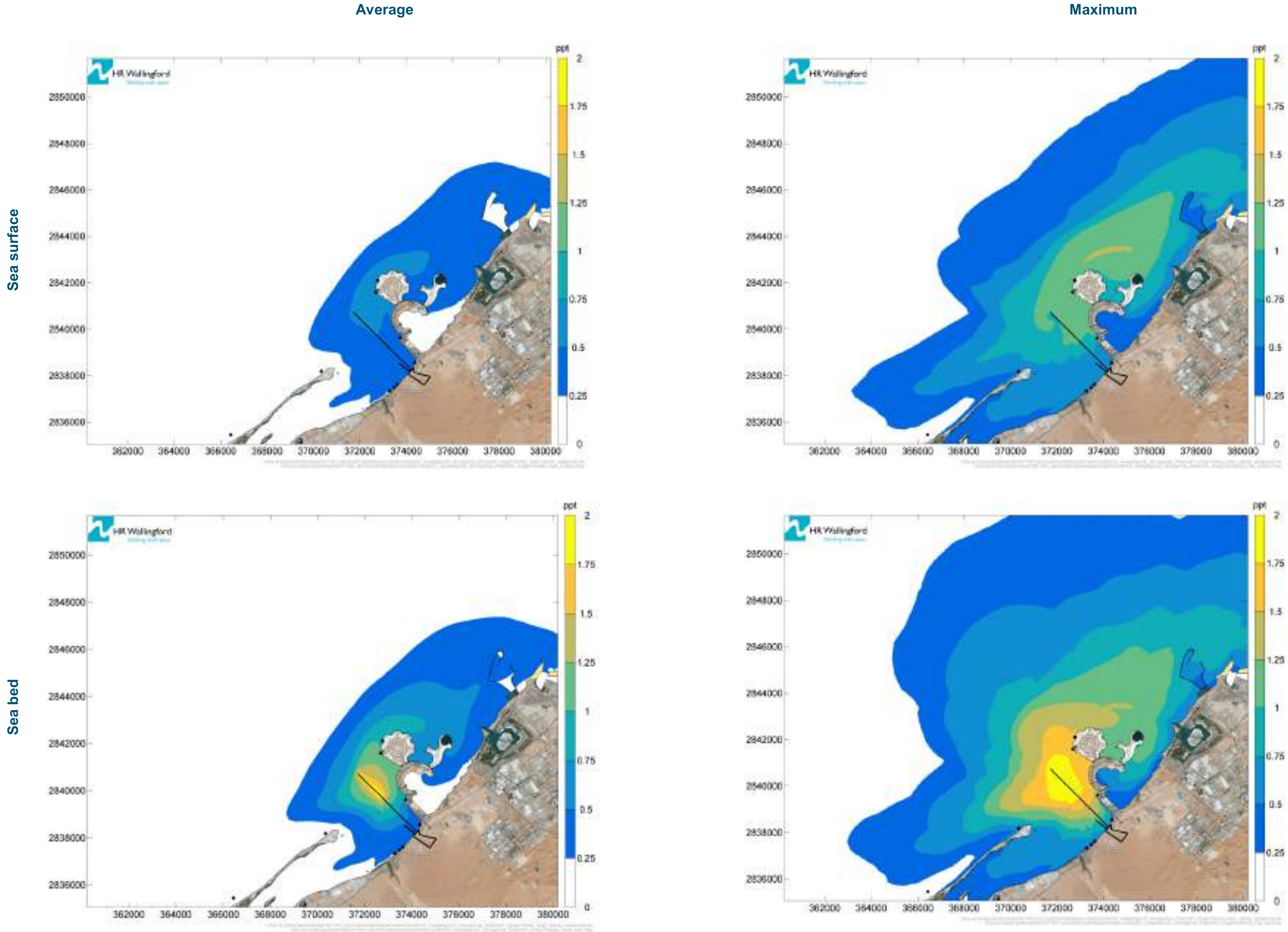


Figure 5.6: Predicted maximum and average excess salinity, stronger winds

Source: Background imagery from Google Earth , using data from SIO, NOAA, US Navy, NGA, GEBCO

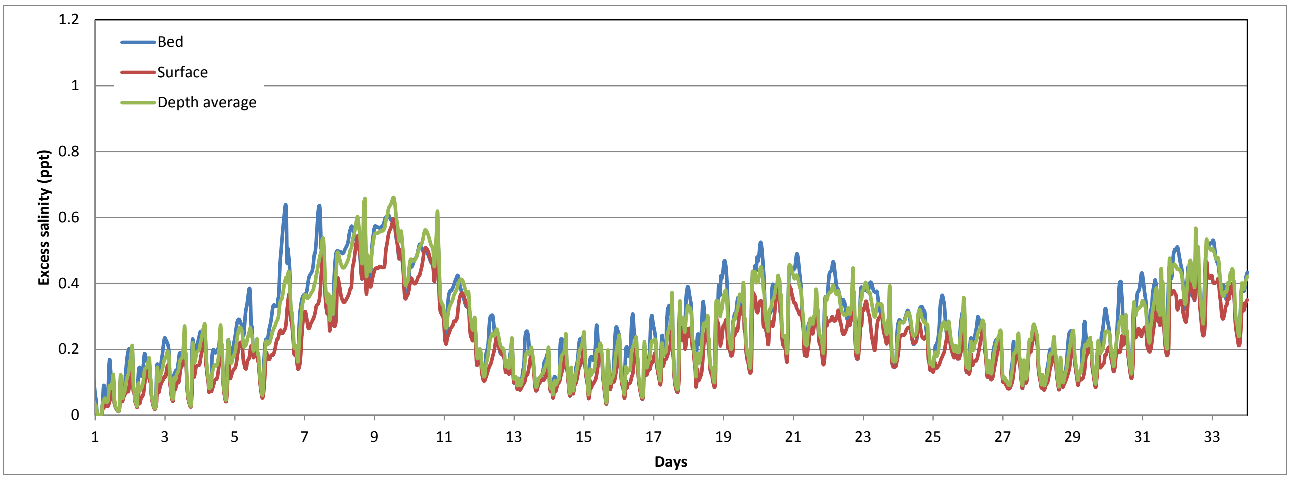


Figure 5.7: Predicted excess salinity at the intakes, weak winds

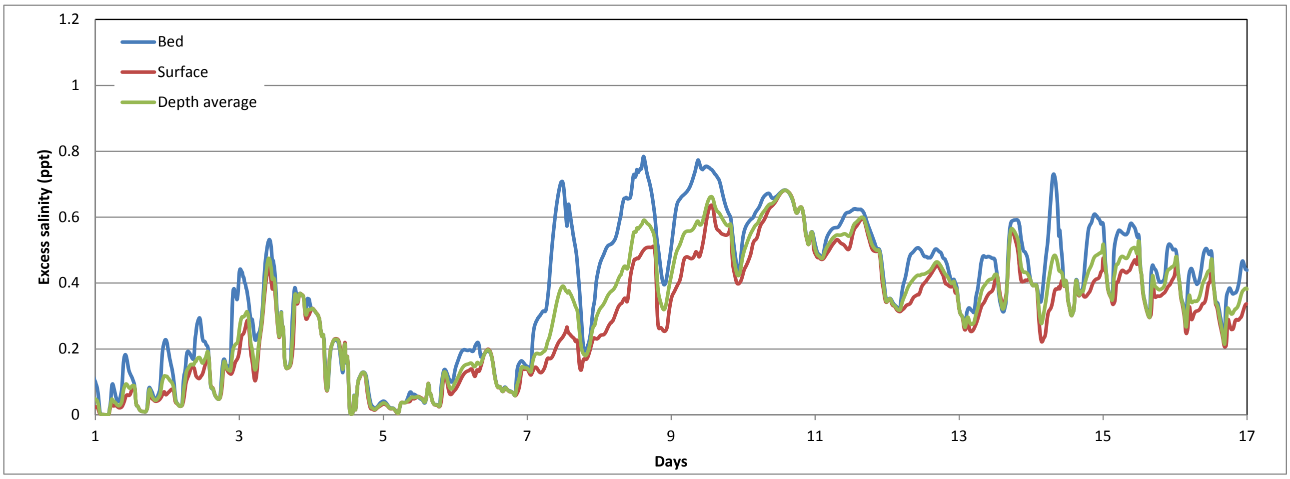


Figure 5.8: Predicted excess salinity at the intakes, stronger winds

5.3.2. Assessment at sensitive marine receptors

A list of sensitive marine receptors was provided by 5 Capitals (Figure 5.9) based on consultation with Umm Al Quwain Planning and Environmental Departments. Times series of excess salinity at each of these locations are shown in Figure 5.10 to Figure 5.21. The time series show excess salinities at the seabed, surface and as a depth-average.

A summary of the maximum predicted excess salinity at each marine receptor is given in Table 5.3. Maximum concentrations between 0.1 ppt and 1.6 ppt are predicted. At Al Sinniyah Island (north), maximum excess salinities of 0.8 ppt are predicted. However, on inspection of the maximum concentration predictions under strong wind conditions (Figure 3.6), it can be seen that the horizontal salinity gradient is relatively strong near this site, and only a small change in the plume position would be required to increase concentrations. It is therefore recommended that a precautionary approach is taken when determining the potential effects at this location. The time series plots should be read in conjunction with the contour plots presented in Section 5.3.1.

Figure 5.9: Locations of sensitive marine receptors

Source: *Site locations provided by 5 Capitals. Background imagery from Google Earth , using data from SIO, NOAA, US Navy, NGA, GEBCO*

Table 5.3: Summary of maximum excess salinity predictions at the marine receptors, offshore intake layout

	Site	Maximum predicted excess salinity (ppt)
1	DIC Hotel and Resort	1.5
2	Pacific Development	1.6
3	Ras Al Khaimah Convention Centre	1.3
4	Tidal channel	1.6
5	Rocky intertidal habitat	0.7
6	Al Sinniyah Island (north)	0.8
7	Residential Compound 3	0.6
8	Al Sinniyah Island (south)	0.1
9	Sparse seagrass habitat	1.4
10	Residential Compound 5	0.3
11	Area of observed turtles	0.6

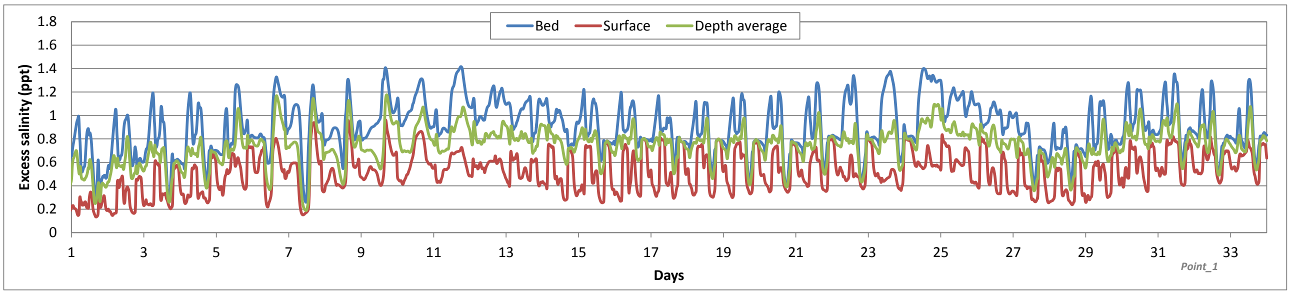


Figure 5.10: Predicted excess salinity at point 1 (DIC Hotel & Resort Project), weak winds

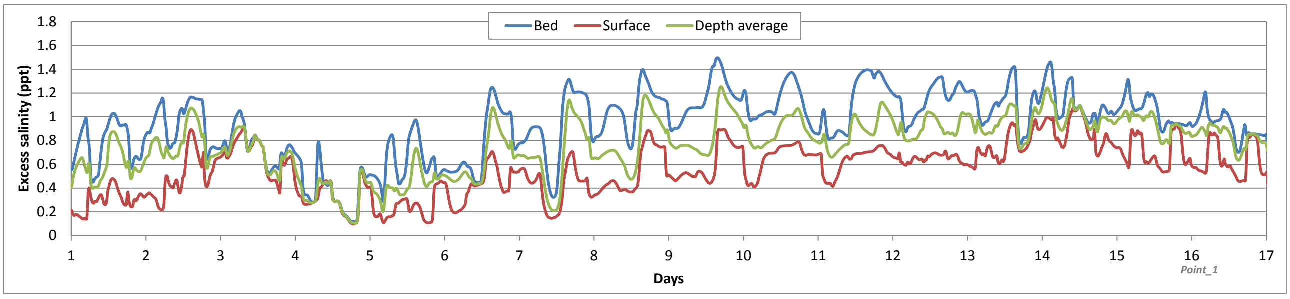


Figure 5.11: Predicted excess salinity at point 1 (DIC Hotel & Resort Project), stronger winds

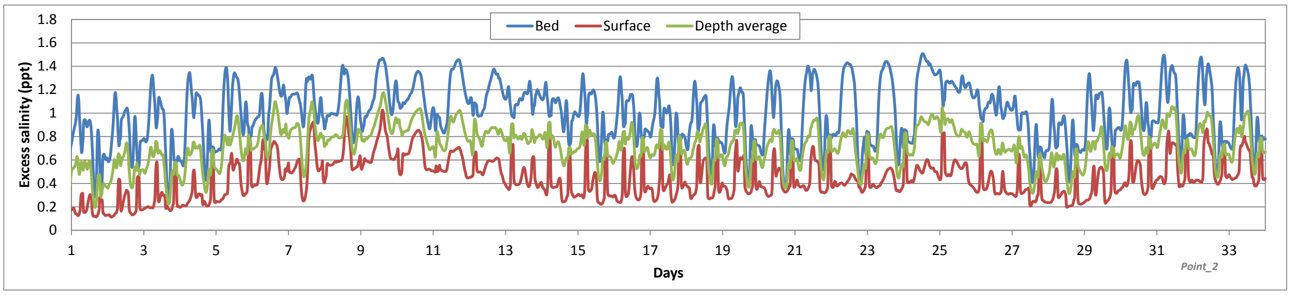


Figure 5.12: Predicted excess salinity at point 2 (Pacific Development), weak winds

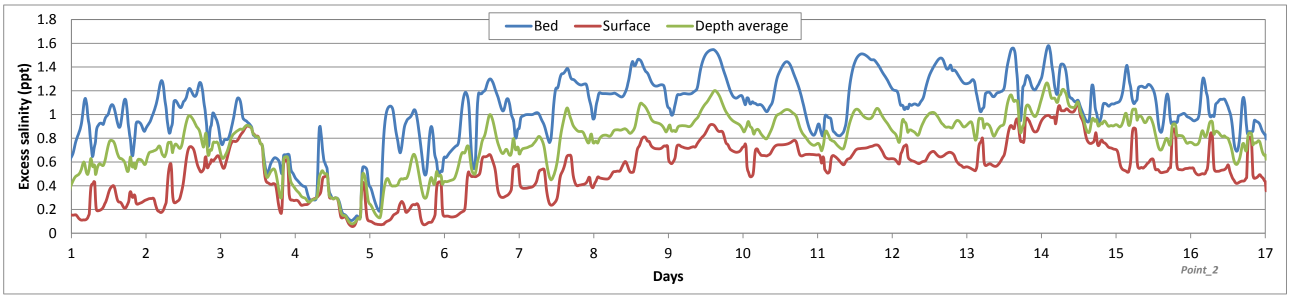


Figure 5.13: Predicted excess salinity at point 2 (Pacific Development), stronger winds

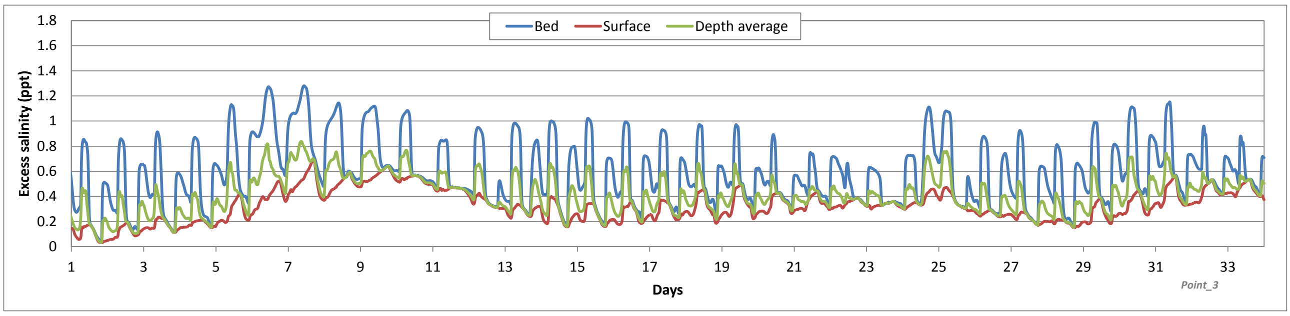


Figure 5.14: Predicted excess salinity at point 3 (Ras Al Khaimah Convention Centre), weak winds

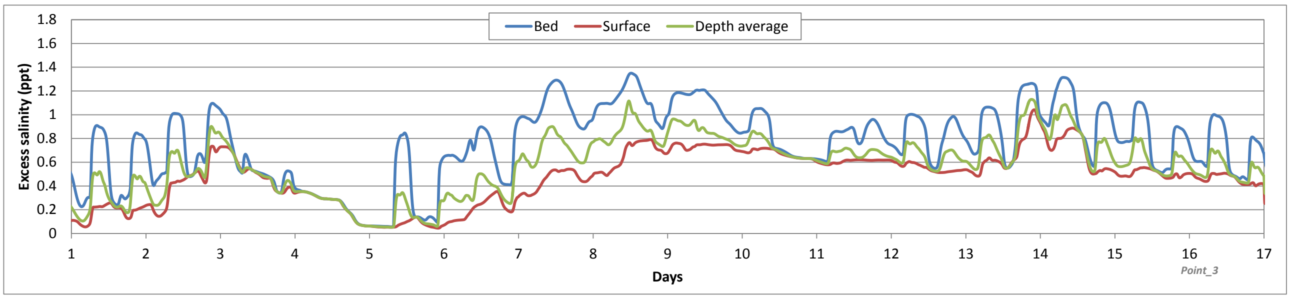


Figure 5.15: Predicted excess salinity at point 3 (Ras Al Khaimah Convention Centre), stronger winds

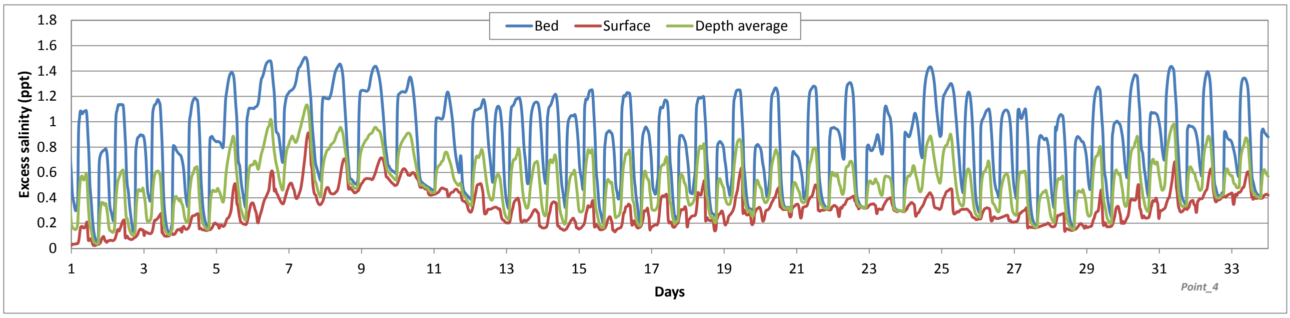


Figure 5.16: Predicted excess salinity at point 4 (tidal channel), weak winds

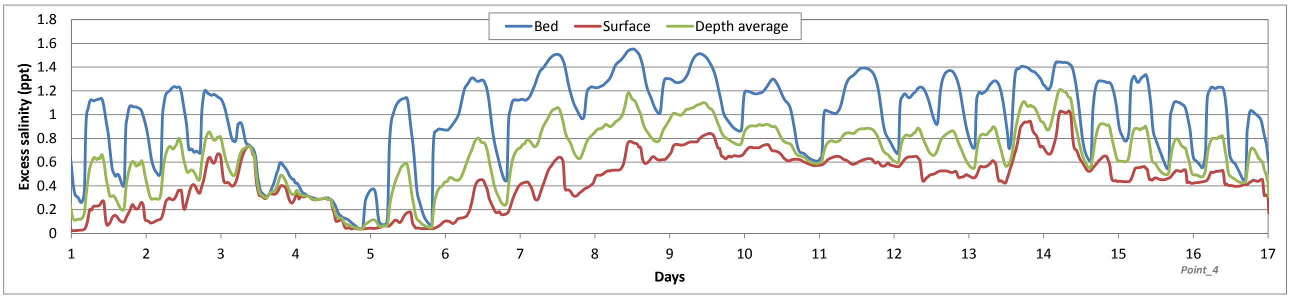


Figure 5.17: Predicted excess salinity at point 4 (tidal channel), stronger winds

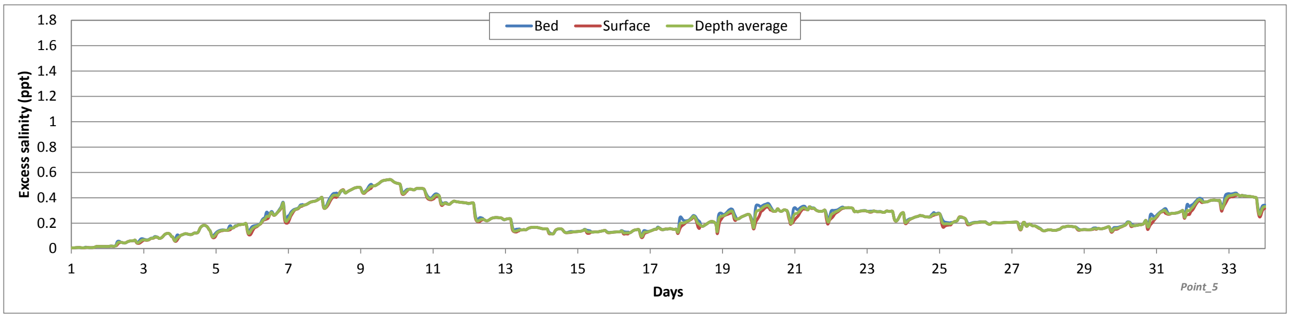


Figure 5.18: Predicted excess salinity at point 5 (rocky intertidal habitat), weak winds

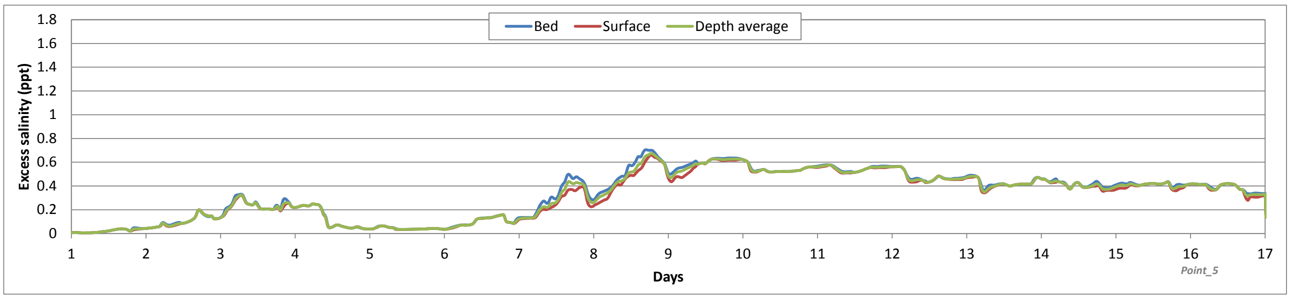


Figure 5.19: Predicted excess salinity at point 5 (rocky intertidal habitat), stronger winds

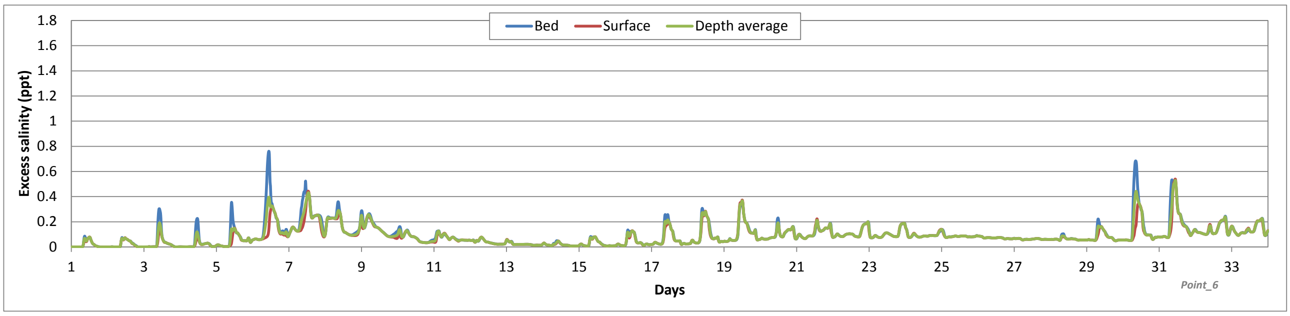


Figure 5.20: Predicted excess salinity at point 6 (Al Sinniyah Island (north)), weak winds

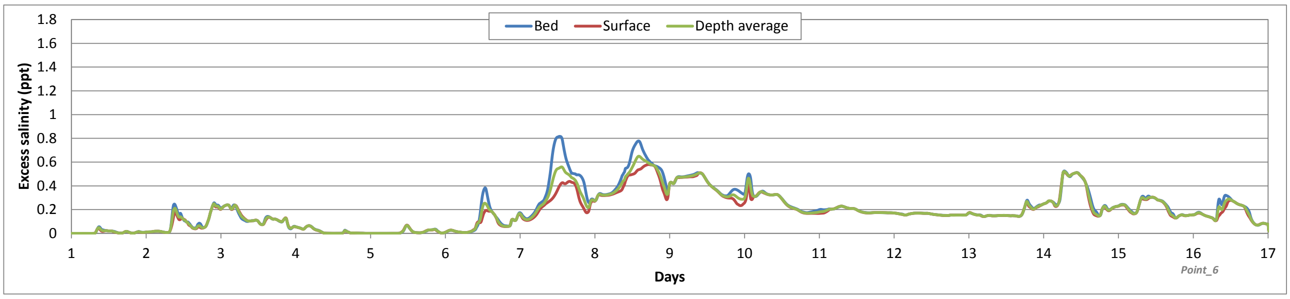


Figure 5.21: Predicted excess salinity at point 6 (Al Sinniyah Island (north)), stronger winds

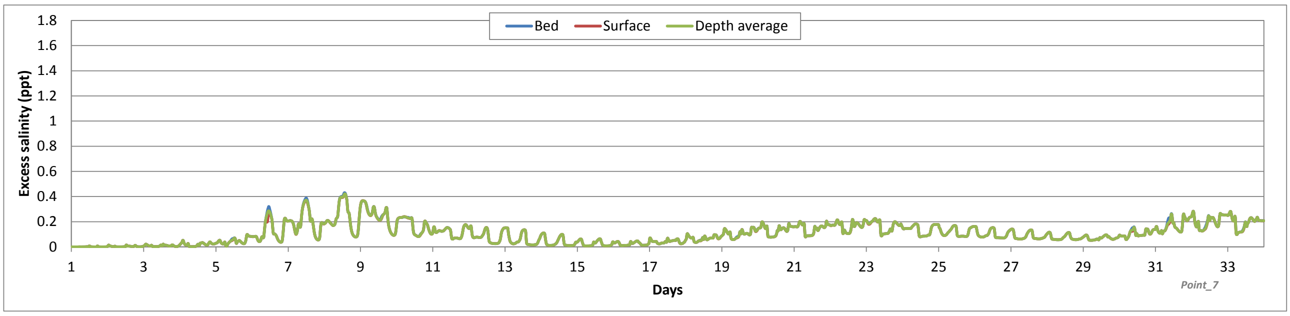


Figure 5.22: Predicted excess salinity at point 7 (Residential Compound 3), weak winds

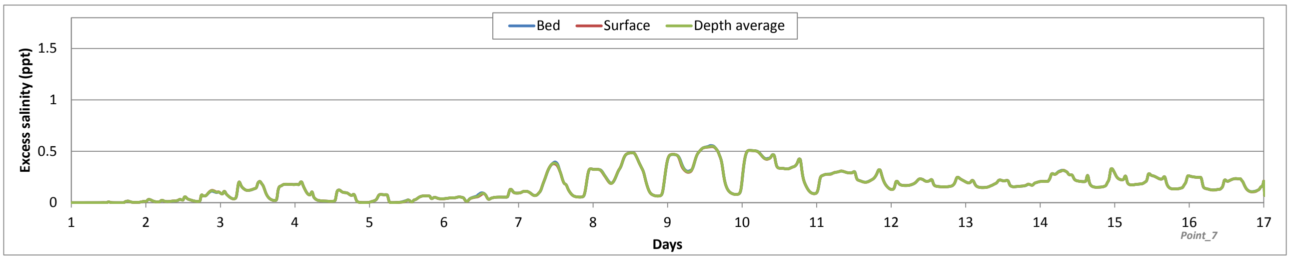


Figure 5.23: Predicted excess salinity at point 7 (Residential Compound 3), stronger winds

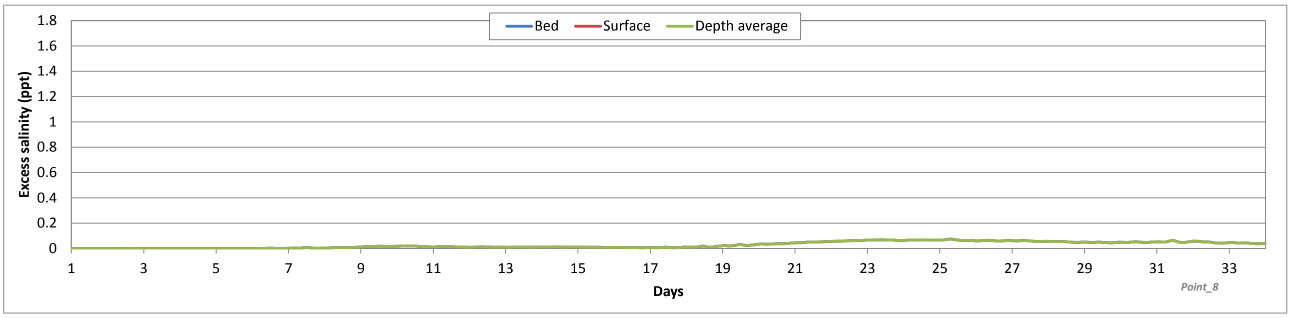


Figure 5.24: Predicted excess salinity at point 8 (Al Sinniyah Island (south)), weak winds

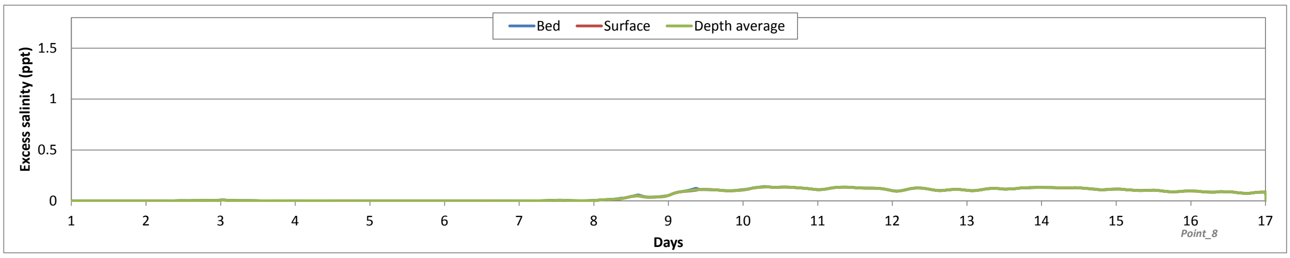


Figure 5.25: Predicted excess salinity at point 8 (Al Sinniyah Island (south)), stronger winds

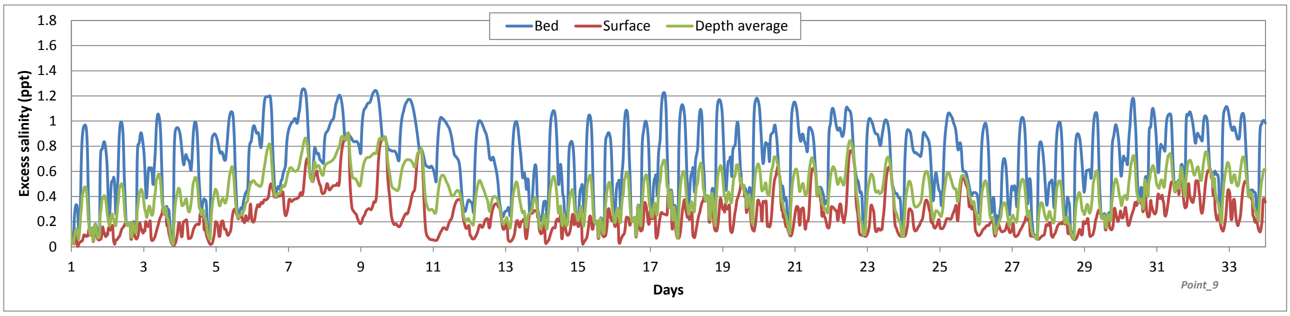


Figure 5.26: Predicted excess salinity at point 9 (sparse seagrass habitat), weak winds

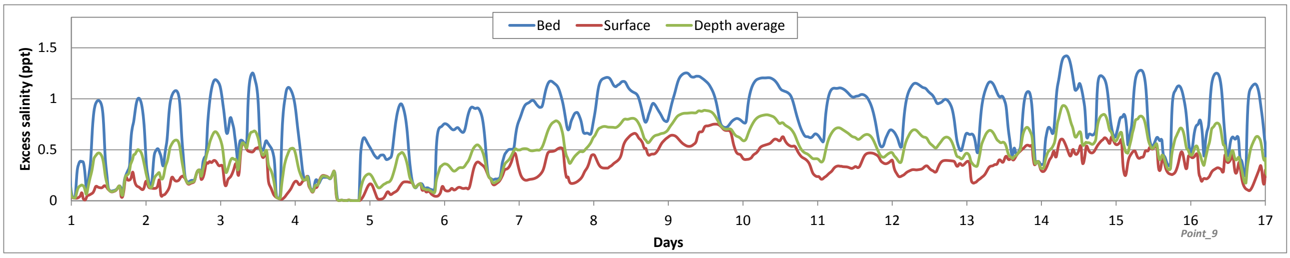


Figure 5.27: Predicted excess salinity at point 9 (sparse seagrass habitat), stronger winds

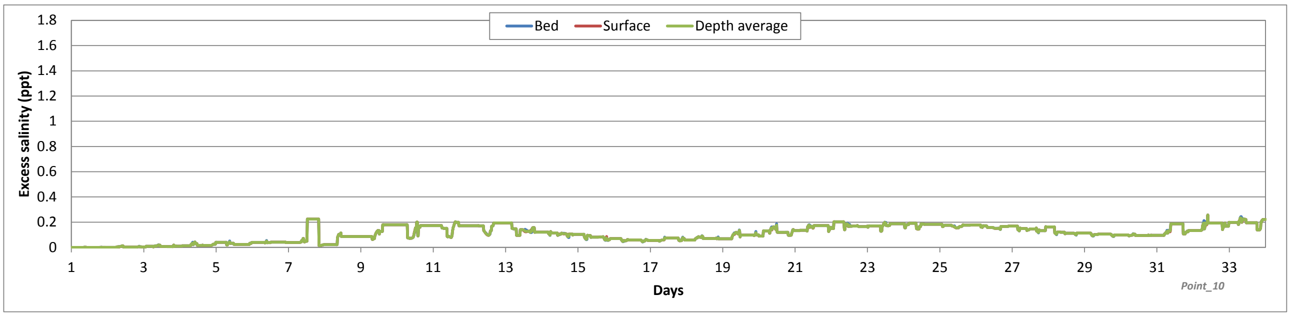


Figure 5.28: Predicted excess salinity at point 10 (Residential Compound 5), weak winds

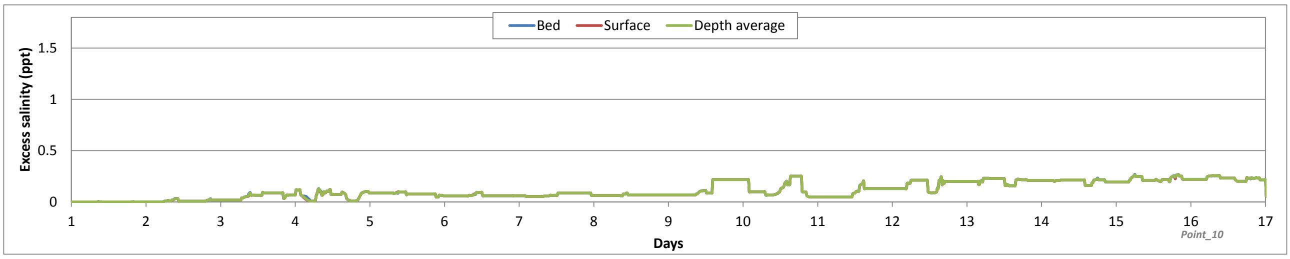


Figure 5.29: Predicted excess salinity at point 10 (Residential Compound 5), stronger winds

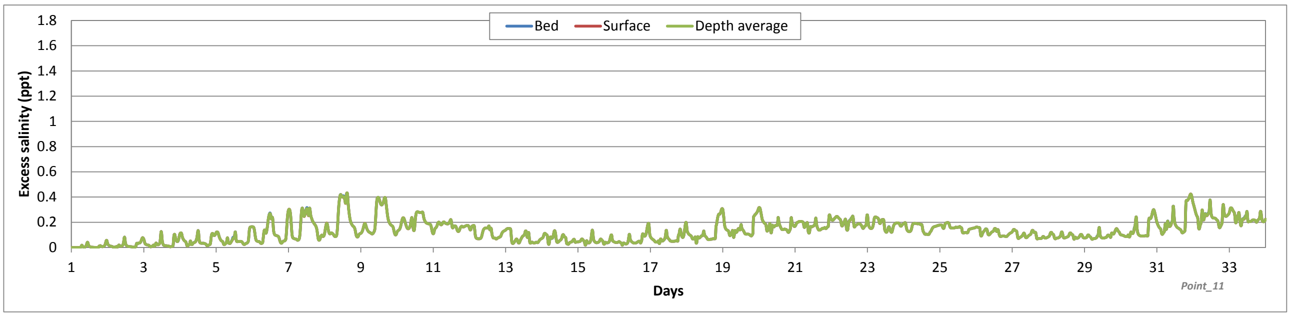


Figure 5.30: Predicted excess salinity at point 11 (area of observed turtles), weak winds

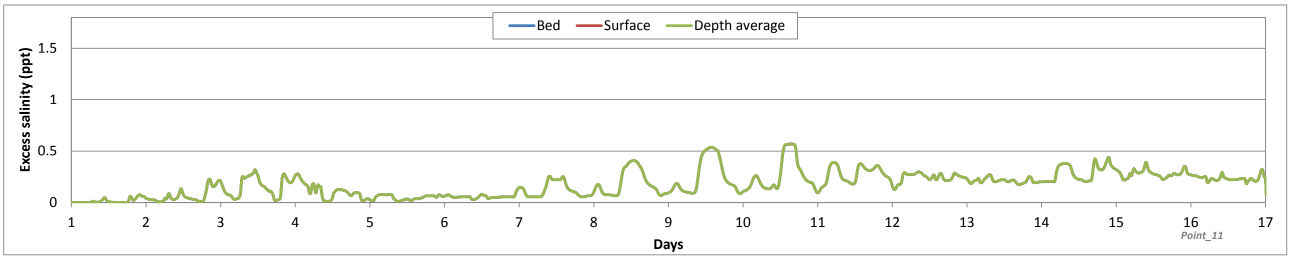


Figure 5.31: Predicted excess salinity at point 11 (qrea of observed turtles), stronger winds

5.4. Open intake layout

5.4.1. Outfall and intake layout

A concept open intake layout with breakwaters proposed by HR Wallingford for ACWA is shown in Figure 5.32 and Figure 5.33. The outfall configuration is the same as described in Section 0. The model bathymetry is shown in Figure 5.34.

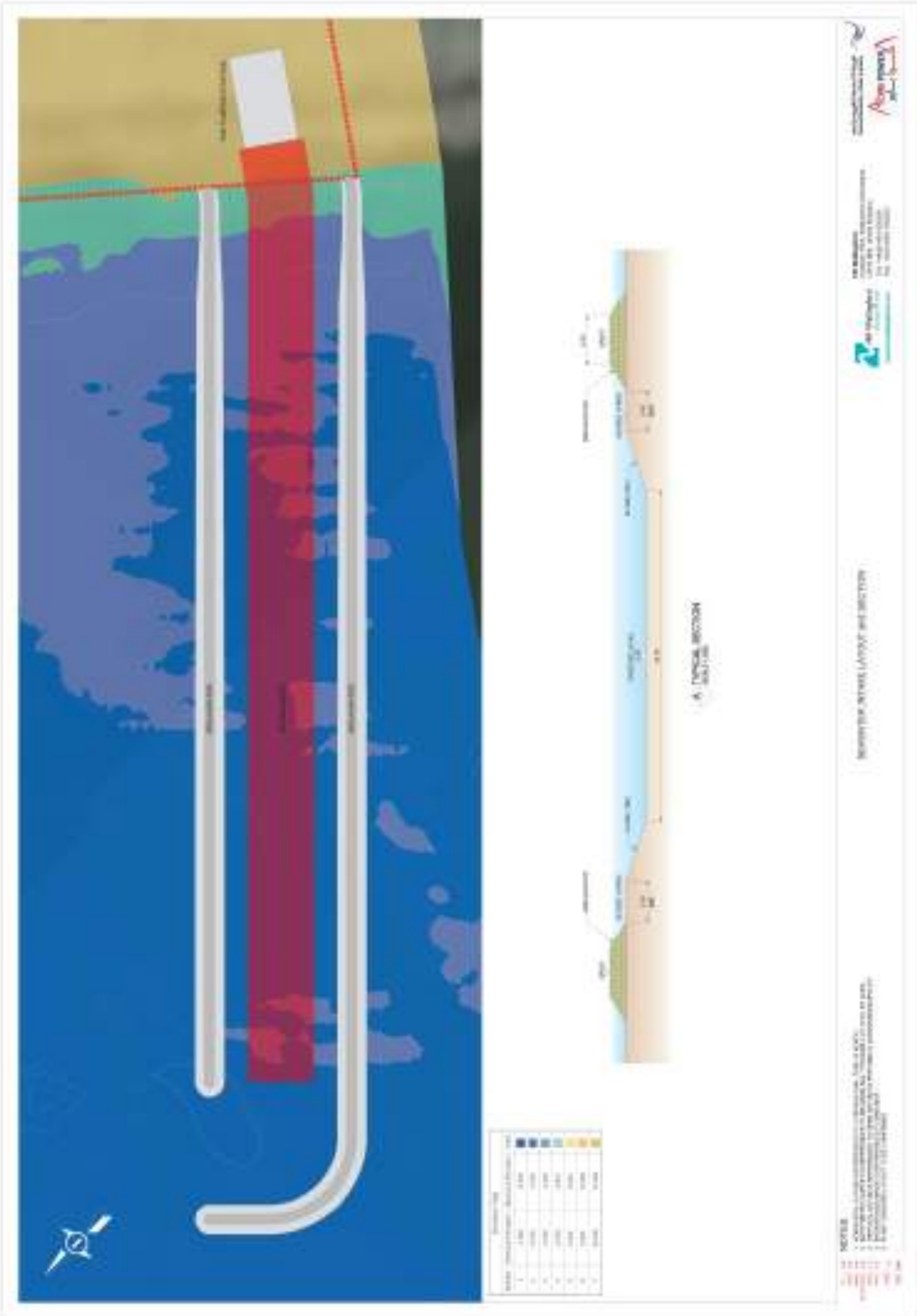


Figure 5.32: Concept open intake layout with breakwaters, seawater intake layout and section

Source: ACWA and HR Wallingford

Figure 5.33: Concept open intake layout with breakwaters layout, general arrangement

Source: ACWA and HR Wallingford

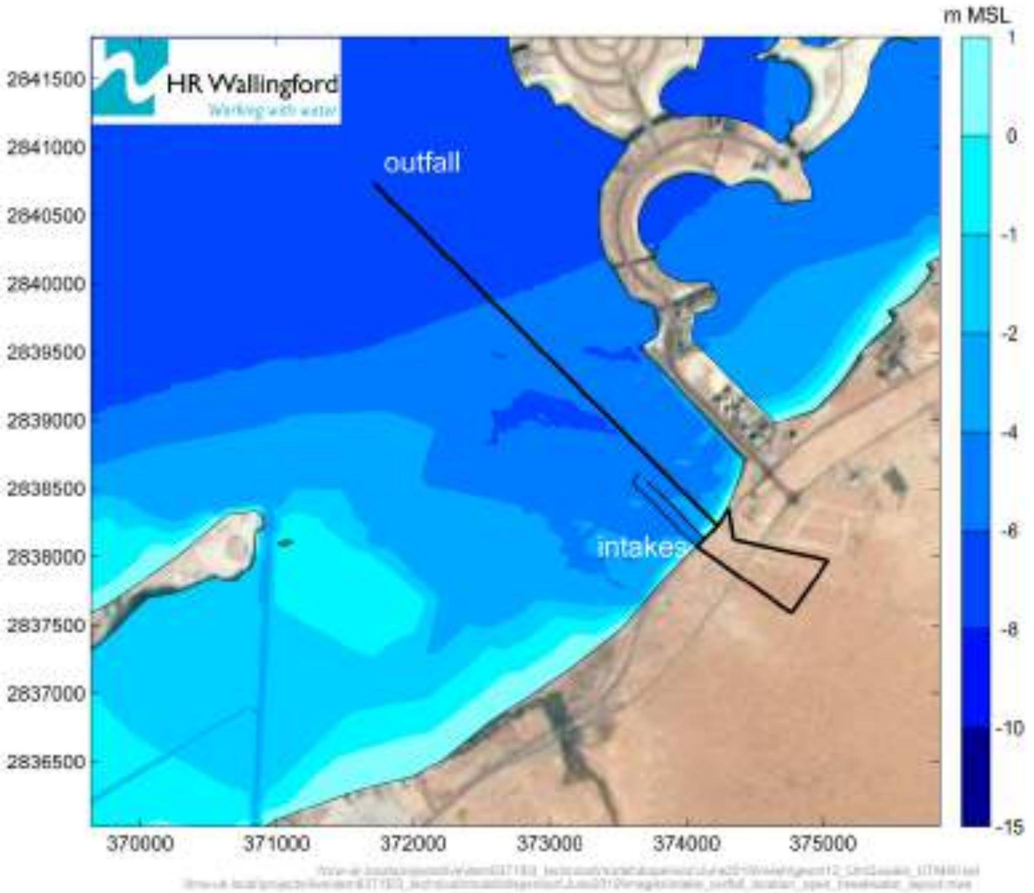


Figure 5.34: Model bathymetry, open intake layout with breakwaters

Source: Background imagery from Google Earth , using data from SIO, NOAA, US Navy, NGA, GEBCO

5.4.2. Brine dispersion patterns

Dispersion and recirculation were simulated for the same two wind periods described in Section 5.2 (referred to as “weak winds” and “stronger winds”). The stronger wind simulations were conducted for 17 days to include a full 15-day spring-neap cycle, and allowing two days’ model spin-up time (for dispersion patterns to reach a dynamic equilibrium). Weak wind simulations were conducted over two spring-neap cycles plus an additional two day period at the start to allow for model spin-up. This extended period was required as the weaker wind simulations took longer for dispersion patterns to reach an approximate dynamic equilibrium. However, we note that such long periods of weak winds are unlikely to occur in reality, and these simulations therefore represent conservative conditions.

Model predictions are presented as:

- Contour plots of average excess salinity at the sea surface and seabed;
- Contour plots of maximum excess salinity at the sea surface and seabed.

In each case, the averages and maxima were calculated over the full simulations, excluding the initial model spin-up periods.

It should be noted that the plots of maximum excess salinity show the maximum predicted values at each model node over the course of the simulation. As the maxima do not occur at the same time at each location, these plots should be thought of as overall plume “footprints”. The contour plots do not include the detail of concentrations in the near-field region around the diffuser, which typically extends 30-40 m from the diffuser.

Predicted excess salinity dispersion patterns are shown in and for the periods of weak winds and stronger winds respectively (Figure 5.35 and Figure 5.36) . As the brine is denser than the ambient seawater, it forms a layer at the seabed, meaning that excess salinities will generally be higher at the seabed than at the sea surface.

The predicted excess salinities are largely similar to those shown for the offshore intake option (Section 5.3.1), apart from small increases in the area immediately to the north-east of the intake breakwaters. These differences may be due to the blocking of the weak currents along the coast by the breakwaters.

Time series of predicted excess salinities in the intake channel are shown in Figure 5.37 and Figure 5.38 for the simulated weak wind and strong wind conditions respectively. Peak excess salinities at the open intake are slightly higher than for the equivalent offshore intake cases, rising from 0.6 to 0.75 ppt for the weaker wind scenario, and from 0.8 to 0.95 ppt for the stronger wind scenario.

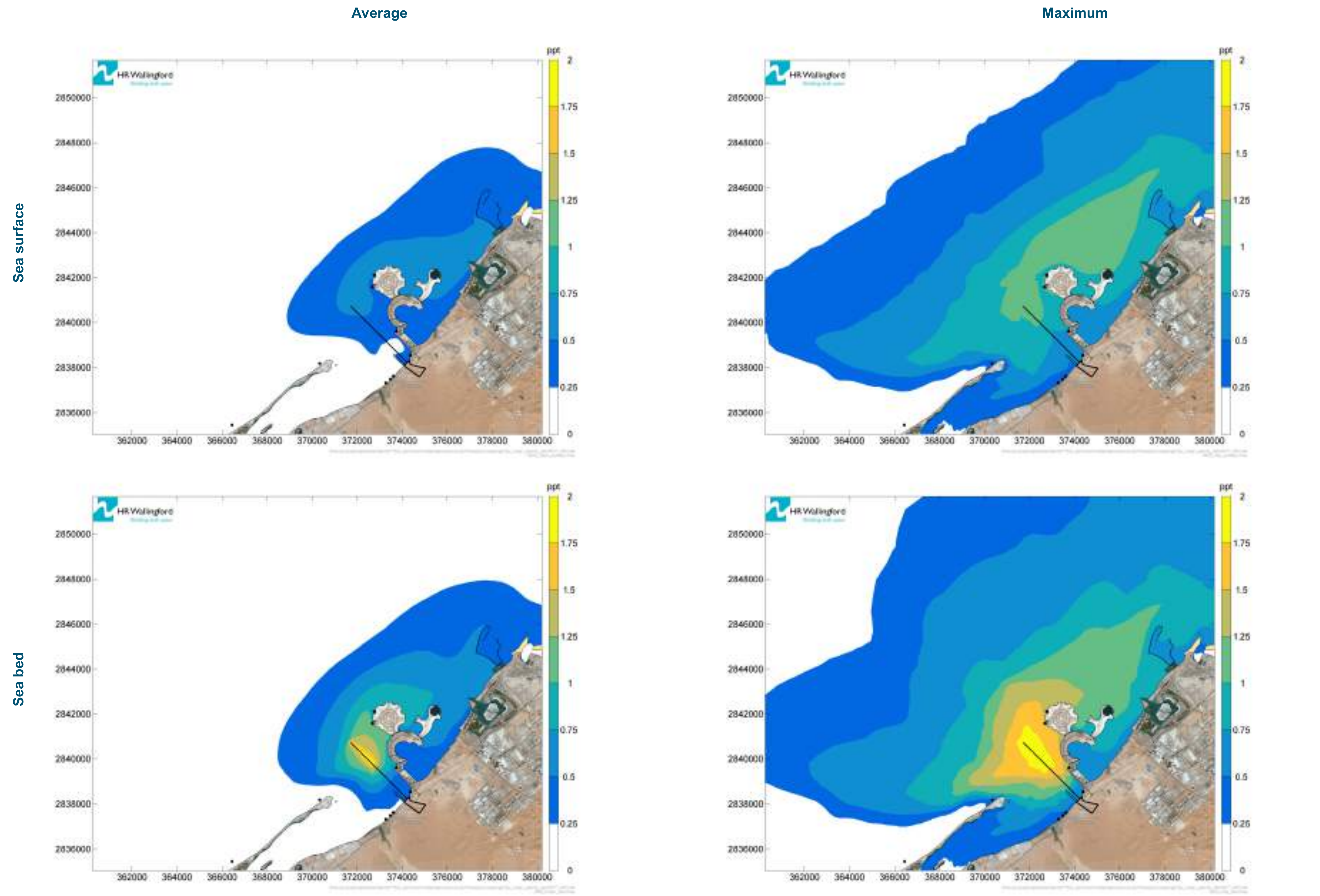


Figure 5.35: Predicted maximum and average excess salinity, weak winds, open intake layout

Source: Background imagery from Google Earth , using data from SIO, NOAA, US Navy, NGA, GEBCO

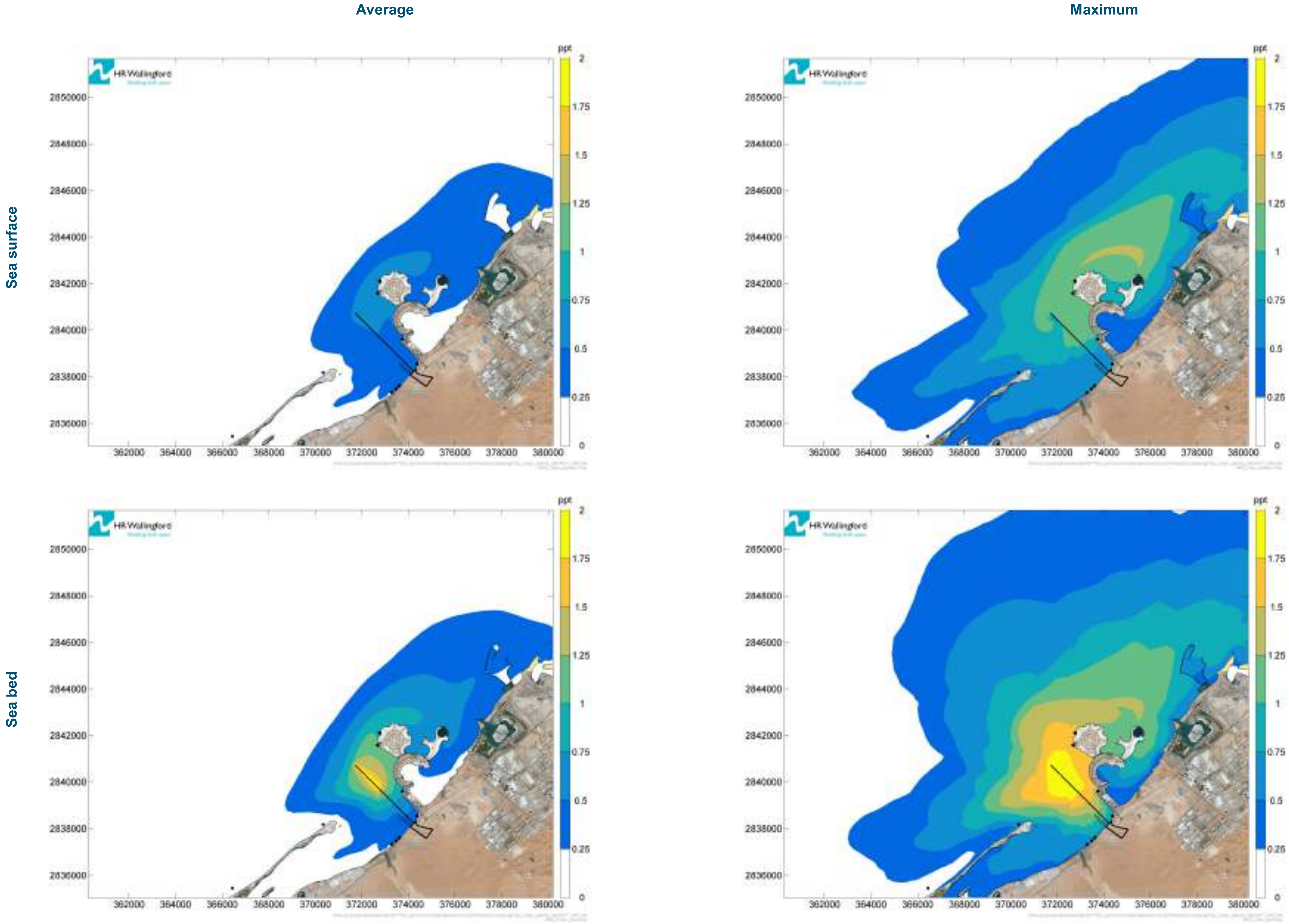


Figure 5.36: Predicted maximum and average excess salinity, stronger winds, open intake layout

Source: Background imagery from Google Earth , using data from SIO, NOAA, US Navy, NGA, GEBCO

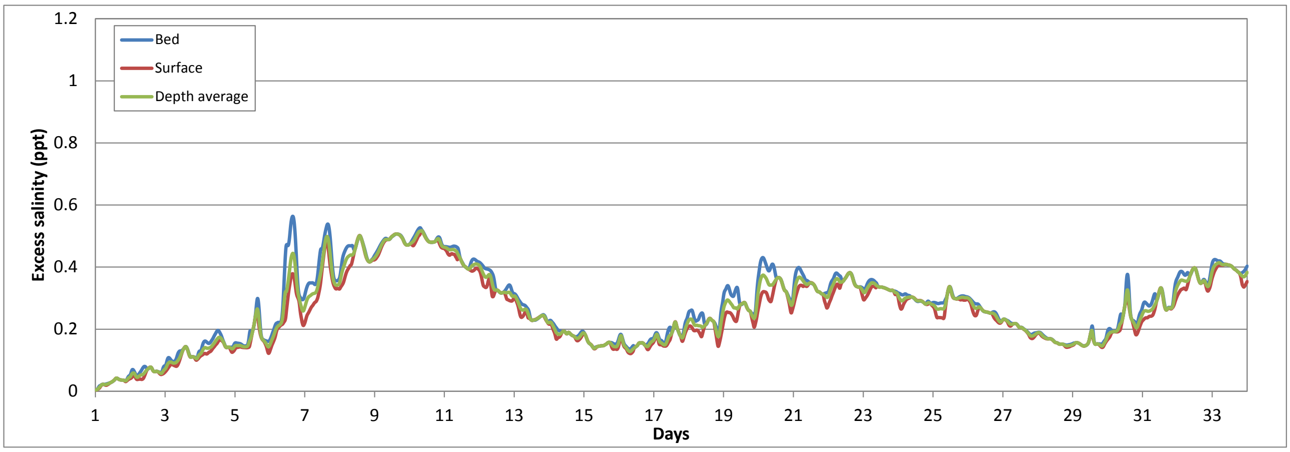


Figure 5.37: Predicted excess salinity at the intakes, weak winds, open intake layout

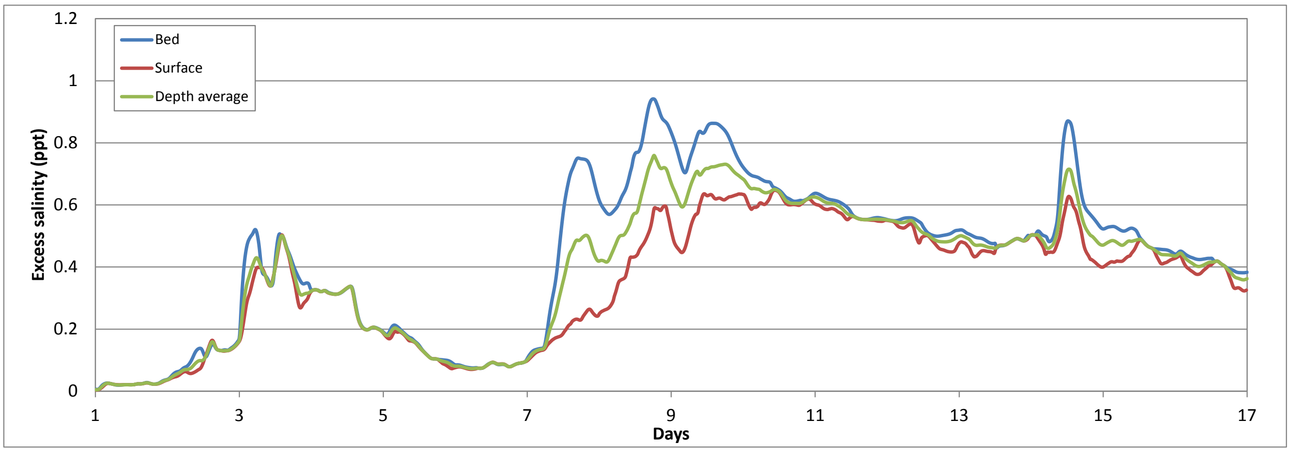


Figure 5.38: Predicted excess salinity at the intakes, stronger winds, open intake layout

5.4.3. Assessment at sensitive marine receptors

Time series of excess salinity at each of the sensitive receivers (Figure 5.9) for the open intake layout are shown in Figure 5.39 to Figure 5.54. The time series show excess salinities at the seabed, surface and as a depth-average.

A summary of the maximum predicted excess salinity at each marine receptor is given in Table 5.4. Maximum concentrations between 0.1 ppt and 1.6 ppt are predicted. The time series plots should be read in conjunction with the contour plots presented in Section 5.4.2.

Table 5.4: Summary of maximum excess salinity predictions at the marine receptors, open intake layout

	Site	Maximum predicted excess salinity (ppt)
1	DIC Hotel and Resort	1.5
2	Pacific Development	1.6
3	Ras Al Khaimah Convention Centre	1.3
4	Tidal Channel	1.6
5	Rocky Intertidal Habitat	0.8
6	Al Sinniyah Island (north)	0.8
7	Residential Compound 3	0.6
8	Al Sinniyah Island (south)	0.1
9	Sparse seagrass Habitat	1.4
10	Residential Compound 5	0.3
11	Area of Observed Turtles	0.6

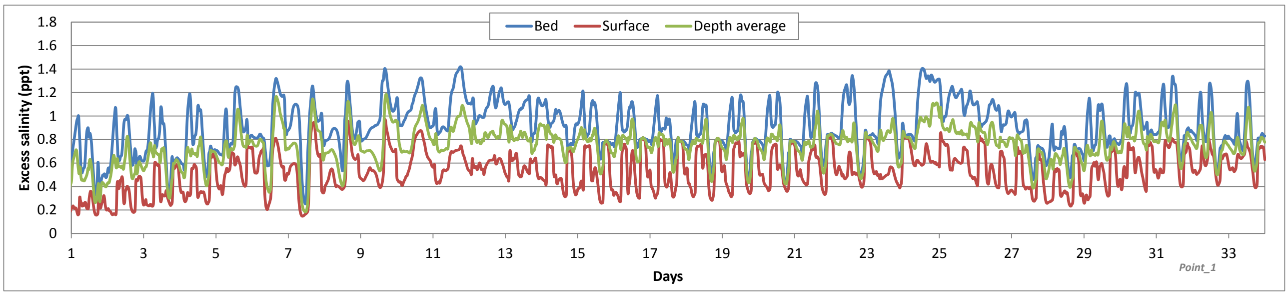


Figure 5.39: Predicted excess salinity at point 1 (DIC Hotel & Resort Project), weak winds, open intake layout

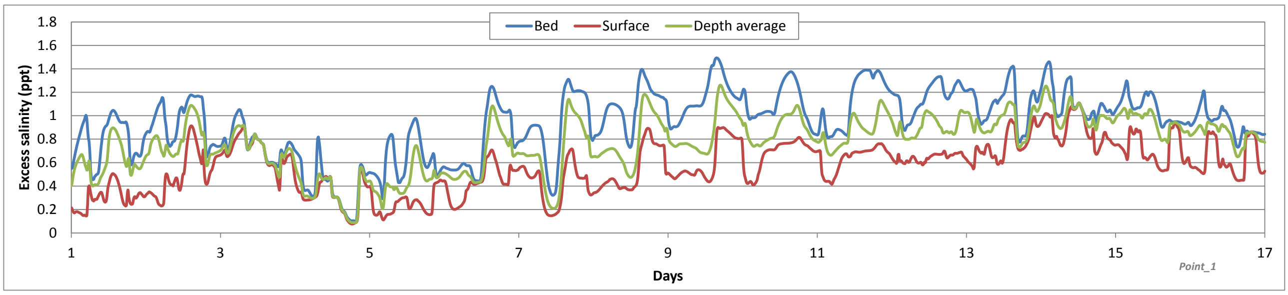


Figure 5.40: Predicted excess salinity at point 1 (DIC Hotel & Resort Project), stronger winds, open intake layout

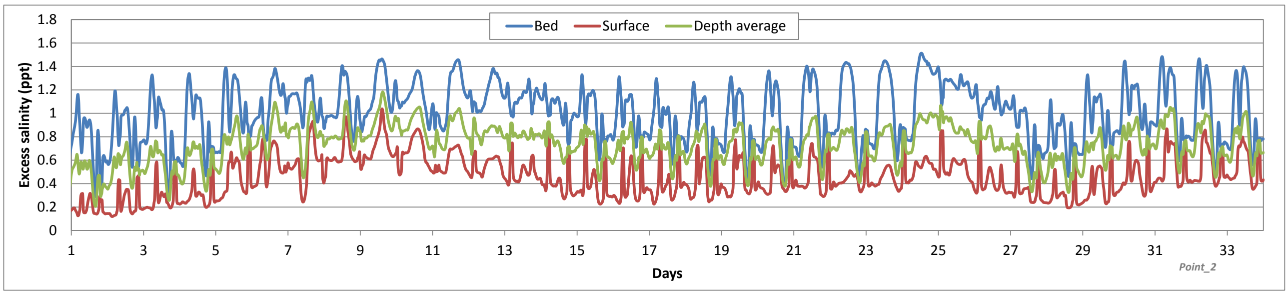


Figure 5.41: Predicted excess salinity at point 2 (Pacific Development), weak winds, open intake layout

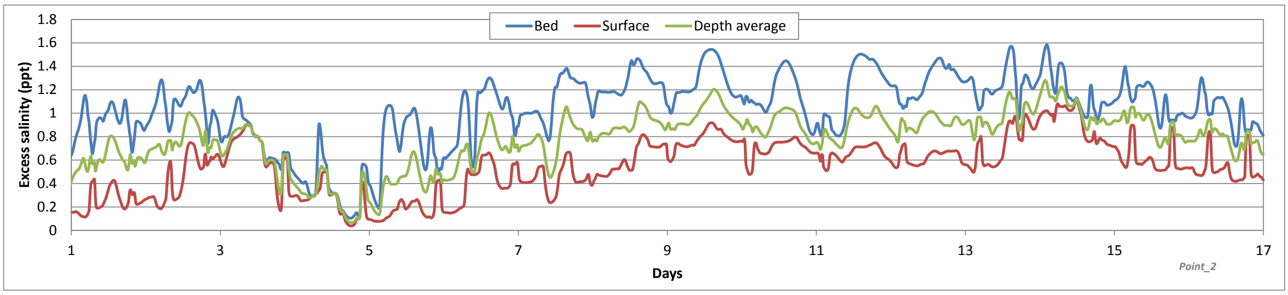


Figure 5.42: Predicted excess salinity at point 2 (Pacific Development), stronger winds, open intake layout

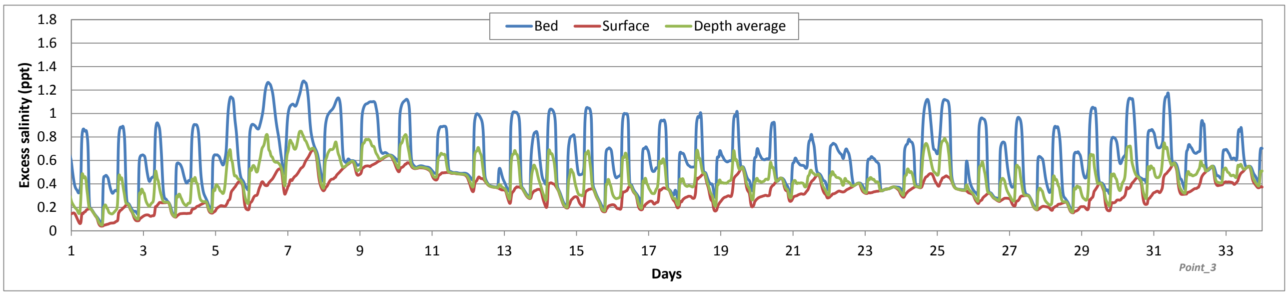


Figure 5.43: Predicted excess salinity at point 3 (Ras Al Khaimah Convention Centre), weak winds, open intake layout

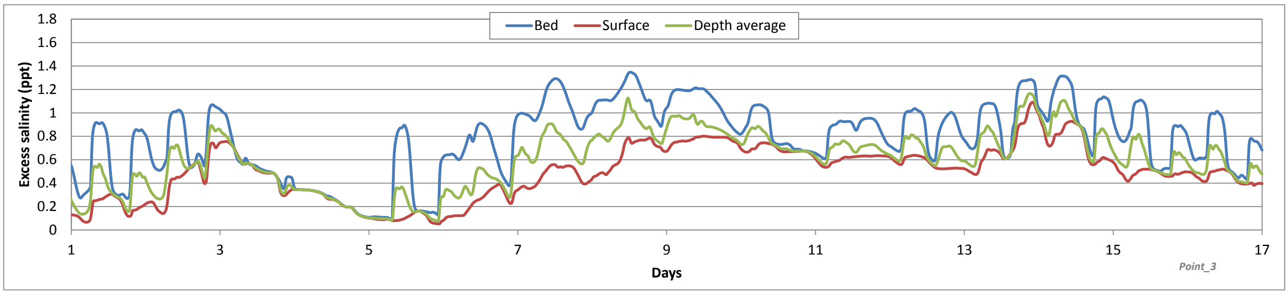


Figure 5.44: Predicted excess salinity at point 3 (Ras Al Khaimah Convention Centre), stronger winds, open intake layout

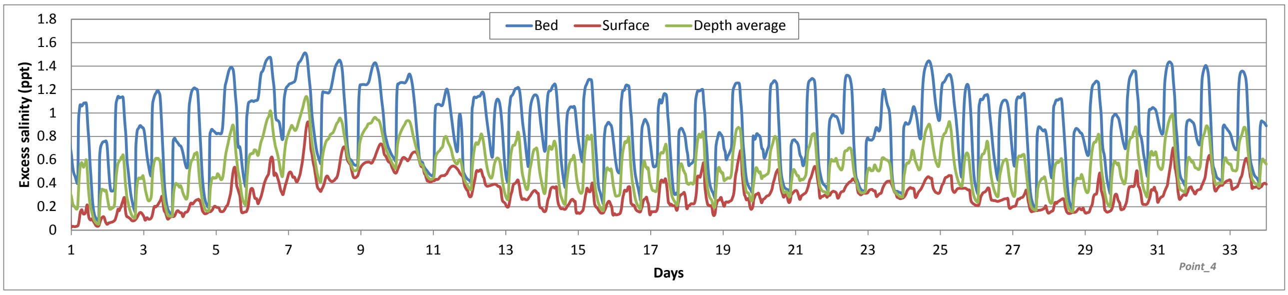


Figure 5.45: Predicted excess salinity at point 4 (tidal channel), weak winds, open intake layout

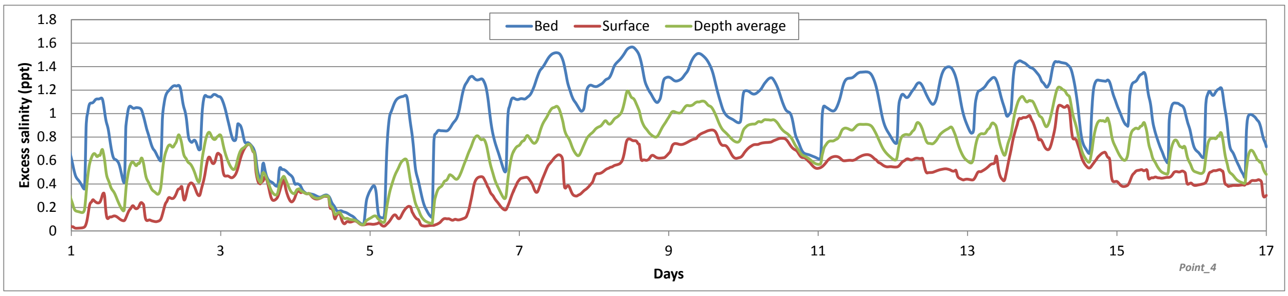


Figure 5.46: Predicted excess salinity at point 4 (tidal channel), stronger winds, open intake layout

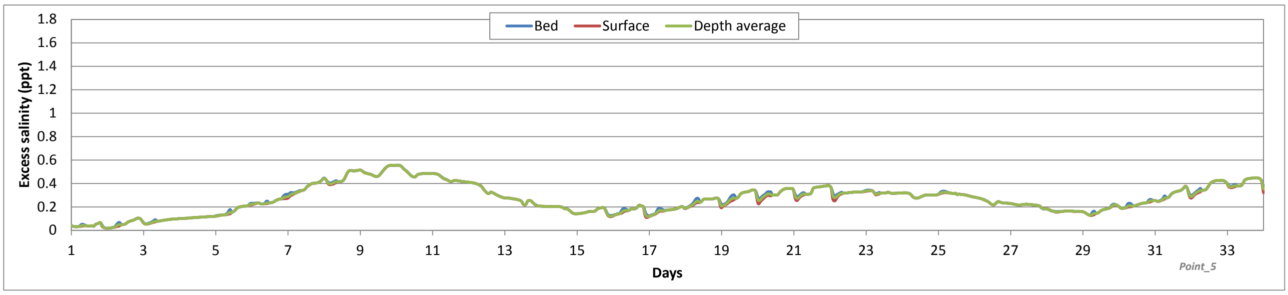


Figure 5.47: Predicted excess salinity at point 5 (rocky intertidal habitat), weak winds, open intake layout

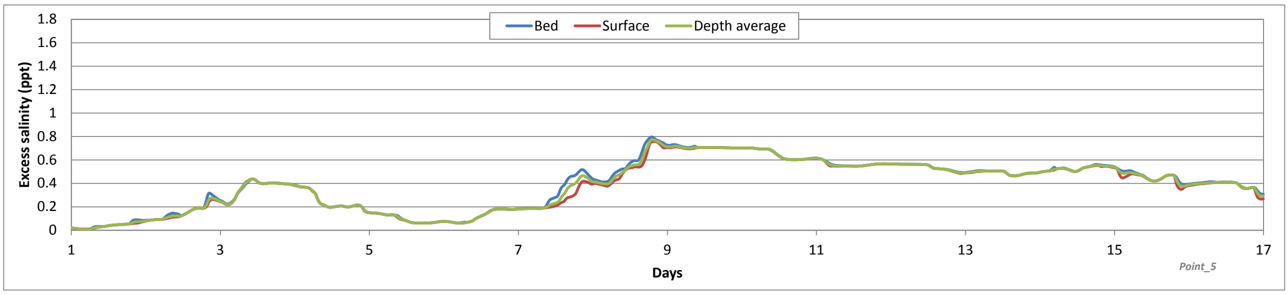


Figure 5.48: Predicted excess salinity at point 5 (rocky intertidal habitat), stronger winds, open intake layout

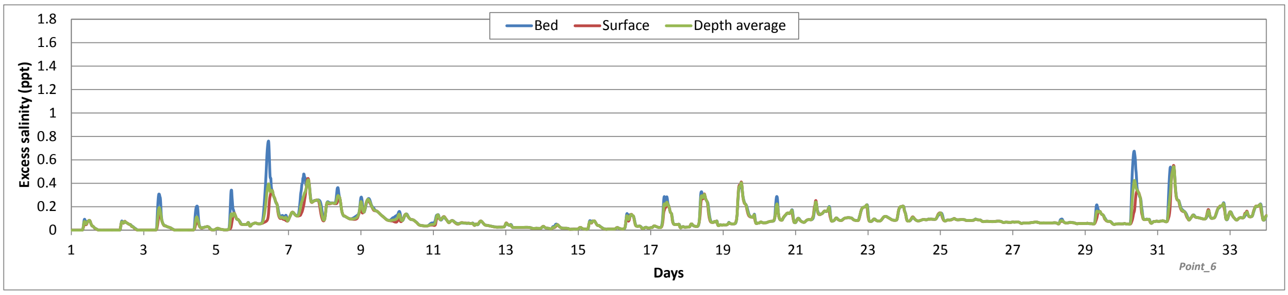


Figure 5.49: Predicted excess salinity at point 6 (Al Sinniyah Island (north)), weak winds, open intake layout

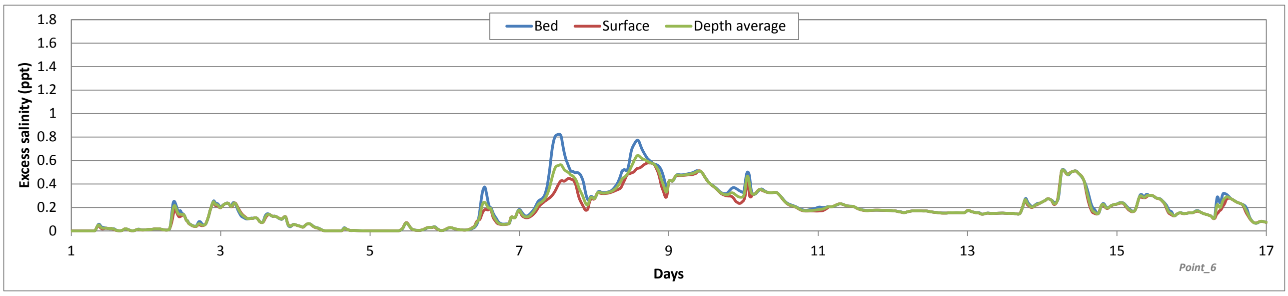


Figure 5.50: Predicted excess salinity at point 6 (Al Sinniyah Island (north)), stronger winds, open intake layout

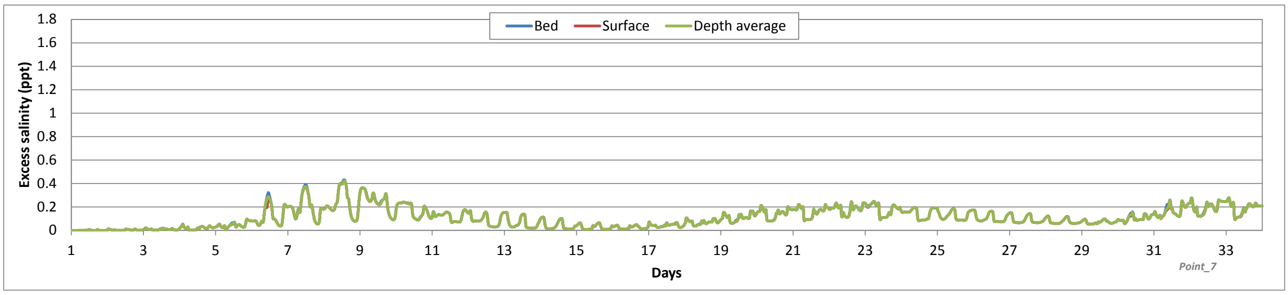


Figure 5.51: Predicted excess salinity at point 7 (Residential Compound 3), weak winds, open intake layout

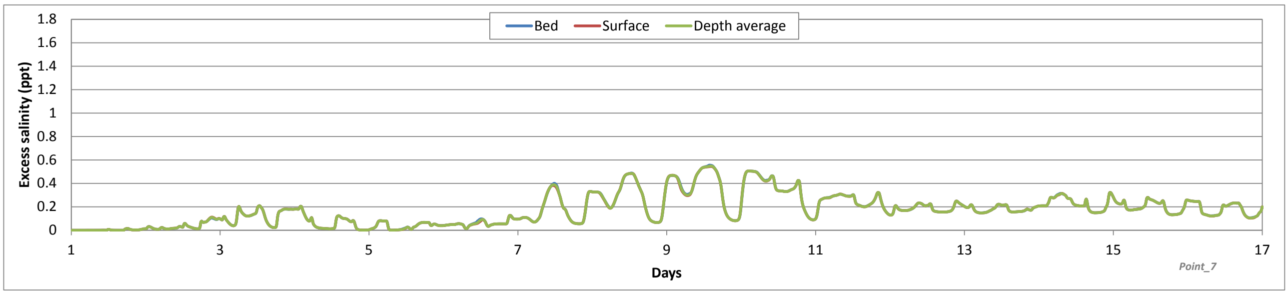


Figure 5.52: Predicted excess salinity at point 7 (Residential Compound 3), stronger winds, open intake layout

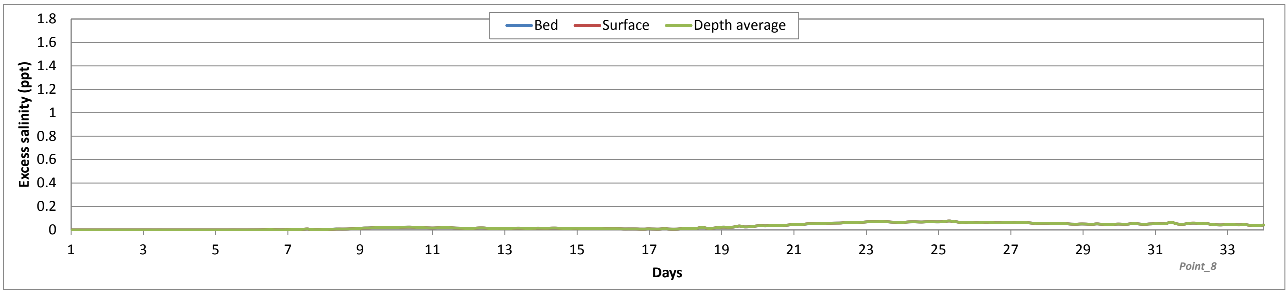


Figure 5.53: Predicted excess salinity at point 8 (Al Sinniyah Island (south)), weak winds, open intake layout

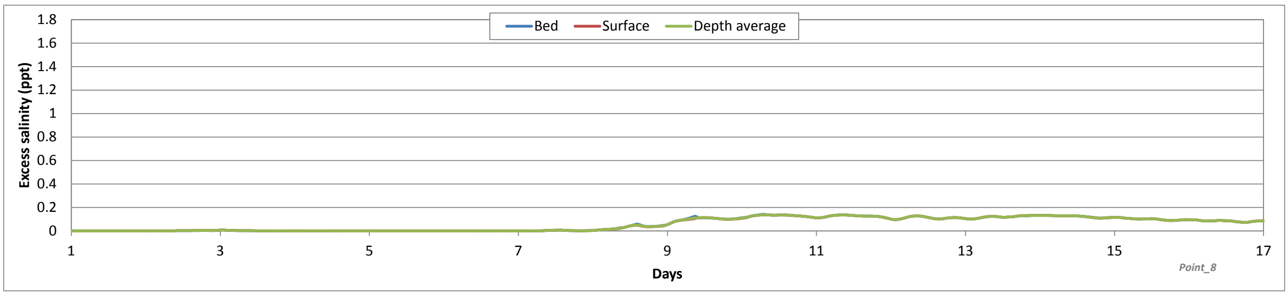


Figure 5.54: Predicted excess salinity at point 8 (Al Sinniyah Island (south)), stronger winds, open intake layout

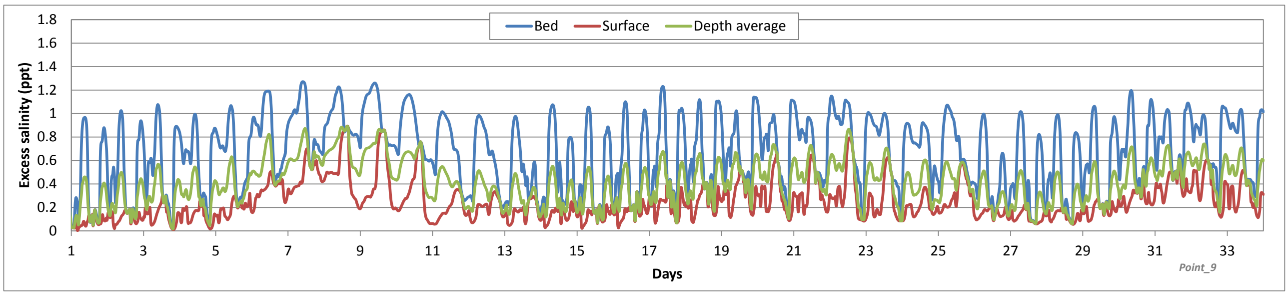


Figure 5.55: Predicted excess salinity at point 9 (sparse seagrass habitat), weak winds, open intake layout

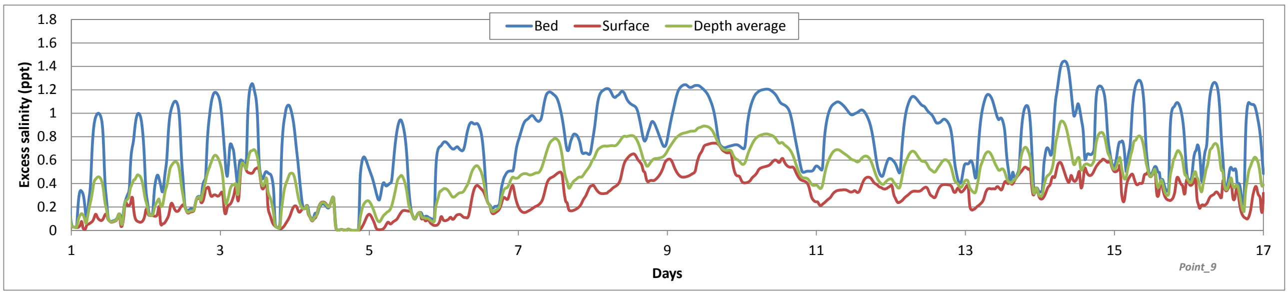


Figure 5.56: Predicted excess salinity at point 9 (sparse seagrass habitat), stronger winds, open intake layout

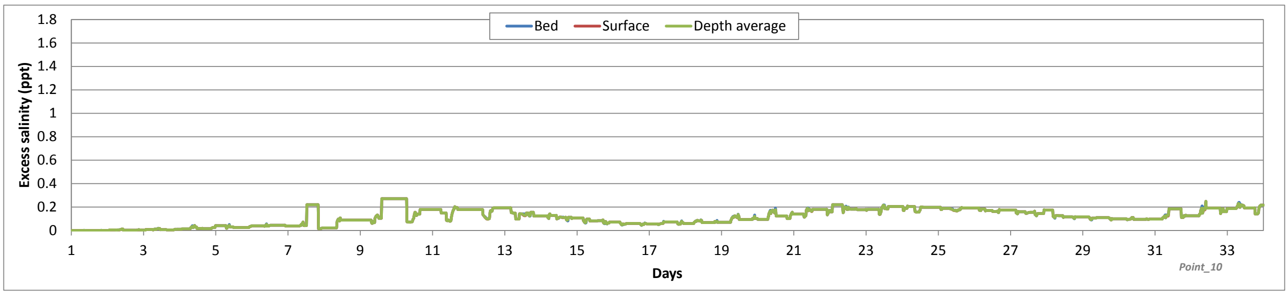


Figure 5.57: Predicted excess salinity at point 10 (Residential Compound 5), weak winds, open intake layout

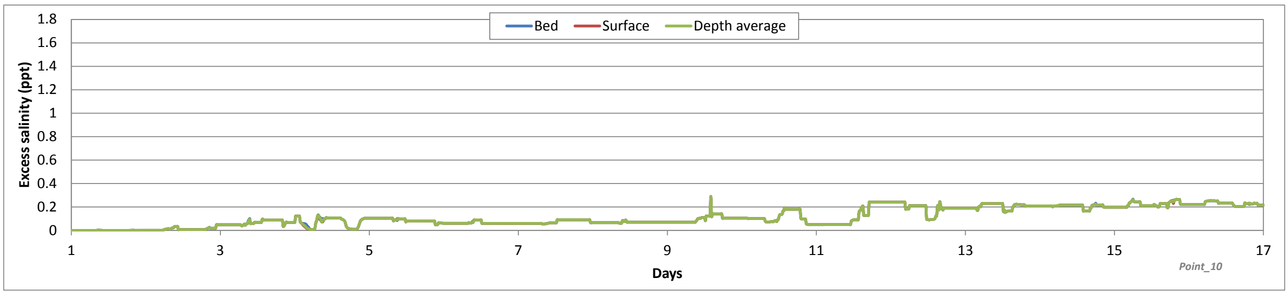


Figure 5.58: Predicted excess salinity at point 10 (Residential Compound 5), stronger winds, open intake layout

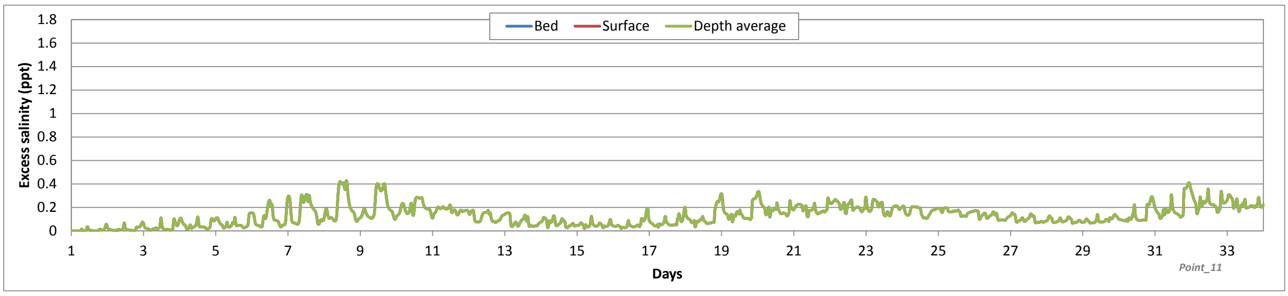


Figure 5.59: Predicted excess salinity at point 11 (Area of Observed Turtles), weak winds, open intake layout

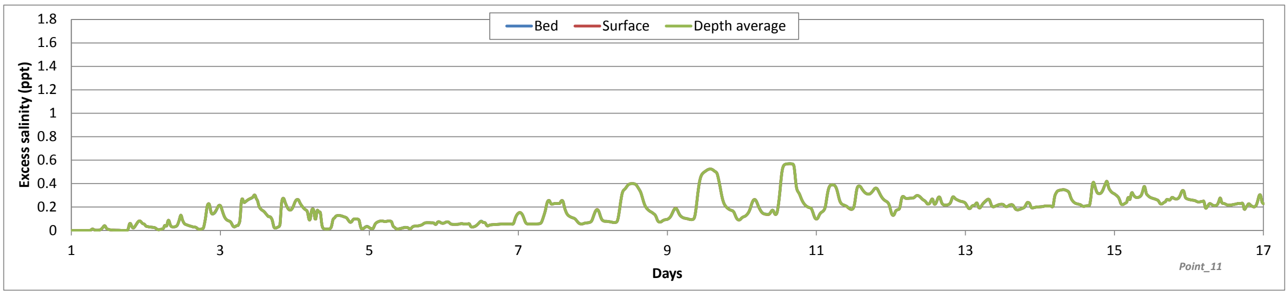


Figure 5.60: Predicted excess salinity at point 11 (Area of Observed Turtles), stronger winds, open intake layout

6. Conclusions

Hydrodynamic and dispersion modelling have been carried out to determine the near- and far-field mixing, dispersion and potential for recirculation of reject brine associated with a proposed 150 MIGD Independent Water Project in Umm Al Quwain.

The intake will be located around 600 m from the shoreline. According to the bathymetric surveys, the bed elevation 600 m offshore results in minimum water depths of around 4 m. This is therefore a relatively shallow intake, and **the EPC contractor should confirm this design with detailed surveys and appropriate design for the intake risers**.

The end of the outfall will be located 3600 m from the shoreline. The proposed outfall location lies outside of the area surveyed data. Therefore we have estimated water depths by interpolating between the depths at the edge of the survey, and data from Admiralty Charts further offshore. Typical water depths appear to be around 6 m at this location. **The EPC contractor should confirm the exact bed elevations with detailed surveys/design.**

The most stringent of the environmental standards applied require the excess salinity to be below 5% of the naturally occurring ambient salinity at the edge of the mixing zone. We have therefore attempted to derive a diffuser design that meets the required level of dilution within the near-field area around the diffuser. However, as the seabed along the proposed outfall corridor slopes relatively gradually, water depths at the proposed outfall location are shallow. This means that the depth of water available for mixing and dilution of the brine is limited.

A concept design for the proposed outfall was derived consisting of a 1500 m-long diffuser, with 40 single-port risers, equally spaced along the pipe. The end point of the 1500 m diffuser section is located 3.6 km offshore (so the first, shoreward, port discharges at 2.1 km offshore). Port diameters are about 0.4 m and each port was assumed to be located around 1 m above the seabed. The ports were assumed to make an angle of about 30° with the seabed, and the port on each riser is orientated normal to the diffuser pipe axis, with neighbouring risers discharging in opposite directions.

This concept configuration was predicted to reduce excess salinities to within 5% of the ambient values within the near-field area, which extends about 30-40 m from the outfall. The saline layer that forms at the bed will be around 2-3 m deep at this point, which means that the spreading layer will occupy a significant proportion of the water depth.

Dispersion of the brine over the wider area, and its potential for build-up around the diffuser over successive tides was assessed using detailed 3D hydrodynamic dispersion modelling. The hydrodynamic model was validated using data from a single Acoustic Doppler Current Profiler (ADCP) deployed for 14 days. The instrument was located in very shallow water and, as result, the recorded currents were quite noisy and difficult to interpret. **As the outfall and intake are to be located much further offshore, additional ADCP deployments at 1-2 km from the shore are recommended.** The modelling identified that local currents were sensitive to assumptions made about the bathymetry in the shallow area around the islands between the plant site and Umm al Quwain town. Little or no bathymetry data are available in this area. **Collection of additional bathymetry information in this area is recommended to reduce modelling uncertainties and give more reliable predictions.**

At the seabed, maximum excess salinities outside the near-field region are below 2 ppt, although excess salinities above 1 ppt are predicted up to around 4 -8 km from the outfall. On average, excess salinities are predicted to exceed 1 ppt up to 2 km from the outfall. This demonstrates that rates of dilution in the spreading layer beyond the near-field are likely to be slow.

Excess salinities of up to 0.8 ppt were predicted at the intake, with highest levels typically predicted to occur during stronger Shamal winds.

Maximum predicted excess salinities between 0.1 ppt and 1.6 ppt were predicted at nearby marine receptors. At the north-eastern corner of Al Sinniyah Island, maximum excess salinities of 0.8 ppt were predicted. However, the horizontal salinity gradient is relatively strong near this site, and only a small change in the plume position would be required to increase concentrations. It is therefore recommended that a precautionary approach is taken when determining the potential effects at this location

An option for an intake consisting of an open channel with breakwaters was also investigated. Generally, the results were similar to the offshore intake case in terms of excess salinity footprints and salinities at sensitive sites. Peak predicted excess salinities at the intake were increased slightly from 0.6 to 0.75 ppt (weaker wind case) and from 0.8 to 0.95 ppt (stronger wind case).

7. References

HR Wallingford, 2018a. Umm Al Quwain 45 MIGD desalination plant: brine dispersion and recirculation assessment, HR Wallingford Report DEM8286-RT001-R01-00, September 2018.

HR Wallingford, 2018b. Umm Al Quwain 45 MIGD desalination plant: dredging plume dispersion assessment, HR Wallingford Report DEM8286-RT002-R01-00, October 2018.

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HR Wallingford is an independent engineering and environmental hydraulics organisation. We deliver practical solutions to the complex water-related challenges faced by our international clients. A dynamic research programme underpins all that we do and keeps us at the leading edge. Our unique mix of know-how, assets and facilities includes state of the art physical modelling laboratories, a full range of numerical modelling tools and, above all, enthusiastic people with world-renowned skills and expertise.

FS 516431
EMS 558310
OHS 595357

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APPENDIX G – SOIL ANALYSIS LABORATORY RESULTS (2018 & 2019)

Soil analysis laboratory results 2018

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LB-073-TEST

CORE LABORATORY

TESTING | INVESTIGATION | ASSURING

LABORATORY TEST REPORT ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING
Date : 15/09/2018
Nature of Business : Environment Consultant
Report No : RP/SA-00952/08
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates
Sample No : SP/SA-00952/08
Sampling Report No : SRN/SA-00952/08

Sample Detail

Sample Type : Soil
Source of Sample : Soil (Existing Material @ Site)
Sampling Point : S-1, 25.654819 N, 55.746942 E
Sampling Location : S-1,FEWA 45 MIGD SWRO Independent Water Project, Umm Al Quwain, UAE

On-Site Details

pH / Temperature : Not Applicable
Appearance : Brown Solid
Preservation : Yes

Sampling Detail

Apparatus : Hand Auger and Bottle
Quantity / Size : Glass Bottle (1*1Kg)
Sampling Date / Time : 04/09/2018 / 10:10 Hrs
Receiving Date : 04/09/2018 **Time :** 13:45 Hrs
Method : SESDPROC-300-R3 / Grab
Collected by : SL/BN (Core Lab Rep.)
Delivered by : SL/BN (Core Lab Rep.)
Received by : DC (Core Lab Rep.)

Results of Chemical Analysis	**Tested by :** AC / DC		**Date of Analysis :** 04/09/2018 - 15/09/2018	
Parameters	**RESULT**	**Unit**	**MDL**	**Test Method**
pH @ 25 °C *	9.4	-	0.1	BS EN 15933 £
Oil & Grease	1.71	% dry solid	0.15	APHA AWWA 5520 E
Gasoline Range (C5 - C10)	< 2.0	mg/Kg	2.0	USEPA 8015
Diesel Range (C11 - C28)	< 20.0	mg/Kg	20.0	USEPA 8015
Motor Oil Range (C29 - C40)	< 50.0	mg/Kg	50.0	USEPA 8015
Chloride as Cl	34	mg/Kg	1	British Standard 1377 Part 3 £
Sulfate as SO4	10	mg/Kg	1	British Standard 1377 Part 3 £
Phosphate Phosphorus as PO4	743.6	mg/Kg	1.0	APHA AWWA 3120 B / Calculation
Orthophosphate as P2O5	555.7	mg/Kg	1.0	APHA AWWA 3120 B / Calculation
Nitrate as NO3	< 1.5	mg/Kg	1.5	Cadmium Reduction Method £
Total Kjeldahl Nitrogen (TKN)	< 5.0	mg/Kg	5.0	APHA AWWA Norg C
Sodium as Na	1615.5	mg/Kg	1.0	APHA AWWA 3120 B
Potassium as K	1071.8	mg/Kg	1.0	APHA AWWA 3120 B
Arsenic as As *	< 5.0	mg/kg	5.0	APHA AWWA 3120 B
Barium as Ba *	20.5	mg/kg	1.0	APHA AWWA 3120 B
Cadmium as Cd *	< 2.0	mg/kg	2.0	APHA AWWA 3120 B
Chromium as Cr *	67.6	mg/kg	1.0	APHA AWWA 3120 B
Hexavalent Chromium as Cr VI	< 5.0	mg/Kg	5.0	USEPA 3060 / APHA AWWA 3120 B
Copper as Cu *	8.9	mg/kg	1.0	APHA AWWA 3120 B
Lead as Pb *	4.3	mg/kg	1.0	APHA AWWA 3120 B
Manganese as Mn *	134.0	mg/kg	2.0	APHA AWWA 3120 B
Mercury as Hg	< 1.0	mg/kg	1.0	APHA AWWA 3120 B
Nickel as Ni *	40.0	mg/kg	2.0	APHA AWWA 3120 B
Selenium as Se *	< 1.0	mg/kg	1.0	APHA AWWA 3120 B
Zinc as Zn *	2.4	mg/kg	2.0	APHA AWWA 3120 B

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LB-073-TEST

TESTING | INVESTIGATION | ASSURING

LABORATORY TEST REPORT ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date** : 15/09/2018
Nature of Business : Environment Consultant	**Report No** : RP/SA-00952/08
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road,	**Sample No** : SP/SA-00952/08
Dubai, United Arab Emirates	**Sampling Report No** : SRN/SA-00952/08

NOTES
Test Method Variation: None
Remarks: 1) * This Test is Accredited by Dubai Municipality (DAC).
2) £ Water / KCl / NaHCO3 Extract
Reference: APHA AWWA WEF 22nd Ed. 2012 Standard Method for the Examination of Water and Waste Water.

Results relates only to the items tested.
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Laboratory Manager
For CORE Laboratory

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LB-073-TEST

TESTING | INVESTIGATION | ASSURING

LABORATORY TEST REPORT ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date :** 15/09/2018
Nature of Business : Environment Consultant	**Report No :** RP/SA-00952/09
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road,	**Sample No :** SP/SA-00952/09
Dubai, United Arab Emirates	**Sampling Report No :** SRN/SA-00952/09

Sample Detail / **On-Site Details**

Sample Type : Soil	**pH / Temperature :** Not Applicable
Source of Sample : Soil (Existing Material @ Site)	**Appearance :** Brown Solid
Sampling Point : S-2, 25.654806 N, 55.747374 E	**Preservation :** Yes
Sampling Location : S-2, FEWA 45 MIGD SWRO Independent Water Project, Umm Al Quwain, UAE	

Sampling Detail

Apparatus : Hand Auger and Bottle	**Method :** SESDPROC-300-R3 / Grab
Quantity / Size : Glass Bottle (1*1Kg)	**Collected by :** SL/BN (Core Lab Rep.)
Sampling Date / Time : 04/09/2018 / 10:15 Hrs	**Delivered by :** SL/BN (Core Lab Rep.)
Receiving Date : 04/09/2018 **Time :** 13:45 Hrs	**Received by :** DC (Core Lab Rep.)

Results of Chemical Analysis	**Tested by :** AC / DC		**Date of Analysis :** 04/09/2018 - 15/09/2018	
Parameters	**RESULT**	**Unit**	**MDL**	**Test Method**
pH @ 25 °C *	**8.8**	-	0.1	BS EN 15933 £
Oil & Grease	**1.05**	% dry solid	0.15	APHA AWWA 5520 E
Gasoline Range (C5 - C10)	**< 2.0**	mg/Kg	2.0	USEPA 8015
Diesel Range (C11 - C28)	**< 20.0**	mg/Kg	20.0	USEPA 8015
Motor Oil Range (C29 - C40)	**< 50.0**	mg/Kg	50.0	USEPA 8015
Chloride as Cl	**18**	mg/Kg	1	British Standard 1377 Part 3 £
Sulfate as SO4	**< 1**	mg/Kg	1	British Standard 1377 Part 3 £
Phosphate Phosphorus as PO4	**518.1**	mg/Kg	0.10	APHA AWWA 3120 B / Calculation
Orthophosphate as P2O5	**387.2**	mg/Kg	2.0	APHA AWWA 3120 B / Calculation
Nitrate as NO3	**15.9**	mg/Kg	1.5	Cadmium Reduction Method £
Total Kjeldahl Nitrogen (TKN)	**< 5.0**	mg/Kg	5.0	APHA AWWA Norg C
Sodium as Na	**1359.4**	mg/Kg	1.0	APHA AWWA 3120 B
Potassium as K	**1125.3**	mg/Kg	1.0	APHA AWWA 3120 B
Arsenic as As *	**< 5.0**	mg/kg	5.0	APHA AWWA 3120 B
Barium as Ba *	**24.7**	mg/kg	1.0	APHA AWWA 3120 B
Cadmium as Cd *	**< 2.0**	mg/kg	2.0	APHA AWWA 3120 B
Chromium as Cr *	**63.7**	mg/kg	1.0	APHA AWWA 3120 B
Hexavalent Chromium as Cr VI	**< 5.0**	mg/Kg	5.0	USEPA 3060 / APHA AWWA 3120 B
Copper as Cu *	**1.7**	mg/kg	1.0	APHA AWWA 3120 B
Lead as Pb *	**1.9**	mg/kg	1.0	APHA AWWA 3120 B
Manganese as Mn *	**125.6**	mg/kg	2.0	APHA AWWA 3120 B
Mercury as Hg	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Nickel as Ni *	**55.1**	mg/kg	2.0	APHA AWWA 3120 B
Selenium as Se *	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Zinc as Zn *	**< 2.0**	mg/kg	2.0	APHA AWWA 3120 B

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LB-073-TEST

TESTING | INVESTIGATION | ASSURING

LABORATORY TEST REPORT ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date :** 15/09/2018
Nature of Business : Environment Consultant	**Report No :** RP/SA-00952/09
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road,	**Sample No :** SP/SA-00952/09
Dubai, United Arab Emirates	**Sampling Report No :** SRN/SA-00952/09

NOTES
Test Method Variation: None
Remarks: 1) * This Test is Accreditated by Dubai Municipality (DAC).
2) £ Water / KCl / $NaHCO_3$ Extract
Reference: APHA AWWA WEF 22nd Ed. 2012 Standard Method for the Examination of Water and Waste Water.

Results relates only to the items tested.
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TESTING | INVESTIGATION | ASSURING

LABORATORY TEST REPORT ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING
Nature of Business : Environment Consultant
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates

Date : 15/09/2018
Report No : RP/SA-00952/10
Sample No : SP/SA-00952/10
Sampling Report No : SRN/SA-00952/10

Sample Detail

Sample Type : Soil
Source of Sample : Soil (Existing Material @ Site)
Sampling Point : S-3, 25.654139 N, 55.752123 E
Sampling Location : S-3, FEWA 45 MIGD SWRO Independent Water Project, Umm Al Quwain, UAE

On-Site Details

pH / Temperature : Not Applicable
Appearance : Brown Solid
Preservation : Yes

Sampling Detail

Apparatus : Hand Auger and Bottle
Quantity / Size : Glass Bottle (1*1Kg)
Sampling Date / Time : 04/09/2018 / 10:55 Hrs
Receiving Date : 04/09/2018 **Time** : 13:45 Hrs

Method : SESDPROC-300-R3 / Grab
Collected by : SL/BN (Core Lab Rep.)
Delivered by : SL/BN (Core Lab Rep.)
Received by : DC (Core Lab Rep.)

Results of Chemical Analysis	Tested by : AC / DC		Date of Analysis : 04/09/2018 - 15/09/2018	
Parameters	**RESULT**	**Unit**	**MDL**	**Test Method**
pH @ 25 °C *	9.3	-	0.1	BS EN 15933 E
Oil & Grease	2.51	% dry solid	0.15	APHA AWWA 5520 E
Gasoline Range (C5 - C10)	< 2.0	mg/Kg	2.0	USEPA 8015
Diesel Range (C11 - C28)	< 20.0	mg/Kg	20.0	USEPA 8015
Motor Oil Range (C29 - C40)	< 50.0	mg/Kg	50.0	USEPA 8015
Chloride as Cl	20	mg/Kg	1	British Standard 1377 Part 3 £
Sulfate as SO4	< 1	mg/Kg	1	British Standard 1377 Part 3 £
Phosphate Phosphorus as PO4	493.4	mg/Kg	1.0	APHA AWWA 3120 B / Calculation
Orthophosphate as P2O5	368.8	mg/Kg	1.0	APHA AWWA 3120 B / Calculation
Nitrate as NO3	19.0	mg/Kg	1.5	Cadmium Reduction Method £
Total Kjeldahl Nitrogen (TKN)	< 5.0	mg/Kg	5.0	APHA AWWA Norg C
Sodium as Na	1075.6	mg/Kg	1.0	APHA AWWA 3120 B
Potassium as K	1295.4	mg/Kg	1.0	APHA AWWA 3120 B
Arsenic as As *	< 5.0	mg/kg	5.0	APHA AWWA 3120 B
Barium as Ba *	24.0	mg/kg	1.0	APHA AWWA 3120 B
Cadmium as Cd *	< 2.0	mg/kg	2.0	APHA AWWA 3120 B
Chromium as Cr *	70.5	mg/kg	1.0	APHA AWWA 3120 B
Hexavalent Chromium as Cr VI	< 5.0	mg/Kg	5.0	USEPA 3060 / APHA AWWA 3120 B
Copper as Cu *	1.7	mg/kg	1.0	APHA AWWA 3120 B
Lead as Pb *	1.1	mg/kg	1.0	APHA AWWA 3120 B
Manganese as Mn *	139.4	mg/kg	2.0	APHA AWWA 3120 B
Mercury as Hg	< 1.0	mg/kg	1.0	APHA AWWA 3120 B
Nickel as Ni *	66.3	mg/kg	2.0	APHA AWWA 3120 B
Selenium as Se *	< 1.0	mg/kg	1.0	APHA AWWA 3120 B
Zinc as Zn *	2.7	mg/kg	2.0	APHA AWWA 3120 B

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CORE LABORATORY
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LABORATORY TEST REPORT ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date** : 15/09/2018
Nature of Business : Environment Consultant	**Report No** : RP/SA-00952/10
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road,	**Sample No** : SP/SA-00952/10
Dubai, United Arab Emirates	**Sampling Report No** : SRN/SA-00952/10

NOTES
Test Method Variation: None
Remarks: 1) * This Test is Accreditated by Dubai Municipality (DAC).
2) £ Water / KCl / NaHCO3 Extract
Reference: APHA AWWA WEF 22nd Ed. 2012 Standard Method for the Examination of Water and Waste Water.

Results relates only to the items tested.
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CORE LABORATORY
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LABORATORY TEST REPORT ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING
Nature of Business : Environment Consultant
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates

Date : 15/09/2018
Report No : RP/SA-00952/11
Sample No : SP/SA-00952/11
Sampling Report No : SRN/SA-00952/11

Sample Detail

Sample Type : Soil
Source of Sample : Soil (Existing Material @ Site)
Sampling Point : S-4, 25.655791 N, 55.746530 E
Sampling Location : S-4, FEWA 45 MIGD SWRO Independent Water Project, Umm Al Quwain, UAE

On-Site Details

pH / Temperature : Not Applicable
Appearance : Brown Solid
Preservation : Yes

Sampling Detail

Apparatus : Hand Auger and Bottle
Quantity / Size : Glass Bottle (1*1Kg)
Sampling Date / Time : 04/09/2018 / 11:25 Hrs
Receiving Date : 04/09/2018 **Time :** 13:45 Hrs

Method : SESDPROC-300-R3 / Grab
Collected by : SL/BN (Core Lab Rep.)
Delivered by : SL/BN (Core Lab Rep.)
Received by : DC (Core Lab Rep.)

Results of Chemical Analysis	Tested by : AC / DC		Date of Analysis : 04/09/2018 - 15/09/2018	
Parameters	**RESULT**	**Unit**	**MDL**	**Test Method**
pH @ 25 °C *	**9.3**	-	0.1	BS EN 15933 E
Oil & Grease	**2.20**	% dry solid	0.15	APHA AWWA 5520 E
Gasoline Range (C5 - C10)	**< 2.0**	mg/Kg	2.0	USEPA 8015
Diesel Range (C11 - C28)	**< 20.0**	mg/Kg	20.0	USEPA 8015
Motor Oil Range (C29 - C40)	**< 50.0**	mg/Kg	50.0	USEPA 8015
Chloride as Cl	**62**	mg/Kg	1	British Standard 1377 Part 3 £
Sulfate as SO4	**50**	mg/Kg	1	British Standard 1377 Part 3 £
Phosphate Phosphorus as PO4	**891.3**	mg/Kg	1.0	APHA AWWA 3120 B / Calculation
Orthophosphate as P2O5	**666.2**	mg/Kg	1.0	APHA AWWA 3120 B / Calculation
Nitrate as NO3	**51.2**	mg/Kg	1.5	Cadmium Reduction Method £
Total Kjeldahl Nitrogen (TKN)	**< 5.0**	mg/Kg	5.0	APHA AWWA Norg C
Sodium as Na	**2893.1**	mg/Kg	1.0	APHA AWWA 3120 B
Potassium as K	**942.1**	mg/Kg	1.0	APHA AWWA 3120 B
Arsenic as As *	**< 5.0**	mg/kg	5.0	APHA AWWA 3120 B
Barium as Ba *	**24.1**	mg/kg	1.0	APHA AWWA 3120 B
Cadmium as Cd *	**< 2.0**	mg/kg	2.0	APHA AWWA 3120 B
Chromium as Cr *	**52.4**	mg/kg	1.0	APHA AWWA 3120 B
Hexavalent Chromium as Cr VI	**< 5.0**	mg/Kg	5.0	USEPA 3060 / APHA AWWA 3120 B
Copper as Cu *	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Lead as Pb *	**4.3**	mg/kg	1.0	APHA AWWA 3120 B
Manganese as Mn *	**92.3**	mg/kg	2.0	APHA AWWA 3120 B
Mercury as Hg	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Nickel as Ni *	**23.5**	mg/kg	2.0	APHA AWWA 3120 B
Selenium as Se *	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Zinc as Zn *	**< 2.0**	mg/kg	2.0	APHA AWWA 3120 B

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LABORATORY TEST REPORT ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date :** 15/09/2018
Nature of Business : Environment Consultant	**Report No :** RP/SA-00952/11
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road,	**Sample No :** SP/SA-00952/11
Dubai, United Arab Emirates	**Sampling Report No :** SRN/SA-00952/11

NOTES
Test Method Variation: None
Remarks: 1) * This Test is Accreditated by Dubai Municipality (DAC).
2) £ Water / KCl / NaHCO3 Extract
Reference: APHA AWWA WEF 22nd Ed. 2012 Standard Method for the Examination of Water and Waste Water.

Results relates only to the items tested.

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Soil analysis laboratory results 2019 including from laydown area 1 & 2

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CORE LABORATORY
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LABORATORY ANALYSIS ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date :** 01/07/2019
Nature of Business : Environment Consultant	**Report No :** RP/SA-02285/01
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates	**Sample No :** SP/SA-02285/01
	Sampling Report No : SRN/SA-02285/01

Sample Detail / **On-Site Details**

Sample Type : Soil	**pH / Temperature :** Not Applicable
Source of Sample : Existing Soil Material	**Appearance :** Brown Soil
Sampling Point : Soil No. 4, Surface Soil - 0.20 cm, 25.653140 N, 55.752048 E	**Preservation :** Yes
Sampling Location : Project 1305/001/061 FEWA UAQ 45 MIGD SWRO, Umm Al Quwain, UAE	

Sampling Detail

Apparatus : Hand Auger and Bottles	**Method :** SESDPROC-300-R3 / Grab
Quantity / Size : Plastic Bag (1*1 Kg)	**Collected by :** SI (Core Lab Rep.)
Sampling Date / Time : 24/06/2019 / 10:00 Hrs	**Delivered by :** SI (Core Lab Rep.)
Receiving Date : 24/06/2019 **Time :** 13:00 Hrs	**Received by :** DC (Core Lab Rep.)

Results of Chemical Analysis	Tested by : AI/DC		Date of Analysis : 24/06/2019 - 01/07/2019	
Parameters	**RESULT**	**Unit**	**MDL**	**Test Method**
pH @ 25 °C *	9.3	-	0.1	BS EN 15933 E
Oil & Grease	< 0.15	% dry solid	0.15	APHA AWWA 5520 E
Chloride as Cl	72	mg/Kg	1	British Standard 1377 Part 3
Sulfate as SO4	52	mg/Kg	1	British Standard 1377 Part 3
Phosphate Phosphorus as PO4	545.98	mg/Kg	0.10	USEPA PhosVer 3 Method £
Orthophosphate as P2O5	408.0	mg/Kg	2.0	Phos Ver 3 Method £
Nitrate Nitrogen as NO3-N	13.3	mg/Kg	1.5	Cadmium Reduction Method £
Total Kjeldahl Nitrogen (TKN)	160.9	mg/Kg	5.0	APHA AWWA Norg C
Gasoline Range (C5 - C10)	< 2.0	mg/Kg	2.0	USEPA 8015
Diesel Range (C11 - C28)	< 20.0	mg/Kg	20.0	USEPA 8015
Motor Oil Range (C29 - C40)	< 50.0	mg/Kg	50.0	USEPA 8015
Sodium as Na	325.7	mg/Kg	1.0	APHA AWWA 3120 B
Potassium as K	862.1	mg/Kg	1.0	APHA AWWA 3120 B
Arsenic as As *	< 5.0	mg/kg	5.0	APHA AWWA 3120 B
Barium as Ba *	20.8	mg/kg	1.0	APHA AWWA 3120 B
Cadmium as Cd *	< 2.0	mg/kg	2.0	APHA AWWA 3120 B
Chromium as Cr *	34.1	mg/kg	1.0	APHA AWWA 3120 B
Hexavalent Chromium as Cr VI	< 5.0	mg/Kg	5.0	USEPA 3060 / APHA AWWA 3120 B
Copper as Cu *	6.9	mg/kg	1.0	APHA AWWA 3120 B
Lead as Pb *	10.2	mg/kg	1.0	APHA AWWA 3120 B
Manganese as Mn *	145.6	mg/kg	2.0	APHA AWWA 3120 B
Mercury as Hg	< 1.0	mg/kg	1.0	APHA AWWA 3120 B
Nickel as Ni *	71.9	mg/kg	2.0	APHA AWWA 3120 B
Selenium as Se *	< 1.0	mg/kg	1.0	APHA AWWA 3120 B
Zinc as Zn *	26.8	mg/kg	2.0	APHA AWWA 3120 B

LABORATORY ANALYSIS ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date :** 01/07/2019
Nature of Business : Environment Consultant	**Report No :** RP/SA-02285/01
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road,	**Sample No :** SP/SA-02285/01
Dubai, United Arab Emirates	**Sampling Report No :** SRN/SA-02285/01

Test Method Variation: None
Remarks: 1) * This Test is Accredited by Emirates International Accreditation Centre (EIAC).
2) £ Water / KCl / $NaHCO_3$ Extract
Reference: APHA AWWA WEF 23rd Ed. 2017 Standard Method for the Examination of Water and Waste Water.

Results relates only to the items tested.
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CORE LABORATORY
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LABORATORY ANALYSIS ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date :** 01/07/2019
Nature of Business : Environment Consultant	**Report No :** RP/SA-02285/02
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road,	**Sample No :** SP/SA-02285/02
Dubai, United Arab Emirates	**Sampling Report No :** SRN/SA-02285/02

Sample Detail / **On-Site Details**

Sample Type : Soil	**pH / Temperature :** Not Applicable
Source of Sample : Existing Soil Material	**Appearance :** Brown Soil
Sampling Point : Soil No. 5, Surface Soil - 0.20 cm, 25.652668 N, 55.750461 E	**Preservation :** Yes
Sampling Location : Project 1305/001/061 FEWA UAQ 45 MIGD SWRO, Umm Al Quwain, UAE	

Sampling Detail

Apparatus : Hand Auger and Bottles	**Method :** SESDPROC-300-R3 / Grab
Quantity / Size : Plastic Bag (1*1 Kg)	**Collected by :** SI (Core Lab Rep.)
Sampling Date / Time : 24/06/2019 / 10:15 Hrs	**Delivered by :** SI (Core Lab Rep.)
Receiving Date : 24/06/2019 **Time :** 13:00 Hrs	**Received by :** DC (Core Lab Rep.)

Results of Chemical Analysis	Tested by : AI/DC		Date of Analysis : 24/06/2019 - 01/07/2019	
Parameters	**RESULT**	**Unit**	**MDL**	**Test Method**
pH @ 25 °C *	**9.8**	-	0.1	BS EN 15933 E
Oil & Grease	**< 0.15**	% dry solid	0.15	APHA AWWA 5520 E
Chloride as Cl	**68**	mg/Kg	1	British Standard 1377 Part 3
Sulfate as SO4	**12**	mg/Kg	1	British Standard 1377 Part 3
Phosphate Phosphorus as PO4	**458.32**	mg/Kg	0.10	USEPA PhosVer 3 Method £
Orthophosphate as P2O5	**342.5**	mg/Kg	2.0	Phos Ver 3 Method £
Nitrate Nitrogen as NO3-N	**7.6**	mg/Kg	1.5	Cadmium Reduction Method £
Total Kjeldahl Nitrogen (TKN)	**108.9**	mg/Kg	5.0	APHA AWWA Norg C
Gasoline Range (C5 - C10)	**< 2.0**	mg/Kg	2.0	USEPA 8015
Diesel Range (C11 - C28)	**< 20.0**	mg/Kg	20.0	USEPA 8015
Motor Oil Range (C29 - C40)	**< 50.0**	mg/Kg	50.0	USEPA 8015
Sodium as Na	**248.9**	mg/Kg	1.0	APHA AWWA 3120 B
Potassium as K	**837.8**	mg/Kg	1.0	APHA AWWA 3120 B
Arsenic as As *	**< 5.0**	mg/kg	5.0	APHA AWWA 3120 B
Barium as Ba *	**21.7**	mg/kg	1.0	APHA AWWA 3120 B
Cadmium as Cd *	**< 2.0**	mg/kg	2.0	APHA AWWA 3120 B
Chromium as Cr *	**31.8**	mg/kg	1.0	APHA AWWA 3120 B
Hexavalent Chromium as Cr VI	**< 5.0**	mg/Kg	5.0	USEPA 3060 / APHA AWWA 3120 B
Copper as Cu *	**7.1**	mg/kg	1.0	APHA AWWA 3120 B
Lead as Pb *	**6.5**	mg/kg	1.0	APHA AWWA 3120 B
Manganese as Mn *	**169.2**	mg/kg	2.0	APHA AWWA 3120 B
Mercury as Hg	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Nickel as Ni *	**86.2**	mg/kg	2.0	APHA AWWA 3120 B
Selenium as Se *	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Zinc as Zn *	**13.1**	mg/kg	2.0	APHA AWWA 3120 B

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LABORATORY ANALYSIS ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date :** 01/07/2019
Nature of Business : Environment Consultant	**Report No :** RP/SA-02285/02
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road,	**Sample No :** SP/SA-02285/02
Dubai, United Arab Emirates	**Sampling Report No :** SRN/SA-02285/02

Test Method Variation: None
Remarks: 1) * This Test is Accredited by Emirates International Accreditation Centre (EIAC).
2) £ Water / KCl / NaHCO3 Extract
Reference: APHA AWWA WEF 23rd Ed. 2017 Standard Method for the Examination of Water and Waste Water.

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LABORATORY ANALYSIS ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING
Date : 14/08/2019
Nature of Business : Environment Consultant
Report No : RP/SA-02441/01
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates
Sample No : SP/SA-02441/01
Sampling Report No : Not Applicable

Sample Detail

Sample Type : Soil
Source of Sample : Existing Soil Material
Sampling Point : Soil Sample 1, Laydown Area 1, N 25 39 05.0" , E 055 44 36.2"
Sampling Location : Project 1305/001/061 FEWA 150 MIGD SWRO-UAQ, Umm Al Quwain, UAE

On-Site Details

pH / Temperature : Not Applicable
Appearance : Brown Moist Solid
Preservation : Yes

Sampling Detail

Apparatus : Not Given
Quantity / Size : Plastic (1*1 Kg)
Sampling Date / Time : 30/07/2019 / Not Given
Receiving Date : 30/07/2019 **Time :** 14:00 Hrs
Method : Not Given
Collected by : Client Rep.
Delivered by : Client Rep.
Received by : AI (Core Lab Rep.)

Results of Chemical Analysis	**Tested by :** AI/ GT/ DC		**Date of Analysis :** 30/07/2019 - 08/08/2019	
Parameters	**RESULT**	**Unit**	**MDL**	**Test Method**
pH @ 25 °C *	**8.9**	-	0.1	BS EN 15933 E
Oil & Grease	**0.22**	% dry solid	0.15	APHA AWWA 5520 E
Chloride as Cl	**3616**	mg/Kg	1	British Standard 1377 Part 3
Sulfate as SO4	**4197**	mg/Kg	1	British Standard 1377 Part 3
Phosphate Phosphorus as PO4	**393.06**	mg/Kg	0.10	USEPA PhosVer 3 Method £
Orthophosphate as P2O5	**293.8**	mg/Kg	2.0	Phos Ver 3 Method £
Nitrate Nitrogen as NO3-N	**70.5**	mg/Kg	1.5	Cadmium Reduction Method £
Total Kjeldahl Nitrogen (TKN)	**100.0**	mg/Kg	5.0	APHA AWWA Norg C
Gasoline Range (C5 - C10)	**< 2.0**	mg/Kg	2.0	USEPA 8015
Diesel Range (C11 - C28)	**< 20.0**	mg/Kg	20.0	USEPA 8015
Motor Oil Range (C29 - C40)	**< 50.0**	mg/Kg	50.0	USEPA 8015
Sodium as Na	**3089.9**	mg/Kg	1.0	APHA AWWA 3120 B
Potassium as K	**840.5**	mg/Kg	1.0	APHA AWWA 3120 B
Arsenic as As *	**< 5.0**	mg/kg	5.0	APHA AWWA 3120 B
Barium as Ba *	**17.9**	mg/kg	1.0	APHA AWWA 3120 B
Cadmium as Cd *	**< 2.0**	mg/kg	2.0	APHA AWWA 3120 B
Chromium as Cr *	**30.8**	mg/kg	1.0	APHA AWWA 3120 B
Hexavalent Chromium as Cr VI	**< 5.0**	mg/Kg	5.0	USEPA 3060 / APHA AWWA 3120 B
Copper as Cu *	**3.8**	mg/kg	1.0	APHA AWWA 3120 B
Lead as Pb *	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Manganese as Mn *	**110.3**	mg/kg	2.0	APHA AWWA 3120 B
Mercury as Hg	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Nickel as Ni *	**88.7**	mg/kg	2.0	APHA AWWA 3120 B
Selenium as Se *	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Zinc as Zn *	**7.9**	mg/kg	2.0	APHA AWWA 3120 B

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LABORATORY ANALYSIS ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date :** 14/08/2019
Nature of Business : Environment Consultant	**Report No :** RP/SA-02441/01
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates	**Sample No :** SP/SA-02441/01
	Sampling Report No : Not Applicable

Test Method Variation: None
Remarks: 1) * This Test is Accredited by Emirates International Accreditation Centre (EIAC).
2) £ Water / KCl / $NaHCO_3$ Extract
Reference: APHA AWWA WEF 23rd Ed. 2017 Standard Method for the Examination of Water and Waste Water.

Results relates only to the items tested.

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CORE LABORATORY
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LABORATORY ANALYSIS ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING
Nature of Business : Environment Consultant
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates

Date : 14/08/2019
Report No : RP/SA-02441/02
Sample No : SP/SA-02441/02
Sampling Report No : Not Applicable

Sample Detail

Sample Type : Soil
Source of Sample : Existing Soil Material
Sampling Point : Soil Sample 2, Laydown Area 1, N 25 39 02.4" , E 055 44 38.7"
Sampling Location : Project 1305/001/061 FEWA 150 MIGD SWRO-UAQ, Umm Al Quwain, UAE

On-Site Details

pH / Temperature : Not Applicable
Appearance : Brown Solid
Preservation : Yes

Sampling Detail

Apparatus : Not Given
Quantity / Size : Plastic (1*1 Kg)
Sampling Date / Time : 30/07/2019 / Not Given
Receiving Date : 30/07/2019 **Time :** 14:00 Hrs

Method : Not Given
Collected by : Client Rep.
Delivered by : Client Rep.
Received by : AI (Core Lab Rep.)

Results of Chemical Analysis | **Tested by :** AI/ GT/ DC | **Date of Analysis :** 30/07/2019 - 08/08/2019

Parameters	RESULT	Unit	MDL	Test Method
pH @ 25 °C *	**9.2**	-	0.1	BS EN 15933 E
Oil & Grease	**0.16**	% dry solid	0.15	APHA AWWA 5520 E
Chloride as Cl	**20**	mg/Kg	1	British Standard 1377 Part 3
Sulfate as SO4	**6**	mg/Kg	1	British Standard 1377 Part 3
Phosphate Phosphorus as PO4	**744.42**	mg/Kg	0.10	USEPA PhosVer 3 Method £
Orthophosphate as P2O5	**556.4**	mg/Kg	2.0	Phos Ver 3 Method £
Nitrate Nitrogen as NO3-N	**49.3**	mg/Kg	1.5	Cadmium Reduction Method £
Total Kjeldahl Nitrogen (TKN)	**50.6**	mg/Kg	5.0	APHA AWWA Norg C
Gasoline Range (C5 - C10)	**< 2.0**	mg/Kg	2.0	USEPA 8015
Diesel Range (C11 - C28)	**< 20.0**	mg/Kg	20.0	USEPA 8015
Motor Oil Range (C29 - C40)	**< 50.0**	mg/Kg	50.0	USEPA 8015
Sodium as Na	**420.0**	mg/Kg	1.0	APHA AWWA 3120 B
Potassium as K	**696.5**	mg/Kg	1.0	APHA AWWA 3120 B
Arsenic as As *	**< 5.0**	mg/kg	5.0	APHA AWWA 3120 B
Barium as Ba *	**23.6**	mg/kg	1.0	APHA AWWA 3120 B
Cadmium as Cd *	**< 2.0**	mg/kg	2.0	APHA AWWA 3120 B
Chromium as Cr *	**38.2**	mg/kg	1.0	APHA AWWA 3120 B
Hexavalent Chromium as Cr VI	**< 5.0**	mg/Kg	5.0	USEPA 3060 / APHA AWWA 3120 B
Copper as Cu *	**3.9**	mg/kg	1.0	APHA AWWA 3120 B
Lead as Pb *	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Manganese as Mn *	**126.2**	mg/kg	2.0	APHA AWWA 3120 B
Mercury as Hg	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Nickel as Ni *	**49.4**	mg/kg	2.0	APHA AWWA 3120 B
Selenium as Se *	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Zinc as Zn *	**4.9**	mg/kg	2.0	APHA AWWA 3120 B

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LB-073-TEST

TESTING | INVESTIGATION | ASSURING

LABORATORY ANALYSIS ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date :** 14/08/2019
Nature of Business : Environment Consultant	**Report No :** RP/SA-02441/02
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates	**Sample No :** SP/SA-02441/02
	Sampling Report No : Not Applicable

Test Method Variation: None
Remarks: 1) * This Test is Accredited by Emirates International Accreditation Centre (EIAC).
2) £ Water / KCl / $NaHCO_3$ Extract
Reference: APHA AWWA WEF 23rd Ed. 2017 Standard Method for the Examination of Water and Waste Water.

Results relates only to the items tested.

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DISCLAIMER: For complete scope of accreditation kindly visit EIAC website http://www.eiac.gov.ae/en/accrediatedcabs/Pages/default.aspx

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LABORATORY ANALYSIS ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING
Nature of Business : Environment Consultant
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates

Date : 14/08/2019
Report No : RP/SA-02441/03
Sample No : SP/SA-02441/03
Sampling Report No : Not Applicable

Sample Detail

Sample Type : Soil
Source of Sample : Existing Soil Material
Sampling Point : Soil Sample 3, Laydown Area 1, N 25 39 09.4" , E 055 44 44.8"
Sampling Location : Project 1305/001/061 FEWA 150 MIGD SWRO-UAQ, Umm Al Quwain, UAE

On-Site Details

pH / Temperature : Not Applicable
Appearance : Brown Solid
Preservation : Yes

Sampling Detail

Apparatus : Not Given
Quantity / Size : Plastic (1*1 Kg)
Sampling Date / Time : 30/07/2019 / Not Given
Receiving Date : 30/07/2019 **Time :** 14:00 Hrs

Method : Not Given
Collected by : Client Rep.
Delivered by : Client Rep.
Received by : Al (Core Lab Rep.)

Results of Chemical Analysis | **Tested by :** Al/ GT/ DC | **Date of Analysis :** 30/07/2019 - 08/08/2019

Parameters	RESULT	Unit	MDL	Test Method
pH @ 25 °C *	**8.7**	-	0.1	BS EN 15933 E
Oil & Grease	**0.17**	% dry solid	0.15	APHA AWWA 5520 E
Chloride as Cl	**30**	mg/Kg	1	British Standard 1377 Part 3
Sulfate as SO4	**32**	mg/Kg	1	British Standard 1377 Part 3
Phosphate Phosphorus as PO4	**344.62**	mg/Kg	0.10	USEPA PhosVer 3 Method £
Orthophosphate as P2O5	**257.6**	mg/Kg	2.0	Phos Ver 3 Method £
Nitrate Nitrogen as NO3-N	**69.4**	mg/Kg	1.5	Cadmium Reduction Method £
Total Kjeldahl Nitrogen (TKN)	**100.8**	mg/Kg	5.0	APHA AWWA Norg C
Gasoline Range (C5 - C10)	**< 2.0**	mg/Kg	2.0	USEPA 8015
Diesel Range (C11 - C28)	**< 20.0**	mg/Kg	20.0	USEPA 8015
Motor Oil Range (C29 - C40)	**< 50.0**	mg/Kg	50.0	USEPA 8015
Sodium as Na	**388.2**	mg/Kg	1.0	APHA AWWA 3120 B
Potassium as K	**604.5**	mg/Kg	1.0	APHA AWWA 3120 B
Arsenic as As *	**< 5.0**	mg/kg	5.0	APHA AWWA 3120 B
Barium as Ba *	**21.8**	mg/kg	1.0	APHA AWWA 3120 B
Cadmium as Cd *	**< 2.0**	mg/kg	2.0	APHA AWWA 3120 B
Chromium as Cr *	**43.0**	mg/kg	1.0	APHA AWWA 3120 B
Hexavalent Chromium as Cr VI	**< 5.0**	mg/Kg	5.0	USEPA 3060 / APHA AWWA 3120 B
Copper as Cu *	**2.7**	mg/kg	1.0	APHA AWWA 3120 B
Lead as Pb *	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Manganese as Mn *	**121.1**	mg/kg	2.0	APHA AWWA 3120 B
Mercury as Hg	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Nickel as Ni *	**63.3**	mg/kg	2.0	APHA AWWA 3120 B
Selenium as Se *	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Zinc as Zn *	**8.3**	mg/kg	2.0	APHA AWWA 3120 B

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LABORATORY ANALYSIS ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date :** 14/08/2019
Nature of Business : Environment Consultant	**Report No :** RP/SA-02441/03
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates	**Sample No :** SP/SA-02441/03
	Sampling Report No : Not Applicable

Test Method Variation: None
Remarks: 1) * This Test is Accredited by Emirates International Accreditation Centre (EIAC).
2) £ Water / KCl / $NaHCO_3$ Extract
Reference: APHA AWWA WEF 23rd Ed. 2017 Standard Method for the Examination of Water and Waste Water.

Results relates only to the items tested.

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Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING
Nature of Business : Environment Consultant
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates

Date : 14/08/2019
Report No : RP/SA-02441/04
Sample No : SP/SA-02441/04
Sampling Report No : Not Applicable

Sample Detail

Sample Type : Soil
Source of Sample : Existing Soil Material
Sampling Point : Soil Sample 4, Laydown Area 2, N 25 39 01.4" , E 055 45 00.2"
Sampling Location : Project 1305/001/061 FEWA 150 MIGD SWRO-UAQ, Umm Al Quwain, UAE

On-Site Details

pH / Temperature : Not Applicable
Appearance : Brown Solid
Preservation : Yes

Sampling Detail

Apparatus : Not Given
Quantity / Size : Plastic (1*1 Kg)
Sampling Date / Time : 30/07/2019 / Not Given
Receiving Date : 30/07/2019 **Time :** 14:00 Hrs

Method : Not Given
Collected by : Client Rep.
Delivered by : Client Rep.
Received by : AI (Core Lab Rep.)

Results of Chemical Analysis — **Tested by :** AI/ GT/ DC — **Date of Analysis :** 30/07/2019 - 08/08/2019

Parameters	RESULT	Unit	MDL	Test Method
pH @ 25 °C *	**9.0**	-	0.1	BS EN 15933 E
Oil & Grease	**0.15**	% dry solid	0.15	APHA AWWA 5520 E
Chloride as Cl	**30**	mg/Kg	1	British Standard 1377 Part 3
Sulfate as SO4	**10**	mg/Kg	1	British Standard 1377 Part 3
Phosphate Phosphorus as PO4	**582.54**	mg/Kg	0.10	USEPA PhosVer 3 Method £
Orthophosphate as P2O5	**435.4**	mg/Kg	2.0	Phos Ver 3 Method £
Nitrate Nitrogen as NO3-N	**48.5**	mg/Kg	1.5	Cadmium Reduction Method £
Total Kjeldahl Nitrogen (TKN)	**99.6**	mg/Kg	5.0	APHA AWWA Norg C
Gasoline Range (C5 - C10)	**< 2.0**	mg/Kg	2.0	USEPA 8015
Diesel Range (C11 - C28)	**< 20.0**	mg/Kg	20.0	USEPA 8015
Motor Oil Range (C29 - C40)	**< 50.0**	mg/Kg	50.0	USEPA 8015
Sodium as Na	**253.4**	mg/Kg	1.0	APHA AWWA 3120 B
Potassium as K	**940.2**	mg/Kg	1.0	APHA AWWA 3120 B
Arsenic as As *	**< 5.0**	mg/kg	5.0	APHA AWWA 3120 B
Barium as Ba *	**20.0**	mg/kg	1.0	APHA AWWA 3120 B
Cadmium as Cd *	**< 2.0**	mg/kg	2.0	APHA AWWA 3120 B
Chromium as Cr *	**35.6**	mg/kg	1.0	APHA AWWA 3120 B
Hexavalent Chromium as Cr VI	**< 5.0**	mg/Kg	5.0	USEPA 3060 / APHA AWWA 3120 B
Copper as Cu *	**5.2**	mg/kg	1.0	APHA AWWA 3120 B
Lead as Pb *	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Manganese as Mn *	**153.4**	mg/kg	2.0	APHA AWWA 3120 B
Mercury as Hg	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Nickel as Ni *	**86.0**	mg/kg	2.0	APHA AWWA 3120 B
Selenium as Se *	**< 1.0**	mg/kg	1.0	APHA AWWA 3120 B
Zinc as Zn *	**8.9**	mg/kg	2.0	APHA AWWA 3120 B

LABORATORY ANALYSIS ON SOIL

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date :** 14/08/2019
Nature of Business : Environment Consultant	**Report No :** RP/SA-02441/04
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road,	**Sample No :** SP/SA-02441/04
Dubai, United Arab Emirates	**Sampling Report No :** Not Applicable

Test Method Variation: None
Remarks: 1) * This Test is Accredited by Emirates International Accreditation Centre (EIAC).
2) £ Water / KCl / $NaHCO_3$ Extract
Reference: APHA AWWA WEF 23rd Ed. 2017 Standard Method for the Examination of Water and Waste Water.

Results relates only to the items tested.

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Appendix H – Groundwater Analysis Laboratory Results

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LABORATORY TEST REPORT ON GROUNDWATER

Client Name :5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date** : 15/09/2018
Nature of Business : Environment Consultant	**Report No** : RP/SA-00952/13
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates	**Sample No** : SP/SA-00952/13
	Sampling Report No : SRN/SA-00952/13

Sample Detail / **On-Site Details**

Sample Type : Liquid (Ground Water)	**pH / Temperature** : 32.3ºC
Source of Sample : Ground Water from Borehole	**Appearance** : Mild Turbid Liquid
Sampling Point : GW1, BH1, Total Depth- 3 m, 25.654344 N, 55.747632 E	**Preservation** : Yes
Sampling Location : GW1, BH1, FEWA 45 MIGD SWRO Independent Water Project, Umm Al Quwain, UAE	

Sampling Detail

Apparatus : Bailer and Bottles	**Method** : APHA 1060 B & 9060
Quantity / Size : Plastic (1*1 Ltr)	**Collected by** : SL/BN (Core Lab Rep.)
Sampling Date / Time : 06/09/2018 / 12:10 Hrs	**Delivered by** : SL/BN (Core Lab Rep.)
Sample Transport Condition : Below 10°C (Micro)	
Receiving Date :06/09/2018 **Time** : 13:50 Hrs	**Received by** : AC (Core Lab Rep.)
Sample Temperature on Receipt : Below 10°C (Micro)	**Sample Condition** : OK

Result of Chemical and Microbiological Analysis	**Tested by** : AC/DC/DT/MK		**Date of Analysis** : 06/09/2018 - 15/09/2018	
Parameters	**RESULT**	**Unit**	**MDL**	**Test Method**
pH @ 20 °C *	7.7	-	0.1	APHA AWWA 4500 H+ B
Oil & Grease (emulsified) *	< 10	mg/L	10	APHA AWWA 5520 B
TPH Gasoline Range (C5 - C10)	< 0.02	mg/L	0.02	USEPA 8015
TPH Diesel Range (C11-C28)	< 0.10	mg/L	0.10	USEPA 8015
TPH Motor Oil Range (C29 - C40)	< 0.50	mg/L	0.50	USEPA 8015
Chloride as Cl- *	15530	mg/L	1	APHA AWWA 4500 Cl B
Total Sulfates as SO4 *	4499	mg/L	8	APHA AWWA 4500 SO4 C
Phosphate - Phosphorus as PO4 *	< 0.02	mg/L	0.02	USEPA Phos Ver 3
Orthophosphate as P2O5 *	< 0.02	mg/L	0.02	USEPA PhosVer 3 Method
Nitrate as NO3 *	7.30	mg/L	0.01	Cadmium Reduction Method
Total Kjeldahl Nitrogen (TKN) *	< 0.5	mg/L	0.5	APHA AWWA 4500 Norg C
Potassium as K *	230.00	mg/L	0.10	APHA AWWA 3030 E / 3120 B
Sodium as Na *	6270.00	mg/L	0.10	APHA AWWA 3030 E / 3120 B
Arsenic as As *	< 0.01	mg/L	0.01	APHA AWWA 3030 E / 3120 B
Barium as Ba	0.05	mg/L	0.01	APHA AWWA 3030 E / 3120 B
Cadmium as Cd *	< 0.002	mg/L	0.002	APHA AWWA 3030 E / 3120 B
Chromium as Cr *	< 0.006	mg/L	0.006	APHA AWWA 3030 E / 3120 B
Hexavalent Chromium as Cr VI	< 0.05	mg/L	0.05	USEPA 3060 / APHA 3120 B
Copper as Cu *	0.006	mg/L	0.006	APHA AWWA 3030 E / 3120 B
Lead as Pb *	< 0.015	mg/L	0.015	APHA AWWA 3030 E / 3120 B
Manganese as Mn *	0.061	mg/L	0.002	APHA AWWA 3030 E / 3120 B
Mercury as Hg	< 0.001	mg/L	0.001	APHA AWWA 3030 E / 3120 B
Nickel as Ni *	< 0.005	mg/L	0.005	APHA AWWA 3030 E / 3120 B
Selenium as Se *	< 0.02	mg/L	0.02	APHA AWWA 3030 E / 3120 B
Zinc as Zn *	0.018	mg/L	0.006	APHA AWWA 3030 E / 3120 B
Total Coliforms	280	CFU/100ml	1	APHA AWWA 9222 B
Fecal Coliforms	200	CFU/100ml	1	APHA AWWA 9222 D
Escherichia coli	200	CFU/100ml	1	APHA AWWA 9222 G

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CORE LABORATORY
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LABORATORY TEST REPORT ON GROUNDWATER

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date :** 15/09/2018
Nature of Business : Environment Consultant	**Report No :** RP/SA-00952/13
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road,	**Sample No :** SP/SA-00952/13
Dubai, United Arab Emirates	**Sampling Report No :** SRN/SA-00952/13

NOTES
Test Variation: None
Remarks: 1) * This Test is Accredited by Dubai Municipality (DAC).
2) ND - Not Detected (<1), CFU - Colony Forming Unit

Reference: APHA AWWA WEF 22nd Ed. 2012 Standard Method for the Examination of Water and Waste Water.

Results relates only to the items tested.
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CORE LABORATORY
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LABORATORY TEST REPORT ON GROUNDWATER

Client Name :5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING
Nature of Business : Environment Consultant
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates
Date : 15/09/2018
Report No : RP/SA-00952/14
Sample No : SP/SA-00952/14
Sampling Report No : SRN/SA-00952/14

Sample Detail

Sample Type : Liquid (Ground water)
Source of Sample : Ground Water from Borehole
Sampling Point : GW 2, BH 2, Total Depth-1.3 m, 25.654376 N, 55.750250 E
Sampling Location : GW 2, BH 2, FEWA 45 MIGD SWRO Independent Water Project, Umm Al Quwain, UAE

On-Site Details

pH / Temperature : 32.2°C
Appearance : Mild Turbid Liquid
Preservation : Yes

Sampling Detail

Apparatus : Bailer and Bottles
Quantity / Size : Plastic (1*1 Ltr), Amber (1*1 L), Glass (2*1 Ltr) & Micro (1*500ml)
Sampling Date / Time : 05/09/2018 / 10:30 Hrs
Sample Transport Condition : Below 10°C (Micro)
Receiving Date :05/09/2018 **Time** : 13:45 Hrs
Sample Temperature on Receipt : Below 10°C (Micro)
Method : APHA 1060 B & 9060
Collected by : SL/BN (Core Lab Rep.)
Delivered by : SL/BN (Core Lab Rep.)
Received by : DC (Core Lab Rep.)
Sample Condition : OK

Result of Chemical and Microbiological Analysis	Tested by : AC/DC/DT/MK		Date of Analysis : 05/09/2018 - 15/09/2018	
Parameters	**RESULT**	**Unit**	**MDL**	**Test Method**
pH @ 20 °C *	**7.1**	-	0.1	APHA AWWA 4500 H+ B
Oil & Grease (emulsified) *	**< 10**	mg/L	10	APHA AWWA 5520 B
TPH Gasoline Range (C5 - C10)	**< 0.02**	mg/L	0.02	USEPA 8015
TPH Diesel Range (C11-C28)	**< 0.10**	mg/L	0.10	USEPA 8015
TPH Motor Oil Range (C29 - C40)	**< 0.50**	mg/L	0.50	USEPA 8015
Chloride as Cl- *	**55811**	mg/L	1	APHA AWWA 4500 Cl B
Total Sulfates as SO4 *	**9599**	mg/L	8	APHA AWWA 4500 SO4 C
Phosphate - Phosphorus as PO4 *	**< 0.02**	mg/L	0.02	USEPA Phos Ver 3
Orthophosphate as P2O5 *	**< 0.02**	mg/L	0.02	USEPA PhosVer 3 Method
Nitrate as NO3 *	**15.80**	mg/L	0.01	Cadmium Reduction Method
Total Kjeldahl Nitrogen (TKN) *	**< 0.5**	mg/L	0.5	APHA AWWA 4500 Norg C
Potassium as K *	**1304.00**	mg/L	0.10	APHA AWWA 3030 E / 3120 B
Sodium as Na *	**31280.00**	mg/L	0.10	APHA AWWA 3030 E / 3120 B
Arsenic as As *	**< 0.01**	mg/L	0.01	APHA AWWA 3030 E / 3120 B
Barium as Ba	**< 0.01**	mg/L	0.01	APHA AWWA 3030 E / 3120 B
Cadmium as Cd *	**< 0.002**	mg/L	0.002	APHA AWWA 3030 E / 3120 B
Chromium as Cr *	**< 0.006**	mg/L	0.006	APHA AWWA 3030 E / 3120 B
Hexavalent Chromium as Cr VI	**< 0.05**	mg/L	0.05	USEPA 3060 / APHA 3120 B
Copper as Cu *	**< 0.006**	mg/L	0.006	APHA AWWA 3030 E / 3120 B
Lead as Pb *	**< 0.015**	mg/L	0.015	APHA AWWA 3030 E / 3120 B
Manganese as Mn *	**0.011**	mg/L	0.002	APHA AWWA 3030 E / 3120 B
Mercury as Hg	**< 0.001**	mg/L	0.001	APHA AWWA 3030 E / 3120 B
Nickel as Ni *	**< 0.005**	mg/L	0.005	APHA AWWA 3030 E / 3120 B
Selenium as Se *	**< 0.02**	mg/L	0.02	APHA AWWA 3030 E / 3120 B
Zinc as Zn *	**0.046**	mg/L	0.006	APHA AWWA 3030 E / 3120 B
Total Coliforms	**Not Detected**	CFU/100ml	1	APHA AWWA 9222 B
Fecal Coliforms	**Not Detected**	CFU/100ml	1	APHA AWWA 9222 D
Escherichia coli	**Not Detected**	CFU/100ml	1	APHA AWWA 9222 G

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LABORATORY TEST REPORT ON GROUNDWATER

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date** : 15/09/2018
Nature of Business : Environment Consultant	**Report No** : RP/SA-00952/14
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road,	**Sample No** : SP/SA-00952/14
Dubai, United Arab Emirates	**Sampling Report No** : SRN/SA-00952/14

NOTES
Test Variation: None
Remarks: 1) * This Test is Accreditated by Dubai Municipality (DAC).
2) ND - Not Detected (<1), CFU - Colony Forming Unit

Reference: APHA AWWA WEF 22nd Ed. 2012 Standard Method for the Examination of Water and Waste Water.

Results relates only to the items tested.
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Liwelyn Villapando
Laboratory Manager
For CORE Laboratory

APPENDIX I – POND WATER ANALYSIS RESULTS

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DAC LB-073-TEST

CORE LABORATORY
TESTING | INVESTIGATION | ASSURING

LABORATORY TEST REPORT ON POND WATER

Client Name :5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date** : 15/09/2018
Nature of Business : Environment Consultant	**Report No** : RP/SA-00952/12
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road,	**Sample No** : SP/SA-00952/12
Dubai, United Arab Emirates	**Sampling Report No** : SRN/SA-00952/12

Sample Detail | **On-Site Details**

Sample Type : Pond Water	**pH / Temperature** : 19.1°C
Source of Sample : Pond Water	**Appearance** : Mild Turbid Liquid
Sampling Point : 25°39 15.2 N, 55°45 01.9 E	**Preservation** : Yes
Sampling Location : Pond Water, FEWA 45 MIGD SWRO Independent Water Project, Umm Al Quwain, UAE	

Sampling Detail

Apparatus : Bailer and Bottles	**Method** : APHA 1060 B & 9060
Quantity / Size : Plastic (1*1 Ltr), Amber (1*1 L), Glass (2*1 Ltr) & Micro (1*500ml)	**Collected by** : SL/BN (Core Lab Rep.)
Sampling Date / Time : 04/09/2018 / 11:55 Hrs	**Delivered by** : SL/BN (Core Lab Rep.)
Sample Transport Condition : Below 10°C (Micro)	
Receiving Date :04/09/2017 **Time** : 13:45 Hrs	**Received by** : DC (Core Lab Rep.)
Sample Temperature on Receipt : Below 10°C (Micro)	**Sample Condition** : OK

Result of Chemical and Microbiological Analysis	**Tested by** : AC/DC/DT/MK	**Date of Analysis** : 04/09/2017 - 15/09/2018		
Parameters	**RESULT**	**Unit**	**MDL**	**Test Method**
pH @ 20 °C *	**8.1**	-	0.1	APHA AWWA 4500 H+ B
Oil & Grease (emulsified) *	**< 10**	mg/L	10	APHA AWWA 5520 B
TPH Gasoline Range (C5 - C10)	**< 0.02**	mg/L	0.02	USEPA 8015
TPH Diesel Range (C11-C28)	**< 0.10**	mg/L	0.10	USEPA 8015
TPH Motor Oil Range (C29 - C40)	**< 0.50**	mg/L	0.50	USEPA 8015
Chloride as Cl- *	**40281**	mg/L	1	APHA AWWA 4500 Cl B
Total Sulfates as SO4 *	**8800**	mg/L	8	APHA AWWA 4500 SO4 C
Phosphate - Phosphorus as PO4 *	**< 0.02**	mg/L	0.02	USEPA Phos Ver 3
Orthophosphate as P2O5 *	**< 0.02**	mg/L	0.02	USEPA PhosVer 3 Method
Nitrate as NO3 *	**0.80**	mg/L	0.01	Cadmium Reduction Method
Total Kjeldahl Nitrogen (TKN) *	**0.6**	mg/L	0.5	APHA AWWA 4500 Norg C
Potassium as K *	**898.00**	mg/L	0.10	APHA AWWA 3030 E / 3120 B
Sodium as Na *	**20840.00**	mg/L	0.10	APHA AWWA 3030 E / 3120 B
Arsenic as As *	**< 0.01**	mg/L	0.01	APHA AWWA 3030 E / 3120 B
Barium as Ba	**< 0.01**	mg/L	0.01	APHA AWWA 3030 E / 3120 B
Cadmium as Cd *	**< 0.002**	mg/L	0.002	APHA AWWA 3030 E / 3120 B
Chromium as Cr *	**< 0.006**	mg/L	0.006	APHA AWWA 3030 E / 3120 B
Hexavalent Chromium as Cr VI	**< 0.05**	mg/L	0.05	USEPA 3060 / APHA 3120 B
Copper as Cu *	**< 0.006**	mg/L	0.006	APHA AWWA 3030 E / 3120 B
Lead as Pb *	**< 0.015**	mg/L	0.015	APHA AWWA 3030 E / 3120 B
Manganese as Mn *	**0.014**	mg/L	0.002	APHA AWWA 3030 E / 3120 B
Mercury as Hg	**< 0.001**	mg/L	0.001	APHA AWWA 3030 E / 3120 B
Nickel as Ni *	**< 0.005**	mg/L	0.005	APHA AWWA 3030 E / 3120 B
Selenium as Se *	**< 0.02**	mg/L	0.02	APHA AWWA 3030 E / 3120 B
Zinc as Zn *	**< 0.006**	mg/L	0.006	APHA AWWA 3030 E / 3120 B
Total Coliforms	**Not Detected**	CFU/100ml	1	APHA AWWA 9222 B
Fecal Coliforms	**Not Detected**	CFU/100ml	1	APHA AWWA 9222 D
Escherichia coli	**Not Detected**	CFU/100ml	1	APHA AWWA 9222 G

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LB-073-TEST

CORE LABORATORY
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LABORATORY TEST REPORT ON POND WATER

Client Name : 5 CAPITALS ENVIRONMENTAL AND MANAGEMENT CONSULTING	**Date** : 15/09/2018
Nature of Business : Environment Consultant	**Report No** : RP/SA-00952/12
Client Address : P O Box 119899, Sheikha Sana Bldg, Shk Zayed Road, Dubai, United Arab Emirates	**Sample No** : SP/SA-00952/12
	Sampling Report No : SRN/SA-00952/12

Notes
Test Variation: None
Remarks: 1) * This Test is Accreditated by Dubai Municipality (DAC).
2) ND - Not Detected (<1), CFU - Colony Forming Unit

Reference: APHA AWWA WEF 22nd Ed. 2012 Standard Method for the Examination of Water and Waste Water.

Results relates only to the items tested.
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DISCLAIMER: For complete scope of accreditation kindly visit DAC website http://www.dac.dm.ae/dac/major/home

Liwelyn Villapando
Laboratory Manager
For CORE Laboratory

APPENDIX J – AMBIENT AIR QUALITY INSTRUMENT CALIBRATION CERTIFICATE

Certificate of Calibration

Certificate Number: EDCQP200-4.11.5

Environmental Devices Corporation certifies the Haz-Scanner model HIM-6000 is calibrated to published specifications and NIST traceable.

Calibration Dust Specifications are NIST traceable using Coulter Mutisizer II e. ISO12103 –1 A2 Fine Test Dust and is designed to agree with EPA Class I and Class III FRM and FEM particulate samplers and monitors and EN 12341 and EN 14907 standards.

Gas sensors are Calibrated against NIST/EPA traceable Calibration Gas using NIST primary Flow Standard: LFE774300 to ISO 17025 and EPA Instrumental Test Methods as defined by 40 CFR Part 60.

Quality system standard to meet the requirements of ANSI/ASQC standard Q9000-1994 (ISO 9001), MIL-STD 45662A, and customer's specification if required.

Temperature = 22°C
Relative Humidity = 30%
Atmospheric Pressure = 760 mmHg
Measurement Uncertainty Estimated @ 95% Confidence Level (k=2) using ISO 17025 guidelines.

Model	Serial Number	Calibration Date	Next Calibration Due
HIM-6000	9140022	July 2018	July 2019

Calibration Span Accessory if purchased	Sensor A K=	Sensor B K=	Model :

Dan Okuniewicz	Mark Sullivan
Technician	Supervisor

Environmental Devices Corporation
4 Wilder Drive Building #15
Plaistow, NH 03865
ISO-9001 Certified

PARTICULATES NOT OTHERWISE REGULATED, RESPIRABLE 0600

DEFINITION: aerosol collected by sampler with 4-µm median cut point | CAS: None | RTECS: None

METHOD: 0600, Issue 3	EVALUATION: FULL	Issue 1: 15 February 1984 Issue 3: 15 January 1998

OSHA: 5 mg/m³
NIOSH: no REL
ACGIH: 3 mg/m³

PROPERTIES: contains no asbestos and quartz less than 1%; penetrates non-ciliated portions of respiratory system

SYNONYMS: nuisance dusts; particulates not otherwise classified

SAMPLING

SAMPLER:	CYCLONE + FILTER (10-mm nylon cyclone, Higgins-Dewell [HD] cyclone, or Aluminum cyclone + tared 5-µm PVC membrane)
FLOW RATE:	nylon cyclone: 1.7 L/min HD cyclone: 2.2 L/min Al cyclone: 2.5 L/min
VOL-MIN: **-MAX:**	20 L @ 5 mg/m³ 400 L
SHIPMENT:	routine
SAMPLE STABILITY:	stable
BLANKS:	2 to 10 field blanks per set

ACCURACY

RANGE STUDIED:	0.5 to 10 mg/m³ (lab and field)
BIAS:	dependent on dust size distribution [1]
OVERALL PRECISION ($\hat{S}_{rT}$):	dependent on size distribution [1,2]
ACCURACY:	dependent on size distribution [1]

MEASUREMENT

TECHNIQUE:	GRAVIMETRIC (FILTER WEIGHT)
ANALYTE:	mass of respirable dust fraction
BALANCE:	0.001 mg sensitivity; use same balance before and after sample collection
CALIBRATION:	National Institute of Standards and Technology Class S-1.1 or ASTM Class 1 weights
RANGE:	0.1 to 2 mg per sample
ESTIMATED LOD:	0.03 mg per sample
PRECISION:	<10 µg with 0.001 mg sensitivity balance; <70 µg with 0.01 mg sensitivity balance [3]

APPLICABILITY: The working range is 0.5 to 10 mg/m³ for a 200-L air sample. The method measures the mass concentration of any non-volatile respirable dust. In addition to inert dusts [4], the method has been recommended for respirable coal dust. The method is biased in light of the recently adopted international definition of respirable dust, e.g., ≈ +7% bias for non-diesel, coal mine dust [5].

INTERFERENCES: Larger than respirable particles (over 10 µm) have been found in some cases by microscopic analysis of cyclone filters. Over-sized particles in samples are known to be caused by inverting the cyclone assembly. Heavy dust loadings, fibers, and water-saturated dusts also interfere with the cyclone's size-selective properties. The use of conductive samplers is recommended to minimize particle charge effects.

OTHER METHODS: This method is based on and replaces Sampling Data Sheet #29.02 [6].

ENVIRONMENTAL DEVICES CORPORATION

Calibration Report

Date: July 2018

Customer Name:

System ID: Serial Number 9140022

Notes:

BASIC CHECK

Power Voltage	PASS
CPU Diagnostic Test	PASS
Air Flow Rate	PASS
Digital Communication	PASS
Sensor Output Voltages	PASS
Signal Channel Voltages	PASS
Memory Card Voltages	PASS

SENSOR	Low Span	Observed Low Test Result	High Span	Observed High Test Result	Calibration Accuracy
PM A *(10μm)*	0 μg/m³	0 μg/m³	5000 μg/m³	5000 μg/m³	+/- 10ug/m3
PM B *(2.5μm)*	0 μg/m³	0 μg/m³	5000 μg/m³	5000 μg/m³	+/- 10 ug/m3
CH4	0 ppm	0 ppm	25000 ppm	25000 ppm	+/- 25 ppm
CO	0 ppm	0 ppm	2.5 ppm	2.5 ppm	+/- 0.01 ppm
H2S	0 ppb	0 ppb	652 ppb	652 ppb	+/-5ppb
NO_2	0 ppb	0 ppb	374 ppb	374 ppb	+/- 5 ppb
SO_2	0 ppb	0 ppb	352 ppb	352 ppb	+/- 5 ppb
VOC	0 ppb	0 ppb	500 ppb	500 ppb	+/- 5ppb
O3	0 ppb	0 ppb	58 ppb	58 ppb	+/- .1 ppb
Temperature	0°C	0°C	50°C	50°C	+/- 2°C
Relative Humidity	13%	13%	75%	75%	+/- 3%

Wind Speed and Direction Not Returned

Calibration Technician Dan Okuniewicz
Dan Okuniewicz

Supervisor
Mark Sullivan

C-AQ-0

Certificate of Calibration

Certificate Number: EDCQP200-4.11.5

Environmental Devices Corporation certifies the Haz-Scanner model HIM-6000 is calibrated to published specifications and NIST traceable.

Calibration Dust Specifications are NIST traceable using Coulter Mutisizer II e. ISO12103 –1 A2 Fine Test Dust and is designed to agree with EPA Class I and Class III FRM and FEM particulate samplers and monitors and EN 12341 and EN 14907 standards.

Gas sensors are Calibrated against NIST/EPA traceable Calibration Gas using NIST primary Flow Standard: LFE774300 to ISO 17025 and EPA Instrumental Test Methods as defined by 40 CFR Part 60.

Quality system standard to meet the requirements of ANSI/ASQC standard Q9000-1994 (ISO 9001), MIL-STD 45662A, and customer's specification if required.

Temperature = 22°C
Relative Humidity = 30%
Atmospheric Pressure = 760 mmHg
Measurement Uncertainty Estimated @ 95% Confidence Level (k=2) using ISO 17025 guidelines.

Model	Serial Number	Calibration Date	Next Calibration Due
HIM-6000	914003	January 8, 2018	January 2019

Calibration Span Accessory if purchased	Sensor A K=	Sensor B K=	Model :
Dan Okuniewicz	Mark Sullivan		

Dan Okuniewicz
Technician

Mark Sullivan
Supervisor

Environmental Devices Corporation
4 Wilder Drive Building #15
Plaistow, NH 03865
ISO-9001 Certified

PARTICULATES NOT OTHERWISE REGULATED, RESPIRABLE 0600

DEFINITION: aerosol collected by sampler with 4-µm median cut point | CAS: None | RTECS: None

METHOD: 0600, Issue 3	**EVALUATION: FULL**	**Issue 1: 15 February 1984** **Issue 3: 15 January 1998**

OSHA: 5 mg/m³
NIOSH: no REL
ACGIH: 3 mg/m³

PROPERTIES: contains no asbestos and quartz less than 1%; penetrates non-ciliated portions of respiratory system

SYNONYMS: nuisance dusts; particulates not otherwise classified

SAMPLING

SAMPLER:	CYCLONE + FILTER (10-mm nylon cyclone, Higgins-Dewell [HD] cyclone, or Aluminum cyclone + tared 5-µm PVC membrane)
FLOW RATE:	nylon cyclone: 1.7 L/min HD cyclone: 2.2 L/min Al cyclone: 2.5 L/min
VOL-MIN:	20 L @ 5 mg/m³
-MAX:	400 L
SHIPMENT:	routine
SAMPLE STABILITY:	stable
BLANKS:	2 to 10 field blanks per set

ACCURACY

RANGE STUDIED:	0.5 to 10 mg/m³ (lab and field)
BIAS:	dependent on dust size distribution [1]
OVERALL PRECISION ($\hat{S}_{rT}$):	dependent on size distribution [1,2]
ACCURACY:	dependent on size distribution [1]

MEASUREMENT

TECHNIQUE:	GRAVIMETRIC (FILTER WEIGHT)
ANALYTE:	mass of respirable dust fraction
BALANCE:	0.001 mg sensitivity; use same balance before and after sample collection
CALIBRATION:	National Institute of Standards and Technology Class S-1.1 or ASTM Class 1 weights
RANGE:	0.1 to 2 mg per sample
ESTIMATED LOD:	0.03 mg per sample
PRECISION:	<10 µg with 0.001 mg sensitivity balance; <70 µg with 0.01 mg sensitivity balance [3]

APPLICABILITY: The working range is 0.5 to 10 mg/m³ for a 200-L air sample. The method measures the mass concentration of any non-volatile respirable dust. In addition to inert dusts [4], the method has been recommended for respirable coal dust. The method is biased in light of the recently adopted international definition of respirable dust, e.g., ≈ +7% bias for non-diesel, coal mine dust [5].

INTERFERENCES: Larger than respirable particles (over 10 µm) have been found in some cases by microscopic analysis of cyclone filters. Over-sized particles in samples are known to be caused by inverting the cyclone assembly. Heavy dust loadings, fibers, and water-saturated dusts also interfere with the cyclone's size-selective properties. The use of conductive samplers is recommended to minimize particle charge effects.

OTHER METHODS: This method is based on and replaces Sampling Data Sheet #29.02 [6].

ENVIRONMENTAL DEVICES CORPORATION

Calibration Report

Date: January 8, 2018

Customer Name:
System ID: Serial Number 914003
Notes:

BASIC CHECK

Power Voltage	PASS
CPU Diagnostic Test	PASS
Air Flow Rate	PASS
Digital Communication	PASS
Sensor Output Voltages	PASS
Signal Channel Voltages	PASS
Memory Card Voltages	PASS

SENSOR	Low Span	Observed Low Test Result	High Span	Observed High Test Result	Calibration Accuracy
PM A *(10µm)*	0 µg/m³	0 µg/m³	5000 µg/m³	5000 µg/m³	+/- 10ug/m3
PM B *(2.5µm)*	0 µg/m³	0 µg/m³	5000 µg/m³	5000 µg/m³	+/- 10 ug/m3
CH4	0 ppm	0 ppm	25000 ppm	25000 ppm	+/- 25 ppm
CO	0 ppm	0 ppm	2.5 ppm	2.5 ppm	+/- 0.01 ppm
CO_2	300ppm	300 ppm	1000 ppm	1000 ppm	+/- 50 ppm
H2S	0 ppb	0 ppb	652 ppb	652 ppb	+/-5ppb
NO_2	0 ppb	0 ppb	374 ppb	374 ppb	+/- 5 ppb
SO_2	0 ppb	0 ppb	352 ppb	352 ppb	+/- 5 ppb
VOC	0 ppb	0 ppb	500 ppb	500 ppb	+/- 5ppb
O3	0 ppb	0 ppb	58 ppb	58 ppb	+/- .1 ppb
Temp	0°C	0°C	50°C	50°C	+/- 2°C
RH	13%	13%	75%	75%	+/- 3%

Wind Speed and Direction not returned with Device

Calibration Technician Dan Okuniewicz

Dan Okuniewicz

Supervisor

Mark Sullivan

APPENDIX K – AIR QUALITY LABORATORY RESULTS

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RPSA 00952-02-02

HOURLY & 24 HOURS AVERAGE DATA FOR AMBIENT AIR QUALITY

Client Detail			Lab ID Detail		
	Name	5 Capitals Environmental and Management Consulting		Date	09/09/2018
	Address	Sheikh Zayed Road, Near Dubai Mall Station,		Report Number	RPSA 00952-02-02
		P O Box 119899, Dubai, United Arab Emirates		Sample Number	RPSA 00952-02
	Nature of Business	Environmental Consultant			
	Reference	AAQM 02 - Open Area			

Hourly Average Results	CO	NO_2	SO_2	O_3	VOC	PM 2.5	PM 10	Temp	U.R.	VV.	DV
	mg/m^3	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	$\mu g/m^3$	$\mu g/m^3$	°C	%	kph	°
Detection Limit	0.02	38	52	20	0.02	10	10	0.1	0.1	0.1	1
06 -07 September 2018											DAY 3
24 Hours Avg	0.26	62	< 52	29	0.06	39	87	33.7	34.6	6.2	73

CORE DUBAI-U.A.E. LABORATORY P.O.Box: 232686 كور لابوراتوري

Murtaza Huseni
Manager Technical & Operation
For CORE Laboratory

APPENDIX L – SOUND LEVEL METER CALIBRATION CERTIFICATE

Certificate of Calibration

Equipment Details

Instrument Manufacturer	Cirrus Research Plc
Instrument Type	CR:171B
Description	Sound Level Meter
Serial Number	G071110

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2013, IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:2003, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.

Sound Level Meters. All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards (A.0.6) The standards are:

Microphone Type	GRAS 40AP	Serial Number	173198	Calibration Ref	0170
Calibrator Type	B&K 4231	Serial Number	2594796	Calibration Ref	A1811

Calibrated by T. A Goodwil

Calibration Date 29 March 2019

Calibration Certificate Number 269568

This Calibration Certificate is valid for 12 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

VERIFIED BY
[illegible]
[illegible]

APPENDIX M – NOISE MONITORING RESULTS (2018 & 2019)

Noise monitoring results 2018

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CORE LABORATORY
TESTING | INVESTIGATION | ASSURING

LABORATORY REPORT FOR AMBIENT NOISE MONITORING

Client Detail

Name	5 Capitals Environmental & Management Consulting	Date	09/09/2018
Addres:	Sheikh Zayed Road, Near Dubai Mall Station, P O Box 119899 Dubai, United Arab Emirates	Report Number	RPSA 00952-03-07
Nature of Business	Environmental Consultant	Sample Number	SPSA 00952-03
Reference	AAQM - Ambient Noise Quality Monitoring		

(Lab ID Detail)

Project Detail

Name	Umm Al Quwain Project	ID	Not Given
Address	Umm Al Quwain, United Arab Emirates		
Consultant	5 Capitals Environmental & Management Consulting		
Contractor	No Specific Contractor		

Monitoring Detail

Locatio (GPS)	As stated Below	On-Site Observation	
Point	NQM,Project Site	Area Activity	Normal
Start Date	As Mentioned Below	Area Condition	Open Area
End Date	As Mentioned Below	Exposure Time	30 mins

Monitoring Details

Parameter	Unit	Lab Detection Limit	UAE Federal Law Limits		Test Method
			Day Time	Night Time	
Noise Monitoring (Lmin, Lmax, LAeq, L10 & L90	dBA	30	55-65	45-55	EPA Victoria (Australia) Publication 280 1991

Monitoring Average Results

Location Description	PERIOD	DAY	NIGHT	EVENING
N-1 Open Area, Near the Road Coordinate: 25.655813 N 55.746862 E	DATE	05/09/2018	05/09/2018	05/09/2018
	TIME	10:00 - 10:30	18:00 - 18:30	19:00 - 19:30
	Lmin	42	47	46
	Lmax	57	58	62
	LAeq	48	50	53
	L10	48	53	55
	L90	44	47	49
N-2 Open Area Coordinate: 25.655233 N 55.747661 E	DATE	06/09/2018	06/09/2018	06/09/2018
	TIME	08:30 - 09:00	18:00 - 18:30	20:30 - 21:00
	Lmin	40	45	45
	Lmax	56	56	61
	LAeq	46	49	52
	L10	49	52	54
	L90	42	46	48
N-3 Open Area, Near the Road Coordinate: 25.654581 N 55.748800 E	DATE	06/09/2018	06/09/2018	06/09/2018
	TIME	09:30 - 10:00	18:30 - 19:00	20:00 - 20:30
	Lmin	44	45	47
	Lmax	58	52	53
	LAeq	49	45	47
	L10	51	57	49
	L90	46	56	46
N-4 Open Area Coordinate: 25.653974 N 55.753592 E	DATE	05/09/2018	05/09/2018	05/09/2018
	TIME	10:00 - 10:30	19:15 - 19:45	22:00 - 22:30
	Lmin	43	44	45
	Lmax	57	51	52
	LAeq	48	45	46
	L10	50	46	47
	L90	44	44	45

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RPSA 00952-03-07

LABORATORY REPORT FOR AMBIENT NOISE MONITORING

Client Detail

Name	**5 Capitals Environmental & Management Consulting**
Address	Sheikh Zayed Road, Near Dubai Mall Station, P O Box 119899 Dubai, United Arab Emirates
Nature of Business	Environmental Consultant
Reference	AAQM - Ambient Noise Quality Monitoring

Lab ID Detail

Date	09/09/2018
Report Number	RPSA 00952-03-07
Sample Number	SPSA 00952-03

Project Detail

Name	Umm Al Quwain Project
Address	Umm Al Quwain, United Arab Emirates
Consultant	5 Capitals Environmental & Management Consulting
Contractor	No Specific Contractor
ID	**Not Given**

Monitoring Detail

Location (GPS)	As stated Below
Point	NQM,Project Site
Start Date	As Mentioned Below
End Date	As Mentioned Below

On-Site Observation

Area Activity	Normal
Area Condition	Open Area
Exposure Time	30 mins

Monitoring Details

Parameter	Unit	Lab Detection Limit	UAE Federal Law Limits		Test Method
			Day Time	Night Time	
Noise Monitoring (Lmin, Lmax, LAeq, L10 & L90	dBA	30	55-65	45-55	EPA Victoria (Australia) Publication 280 1991

Monitoring Average Results

Location Description	PERIOD	DAY	NIGHT	EVENING
N-5 Open Area, Near the Road Coordinate: 25.660494 N 55.750476 E	DATE	07/09/2018	07/09/2018	07/09/2018
	TIME	13:00 - 13:30	18:00 - 18:30	21:00 - 21:30
	Lmin	46	49	50
	Lmax	70	75	80
	LAeq	55	58	62
	L10	58	61	63
	L90	49	52	60

Notes

Test Variation	None
Remarks	1) This test is Accreditated by Dubai Municipality (DAC). 2) *dBA means decibels adjusted. dBA is used for determining the sound exposure to humans.
Reference	1) # Annex (6), Allowable Limits for Noise Level in Different Areas , UAE Cabinet Decree (12) of 2006.
Monitored By	BN/SL
Equipment Ref. No.	C-NM-04 & C-NM-05

كور لابوراتري P.O.Box: 232686 CORE DUBAI-U.A.E. CORE LABORATORY

Murtaza Huseni
Manager (Technical & Operations)
For CORE Laboratory

AN ISO/IEC 17025 ACCREDITED LABORATORY

keeping environment first

Noise monitoring results 2019

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DAC LB-073-TEST

CORE LABORATORY
TESTING | INVESTIGATION | ASSURING

RPSA 02285-03

LABORATORY REPORT FOR AMBIENT NOISE MONITORING

Client Detail

Name	5 Capitals Environmental & Management Consulting
Address	Sheikh Zayed Road, Near Dubai Mall Station, P O Box 119899, Dubai, United Arab Emirates
Nature of Business	Environmental Consultant
Reference	ANQM - Ambient Noise Quality Monitoring

Lab ID Detail

Date	09/07/2019
Report Number	RPSA 02285-03
Sample Number	SPSA 02285-03

Project Detail

Name	FEWA 150 MIGD SWRO Independent Water Project
Address	Umm Al Quwain, United Arab Emirates
Consultant	5 Capitals Environmental & Management Consulting
Contractor	No Specific Contractor

ID **Not Given**

Monitoring Detail

Location (GPS)	As stated Below
Point	NQM,Project Site
Start Date	As Mentioned Below
End Date	As Mentioned Below

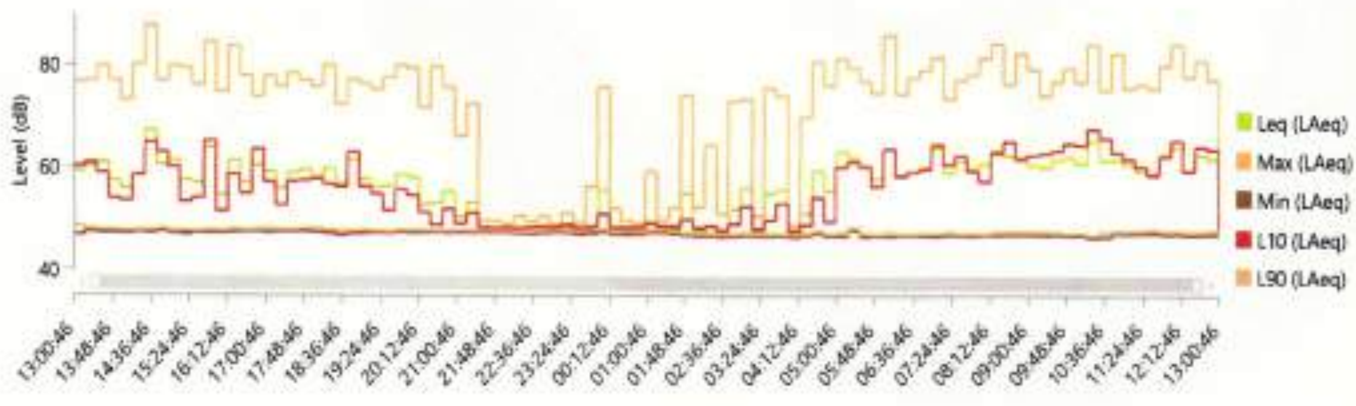
On-Site Observation	
Area Activity	Normal
Area Condition	Open Area
Exposure Time	30 mins

Monitoring Details

Parameter	Unit	Lab Detection Limit	UAE Federal Law Limits Day Time	UAE Federal Law Limits Night Time	Test Method
Noise Monitoring (Lmin, Lmax, LAeq, L10 & L90	dBA	30	55-65	45-55	EPA Victoria (Australia) Publication 280 - 1991

Monitoring Average Results

Location Description	PERIOD	Peak Traffic (Day)	Inter-Peak Traffic (Evening)	Night
Open Area Coordinate: 25°38'50.3"N 55°45'07.6"E Observation: Deserted area, near road, vehicle movement, far from residential and industrial area and nearby camel farm	Date	06/07/2019	05/07/2019	05/07/2019
	Time	08:00 - 08:30	14:00 - 14:30	22:00 - 22:30
	Lmin	**47**	**47**	**47**
	Lmax	**81**	**80**	**50**
	LAeq	**62**	**61**	**48**
	L10	**62**	**59**	**49**
	L90	**48**	**48**	**48**



Time Duration

Notes

Test Variation	None	**Monitored By**	BN/SL
Remarks	1) This test is Accreditated by Emirates International Accreditation Centre (EIAC). 2) *dBA means decibels adjusted. dBA is used for determining the sound exposure to humans.	**Equipment Ref. No.**	C-NM-05
Reference	1) # Annex (6), Allowable Limits for Noise Level in Different Areas", UAE Cabinet Decree (12) of 2006.		

Results relates only to the items tested.

Form No. TDF-31, Issue: 02 / 26.03.2018 , Rev.: 0/-

Eng. Murtaza Huseni
Manager (Technical & Operations)
For CORE Laboratory

AN ISO/IEC 17025 ACCREDITED LABORATORY

LABORATORY REPORT FOR AMBIENT NOISE MONITORING

Client Detail			Lab ID Detail	
Name	5 Capitals Environmental & Management Consulting		Date	02/07/2019
Address	Sheikh Zayed Road, Near Dubai Mall Station,		Report Number	RPSA 02285-03
	P O Box 119899, Dubai, United Arab Emirates		Sample Number	SPSA 02285-03
Nature of Business	Environmental Consultant			
Reference	ANQM - Ambient Noise Quality Monitoring			

Project Detail		
Name	FEWA 150 MIGD SWRO Independent Water Project	ID **Not Given**
Address	Umm Al Quwain, United Arab Emirates	
Consultant	5 Capitals Environmental & Management Consulting	
Contractor	No Specific Contractor	

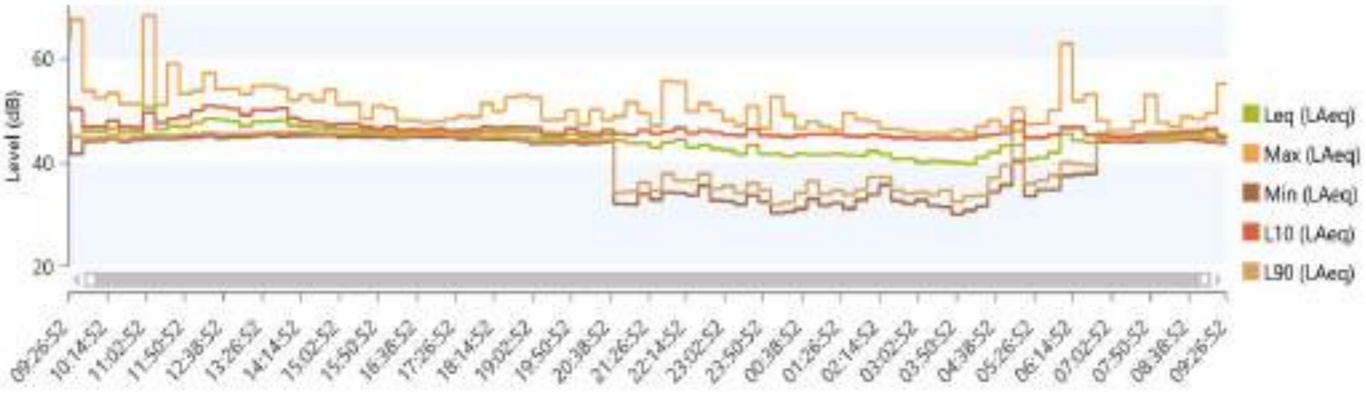
Monitoring Detail		On-Site Observation	
Location (GPS)	As stated Below		
Point	NQM,Project Site	Area Activity	Normal
Start Date	As Mentioned Below	Area Condition	Open Area
End Date	As Mentioned Below	Exposure Time	30 mins

Monitoring Details

Parameter	Unit	Lab Detection Limit	UAE Federal Law Limits		Test Method
			Day Time	Night Time	
Noise Monitoring (Lmin, Lmax, LAeq, L10 & L90	dBA	30	55-65	45-55	EPA Victoria (Australia) Publication 280 - 1991

Monitoring Average Results

Location Description	PERIOD	Peak Traffic (Day)	Inter-Peak Traffic (Evening)	Night
Open Area Coordinate: 25.653060 N 55.752821 E Observation: Deserted area, no vehicle movement, far from residential and industrial area	Date	25/06/2019	24/06/2019	24/06/2019
	Time	08:00 - 08:30	12:00 - 12:30	23:00 - 23:30
	Lmin	**44**	**45**	**33**
	Lmax	**48**	**55**	**49**
	LAeq	**45**	**48**	**42**
	L10	**46**	**50**	**46**
	L90	**45**	**46**	**35**



Time Duration

Notes			
Test Variation	None	Monitored By	BN/SL
Remarks	1) This test is Accreditated by Emirates International Accreditation Centre (EIAC).	Equipment Ref. No.	C-NM-05
	2) *dBA means decibels adjusted. dBA is used for determining the sound exposure to humans.		
Reference	1) # Annex (6), Allowable Limits for Noise Level in Different Areas , UAE Cabinet Decree (12) of 2006.		

Murtaza Huseni
Manager (Technical & Operations)
For CORE Laboratory

APPENDIX N – LABORATORY ACCREDITATION CERTIFICATES

مركز الإمارات العالمي للاعتماد
Emirates International Accreditation Centre

ACCREDITATION CERTIFICATE

051-LB-TEST

Emirates International Accreditation Center

has accredited

CORE LABORATORY

Warehouse No. 6, Dubai Investments Park

Dubai- United Arab Emirates

In accordance with the requirements of **ISO/IEC 17025:2005** to undertake the tests

in the fields of:

Air Quality Monitoring

Environmental

Food

Certificate Validity: 14/11/2018 to 09/04/2020

Initial Accreditation Date: 10/04/2011

This Accreditation is invalid without the attached accreditation scope and shall remain in force within the validity period printed below, subject to continuing compliance with the requirements of the accreditation program.

CHIEF EXECUTIVE OFFICER
APPROVAL

ACCREDITATION CERTIFICATE

LB-073-TEST

Dubai Accreditation Department

has accredited

Core Laboratory
Warehouse No. 6, Dubai Investments Park
Dubai- United Arab Emirates

In accordance with the requirements of ISO/ IEC 17025: 2005 to undertake the tests in the fields of:

Food (Drinking Water)
Air Quality Monitoring
Environmental

For the tasks listed in the attached Scope of Accreditation

This Accreditation is invalid without the attached scope of accreditation and shall remain in force within the validity period printed below, subject to continuing compliance with the requirements of the accreditation program.

Validity of Certificate: from 10- 04- 2017 to 09- 04- 2020

Initial Accreditation Date: 10- 04- 2011

Director, Dubai Accreditation Department

SCOPE OF ACCREDITATION

Food (Drinking Water) Testing

Core Laboratory

Warehouse No. 6, Dubai Investments Park

Dubai- United Arab Emirates

Issue No: 03 **Issue date: 10- 04- 2017** **Accreditation Certificate No: LB-073-TEST**

Type of Task	Materials/Products	Task Name	Standard method
Chemistry	Drinking Water	pH	APHA 4500 H^+
		Alkalinity	APHA 2320 B
		Total Hardness	APHA 2340 C
		Ca & Mg Hardness	In House Procedure IP-01
		Chloride	APHA 4500 Cl^- B
		Sulphate	APHA 4500 SO_4^{2-}
		Total Solids	APHA 2540 B
		Total Dissolved Solids	APHA 2540 C
		Metals: Cu, Pb, Zn, Ni, Cr, Mn, Co, Fe, Cd,	APHA AWWA 3030, 3120
		Total Organic Carbon	APHA AWWA 5310 B

Note: For history details of accredited conformity assessment activities, please refer to Dubai Accreditation Department, Dubai Municipality.

SCOPE OF ACCREDITATION

Air Quality Monitoring Testing

Core Laboratory

Warehouse No. 6, Dubai Investments Park

Dubai- United Arab Emirates

Issue No: 03 **Issue date: 24- 08- 2017** **Accreditation Certificate No: LB-073-TEST**

Type of Task	Materials/Products	Task Name	Standard method
Ambient Atmosphere	Indoor/ Outdoor	TSP, PM10, PM2.5, PM1.0	In house Procedure IP-04
		CO_2, CO, NO_2, SO_2, Ozone, VOC, H_2S, NH_3, HF, Methane, Formaldehyde, Temperature, Humidity, For outdoor Wind Speed, Wind Direction.	In house Procedure IP-10
		BTEX (Benzen, Toulene, ethylbenzene, xylene)	NIOSH Manual of Analytical Methods (NMAM), Fourth Edition METHOD 1501
		Metals: (Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni, Zn)	NIOSH Manual of Analytical Methods (NMAM), Fourth Edition METHOD 7306
		Asbestos (Sampling)	OSHA 1910.1001 App B
		H_2S (Detection limit 3 ppb)	In house Procedure IP-12

Note: For history details of accredited conformity assessment activities, please refer to Dubai Accreditation Department, Dubai Municipality.

SCOPE OF ACCREDITATION

Air Quality Monitoring Testing

Core Laboratory

Warehouse No. 6, Dubai Investments Park

Dubai- United Arab Emirates

Issue No: 03 **Issue date: 24- 08- 2017** **Accreditation Certificate No: LB-073-TEST**

Type of Task	Materials/Products	Task Name	Standard method
Ambient Atmosphere	Indoor/ Outdoor	Noise/sound pressure level (Leq Min / Max)	EPA Victoria (Australia) Publication 280 - 1991
		Light intensity	Canada Occupational Health and Safety Regulations (SOR/86-304) Part VI; In house Procedure IP-11
	Stack Emission	Carbon monoxide (CO)	In house Procedure IP-06, USEPA CTM 030 & USEPA CTM 034
		Nitrogen Dioxide (NO_2)	
		Nitrogen Oxide (NO)	
		Oxides of Nitrogen (NOX)	
		Sulphur dioxide (SO_2)	In house Procedure IP-06 & Electrochemical Sensor
		Oxygen (O_2)	In house Procedure IP-06, USEPA CTM 030 & USEPA CTM 034

Note: For history details of accredited conformity assessment activities, please refer to Dubai Accreditation Department, Dubai Municipality.

SCOPE OF ACCREDITATION

Air Quality Monitoring Testing

Core Laboratory

Warehouse No. 6, Dubai Investments Park

Dubai- United Arab Emirates

Issue No: 03 **Issue date: 24- 08- 2017** **Accreditation Certificate No: LB-073-TEST**

Type of Task	Materials/Products	Task Name	Standard method
Ambient Atmosphere	Stack Emission	Carbon dioxide (CO_2)	In house Procedure IP-06 & Electrochemical Sensor (Testo 350XL)
		Ambient Temperature	In house Procedure IP-06, Direct Sensor Readout (Testo 350XL)
		Stack Temperature	
		Stack Flow	
		Particulate Matter (TSP)	USEPA Method 5 & 17
		VOC (Volatile Organic Compound)	In house method IP-17 / USEPA Method 18 - CFR 40 part 60 (adsorption tube)
Ambient Atmosphere	Biogas	Temperature Humidity Methane (as CH_4) Carbon Dioxide Oxygen Hydrogen Sulfide	In house method IP-15 (Electrochemical and IR sensor)

Note: For history details of accredited conformity assessment activities, please refer to Dubai Accreditation Department, Dubai Municipality.

SCOPE OF ACCREDITATION

Air Quality Monitoring Testing

Core Laboratory

Warehouse No. 6, Dubai Investments Park

Dubai- United Arab Emirates

Issue No: 03 **Issue date: 24- 08- 2017** **Accreditation Certificate No: LB-073-TEST**

Type of Task	Materials/Products	Task Name	Standard method
Ambient Atmosphere	Biogas	Siloxane as: Hexamethylcyclotrisiloxane Octamethylcyclotetrasiloxane Decamethylcyclopentasiloxane Trimethylsilanol Hexamethyldisiloxane OctamethyltrisiloxaneDecamethyltetrasiloxane	In house method (IP-16) (Using GC/MS)

Note: For history details of accredited conformity assessment activities, please refer to Dubai Accreditation Department, Dubai Municipality.

SCOPE OF ACCREDITATION

Environmental Testing

Core Laboratory

Warehouse No. 6, Dubai Investments Park

Dubai- United Arab Emirates

Issue No: 06 **Issue date: 24- 08- 2017** **Accreditation Certificate No: LB-073-TEST**

Type of Task	Materials/Products	Task Name	Standard method
Chemical	Water/ Waste Water	pH	APHA AWWA 4500 H^+
		Total Dissolved Solids	APHA AWWA 2540 C
		Total Suspended Solids	APHA AWWA 2540 D
		Total Solids	APHA AWWA 2540 B
		Chemical Oxygen Demand	APHA AWWA 5220 B & D
		Biochemical Oxygen Demand	APHA AWWA 5210 B
		Oil & Grease	APHA AWWA 5520 B
		Metals: Cu, Pb, Cd, Zn, Ni, Cr, Mn, Co, Fe	APHA AWWA 3030,3120
		Total Organic Carbon	APHA AWWA 5310 B
	Waste Water	Sampling and Sample handling of Waste Water	DMS 11/ 12
	Swimming Pool Water	pH	APHA AWWA 4500 H^+
		Alkalinity	APHA AWWA 2320 B
		Total Dissolved Solids	APHA AWWA 2540 C

Note: For history details of accredited conformity assessment activities, please refer to Dubai Accreditation Department, Dubai Municipality.

SCOPE OF ACCREDITATION

Environmental Testing

Core Laboratory

Warehouse No. 6, Dubai Investments Park

Dubai- United Arab Emirates

Issue No: 06 **Issue date: 24- 08- 2017** **Accreditation Certificate No: LB-073-TEST**

Type of Task	Materials/Products	Task Name	Standard method
Chemical	Swimming Pool Water	Ca & Mg Hardness	In House Procedure IP-01
		Chloride	APHA AWWA 4500 Cl- B
		Sulphate	APHA AWWA 4500 SO4
		Total Solids	APHA AWWA 2540 B
	solids/ Waste Solids	Total, Fixed, Volatile Solids in Solids and Semisolids Samples	APHA AWWA 2540 G
	Water	Conductivity	APHA/AWWA 2510 B
		Oil & grease (Free)	Gravimetric / IP-13
		Fluoride	USEPA SPADNS Reagent Method
		Cyanide	Pyridine - Pyrazalone Method
		Total & Residual chlorine	USEPA DPD Method
		Sulfate	USEPA SulfaVer 4 Method
		Sulfide	USEPA Methylene Blue Method
		Silica	Silicomolybdate Method

Note: For history details of accredited conformity assessment activities, please refer to Dubai Accreditation Department, Dubai Municipality.

SCOPE OF ACCREDITATION

Environmental Testing

Core Laboratory

Warehouse No. 6, Dubai Investments Park

Dubai- United Arab Emirates

Issue No: 06 **Issue date: 24- 08- 2017** **Accreditation Certificate No: LB-073-TEST**

Type of Task	Materials/Products	Task Name	Standard method
Chemical	Water	Turbidity	USEPA 180.1
		Total Kjeldahl Nitrogen TKN	APHA - AWWA 4500 N Org C
		Total nitrogen TN	ASTM D-5176
		Nitrate-Nitrogen	Cadmium Reduction Method
		Ammonia- Nitrogen	Salicylate Method/Probe method
		Phosphate-phosphorus as PO4	USEPA Phos Ver 3 Method
		Total phosphorus as P	HACH Acid Persulfate/ USEPA Phos Ver 3 Method
		Metals: Na, K, Al, B, Sr, Mo, Se, Ag, V, Sb and As	APHA/AWWA 3030E/3120B
Chemical	Soil	TOC	Walkley Black Method
		pH	BS EN 15933
		Metals: Cd, Cr, Cu, Co, Pb, Mo, Ni, Zn, As, Ba, Mn, Al, B, Sr, Se and V	EPA 3050B &APHA-AWWA 3120 B

Note: For history details of accredited conformity assessment activities, please refer to Dubai Accreditation Department, Dubai Municipality.

APPENDIX O – VEHICLE COMPOSITION DURING THE CONSTRUCTION PHASE

UMM AL QUWAIN INDEPENDENT WATER PROJECT CONSTRUCTION MACHINERIES EMISSON CONPONENT

Mechanical type	Oil Consumption	Spec.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Daliy Oil Consumption(L)	Monthly Oil Consumption(L)	Remarks
Heavy Construction																																						
Concrete Batching Plant	N/A	75m3/h								1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1									N/A	N/A	
Mortar Mixer	N/A	1.5m3										1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								N/A	N/A	
Concrete Mixing Truck	30L/100KM	6m3								1	2	3	4	4	4	4	4	4	4	4	3	3	2	2	2	1										10	200	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Concrete Transfer Pump	30L/100KM	80m3/h								1	1	1	2	2	2	2	2	2	2	2	2	1	1	1	1	1										10	200	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Mobile Crane	3.5L/H	25t									1	1	1	1	2	2	2	2	2	1	1	1	1	1	1											28	728	按8小时工作，一个月26天 8H/Day,26 Days/Month
Mobile Crane	3.5L/H	16t					1	1	1	1	1	1	1	2	2	2	2	2	1	1	1	1	1	1	1	1										28	728	按8小时工作，一个月26天 8H/Day,26 Days/Month
Gantry Crane	N/A	20t								1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										N/A	N/A	
Excavator	3.5L/H	1.5m3					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1														28	728	按8小时工作，一个月26天 8H/Day,26 Days/Month
Excavator	3.5L/H	1m3					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1														28	728	按8小时工作，一个月26天 8H/Day,26 Days/Month
Flatbed Truck	30L/100KM	25t											1	1	1	1	1	1	1	1	1	1	1													10	260	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Motor Truck	30L/100KM	15t											1	1	1	1	1	1	1	1	1	1	1													10	260	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Motor Truck	30L/100KM	5t									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1											10	260	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Autodumper	30L/100KM	15t					4	4	4	4	4	4	4	4	4	4	4	3	3	3	2	2														10	260	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Autodumper	30L/100KM	4.5t								3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	1	1									10	260	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Wheel Loader	30L/100KM	3m3					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1														10	260	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Wheel Loader	30L/100KM	2m3						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1														10	260	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Bulldozer	30L/100KM					1	1	1	1	1	1	1	1																							6	156	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Road Roller	30L/100KM	16t					1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1											6	156	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Heavy Construction																																						
Crawler Crane	2.5L/H	150t																			1															20	520	按8小时工作，一个月26天 8H/Day,26 Days/Month
Crawler Crane	2.5L/H	50t															1	1	1	1	1	1	1	1												20	520	按8小时工作，一个月26天 8H/Day,26 Days/Month
Mobile Crane	3.5L/H	50t																	1	2	2	2	2	2	2	2	1									28	728	按8小时工作，一个月26天 8H/Day,26 Days/Month
Mobile Crane	3.5L/H	25t															1	1	1	2	2	2	2	2	2	2	1									28	728	按8小时工作，一个月26天 8H/Day,26 Days/Month
Gantry Crane	N/A	20t															1	1	1	1	1	1	1	1	1	1	1	1								N/A	N/A	
Flatbed Truck	30L/100KM	20t															1	1	1	1	1	1	1	1	1	1	1	1								10	260	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Lorry-Mounted Crane	3.5L/H	10t																			1	1	1	1	1	1	1	1	1	1						28	728	按8小时工作，一个月26天
7T Forklift	30L/100KM	7t															1	1	1	1	1	1	1	1	1	1										28	728	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
5T Forklift	30L/100KM	5t																							1	1	1	1	1	1	1	1	1			28	728	每天按30公里计算, 一个月26天 30Km/Day, 26 Days/Month
Veneer Reeling Machine	N/A																	1	1	1	1	1	1	1	1	1	1									N/A	N/A	
Air Compressor	N/A	ZV-6/8																1	1	1	1	1	1	1	1	1	1									N/A	N/A	
Other																																						
Diesel Generator	8L/H	100MW				1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1			64	1664	按8小时工作
Total Oil Consumption			0	0	0	1820	5460	5876	5876	7056	8088	8288	9208	9780	10508	10508	14408	14148	14148	14876	15404	14684	11988	11468	11416	10072	5096	3380	3120	3120	2392	2392	2392	0	0			

UMM AL QUWAIN INDEPENDENT WATER PROJECT CONSTRUCTION MACHINERIES EMISSON CONPONENT

Mechanical type	**Spec.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**
Heavy Construction Equipment-Civil																																		
Mortar Mixer	1.5m3										1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
Concrete Mixing Truck	6m3								1	2	3	4	4	4	4	4	4	4	4	3	3	2	2	2	1									
Flatbed Truck	25t											1	1	1	1	1	1	1	1	1	1	1												
Motor Truck	15t											1	1	1	1	1	1	1	1	1	1	1												
Motor Truck	5t									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
Autodumper	15t					4	4	4	4	4	4	4	4	4	4	4	3	3	3	2	2													
Autodumper	4.5t								3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	1	1								
Wheel Loader	3m3					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													
Wheel Loader	2m3						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													
Heavy Construction Equipment-Installation																																		
Flatbed Truck	20t															1	1	1	1	1	1	1	1	1	1	1	1							
Lorry-Mounted Crane	10t																			1	1	1	1	1	1	1	1	1	1					
Worker Busies		1	1	2	2	2	4	4	4	4	6	6	6	8	8	8	8	8	8	8	8	8	8	8	6	6	6	4	4	4	2	2	1	1