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Statoil
Statoil Egypt El Dabaa Offshore AS

Environmental Impact Assessment (EIA)

Offshore Exploratory Drilling Well Kiwi A-1X, El Dabaa Offshore Concession, Egypt

455/EJ6172 – 000-EN-REP-06

16 December 2010

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NON-TECHNICAL SUMMARY

WorleyParsons Engineers Egypt Ltd (WPEEL) has conducted an Environmental Impact Assessment (EIA) study for Statoil's proposed offshore exploratory "Kiwi A-1X" well located in the Mediterranean Sea, El Dabaa Offshore Concession, Egypt (Figure 1). WorleyParsons has been also retained by Statoil to conduct an Environmental Risk Assessment (ERA) study for the same offshore exploratory drill well (455/EJ6172-000-EN-REP-07). This EIA report details the environmental impact assessment and summarizes the ERA study.

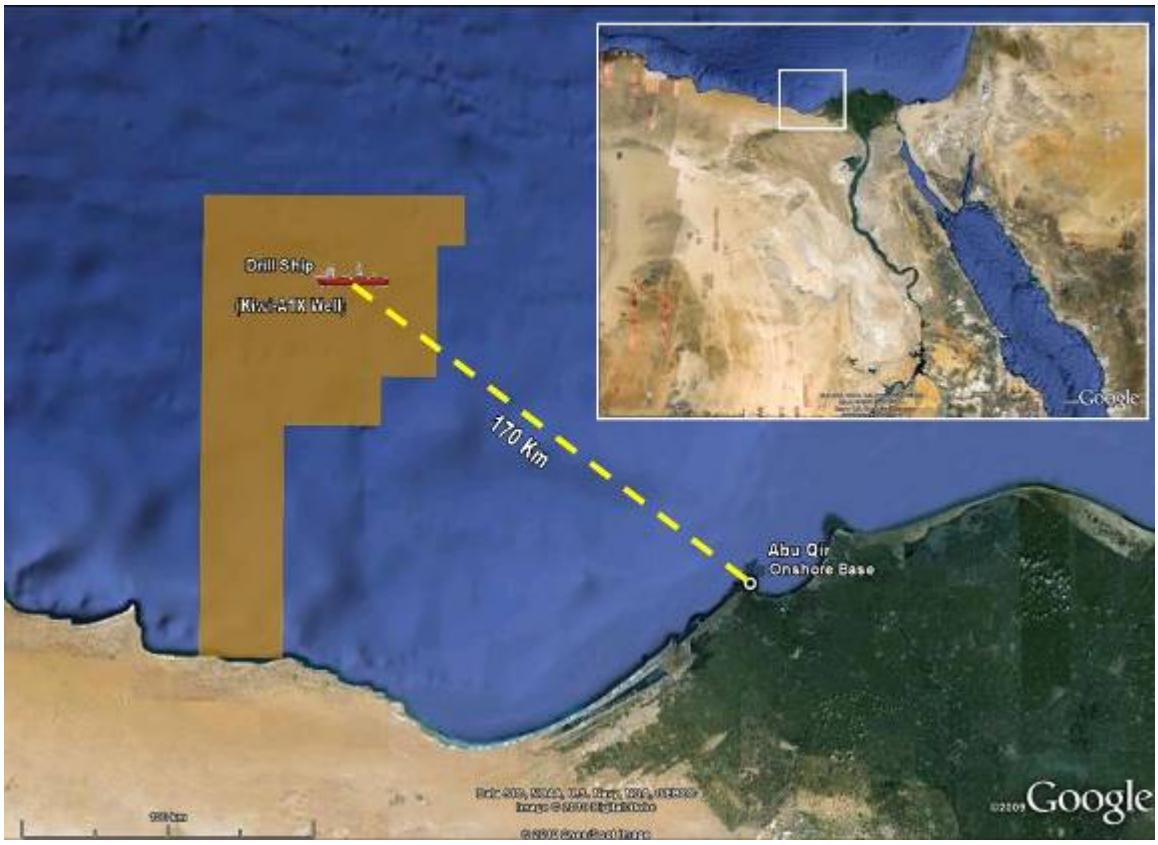

Figure 1 Statoil Concession and Well Location

Statoil contracted Petro Environmental Service Company (PESCo) to perform a surface modelling study of hypothetical oil spills to assess the potential impact of the surface release of oil in case of a blow out event from Kiwi A-1X well. The surface model identified an initial indirect area of influence early in the process, upon which PESCo developed an Oil Spill Response Plan (OSRP) and WorleyParsons developed a Form B study (455/EJ6172-000-EN-REP-04 and 455/EJ6172-000-EN-REP-05). Both the Form B and OSRP have granted the approval of the Egyptian Environmental Affairs Agency (EEAA).

At a later stage, Statoil contracted Applied Science Associates (ASA) to conduct a subsurface trajectory and fates modelling report of a blow out event from Kiwi A-1X offshore well. The indirect

area of influence was consequently updated according to the subsurface model results. According to the subsurface model, the updated indirect area of influence covers about 100 km of the eastern Libyan coast, the Egyptian north coast, Gaza, Israel, Lebanon, Syria, western Cyprus, about 50 km of Turkey's southeast coast and Greece's southeast waters. This EIA study will only address the indirect area of influence within the Egyptian territories. Other indirect area of influence than those covered in this EIA report will be studied in a separate report, "Desktop Screening Report" (455/EJ6172-000-EN-REP-08), which is included in Appendix 9 of this EIA.

The overall objectives of the EIA are to assure compliance with Statoil requirements which draw on IFC standards and; identify and analyse sensitive components of the existing environment; determine the type, nature and importance of the probable environmental impacts during construction and operation; identify and recommend practical and cost effective mitigation measures; recommend a framework for an environmental management and monitoring plan for the project; and ensure that all stakeholders deemed to be influenced by the projects or activities are fully considered.

All offshore activities will be performed using Discoverer Americas drill ship (Figure 2), about 170 km northwest of Abu Qir and 140 km north of El-Dabaa district. The drill ship is fully equipped with drilling and mud management equipment necessary for the proposed operations, with supporting vessels from Abu Qir shore base facility. The Transocean-owned drill ship is newly constructed. It is an offshore enhanced enterprise class with a double hull and dual-activity capability. The supporting vessel, M/V Claire Candies, has a cargo deck of 1000 m^3. Its storage capacities include: 1,793 m^3 of liquid mud (6 tanks with independent discharges), 324 m^3 of dry bulk storage (4 tanks), 80 m^3 of methanol and 23 m^3 of sewage storage. Standby vessels shall also be present near the drill ship throughout the project, for support and emergencies. The Kiwi A-1X offshore exploratory well will involve drilling, casing, cementing and coring activities. It is scheduled for drilling during the second half of November 2010.

Figure 2 Drill Ship and Supporting Vessel

All activities undergone by Statoil shall comply with the Egyptian environmental legislation and regulations, international legislations, regional/international conventions, and Statoil policies and procedures.

An environmental impact analysis was carried out to classify the potential positive and negative impacts from the different phases of the proposed project and including impacts due to non-routine (accidental) events. The most important aspects during routine operations include: vessel movement, drilling operations, waste disposal and discharge, and drill cuttings. No major negative impacts have been identified in any phase of the normal operational activities. All major negative impacts identified before applying any mitigation measures are due to impacts from non-routine events such as inappropriate waste disposal, minor leaks and spills, vessel collision, fire or explosion and well blowout. Potential negative impacts on the regional and national scale are plausible in the unlikely event of a well blowout.

Table 1 summarizes the major project activities and their mitigation measures.

Applying appropriate mitigation measures ensures that there will be no major residual impacts resulting from the project. In conclusion with the effective implementation of mitigation measures, negative impacts shall be reduced or eliminated.

Table 1 Major Project Activities and Mitigation Measures

Planned Project Activities	Mitigation Measures
Drill ship movement Supporting vessels movement Drill ship operations WBM drill cuttings Waste disposal and discharge Helicopter operations	Comply with the requirements of the Egyptian Environmental Law on accepted levels of exhaust emissions. Choose energy sources/fuels for heavy equipment that produce the least amount of CO_2. Apply International good practice and established Statoil standards to operations particularly in emissions reporting Avoiding unnecessary discharge of ballast water Implementation of Statoil's HSE technical and professional requirements Implementation of Waste Management Plan WMP Waste disposal to comply with MARPOL Implementation of Communications Plan Implementation of Environmental Management and Monitoring Plan EMMP

Unplanned Project Activities	Mitigation Measures
Inappropriate waste disposal Leaks and minor spills Vessel collision (Fuel spill) Explosion and Fire Well Blowout	Applying International good practice and established Statoil standards to operations Implementation of Statoil's HSE Management and Risk Management Implementation of Statoil's HSE technical and professional requirements Conducting regular risk reduction reviews on facilities Implementation of OSRP Development of Ship Onboard Pollution and Environmental Protection SOPEP manual Availability of sorbent material and/or necessary oil spill response equipment onboard drill ship and vessels Regular oil spill drills, exercises and training

Positive impacts are expected during the mobilization phase; although very limited, these positive impacts are mainly economic. Potential positive impacts are also possible, on the regional and national economy, in the event of gas/oil discovery.

For all potential accidental events, emergency response plans have been developed to immediately respond to the event, and all employees shall be appropriately trained to implement the response plans in the event of an emergency.

Statoil has taken several precautions to circumvent emergency situations including: well blowout analysis, area of influence study, environmental risk assessment, trajectory modelling of worst case oil spill scenarios, Oil Spill Response Plan (OSRP), general HSE Emergency Response Plan (ERP) and this Environmental Impact Assessment study.

Furthermore, Section 13 of this EIA presents a guide for developing an environmental management and monitoring plan. This will ensure environmental statutory compliance and promote effective environmental management at the proposed site during all project phases. The EIA study also presents a monitoring plan, which is necessary for the elimination and/or minimisation of potential negative environmental impacts.

Finally, based on the findings and recommendations of the environmental and social impact assessment for the proposed exploratory activities, the assessment team concludes that if mitigation and monitoring measures are followed properly, the project shall be operating meeting all regulatory requirements without any tangible impacts to the environment.

A full copy of this EIA is available on Statoil's homepage – www.statoil.com

List of Acronyms

ANSI	American National Standards Institute
BHA	Bottom Hole Assembly
BML	Below the Mud Line
BOD	Biological Oxygen Demand
BOP	Blow-Out Preventers
BOS	Base of Salt
CAPMAS	Central Agency for Public Mobilization and Statistics
CBD	Convention on Biological Diversity
CO	Carbon monoxide
COD	Chemical Oxygen Demand
DO	Dissolved oxygen
DP	Dynamically-Positioned
ECMWF	European Centre for Medium-Range Weather Forecasts
EEAA	Egyptian Environmental Affairs Agency
EFS	Environmental Fieldwork Supervisor
EGAS	Egyptian Natural Gas Holding Company
EGPC	Egyptian General Petroleum Corporation
EIA	Environmental Imapct Assessment
EMMP	Environmental Management and Monitoring Plan
EMP	Environmental Management Plan
ER	Executive Regulations
ERP	Emergency Response Plan
FAO	Food and Agriculture Organization
H_2S	Hydrogen Sulphide
HPWHD	High Pressure Wellhead Housing
HSE	Health Safety and Environment
HSSE	Health Safety Security Environment
IFC	International Finance Corporation

IMDG	International Maritime Dangerous Goods
IN	Insignificant (impact)
ISR	Integrity and Social Responsibility
LPWHD	Low Pressure Wellhead Housing
LTOBM	Low-Toxicity Oil Based Mud
LWD	Logging-while-drilling
MA	Major (impact)
MARPOL	International Convention for the Prevention of Pollution From Ships
MI	Minor (impact)
MO	Moderate (impact)
MSDS	Material Safety Data Sheets
NO_2	Nitrogen dioxide
NORM	Natural Occuring Radioactive Material
NTU	Nephelometric Turbidity Unit
OBM	Oil Based Mud
OPEC	Organization of the Petroleum Exporting Countries
OPRC	International Convention on Oil Pollution Preparedness, Response and Co-operation
P&A	Permanently Abandoned
PAD	Pump-and-Dump
PESCo	Petro Environmental Services Company
PM_{10}	Particulate Matter of size 10 microns
PPE	Personal Protection Equipment
PTD	Proposed Total Depth
ROV	Remotely Operated Vehicles
SBM	Synthetic Based Mud
Sm	Standard Meter
SO_2	Sulphur Dioxide
SOBM	Synthetic Oil Base Mud

SOPEP	Ship Onboard Pollution and Environmental Protection
TCC	Thermomechanical Cuttings Cleaner
TDS	Total Dissolved Solids
TOS	Top of Salt
TVD	Total Vertical Depth
TVD-SS	True Vertical Depth Sub Sea
UNCLOS	United Nations Convention on the Law of the Sea
VOC	Volatile Organic Compounds
VR	Valued Receptor
WBM	Water Based Mud
WBM	Water Based Mud
WM	Waste Management
WMP	Waste Management Plan

CONTENTS

NON-TECHNICAL SUMMARY III

1. INTRODUCTION 1

1.1 Project Background 1

1.2 EIA Objectives 3

1.3 Methodology and Structure of this EIA 3

2. POLICY LEGAL AND ADMINISTRATION FRAMEWORK 4

2.1 Competent Authorities 4

2.1.1 Egyptian Environmental Affairs Agency (EEAA) 4

2.1.2 Egyptian Natural Gas Holding Company (EGAS) 4

2.2 National Legislation 5

2.2.1 Law 4/1994 Modified by Law 9/2009 5

2.2.2 Additional Laws and Regulations 12

2.3 Environmental Impact Assessment Guidelines 12

2.4 Statoil Health, Safety, Security and Environmental Policy 13

2.5 Regional/International Standards and Conventions 13

3. PROJECT DESCRIPTION 16

3.1 Project Location 16

3.2 Well Information 18

3.2.1 Well Objective and Design 18

3.2.2 Additional Well Specific Data 18

3.3 Process Description 19

3.3.1 Drilling Programme 19

3.3.2 Cementing and Casing Programme 21

3.3.3 Coring Programme 22

3.4 Schedule 22

3.5 Drill Ship and Support Vessels 23

3.5.1 Drill Ship 23

3.5.2 Supply Vessel 28

3.5.3 Standby Vessels 31
3.6 Materials 35
3.6.1 Drilling Mud 35
3.6.2 Auxiliary Chemicals to be Used 38
3.7 Personnel Requirements 39
3.8 Effluents and Emissions 39
3.8.1 Non-Hazardous Solid Wastes 39
3.8.2 Hazardous Solid Wastes 40
3.8.3 Non-Hazardous Liquid Wastes 42
3.8.4 Hazardous Liquid Wastes 43
3.8.5 Medical Wastes 43
3.9 Waste Management 43
3.10 Safety Equipment 45
3.11 Policy for Environmental Protection 46
4. AREA OF INFLUENCE 47
4.1 Defining Area of Influence 47
4.2 Direct Area of Influence 48
4.3 Indirect Area of Influence 50
4.3.1 Surface Modelling 50
4.3.2 Subsurface Modelling 52
4.3.3 Identification of Indirect Area of Influence 54
5. DESCRIPTION OF THE DIRECT AREA OF INFLUENCE 56
5.1 Introduction 56
5.2 Air and Climate 56
5.2.1 Climate 57
5.2.2 Temperature 58
5.2.3 Rainfall 59
5.2.4 Relative Humidity 60
5.2.5 Fog, Smoke/Haze, Vision Obstruction, and Dew Point 60

5.2.6 Air Quality 61
5.2.7 Natural Hazards 62
5.3 Water 63
5.3.1 Oceanographic Characteristics 63
5.3.2 Marine Water Quality 66
5.3.3 Sediment Quality 67
5.4 Marine Ecology and Biodiversity 67
5.4.1 Plankton 67
5.4.2 Benthic Species 68
5.4.3 Fish and Prawns 68
5.4.4 Sea Turtles 68
5.4.5 Marine Mammals 69
5.4.6 Concession Area Sensitivity 69
5.5 Human Environment 69
5.5.1 Population Profile 69
5.5.2 Area Profile 69
5.5.3 Social Services Profile 71
5.5.4 Economic Services Profile 72
5.5.5 Archaeological Profile 77
6. DESCRIPTION OF THE INDIRECT AREA OF INFLUENCE 80
6.1 Air and Climate 81
6.1.1 Climate 81
6.1.2 Air Quality 85
6.2 Land 92
6.2.1 Geology 92
6.2.2 Sediment Quality 93
6.2.3 Physical profile of the coastline 93
6.3 Water Quality 94
6.3.1 Characteristics 94

6.3.2 Water Balance of the Mediterranean Sea 95
6.3.3 Oceanographic Characteristics 96
6.3.4 Marine Water Quality 99
6.3.5 Marine Ecology and Biodiversity 106
6.3.6 Surface Water 113
6.3.7 Shoreline Sensitivity 114
6.3.8 Onshore Natural Protectorates on the Egyptian Mediterranean Sea Coasts 118
6.3.9 Human Environment 135
7. PROJECT JUSTIFICATION AND ANALYSIS OF ALTERNATIVES 141
7.1 The “No Action” Alternative 141
7.2 Reasons for Choosing the Drilling Location 141
7.3 Drilling Mud Alternatives 141
7.4 Alternative Drilling Technology 142
8. ENVIRONMENTAL IMPACTS FROM PLANNED EVENTS 143
8.1 Environmental Impact Assessment Procedure 143
8.1.1 Valued Receptors 143
8.1.2 Project Environmental Aspects 145
8.1.3 Impact Evaluation 146
8.1.4 Impact Significance Assessment 148
8.2 Predicted Impacts 148
8.2.1 Predicted Impacts during Mobilisation Phase 148
8.2.2 Predicted Impacts during Drilling Phase 154
8.2.3 Predicted Impacts during Demobilisation Phase 167
9. PREDICTED IMPACTS OF ACCIDENTAL (NON-ROUTINE) EVENTS 168
10. DESCRIPTION OF MITIGATION MEASURES 184
10.1 Mitigation Measures during Mobilisation/Demobilization Phase 184
10.1.1 Drill Ship Ballast Exchange 184
10.1.2 Drill Ship Waste Disposal 185
10.1.3 Drill Ship Use of Engines, Generators and Machinery 185

10.1.4 Company Communication Strategy 185
10.2 Mitigation Measures during Drilling Phase 189
10.2.1 Supporting Vessels – Navigation, Ballast Exchange and Waste Disposal 189
10.2.2 Supporting Vessels – Use of Engines, Generators and Machinery 189
10.2.3 Drill Ship Operations (drilling, casing, cementing and coring) 190
10.2.4 Waste disposal (discharge of WBM drill cuttings and drainage of wastewater) 191
10.2.5 Helicopter Operations 191
10.3 Mitigation Measures for Accidental (Non-Routine) Events 200
10.3.1 Inappropriate Waste Disposal 200
10.3.2 Leaks and Minor Spills 200
10.3.3 Vessel Collision (Fuel Spill) 201
10.3.4 Explosion or Fire 201
10.3.5 Well Blowout 201
11. STAKEHOLDER IDENTIFICATION AND CONSULTATION 211
11.1 Introduction 211
11.2 Stakeholder Identification 211
11.3 Stakeholder Analysis 214
11.4 High Priority Stakeholders 215
11.4.1 Egyptian Environmental Affairs Agency (EEAA) 215
11.4.2 Egyptian Natural Gas Holding Company (EGAS) 216
11.4.3 Matrouh and Alexandria Governorates 216
11.4.4 Omyeid Protectorate 216
11.4.5 Abu Qir Supply Base Authority 216
11.5 Stakeholders Consultation 217
12. ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN 219
13. EMERGENCY AND OIL SPILL RESPONSE PLANS 220
13.1 Statoil's Emergency Response Plan (ERP) 220
13.1.1 Objectives 220
13.1.2 Emergency Response Procedures 220

13.1.3 Emergency Response Organisation and Notifications in Emergencies 221
13.1.4 Roles and Responsibilities 222
13.2 Oil Spill Response/Contingency Plan (OSRP) 224
13.2.1 Plan Format 225
14. REFERENCES 226

Tables

Table 2-1 Ambient Air Quality Criteria (µg.m-3) (Annex 5 of the Executive Regulations of Law 4/1994) 6
Table 2-2 Maximum Limits for Gaseous and Vapour Emissions from Industrial Establishments' Stacks (extracted from Table 2, Annex 6 of the Executive Regulations of Law 4) 7
Table 2-3 Liquid Effluent Discharged into Marine Environment 9
Table 3-1 Positioning of “Kiwi A-1X” in Relation to other existing Wells 17
Table 3-2 Well Information 18
Table 3-3 Well Geometry 20
Table 3-4 Cementing Chemicals used for Kiwi A-1X Exploration Drilling 21
Table 3-5 Project Schedule 22
Table 3-6 Discoverer Americas Drill Ship Specifications 24
Table 3-7 M/V Claire Candies Technical Specifications 29
Table 3-8 Olympic Elena Technical Specifications 30
Table 3-9 Esvagt Connector Technical Specifications 31
Table 3-10 Esvagt Dee Technical Specifications 33
Table 3-11 Estimated Drilling Fluids 36
Table 3-12 Water-Based Drilling Fluid Chemicals 36
Table 3-13 LTOBM Drilling Fluid Chemicals 37
Table 3-14 Miscellaneous Chemicals 38
Table 3-15 Contingency Chemicals 38
Table 3-16 Drill Cuttings 40
Table 3-17 Wastes Types and Their Management 44
Table 5-1 Mean Temperatures Recorded at EL Dabaa Concession 58

Table 5-2 Air Temperature Records in Alexandria 59
Table 5-3 Average Number of Days with Precipitation 59
Table 5-4 Mean Relative Humidity Recorded at Alexandria Governorate 60
Table 5-5 Number of Days with Fog, Smoke/Haze and Vision Obstruction in Alexandria 60
Table 5-6 Ambient Air Quality in Alexandria Monitoring Stations 61
Table 5-7 Ambient air quality data recorded over five days in El Dabaa during October 2009 62
Table 5-8 Maximum and mean current speed at El Dabaa Concession 64
Table 5-9 Educational levels within Abu Qir area 71
Table 5-10 Building distribution in Abu Qir 72
Table 5-11 Egypt Economic Performance 73
Table 5-12 Hotels in Alexandria 74
Table 6-1 Expected Thunderstorms 84
Table 6-2 Monthly NO2 Conc. recorded at Alex. University monitoring station during 2008 86
Table 6-3 Monthly NO2 Conc. recorded at Abu Qir monitoring station during 2008 87
Table 6-4 Monthly NO2 Conc. recorded at Damietta monitoring station during 2009 89
Table 6-5 Monthly PM10 Conc. recorded at Damietta monitoring station during 2009. 90
Table 6-6 Monthly SO2 Conc. recorded at Port Said monitoring station during 2008 91
Table 6-7 Mediterranean Water Balance 95
Table 6-8 Names of monitoring stations and their codes 100
Table 6-9 Marine water quality monitoring stations located in transect 1 102
Table 6-10 Marine water quality monitoring stations located in transect 2 103
Table 6-11 Marine water quality monitoring stations located in transect 3 104
Table 6-12 Marine water quality monitoring stations located in transect 4 105
Table 6-13 Distances of the Protectorates from Kiwi A-1X Well 119
Table 6-14 El-Omaed protectorate basic information 120
Table 6-15 El-Salum protectorate basic information 123
Table 6-16 El-Burullus protectorate basic information 126
Table 6-17 Ashtoom El- Gamil protectorate basic information 129
Table 6-18 Key bird species in Lake Manzala 131

Table 6-19 Zaranik protectorate basic information 131
Table 6-20 Basic information of governorates 135
Table 6-21 Egypt Governorates' Human Development Index 136
Table 6-22 Population in governorates 137
Table 6-23 Area profile of governorates 137
Table 6-24 Hotels and Resorts status in some of the governorates....138
Table 6-25 Agriculture profile of the Mediterranean coast governorates....139
Table 8-1 VR identification....144
Table 8-2 VR Categorisation....145
Table 8-3 Project Activities / Environmental Aspects 145
Table 8-4 Basic Impact Index 148
Table 8-5 Impact Significance....148
Table 8-6 Predicted Impacts during Mobilisation Phase 151
Table 8-7 Predicted Impacts during Drilling Phase....161
Table 9-1 Indicative Oil Spill Volumes for Kiwi A-1X Operations....168
Table 9-2 Predicted Impacts during Accidental (Non-Routine) Events 177
Table 10-1 Mitigation Measures during Mobilization/Demobilization Phase 186
Table 10-2 Mitigation Measures during Drilling Phase 192
Table 10-3 Mitigation Measures during Accidental (Non-Routine) Events....203
Table 11-1 Provisional List of Stakeholders 212
Table 11-2 High Priority Stakeholders 215
Table 11-3 Stakeholder Consultation Attendances 217

Figures

Figure 1-1 Kiwi A-1X Well Location....2
Figure 2-1 Statoil HSE Chart....15
Figure 3-1 Kiwi A-1X Well Location....16
Figure 3-2 Location of "Kiwi A-1X" and Other Existing Wells 17
Figure 3-3 Days vs Depth Dryhole....20

Figure 3-4 Discoverer Americas Drill Ship 23
Figure 3-5 M/V Claire Candies Supply Vessel 28
Figure 3-6 Olympic Elena Standby Supply Vessel 28
Figure 3-7 Esvagt Connector 31
Figure 3-8 Esvagt Dee 31
Figure 4-1 Definition of Area of Influence 47
Figure 4-2 Direct Area of Influence 49
Figure 4-3 Probability of Shoreline Oiling 51
Figure 4-4 Trajectory Model of Worst Case Scenario 52
Figure 4-5 Probability Distribution of Oil on Water Surface 53
Figure 4-6 Probability Distribution of Oil on Shorelines 54
Figure 4-7 Indirect Area of Influence 55
Figure 5-1 Location of “Kiwi A-1X” Relevant to Meteorological and Air Quality Data Locations 57
Figure 5-2 Monthly Minimum, Mean and Maximum Temperature (ºC) at El Dabaa concession during the Period 1996-2008 58
Figure 5-3 Historical Occurrences of Tsunami in the Mediterranean 62
Figure 5-4 Bathymetric map of Abu-Qir Bay 63
Figure 5-5 Monthly Mean and Average Wave Height at El Dabaa Field during the Period 1996-2008 65
Figure 5-6 Alexandria governorate districts 70
Figure 5-7 Percentage of Populated and Unpopulated Areas in Alexandria governorate 70
Figure 5-8 Touristic Beaches Nearest to Kiwi A-1X 74
Figure 5-9 Major Gas Fields North of Abu Qir 76
Figure 5-10 Distribution of Industrial Establishments in Alexandria Governorate 77
Figure 5-11 Archaeology in Abu Qir bay 79
Figure 6-1 Transects of the Egyptian North Coast 80
Figure 6-2 Mean Annual Precipitation in Egypt 83
Figure 6-3 Location of the nearest air quality stations to the area of the influence 85
Figure 6-4 Monthly NO2 Conc. recorded at Alex. University monitoring station during 2008 87
Figure 6-5 Monthly NO2 Conc. recorded at Abu Qir monitoring station during 2008 88

Figure 6-6 Monthly NO2 Conc. recorded at Damietta monitoring station during 2009 89
Figure 6-7 Monthly PM10 Conc. recorded at Damietta monitoring station during 2009 90
Figure 6-8 Monthly SO2 Conc. recorded at Port Said monitoring station during 2008 92
Figure 6-9 Bathymetric map of Mediterranean Sea 96
Figure 6-10 Physiography of the Mediterranean Sea (depth distribution and main currents) 97
Figure 6-11 Wave Height (m) and direction in the Mediterranean Sea 98
Figure 6-12 Past, Present and Predicted Sea Level Trends 99
Figure 6-13 Water Monitoring Stations Along The Egyptian Coast 101
Figure 6-14 Marine Turtles in Mediterranean Sea 110
Figure 6-15 Dolphins in the Egyptian Mediterranean Waters 111
Figure 6-16 Marine Mammals in the Egyptian Mediterranean Waters 112
Figure 6-17 Sensitivity Map of Transect 1 (Source EEAA, 1996) 115
Figure 6-18 Sensitivity Map of Transect 2 (Source EEAA, 1996) 116
Figure 6-19 Sensitivity Map of Transect 3 (Source EEAA, 1996) 117
Figure 6-20 Sensitivity Map of Transect 4 (Source EEAA, 1996) 118
Figure 6-21 Illustrates Onshore Protectorates on the Egyptian Mediterranean Coast 119
Figure 6-22 The Nearest Protectorates 120
Figure 6-23 Vegetation and Landscape of El-Omaed Protectorate 122
Figure 6-24 Different Animals of El-Omaed Protectorate 123
Figure 6-25 El-Salum protectorate location 124
Figure 6-26 Marine species in El-Salum protectorate. 125
Figure 6-27 Burullus protectorate location 126
Figure 6-28 Some bird types commonly found in Burullus 128
Figure 6-29 Some birds types in Manzala Lake 130
Figure 6-30 Zaranik Protectorate Map (Location, Boundaries and Main Road) 132
Figure 6-31 Marine and terrestrial mammals in Zaranik 133
Figure 6-32 Some birds species in Zakanik 134
Figure 6-33 Egyptian governorates on the Mediterranean coast 135
Figure 13-1 Emergency Organisation in Case of an Incident on the Discoverer Americas Rig 221

Figure 13-2 Emergency Organisation in Case of an Incident Related to Contractors.....222

Appendices

APPENDIX 1 - FIGURES

APPENDIX 2 - SCHEDULE

APPENDIX 3 - STATOIL HSE POLICY AND GUIDELINES

APPENDIX 4 - WELL DESIGN

APPENDIX 5 - DRILL SHIP AND VESSELS SPECIFICATION

APPENDIX 6 - OIL SPILL AND EMERGENCY RESPONSE PLAN

A. SURFACE OIL SPILL TRAJECTORY MODEL

B. SUBSURFACE OIL SPILL TRAJECTORY MODEL

C. EMERGENCY RESPONSE PLAN

APPENDIX 7 - WASTE MANAGEMENT PLAN

APPENDIX 8 - MATERIAL SAFETY DATA SHEET

APPENDIX 9 - DESKTOP SCREENING REPORT

1. INTRODUCTION

WorleyParsons Engineers Egypt Ltd (WPEEL) has been retained by Statoil for performing an Environmental Impact Assessment (EIA) study for the proposed offshore exploratory "Kiwi A-1X" well located in the Mediterranean Sea, El Dabaa Offshore Concession, Egypt.

WorleyParsons has already completed and issued seven separate deliverables for the proposed offshore exploration project. These deliverables are namely: waste management assessment (455/EJ6172-000-EN-REP-01), stakeholder identification (455/EJ6172-000-EN-REP-02), area of influence (55/EJ6172-000-EN-REP-03), Form B study in both English and Arabic (455/EJ6172-000-EN-REP-04 and 455/EJ6172-000-EN-REP-05), Environmental Risk Assessment (ERA) report (455/EJ6172-000-EN-REP-07) and a Desktop Screening Report (455/EJ6172-000-EN-REP-08).

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At a later stage, Statoil contracted ASA to conduct a subsurface trajectory and fates modelling report of a blow out event from Kiwi A-1X offshore well. The indirect area of influence was consequently updated according to the subsurface model results. This EIA study will only address the indirect area of influence within the Egyptian territories. Other indirect area of influence than those covered in this EIA report will be studied in a separate report, "Screening Report" (455/EJ6172-000-EN-REP-08). This EIA report integrates the environmental and risk assessment results.

It is worth noting that the developed Form B is meeting the national requirements stipulated by the Egyptian Environmental Affairs Agency. On the other hand, this EIA addresses national and international guidelines as well as Statoil Impact Assessment (IA) Guidelines (GL0386) drawn on IFC standards.

1.1 Project Background

Statoil is an international energy company with operations in 40 countries. Building on more than 35 years of experience from oil and gas production on the Norwegian continental shelf, the company is committed to accommodating the world's energy needs in a responsible manner, applying technology and creating innovative business solutions. Statoil is headquartered in Norway with 29 000 employees worldwide. Statoil is the operator in two offshore exploration licences located in the Mediterranean, west of the Nile Delta, El Dabaa Offshore (Block 9) covering an area of 8 368 square kilometres and Ras El Hekma Offshore (Block 10) covering an area of 9 802 square kilometres.

As shown in Figure 1-1, Kiwi A-1X exploration well is located in the Statoil-operated El Dabaa Offshore Concession, Egypt. The well is located approximately 140 km north of El Dabaa district and 170 m northwest Abu Qir with water depth of 8 875 ft and planned total depth of 17 388 ft. The well exact location is 32°15' 32.54"N and 28°38' 45.04" E. It is scheduled for drilling during the second half of October 2010.

The “Kiwi A-1X” offshore exploratory well will involve drilling activities. The main purpose of the drilling is the Upper Miocene formation at a depth of 14 764 ft True Vertical Depth Sub Sea (TVD SS).

The drilling operation will be done by a drill ship coming from Gulf of Mexico fully equipped with drilling and handling equipment necessary for the offshore operations; supporting vessels from Abu Qir shore base facility will be used as well.

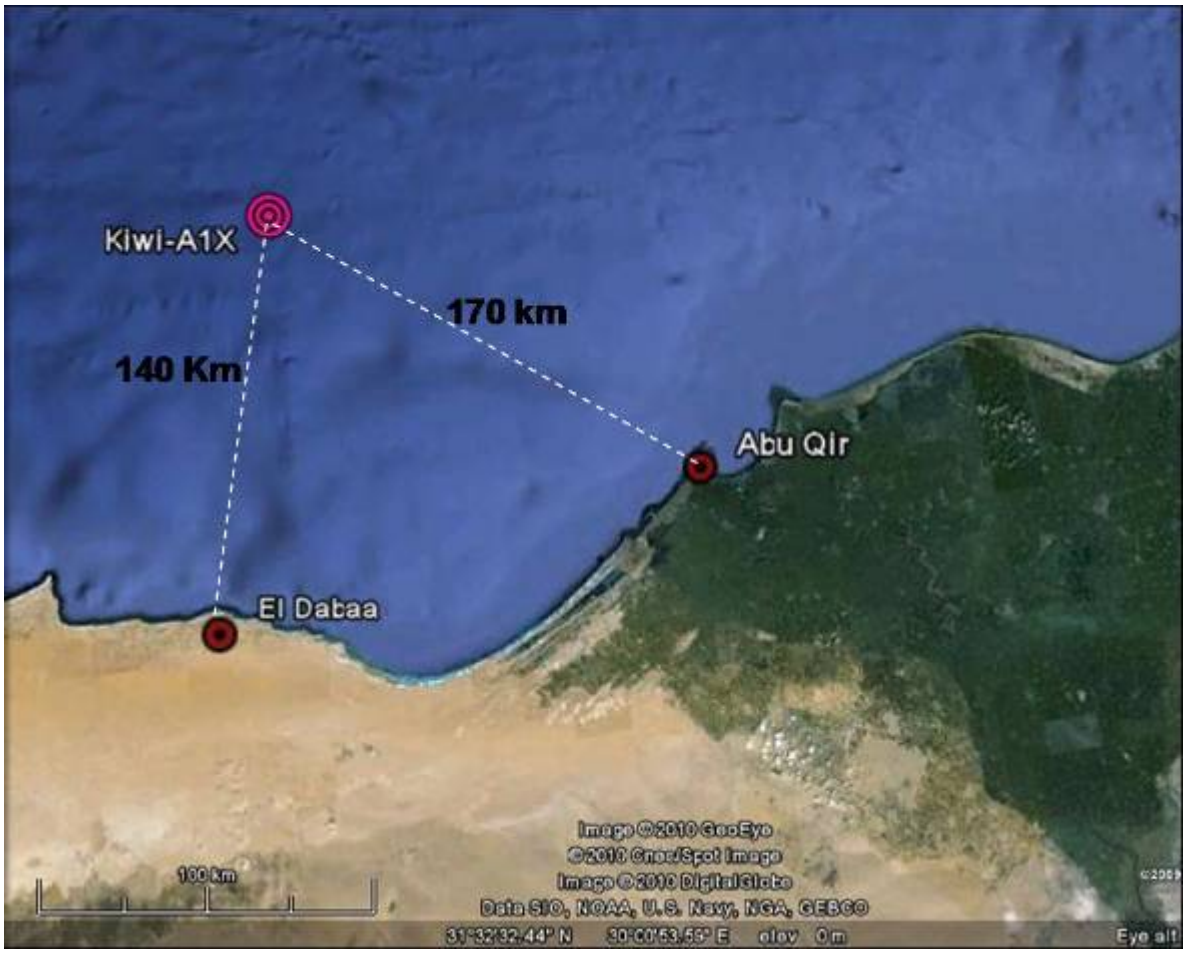

Figure 1-1 Kiwi A-1X Well Location

1.2 EIA Objectives

The overall objectives of the EIA are to:

- meet or surpass the environmental requirements of relevant authorities in Egypt, Statoil specifications and commitments pertaining to social and environmental issues, IFC guidelines and standards, relevant international conventions, and WPEEL high environmental standards;
- identify and analyse sensitive components of the existing environment. Review the existing knowledge and document the regional and site-specific baseline state, and define additional parameters to be investigated in order to describe the pre-project environment. All media potentially affected shall be considered;
- determine the type, nature and importance of the probable environmental impacts (positive, negative, direct and indirect, reversible and irreversible, short term, long term and cumulative) during drilling and decommissioning;
- identify and recommend practical and cost effective mitigation measures early in the process to eliminate, minimise, mitigate or avoid environmental impacts resulting from the project;
- recommend a framework for an environmental management and monitoring plan for the project; and
- ensure that all stakeholders deemed to be influenced by the projects or activities are fully considered, and that communication systems are established during the assessment process and remain effective throughout the life of the activities.

1.3 Methodology and Structure of this EIA

In order to achieve the above-mentioned objectives, the national and international policy and regulatory framework governing the project have been presented in Section 2. The project description and the area of influence were discussed in Section 3 and Section 4 respectively. The different components of the receiving environment (*e.g*. air, climate, land, sea water, marine ecology, biodiversity and human environment) are presented in Section 5. Moreover, the project alternatives are included in Section 6 of this report. Also, an environmental impact analysis is carried out to identify both the positive and negative impacts of the proposed project followed by the mitigation measures required to eliminate/reduce the negative impacts. An overview of the ERA for accidental events performed for the well blow-out scenario is also included. Stakeholder identification and analysis is presented in Section 10. Following that, an environmental management and monitoring plan (EMMP) which presents a framework for providing guidance for developing suitable environmental management and monitoring practices is discussed. A summary of Statoil's Emergency Response Plan and Oil Spill Response Plan has been included in the last sections of the EIA report. All reference material has been included at the end of the report.

2. POLICY LEGAL AND ADMINISTRATION FRAMEWORK

The main objective of the Environmental impact assessment is to meet or surpass the relevant environmental legislative requirements and guidelines, including but not limited to:

- Egyptian legislation: Law 4 of 1994 modified by Law 9 of 2009 and its Executive Regulations (ER) issued via Decree No.338 of 1995 and amended via Decree No.1741 of 2005;
- The requirements of EEAA publication "Environmental Impact Assessment (EIA) guidelines for Oil and Gas sector" (October 2001/January 2005).
- New EIA guideline enforced by the Egyptian Environmental Affairs Agency (EEAA) since July 2009; and
- Statoil's HSSE Policy, Impact Assessment Guideline, and Technical Environment Requirements for offshore plants.

The information provided in this section are similar to those presented in the Form B report which has already covered national regulations. The submitted Form B has granted the EEAA approval (Ref. 6171 dated on 4 October 2010). Nevertheless, a section describing the relevant national legislation for accidental releases has been added to this EIA report. This section was not included in the submitted Form B as the Egyptian Natural Gas Holding Company (EGAS) advised not to add any legislation related to oil spill in the submitted Form B since a separate updated OSRP, including updated information on the subsurface trajectory models, was submitted to EEAA for approval. Moreover, the updated area of influence and Environmental Risk Assessment were not included in the submitted Form B.

2.1 Competent Authorities

2.1.1 Egyptian Environmental Affairs Agency (EEAA)

The Egyptian Environmental Affairs Agency (EEAA) is the competent authority responsible for environmental protection in Egypt. It is responsible for setting standards, formulating environmental policies, implementing Law 4/1994 modified by Law 9/2009 and inspecting compliance. Moreover, the EEAA sets criteria and procedures for mandatory EIAs of projects, approves EIAs and monitoring programmes, and inspects the environmental registers during project operation. The EEAA has the authority to take action against violators of these criteria and conditions.

2.1.2 Egyptian Natural Gas Holding Company (EGAS)

The Egyptian Natural Gas Holding Company (EGAS) was established in 2001 by the Ministry of Petroleum as the main body for handling the natural gas chain of activities in Egypt. It is the authority responsible for all gas-related operations, including exploration, implementation of gas projects and transportation, evaluation and approval of all upgrading plans for gas handling

facilities, management, supervision and follow up of operations and maintenance activities of all gas pipelines and the national gas network, and revision of all natural gas agreements and contract.

2.2 National Legislation

2.2.1 Law 4/1994 Modified by Law 9/2009

Law No. 4, passed in 1994, is the main Environmental Law in Egypt concerning the environment. This law established the EEAA as the competent authority and the ER of this Law was set out in 1995 (Decree 338 of 1995).

Some articles of Law 4 were modified by Law 9 of 2009, and the ER will be modified before the end of 2010. Various decrees have also been passed dealing with drainage of liquid wastes.

Law 9 dictates that the licensing authority must submit to EEAA for assessment the environmental impacts of the proposed development (i.e. the exploratory well). The assessment shall include a statement of all elements of the offshore well's self-monitoring system, and the expected contaminant levels. The EEAA shall verify the foregoing whenever necessary (Article 10, Decree 338 of 1995, amended by Decree 1741 of 2005).

The license application must include comprehensive data about the offshore well, to fulfil the requirements of the form structured by the EEAA and the Competent Administrative Authority (CAA) (A12/D338, amended by D1741).

A register shall be maintained to record the offshore well's impact on the environment (A17/D338, amended by D1741), according to Annex 3 of the Executive Regulation and such register shall include the following information:

- Emissions emanating or draining from the offshore well and the limits thereof;
- The efficiency of treatment processes and specification of any residual material from the treatment process;
- Details of environmental safety and environmental self-monitoring procedures applied in the offshore well;
- The results of periodic tests and measurements, together with a record of sampling time, location, and the number of samples; and
- The name of the officer in charge of maintaining the register.

The EEAA must be notified by registered letter of any deviation from the established criteria. The letter must also outline the procedures taken to correct the problem (A17/D338, amended by D1741). The EEAA shall be responsible to follow up the data included in the offshore well's register, to ensure conformity with the actual conditions, commitment to the self-monitoring plan and the efficiency of equipment and personnel responsible for the monitoring. The EEAA has the

authority to visit the offshore well to ensure conformity. If a violation occurs and the establishment fails to comply within 60 days, the violating activity could be suspended, and/or court action taken (A18/D338, amended by D1741).

The EEAA must be notified of any expansions, modifications or renewals to the existing offshore well or any work that might result in an adverse impact on the environment or workers. Such expansions/modifications/renewals are subject to Articles 19, 20, 21, and 22 of Law 9 (A19/D338, amended by D1741).

AIR EMISSIONS

The offshore exploration well must demonstrate that it will meet air emission standards taking into account (A34 - 36/D338). The cumulative contaminant levels due to incremental effects when combined with emissions from existing wells in the area should not exceed the limits in Annex 5 of the ER (presented in Table 2-1) (A34/D338, amended by D1741).

Reference is also made in D1741/2005 to "guidelines for specific limits", which shall be published by the EEAA in coordination with the authorities involved. However, the latter guidelines have not been published yet.

Gas releases, noxious and harmful smoke, fumes resulting from burning fuel, precautions and permissible limits as well as specifications of chimneys are regulated by Articles 36, 37, and 42/D338, amended by D1741, and Annex 6 of the ER. Table 2-2 presents maximum limits for certain gaseous emissions from industrial establishments' stacks (extracted from Table 2, Annex 6 of the ER.

Table 2-1 Ambient Air Quality Criteria (µg.m^{-3}) (Annex 5 of the Executive Regulations of Law 4/1994)

Pollutant	Average Period	Egyptian Standards
Sulphur dioxide (SO_2)	1 hour	350
	24 hours	150
	1 year	60
Carbon monoxide	1 hour	30 000
	8 hours	10 000
Nitrogen dioxide (NO_2)	1 hour	400
	24 hours	150
Ozone	1 hour	200
	8 hours	120

Pollutant	Average Period	Egyptian Standards
Suspended Particles measured as black smoke	24 hrs	150
	1 year	60
Total Suspended Particles	24 hrs	230
	1 year	90
Lead	24 hour average over 1 year in urban areas	0.5
	24 hour average over 6 months in industrial zones	1.5
Thoracic particles (PM 10)	24 hrs	150
	1 year	70

Table 2-2 Maximum Limits for Gaseous and Vapour Emissions from Industrial Establishments' Stacks (extracted from Table 2, Annex 6 of the Executive Regulations of Law 4)

Pollutant	Limit Concentration (mg.m^{-3} of exhaust)
Aldehydes (measured as Formaldehyde)	20
Antimony	20
Carbon monoxide	500 for existing facilities
	250 for facilities to be constructed after the amended executive regulations are issued
Sulphur Dioxide	
– Burning coke and petroleum	2 500 for existing facilities
	4 000 for facilities to be constructed after the executive regulations are issued
– Non-ferrous industries	3 000
– Sulphuric acid Industry & other sources	1 500
Sulphur trioxide in addition to sulphuric acid	150

Pollutant	Limit Concentration (mg.m^{-3} of exhaust)
Nitric acid resulting from nitric acid Industry	2 000
Hydrochloric acid (hydrogen chloride)	100
Hydrofluoric acid (hydrogen fluoride)	15
Lead	2
Mercury	3
Arsenic	20
Heavy elements (total)	25
Silicon Fluoride	10
Flor	20
Tar	
– Graphite Electrodes Industry	50
Cadmium	10
Hydrogen Sulphide	10
Chlor	20
Carbon	
Garbage burning	50
Electrodes industry	250
Organic Compounds	
– Burning of organic liquids	50 0.04% of crude (oil refining)
Copper	20
Nickel	20
Nitrogen oxides	
– Nitric acid industry	3 000 for existing facilities 400 for facilities to be constructed after the amended executive regulations are issued
– Other sources	300

CONDITIONS IN THE WORKPLACE

The offshore well must operate such that any possible leakage or emission of air pollutants inside the workplace will not affect worker's health and safety (A45/D338). Annex 8 of the ER provides the maximum limits for air pollutants inside the workplace. Suitable Personal Protective Equipment (PPE) is to be provided as required for workers in different areas of the well (A46/D338).

DISPOSAL OF LIQUID WASTE

The Kiwi A-1X exploratory well project will have a controlled and tested marine discharge. Projects are licensed to discharge effluents containing degradable substances into the marine environment after treatment that complies with the limits presented in Annex 1 of the ER of Law 4 amended by Law 9. "Industrial establishments shall also be prohibited to drain the non-degradable substances, as prescribed in Annex No. 10 to these Regulations, into the water environment" (Article No. 58 of the ER D338, amended by Decree 1741). The parameters set in Annex 1 of the ER No. 1741of 2005 represented in Table 2-3. By all means, discharge into the marine environment is not allowed at distances less than 500 m from the shore.

Table 2-3 Liquid Effluent Discharged into Marine Environment

Parameters	Units	Criteria for Discharge to Marine
Temperature	^{o}C	should not exceed 10^{o}C above prevailing rate, with a maximum of 38^{o}C
pH		6 – 9
Colour		Free from colouring materials
Biological Oxygen Demand (BOD)	$mg.L^{-1}$	60
Chemical Oxygen Demand COD (dichromate)	$mg.L^{-1}$	100
Total Dissolved Solids (TDS)	$mg.L^{-1}$	2,000 above or below the prevailing TDS level in the marine environment to which waste water is disposed of
Suspended Materials	$mg.L^{-1}$	60
Turbidity	NTU	50
Sulphides	$mg.L^{-1}$	1.0
Oil and grease	$mg.L^{-1}$	15
Phosphate	$mg.L^{-1}$	5.0

Parameters	Units	Criteria for Discharge to Marine
Nitrate	$mg.L^{-1}$	40
Phenols	$mg.L^{-1}$	0.015
Fluorides	$mg.L^{-1}$	1.0
Aluminium	$mg.L^{-1}$	3.0
Ammonia (nitrogen)	$mg.L^{-1}$	5.0
Mercury	$mg.L^{-1}$	0.005
Lead	$mg.L^{-1}$	0.5
Cadmium	$mg.L^{-1}$	0.05
Arsenic	$mg.L^{-1}$	0.05
Chromium	$mg.L^{-1}$	1.0
Copper	$mg.L^{-1}$	1.5
Nickel	$mg.L^{-1}$	0.1
Iron	$mg.L^{-1}$	1.5
Manganese	$mg.L^{-1}$	1.0
Zinc	$mg.L^{-1}$	5.0
Silver	$mg.L^{-1}$	0.1
Barium	$mg.L^{-1}$	2.0
Cobalt	$mg.L^{-1}$	2.0
Other metals	$mg.L^{-1}$	0.1
Pesticides (of all types)	$mg.L^{-1}$	0.2
Cyanide	$mg.L^{-1}$	0.1
Industrial Detergents	$mg.L^{-1}$	0.5
Coliform (Most Probable Number in 100 cm^3)		4,000

HAZARDOUS MATERIAL AND WASTE

The production and displacement of hazardous materials and wastes is prohibited without a license. The license is issued for a fixed time interval. The permit requirements are summarised in A26/D338, amended by D1741. Management of hazardous wastes is subject to rules and procedures, which are set out in A28/D338, amended by D1741.

Hazardous substances are defined by Law 4 as "substances having dangerous properties which are hazardous to human health, or which adversely affect the environment, such as contagious, toxic, explosive or flammable substances or those with ionizing radiation."

A hazardous waste is defined by Law 4 as the "waste of activities and processes or its ashes which retain the properties of hazardous substances and have no subsequent original or alternative uses, such as clinical waste from medical treatments or the waste resulting from the manufacture of any pharmaceutical products, drugs, organic solvents, printing fluid, dyes and painting materials".

Hazardous wastes generated due to the offshore activities are either liquid or solid. Hazardous liquid wastes include used oil generated from engine oil changes, lubricants generated from equipment lube oil changes, and chemicals used in cleaning tanks and pipelines. Hazardous solid wastes include absorbents used for spill clean-up, oily rags, batteries, used oil filters of engines, fluorescent light bulbs, paint materials generated from any painting or coating activities, and empty drums with chemical/oil residue.

ACCIDENTAL RELEASES

Article 50 of the Executive Regulations of Law 4 of 1994 states that:

"Ship owners, ship captains, or any other persons in charge of ships and those responsible for oil transport consignments within ports, territorial waters, or the exclusive economic zone of the Arab Republic of Egypt, and the companies operating in hydrocarbon exploration and extraction, must immediately notify the competent administrative bodies of every oil leakage incident upon its occurrence".

The responsible parties must indicate the place and circumstances of any incident, type of leaking materials, quantities, and the procedures taken to stop or limit such leakage, with the provision that the notification shall include the following data:

- procedures taken for dealing with the leakage;
- quantities and types of dispersants used;
- probable source of leakage, and whether or not a fire has broken out;
- direction in which the formed oil spill is moving;
- rate of leakage, if ongoing;
- dimensions of the oil spill;

- wind velocity and speed, temperature, and extent of visibility;
- direction of current speed, and water temperature;
- condition of the sea;
- tide status (spring, neaps, flood, ebb);
- details of threatened coastal areas;
- nature of the area: coral reefs – marine organisms; and
- reporting source: -name – telephone – address.

In all cases, the competent administrative bodies are required to notify the EEAA of all information on a given incident, upon its occurrence, in order to enable the EEAA to follow up the procedures taken, according to its responsibilities, as prescribed in Article No. 5 of Law 4.

2.2.2 Additional Laws and Regulations

a) Law 59/1960 on Naturally Occurring Radioactive Material (NORM) Management.

b) Law 280/1960 for applicable rules in harbours and territorial sea.

c) Law 79/1961 on Marine Disasters and Wreckage.

d) Law 38/1976 on Municipal Waste Management.

e) Law 102/1983 on Natural Protectorates.

f) Law 124/1983 on Fishing, Aquatic Life and the Regulation of Fish Farms.

g) Law 13/2003 Book 5 on Egyptian Labour Law - Work Environment.

h) Decree 458/2007by Ministry of Health on Permissible Limits for Drinking Water.

i) Decree 44/2000 by the Ministry of Housing on Permissible Limits for Discharged Sewage Wastewater.

j) Decree 192/2001 by the Ministry of Health on Hazardous Medical Waste.

k) Decree 120/2007 by the Ministry of Agriculture on prohibiting yearly the navigation of local fishing boats/vessels as well as fishing activities in the Mediterranean Sea for nearly one and half month; particularly during the period of 1 May until 15 June.

2.3 Environmental Impact Assessment Guidelines

According to the national EIA guidelines for Oil and Gas sector (October 2001/January 2005), the proposed drilling activities are classified under “Category B” projects.

Similarly, and according to the new EIA guidelines second edition, issued by the EEAA in January 2009, the petroleum and gas sector projects have been categorized. Examples of the types of projects that require submission of Environmental Screening (Form B) are the following:

- Exploratory drilling activities without further development for onshore/offshore oil/gas wells.
- Drilling activities for production wells which are in an area with existing production facility and which will have no new expansions and to be connected with the existing facilities.
- Exploratory surveying (geological/geophysical) for onshore or offshore gas or oil deposits.

Therefore, and according to the national EIA guidelines for Oil and Gas sector (October 2001/January 2005) as well as the new EIA guidelines issued by the EEAA, the “Kiwi A-1X” project is considered a “Category B” project as the main project purpose is “exploratory drilling”.

2.4 Statoil Health, Safety, Security and Environmental Policy

Figure 2-1 shows Statoil HSE chart, Statoil HSE policy and guidelines can be seen in Appendix 3. Statoil has set out some responsibilities, and measures through guidelines like: Impact Assessment (IA) Guideline that intends to offer helpful guidance on how to fulfil the requirements for IA in projects. Statoil has also conducted the document “Technical Environment Requirements for Offshore Plants” which describes the group’s technical environmental requirements and is applicable for all offshore activities. In order to achieve HSSE performance, Statoil has set out some responsibilities, commitments and measures regarding all the activities and operations conducted through Statoil Governing Document HSE Risk Management (HSE 01.02). According to HSE 01.02, an impact assessment for such projects shall be carried out as per principles set out in the Statoil IA Guideline.

2.5 Regional/International Standards and Conventions

Since 1936, Egypt has been party to many regional and international conventions, treaties and agreements addressing environmental protection, the conservation of nature in general and biodiversity in particular. Relevant international and national legislation and guidelines include but not limited to:

- Agreement for the Establishment of a General Fisheries Council for the Mediterranean (Rome, 1949).
- OILPOL, International Convention for the Prevention of Pollution of the Sea by Oil, regulating the discharge of oil or oily mixtures to sea from vessels (1954).
- MARPOL, International Convention for the Protection of Pollution from Ships (MARPOL) (1973).
- The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Dumping Convention) regulates the disposal of potentially hazardous materials to sea.

- Convention of the Protection of the Mediterranean Sea against Pollution (Barcelona, 1976).
- Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean (Barcelona, 1976).
- United Nations Convention on the Law of the Sea (UNCLOS) (1982).
- Protocol Concerning Mediterranean Specially Protected Areas (Geneva, 1982).
- Protocol on Substances that Deplete the Ozone Layer (Montreal, 1987).
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989).
- International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC) (London, 1990).
- Convention on Biological Diversity (CBD) (Rio de Janeiro, 1992).
- United Nations Framework Convention on Climate Change (Kyoto, 1997).
- Kyoto Protocol (2005).
- The International Maritime Dangerous Goods (IMDG) Code (2006 Edition).

Figure 2-1 Statoil HSE Chart

3. PROJECT DESCRIPTION

3.1 Project Location

The Kiwi A-1X offshore exploration well involves drilling activities for the well within El Dabaa offshore concession, in the Mediterranean Sea. The well's exact location is 32°15'32.54"N; 28°38'45.04"E, 170 km northwest of Abu Qir. Figure 3-1 illustrates the well's location in relation to the Abu Qir onshore base.

Figure 3-1 Kiwi A-1X Well Location

Figure 3-2 shows the location of the well and the other wells nearby.

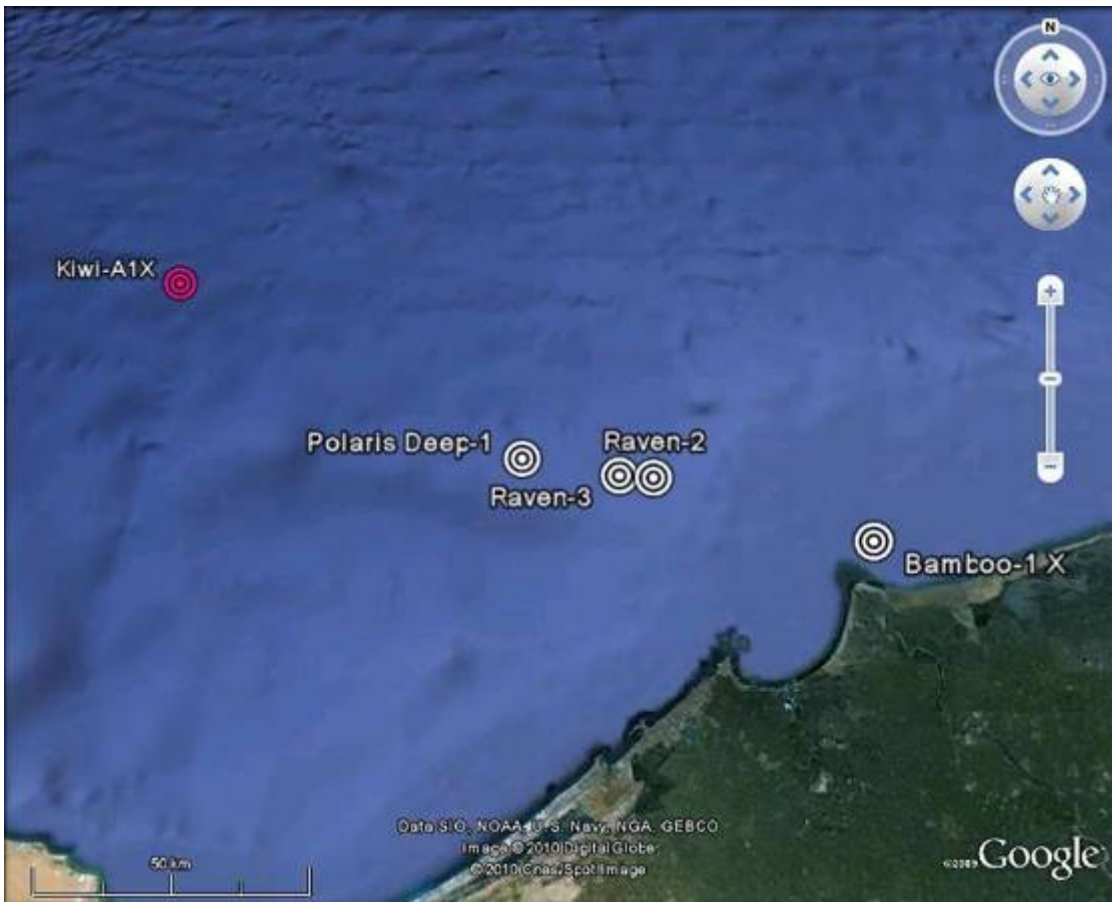

Figure 3-2 Location of "Kiwi A-1X" and Other Existing Wells

The distances between "Kiwi A-1X" and other existing wells are given in Table 3-1.

Table 3-1 Positioning of "Kiwi A-1X" in Relation to other existing Wells

Offshore Wells in Project Area	Approximate Distances from "Kiwi A-1X" (km)	Location from "Kiwi A-1X"
Polaris Deep-1	106	SE
Raven-2	135	SE
Raven-3	128	SE
Bamboo-1X	185	SE

3.2 Well Information

Kiwi A-1X offshore exploration well will be a vertical well with a possible by-pass through any of the target reservoirs if found hydrocarbon bearing.

The well's primary target is the Upper Miocene formation at a depth of 14 764' True Vertical Depth Sub Sea (TVD-SS). The well's secondary target is in the Upper-Mid Miocene formation at a depth of 16 831' TVD-SS.

3.2.1 Well Objective and Design

Kiwi A-1X offshore exploration well proposed to satisfy the following objectives:

- Drill vertical well to prove the presence of commercial accumulation of hydrocarbon fluids in the well targets with a possible by-pass through any of the target reservoirs, if found hydrocarbon bearing. The proposed total depth of the well is 17 388' TVD-SS;
- Drill the well safely, on time and within the proved budget; and
- Collect a good database set, which can help in the future development.

A detailed well design for Kiwi A-1X is presented in Appendix 4.

3.2.2 Additional Well Specific Data

Table 3-2 outlines the well information.

Table 3-2 Well Information

Rig name	Discoverer Americas	**Area**	Egypt	**License**	El Dabaa
Well name	Kiwi A1X	**Type**	Vertical, Exploration	**Objective**	Oil/Gas
Water depth	8,875 ft (2,705m)	**Air gap**	92 ft (28 m)	**H2S preparedness**	Y
Partners	Sipex (20%)				
Schedule	The activity is planned to start on 20 October, 2010				

Location	**Surface Location**		**Target Location**	
	Lat.	**Long.**	**Lat.**	**Long.**
UTM:	655,029 m	3,570,337 m	655,029 m	3,570,337 m
Geographic:	32° 15' 32.54"	28° 38' 45.04"	32° 15' 32.54"	28° 38' 45.04"
Primary target:	Formation:	Upper Miocene	Depth:	14,764' TVD SS
Secondary target:	Formation:	Upper-Mid Miocene	Depth:	16,831' TVD SS
TD Criteria	Planned TD: 17 388' MD-SS / 17 388' TVD-SS			

3.3 Process Description

Seismic surveys and geological knowledge give an overview of the underlying rock structure; however the properties of the rocks, as well as the presence of hydrocarbons, can only be determined by drilling into the rock layers. Exploratory drilling offshore is designed to provide further information on the commercial viability of hydrocarbon extraction in the Concession and will be carried out by Discoverer Americas drill ship. Drill ships are the best alternative for exploratory wells as they can be readily moved from one location to another. In this case, Discoverer Americas drill ship shall reach spud location directly from its last operation in the Gulf of Mexico. Two drilling mud systems will be used for the Kiwi A-1X well: the Pump and Dump water based mud, and a low-toxicity oil based mud (LTOBM).

3.3.1 Drilling Programme

The Kiwi A-1X prospect well is planned to be a vertical well with a possible by-pass through any of the target reservoirs if found hydrocarbon bearing. The proposed total depth (TVDSS) is 17 388 ft. The anticipated hydrocarbon is either oil or gas.

Kiwi A-1X well is planned as a vertical well in water depth of 8,875 ft (2,705 m). The well will penetrate 2,227 ft (679 m) to 11,102 ft (3,384 m) SS of Pliocene sediment before topping a ±3,700 ft (1,128 m) thick salt body to 14,764 ft (4,500 m) SS. The primary target will be penetrated upon exiting salt at 14,764 ft (4,500 m) SS in the Upper Miocene (Reservoir I); and subsequent targets thereafter at 16,831 ft (5,130 m) SS (Reservoir II); 17,946 ft (5,470 m) SS (Reservoir III), and 19,521 ft (5,950 m) SS (Qantara sandstones) all in the Mid-Miocene. The proposed total depth (PTD) for the well is 19,521 ft (5,950 m) SS. There is a provision to recover a core in one of the reservoirs from I through III; provided that the reservoir is found to bear hydrocarbon.

The well will be established by jetting-in the 36” structural casing to 320 ft (97 m) BML to 9,287 ft (2,831 m) TVD. A Dril-Quip BBII “Low pressure wellhead housing (LPWHD)” will be run at this time to allow the landing of the 22” surface casing string and the Dril-Quip “High pressure wellhead housing (HPWHD)”. The 28” conductor casing contingency is available in the event there is a concern with the stability of 36” casing shoe (potential for broaching at a later time) or a shallow flow encountered. The riserless operation will be conducted with SW/gel sweeps initially, and with a salt saturated mud cut down to an equivalent 9.0/9.7 ppg on “pump-and-dump” (PAD) operation. A 22” surface casing is planned to top the TOS by drilling riserless ±500 ft (152 m) net into the salt body at 11,602 ft (3,536 m) TVD. These operations are riserless, with returns taken at the mudline. ROV surveillance will provided through this phase.

An 18-3/4” 15M BOP stack and marine drilling riser will run latched and tested, to start the phase of drilling operation with returns to the surface. After landing the 18-3/4” BOP with the marine drilling riser, the well will be displaced to Synthetic Oil Base Mud SOBM and will continue to be drilled with the following geometries:

Table 3-3 Well Geometry

Well Geometry	Well Depth
18” Drilling Lnr. #1,	13 330 ft (2 636 ft BML)
16” Drilling Lnr. #2 (Contingency),	13 630 ft (4 663 ft BML)
14” X 13-5/8” Intermediate casing,	14 164 ft (5 197 ft BML)
Base of Salt (BOS)/Top Res. I	14 856 ft (5 797 ft BML)
9-7/8” Drilling Lnr. #3	15 725 ft (6 759 ft BML)
Top Res. II	16 923 ft (7 956 ft BML)
8 ½” Hole to TD	17 480 ft (8 513 ft BML)

There is a plan in place to recover a core in one of the two target reservoirs; which will be accomplished by drilling an open hole by-pass hole parallel to the original well bore. The well is planned to be permanently abandoned (P&A).

The drilling program schedule is depicted in Figure 3-3.

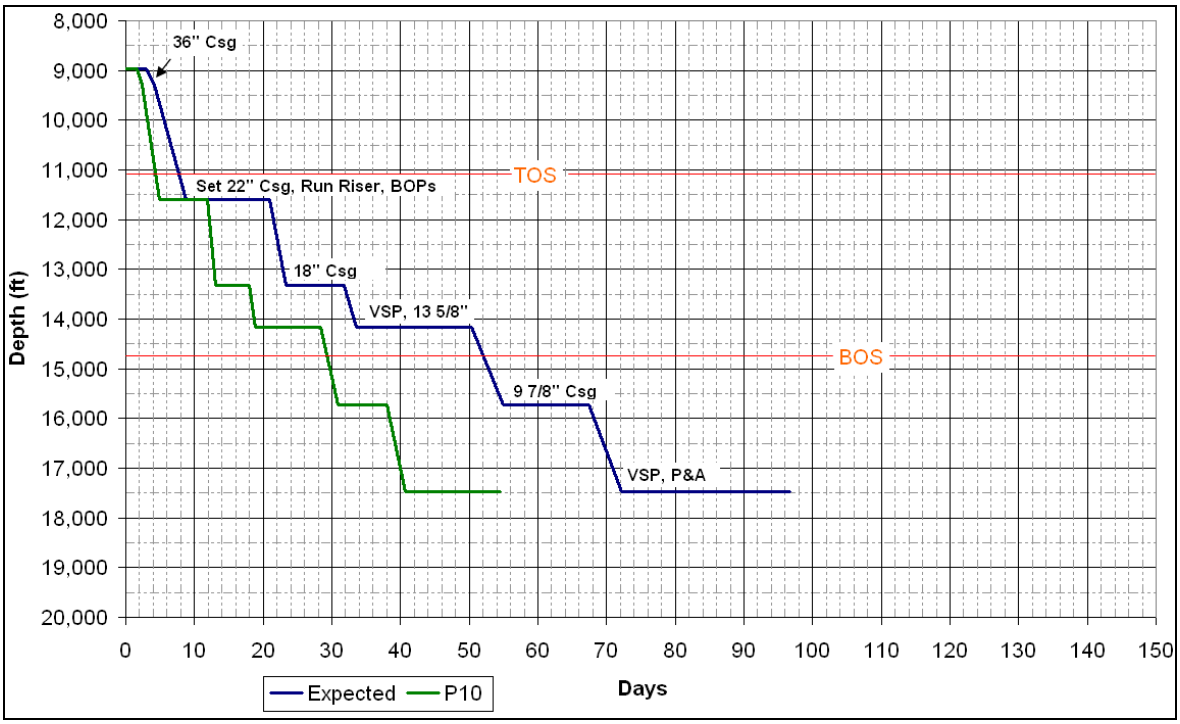

Figure 3-3 Days vs Depth Dryhole

3.3.2 Cementing and Casing Programme

Along the process of the well drilling, casing and cementing procedures will take place. First, the hole section will be drilled and cleaned from cuttings; this will be followed by running casing and cementing activities. These will be performed as per project schedule.

Materials used for the cementing and casing activities include cement and chemical additives. The materials are presented in Table 3-4. Material safety data sheets are provided in Appendix 8.

Table 3-4 Cementing Chemicals used for Kiwi A-1X Exploration Drilling

Trade Name	Function
Dyckerhof G/Norcem G Cr reduced	Cement
Lafarge Class H	Cement
Type I Standard	Cement
Micro Matrix	Cement
Tuned Light XL/TXI lightweight	Cement
HGS-18000 Dry blended	Light Weight Additive
EZ-Flo II	Cement
ZoneSealant 2000	Foamer
FloStop 5000	Foamer
Potassium Chloride (KCl)	Clay Control
SSA-1	Strength retrogression
SSA-2	Strength retrogression
Micromax FF	Weighting material
Microsilica Liquid	Gas control
CFR-3	Dispersant
CFR-8L	Dispersant
HR-4L	Retarder
HR-5L	Retarder
HR-25L N	Retarder
SCR-100 L	Retarder
MMCR	Retarder
Halad-300L-NS	Fluid loss control

3.3.3 Coring Programme

The strategy for coring either of the potential horizons (Res. I or II) relies on the ability to drill a significant hydrocarbon bearing zone in the original hole. For the Res. I located right below base of salt (BOS): a 12 ¼" bit size will be used to drill out of the 13 5/8" casing, drill through the base of salt and through the potential reservoir. This formation will be logged with logging while drilling tools (Gamma ray, resistivity, neutron, density, sonic, and PWD) in order to asses the formation as a potential coring zone. If it is decided to core, the original hole will be cemented back into salt and the original hole will be by-passed with 12 ¼" hole to the core point. A core bit will be run into the hole to recover 100-200ft of core.

A 12 ¼" bit will then be run into the hole to drill to the 9 7/8" casing point. This hole will be evaluated with wire line logs. The 9 7/8" casing will then be run and cemented in place.

If Reservoir I is not cored, there is an option to core Reservoir II if warranted. This would be accomplished in the same manner as Reservoir I with the only difference being the smaller hole size. Reservoir II will be drilled with an 8 ½" hole.

3.4 Schedule

The approximate period of the drilling activities is estimated to be 96.7 days as presented in Table 3-5. A Gantt chart presenting the project schedule is presented in Appendix 2. The planned starting date is the second half of November 2010.

Table 3-5 Project Schedule

Activity	Duration (days)	Cumulative (days)	Depth (ft)
Mob	2.9	2.9	8,967
Jet in 36" Casing	1.3	4.2	9,287
Drill 26" Hole	4.5	8.7	11,603
Case 22"	3.6	12.3	11,603
Run BOPs	8.7	21.0	11,603
Drill 18 1/8" x 21" Hole	2.3	23.3	13,330
Case 18"	8.5	31.8	13,330
Drill 16 1/2" Hole	1.7	33.6	14,164
Case 13 5/8"	16.7	50.3	14,164
Drill 12 1/4" Hole	4.6	54.9	15,725
Case 9 7/8"	12.5	67.5	15,725

Activity	Duration (days)	Cumulative (days)	Depth (ft)
Drill 8 1/2" Hole	4.8	72.2	17,480
Wireline log - VSP	2.9	75.1	17,480
8 1/2" Hole	5.9	81.1	17,480
P&A	15.6	96.7	17,480
TOTAL Duration of the Project (days)		**96.7**	

3.5 Drill Ship and Support Vessels

3.5.1 Drill Ship

Discoverer Americas drill ship (Figure 3-4) will be used to drill Kiwi A-1X offshore well. This will be the second well drilled by Discoverer Americas, a generation five Dynamic Positioning Rig. Its first well operation was Krakatoa well in the Gulf of Mexico. The drill ship is a single hull, dual derrick, dynamically-positioned (DP) enhanced enterprise class drillship capable of operating in moderate environments and water depths up to 12 000 ft (3,657 m) using 18¾" 15 000 psi BOP and 21" OD marine drilling riser. Discoverer Americas is self-propelled, and will reach spud location directly under its own steam.

Figure 3-4 Discoverer Americas Drill Ship

The drill ship is equipped with, but not limited to, the following:

- Drilling equipments
- Storage area
- Power equipments
- Safety equipments
- Cranes
- Helideck
- Accommodation
- Communication and navigation equipments
- Oceanographic and meteorological instruments

The specifications of the Discoverer Americas drill ship are presented in Table 3-6. Further details are provided in Appendix 5.

Table 3-6 Discoverer Americas Drill Ship Specifications

Feature	Specification
General	
Rig	Discoverer Americas
Flag	Marshall Island
Owner	Transocean
Manager	Transocean
Year built	New construction
Design	Transocean Offshore Enhanced Enterprise Class, double hull, dual-activity capability
Builder	Daewoo Shipbuilding & Marine Engineering, South Korea
Classification	DNV +1A1, "Ship Shaped Drilling Unit", EO, DYNPOS, AUTR, HELDK, CRANE, TEMPSTORE
Main Dimensions / Draft / Displacement	

Feature	Specification
Length	835 ft (254 m)
Breadth	125 ft (38 m)
Depth	62 ft (19 m)
Operating Draft	42 ft (13 m)
Maximum Load Displacement	100 000 mt (110 231 lt / 98 421 st)
Operating Parameters	
Outfitted Water Depth	10 000 ft (3 047 m), upgradeable up to 12 000 ft or 3 657 m
Outfitted Drilling Depth	37 000 ft (11 277 m), upgradeable up to 40 000 ft or 12 191 m
Transit Speed	12 knots max
Operating Conditions	Wave: 30 ft (9 m); Wind: 60 knots
Storm Conditions	Wave: 50 ft (15 m); Wind: 100 knots
Machinery	
Main Power	6 x MAN B&W V32/40 14 cylinder engines rated 7 000 kW each, driving 6 x LDW-Siemens S5E1250-10SE+wk generators rated 6 456 kW
Power Distribution	Siemens 11 kV switchboard feeding Siemens Blue variable speed drive, PWM type
Emergency Power	1 x MAN B&W 7L27/38 engine rated 2 310 kW driving 1 x Hyundai 2 100 kW 480V generator
Cranage	4 x 100 MT Hydralift electro-hydraulic knuckle boom cranes, 7.8 m to 45 m lift radius
Drilling Equipment	
Derrick	226 ft x 80 ft x 80 ft (69 m x 24 m x 24 m) base with 20 ft x 60 ft (6 m x 18 m) top dual-activity derrick rated at 2,500 st

Feature	Specification
Drawworks	2 x NOV Active Heave Compensating; rated 1000 ST with 2” line
Rotary	1 x NOV 75.1/2” hydraulic (forward); 1 x NOV 60.1/2” hydraulic (aft)
Top Drive	2 x Maritime Hydraulics MDDM 1 250 st with 2 each AC variable frequency drive motors
Travelling Block	2 x NOV 1 000 st
Drill-pipe	Equipped to drill up to 37 000 ft (11 277 m) drilling depth using 6.5/8” OD with 6.5/8” FH connections; 5.7/8” OD with 5.7/8” XT57 connections & 5” OD with 5" XT50 connections
Drill-collars	As required
Pipe Handling	2 x NOV PRS-5 Pipe Racking Systems; 2 x NOV Riser & Casing Tailing Head 21” OD to 58” OD; 1 x NOV PLS-5 Pick-up and Lay-down System; 1 x NOV Mousehole Hoist Kit (for tubular size 3.1/2” to 20” OD); 2 x NOV AR 4500 Iron Roughnecks (for tubular size 3.1/2” to 9.3/4” OD)
Cementing Unit	Third Party Services
Mud Pumps	4 x NOV HEX 240 Pumps 7 500 psi, each powered by two AC electric motors
Shale Shakers	10 x Brandt LCM-3D/CM-2 Linear Motion Cascade Shakers
Mud Conditioner	2 x Brandt MC-LCM-3D/CMC 0-6 Mud Conditioner with 40 x 4” hydrocyclones each
Mud Shear	1 x Vortex Venture Model VV-VMH-468 with 3 x 4” inlets and 1 x 8” outlet
Mud Hopper	4 x NOV Procon Mud Hopper; 2 x Vortex Venture Lobestar VVE-U6-S-MID high rate barite mixer

Feature	Specification
Degasser	4 x Brandt DG-10 Vacuum Degassers (or equivalent); 1 x Swaco Flow-line Degasser with 12” vent line; 1 x Poor Boy Degasser
Subsea Systems	
BOP	3 x Hydril 18¾" 15K Compact Double Ram Preventer; Vetco 18¾" 15K Super HD Wellhead Connector
LMRP	1 x Hydril 18¾" 10K Annuflex Annular Preventer; 1 x Vetco 18¾" 15K HAR H4 Riser Connector
BOP Handling	Skid system comprised of 3 x 350 st BOP carts and 1 x Auxiliary cart; 2 sets of spider beams rated to 350 st per set
Control System	Hydril Multiplex Control System
Riser Details	134 x Vetco HMF 21” OD, 75 ft (23 m) joints with Class G couplings & 2 x 4.1/2” ID 15K C&K lines
Choke and Kill	3.1/16” x 15K C&K Manifold H2S Service
Diverter	Vetco CSO with 72” bore, 500 psi
Riser Tensioner	6 x Hydralift 400 st direct acting cylinders with 50 ft (15 m) Stroke (or equivalent)

3.5.2 Supply Vessel

M/V Claire Candies (Figure 3-5) will be used as a supply vessel to support Kiwi A-1X offshore well operations. Olympic Elena (Figure 3-6) shall be used as a standby supply vessel.

Figure 3-5 M/V Claire Candies Supply Vessel

Figure 3-6 Olympic Elena Standby Supply Vessel

The following tables outline the technical specifications of the supply vessels to be used:

Table 3-7 M/V Claire Candies Technical Specifications

Feature	Specification
Main Characteristics	
Length Overall	86.70 m / 285 ft
Maximum Draft	5.97 m / 19 ft - 7 ft
Speed T=5.0m	12.0 kts
Deadweight Max.	5255 tonnes / 5793 short tons
Complement	35 persons
Cargo Deck	1 000 m^3 / 10 750 ft^2
Capacities	
Fuel Oil	768 m^3 / 203 000 gallons
Fresh Water	204 m^3 / 53 600 gallons (2 tanks)
Ballast and Rig Water	2 308 m^3 / 609 500 gallons
Liquid Mud	1 793 m^3 / 11 278 barrels (6 tanks, independent discharges)
Dry Bulk Storage	324 m^3 / 11 500 cubic feet (4 tanks)
Methanol	80 m^3 / 502 bbls (single tank)
Sewage	23 m^3 / 6 100 gallons
Machinery	
Diesel Electric Propulsion	AC Drive, Frequency Controlled
Main Generators	4 x 1 700 kW (total 6 800 ekW) Caterpillar 3512C DITA Tier II
Thrusters Forward	2 x 700 kW Controllable Pitch Propeller, Rolls Royce TT16500CP
Thrusters Aft	2 x 1 700 kW Fixed Pitch Propeller, Azimuth (Z-drive)
Variable Speed	Rolls Royce US205
Emergency / Harbor Generator	250 ekW (Caterpillar C9)

Feature	Specification
Main Characteristics	
Propulsion & Steering Control	Kongsberg: K-Pos DP-2

Table 3-8 Olympic Elena Technical Specifications

Feature	Specification
Main Characteristics	
Length (o.a)	74.30 m
Length (p.p)	67.20 m
Breadth (mid)	16.40 m
Depth (main deck)	7.45 m
Max draught	6.20 m
Capacities	
Deck space	683 m^2 , 5 t/m^2
Fuel oil	1273 m^3
Fresh water	676 m^3
Drill water	912 m^3
Brine	424 m^3
Liquid mud	1083 m^3
Dry bulk	320 m^3
Base oil	347 m^3
Others	
Main engine	2 x 1428 / 2 x 968 kW (Caterpillar)
Speed	15.0 kts
Accommodation	22 persons
Deck cranes	3 tons at 10 m & 1 ton at 8 m

A more detailed specification of M/V Claire Candies is provided in Appendix 5.

3.5.3 Standby Vessels

Esvagt Connector (Figure 3-7) and Esvagt Dee (Figure 3-8) shall be used as standby vessels for support and emergencies during the Kiwi A-1X offshore well operations. Esvagt Connector and Esvagt Dee are both multirole emergency response and rescue vessels.

Figure 3-7 Esvagt Connector

Figure 3-8 Esvagt Dee

Table 3-7 and Table 3-9 show the technical specifications of Esvagt Connector and Esvagt Dee standby vessels.

Table 3-9 Esvagt Connector Technical Specifications

Feature	Specification
General	
Built	Year 2000 by Odense Steel Shipyard Limited
Flag	Danish
Approvals	DMA, MCA and Norwegian Regulations as standby/rescue vessel for up to 300 survivors
Main Dimensions / Draft / Displacement	
Length (overall)	56.40 m
Beam	14.60 m
Depth	7.00 m

Feature	Specification
Draught (max)	6.00 m
Air Draft	20.25 m
Deck Load Capacities	
Cargo capacity	400 tons
Deck measurement	12 m x 26 m (300m^2)
Deck strength	5 tons/ m^2
Deck Equipment	
Crane	1 x 80 tm
Crane outreach	12 meters at 4.85 K, 6 meters at 11.20 K
Windlass	1 x 30 ts hydraulic, 1 x 2 cable lifters, 2 x warping ends
Aft capstan	2 x 7 tons hydraulic
Tugger winch	1 x 10 tons hydraulic
Anchors	2 x 1,740 K
Tank Capacities	
Potable water	234 m^3
Ballast / drill water	1,042 m^3
Fuel oil	517 m^3
Oil recovery / brine	512 m^3
Oil dispersant	35 m^3
Waste oil	15 m^3
Sludge	20 m^3
Sewage	20 m^3

Feature	Specification
Fire Fighting	
CO_2 fixed system	Engine room, engine control room, gallery and paint store
Fitted with deluge water spray system	
Life Saving Equipment	
Fast rescue craft	1 x 15 persons Esvagt FRC (heave compensated davit), 1 x 15 persons FRC with waterjet
Life rafts	4 x 25 persons
Further equipment	Seaclaw SAVE harpoon system, 2 x 5000 W searchlights, search pattern facility in video plotter

Table 3-10 Esvagt Dee Technical Specifications

Feature	Specification
General	
Built	Year 2000 by Odense Steel Shipyard Limited
Flag	Danish
Approvals	DMA, MCA and Norwegian Regulations as standby/rescue vessel for up to 300 survivors
Main Dimensions / Draft / Displacement	
Length (overall)	56.40 m
Beam	14.60 m
Depth	7.00 m
Draught (max)	6.00 m

Feature	Specification
Air Draft	20.25 m
Deck Load Capacities	
Cargo capacity	400 tons
Deck measurement	12 m x 26 m (300m^2), including space below Mezz deck)
Free cargo deck space (aft)	13.2 m x 11.6 m
Deck strength	5 tons/ m^2
Deck Equipment	
Crane	1 x 45 tm x 4.5 tons
Crane outreach	12 meters at 1.20 tons
Windlass	1 x 2 cable lifters, 2 x warping ends
Aft capstan	2 x 7 tons hydraulic
Tugger winch	1 x 10 tons hydraulic
Anchors	2 x 1,740 K
Tank Capacities	
Potable water	234 m^3
Ballast / drill water	1,000 m^3
Fuel oil	517 m^3
Oil recovery / brine	500 m^3
Oil dispersant	35 m^3
Waste oil	15 m^3
Sludge	20 m^3
Sewage	20 m^3

Feature	Specification
Fire Fighting	
CO_2 fixed system	Engine room, engine control room, gallery and paint store
Life Saving Equipment	
Daughter craft	1 x 20 persons daughter craft (hydramarine heave compensated davit)
Fast rescue craft	1 x 15 persons Esvagt FRC (heave compensated davit)
Life rafts	4 x 25 persons
Further equipment	Seaclaw SAVE harpoon system, 5000 W Seematz searchlights, satellite television

More detailed specifications of Esvagt Connector and Esvagt Dee is provided in Appendix 5.

3.6 Materials

3.6.1 Drilling Mud

Drilling fluids are considered to be a fundamental part of the drilling process. These fluids, which include various mixtures, are known as drilling mud. Bentonite and other clays and/or polymers are the basic constituents of drilling mud; they are mixed with water to the desired viscosity. The main functions of drilling mud are to control the well bore pressure, and remove cuttings from the well.

Drilling mud is one of the basic tools in the drilling processes, hence it is an important aspect that must be determined in early stages as various kinds of additives and chemicals are used with it and need verification. The most famous drilling mud types are the Water Based Mud (WBM), the Oil Based Mud (OBM), the Low Toxicity Oil Based Mud (LTOBM) and Synthetic-based drilling Mud (SBM). The type of drilling mud used whilst drilling is dependent on the geological properties in the area of the drill site.

Two drilling mud systems will be used for the Kiwi A-1X well: the Pump and Dump water based mud, and a low-toxicity oil based mud (LTOBM).

Table 3-11 shows the estimated quantities of drilling fluids to be used.

Table 3-11 Estimated Drilling Fluids

Hole Section	Base Fluid	Type	Fluid Volume (bbl)	Comment
36”	Water	Seawater	400	Seawater with Hi-Vis Sweeps
26”	Water	PAD	20,000	At TD, displace hole to 12.0 ppg Pad Mud
21”	Oil	Rheliant	10,800	Follow 87.5% OBG
16 ½”	Oil	Rheliant	1,929	
12 ¼”	Oil	Rheliant	1,257	Section will include salt exit strategy – Stress Cage material included
8 ½”	Oil	Rheliant	1,958	Stress Cage material included in system
Total WBM Fluid Volume			**20,400 bbl**	
Total LTOBM Fluid Volume			**15,944 bbl**	

WATER BASED MUD (WBM)

The first mud system to be used will be MI Swaco’s Pump and Dump (WBM) for the 26” hole section. This mud contains: Brine, Barite (Density control), Caustic Soda (Alk. & hardness treatment), Duo Vis (Viscosifier), Defoam (Anti-foam agent), and Myacide 25G (Bacteria Control). This mud will be pumped through the drillstring, but will not return to the drill ship. The riser will not be connected at this point, so the returns from the hole will be at the seabed.

All of these components are non-toxic to marine organisms at the dilution reached shortly after discharge. Despite concerns regarding different methods used for toxicity testing, WBM have been shown to have little or no toxicity to marine organisms (Jones, et. al. 1996).

Table 3-12 provides a list of chemicals to be used in the water-based drilling fluid.

Table 3-12 Water-Based Drilling Fluid Chemicals

Trade Name	Function
Barite	Density control
Caustic Soda	Alkalinity & hardness treatment
Duo-Vis	Viscosifier
Defoam	Anti-foam agent
Myacide 25G	Bacteria control

LOW TOXICITY OIL BASED MUD (LTOBM)

The second system will be MI Swaco's 'Rheliant' Low Toxicity Oil Based Mud (mineral oil based mud). This mud will be used with the riser connected, so the returns will be taken on board the drill ship. These cuttings or any of the drilling fluids will not be discharged to the sea. Instead, they will be shipped back to shore for disposal.

Table 3-13 provides a list of chemicals to be used in the low toxicity oil based drilling fluid.

Table 3-13 LTOBM Drilling Fluid Chemicals

Trade Name	Function
Safe Carbs-all	Bridging agent
RheThik	Rheology Modifier
RheFlat	Rheology Modifier
RheDuce	Dispersant
RheBuild	Viscosifier
Calcium Chloride	Internal phase
G-Seal	LCM
SureWet	Wetting Agent
SureMul	Emulsifier
Ecotrol RD	Filtration Control
VG Plus	Viscosifier
Escaid 110	Mineral Oil
Lime	Alkalinity
Barite	Weighting material

The Discoverer Americas drill ship is equipped with a mud management system that includes mixing, circulating, solid control and storage systems. The drill ship contains one gumbo chain, ten shale shakers, two mud cleaners, two cutting dryers, and two centrifuges. The storage for Water Based Mud (WBM), Low-Toxicity Oil Based Mud (LTOBM) and brine feed stocks is accounted separately. There are mud pumps, rotary hoses, mud conditioner, mud shear, mud hopper, degassers and shale shakers available onboard.

3.6.2 Auxiliary Chemicals to be Used

Auxiliary chemicals to be used for the well operations include: miscellaneous chemicals and contingency chemicals (to be used for safety purposes only if unpredicted events or special problems occur).

Table 3-14 provides the list of miscellaneous chemicals and Table 3-15 provides the list of contingency chemicals. Material safety data sheets for materials are provided in Appendix 8.

Table 3-14 Miscellaneous Chemicals

Trade Name	Function
Stack Magic ECO-F	BOP fluid
Glycol (MEG)	Anti-freeze agent
SC 200 Plus H.D. Degreaser	Detergent
Jet-Lube Extreme	Dope (drill pipe)
BOL 72733	Dope (<16” casing/liner)
Cidgo Lithoble Grease	Dope (>16” casing/liner)

Table 3-15 Contingency Chemicals

Trade Name	Function
Sodium Bicarbonate	pH control
Citric Acid	pH control
Mica	Lost circulation
Safe Scav-All	H_2S Scavenger
Wall-nut	Lost circulation
Kwick Seal-All	Lost circulation
Form A Squeeze	Lost circulation
Form A Set	Lost circulation
G Seal-All	Lost circulation
Vin Seal	Lost circulation
Mica	Lost circulation
GasStop EXP	Gas Migration Control
Super CBL EXP	Gas Migration Control

3.7 Personnel Requirements

The offshore activities shall employ between 160-170 workers on the drill ship per day. Personnel requirements for the offshore operations include, but are not limited to, the following:

a) President/general managers;

b) base and rig managers;

c) drilling and completions manager, drilling director, drilling senior engineers, drilling engineers, and drilling superintendent;

d) wells team leader and well site leader;

e) geologists;

f) Health Safety Security Environment (HSSE) and Health Safety and Environment (HSE) managers and advisors;

g) performance unit leader;

h) logistics managers; and

i) materials coordinator.

3.8 Effluents and Emissions

The main types of wastes generated due to offshore operations fall into the following categories:

- Non-Hazardous solid waste;
- Hazardous solid waste;
- Non-Hazardous liquid waste;
- Hazardous liquid waste; and
- Medical waste.

Waste is initially segregated on the drill ship and loaded onto colour coded skips. The Waste Management Contractor is responsible for loading the waste skips onto the trucks and transporting the waste to the appropriate managing facilities.

3.8.1 Non-Hazardous Solid Wastes

Solid non-hazardous waste includes domestic waste, which is mainly generated due to crew accommodation. Paper, plastic and metals are generally transported onshore to be recycled at the appropriate licensed facilities while other non-hazardous solid wastes are transported to a certified landfill, to undergo further segregation, resulting in more wastes being recycled. Paper waste generated on the drill ship is segregated then transported onshore for recycling. The expected amount of non-hazardous solid wastes to be produced is approximately 0.5 tons per day.

3.8.2 Hazardous Solid Wastes

Generated hazardous solid wastes include contaminated empty drums with chemical/oil residue, filters and hydrocarbons contaminated wastes, cartridges and computer parts, lithium and other batteries, and solid chemicals. All hazardous solid wastes shall be placed in the red container.

Empty drums are to be cleaned, crushed and recycled as scrap metals. Filters and hydrocarbons contaminated wastes, and solid chemicals are to be treated and disposed of at Nasreya authorised disposal area for hazardous wastes which is located in Alexandria governorate.

LTOBM Drill Cuttings

Drill cutting is generated as a result of drilling operations. A total volume of 1,447 tons of cuttings will be generated. Table 3-16 presents the volume of drilling cuttings generated from each hole section.

Table 3-16 Drill Cuttings

Hole section	Cutting volume (tons)
36”	117
26”	747
18 1/8” X 21”	265
16 1/2” X 19”	87
12 ¼”	174
8 1/2"	57
Total Cutting Volume	1,447

Statoil is responsible for monitoring the contractor to ensure proper disposal of the mud cutting according to waste management plan. The disposal system depends on the type of mud system used. LTOBM cutting will be collected in specially designed cuttings bins and sent to TWMA’s Amreya Free Zone treatment site for thermal treatment. The recovered powder will be disposed of in Onyx Landfill.

LTOBM Treatment Process Description

Loading and transportation of LTOBM cuttings from rig to site

Specially designed cuttings bins (Certified to BS 7072 standards) are filled using cuttings transfer pump in an area having a purpose built platform equipped with appropriate spill containment. All the bins are sealed after filling on the drill ship. The capacity of each bin is 6.0 metric tons. The bins are then loaded onto the deck of the offshore supply vessels using the drill ship crane. When

loaded, the bins are transported to the Port, where they are unloaded using a crane to trucks for transportation to the site in Amreya Free Zone.

UNLOADING ON SITE

All drilling wastes arriving on site in cuttings boxes are unloaded using a forklift. Following offloading they are first weighed and inspected to ensure compliance with the site license conditions and in conformance with site procedures. Any drilled cuttings received, which do not comply with site license conditions, are either rejected and returned to the producer or they may be offloaded in the designated quarantine area while investigations are completed. The non-conformance procedure is then followed and recorded in the site logbook. The waste producer is informed of any non-conformance. Records of any unauthorized waste arriving on site are kept. This details the producer, date, time, vehicle registration, waste type, name and address of carrier.

Drilling waste is not received at the site unless there is appropriate equipment and plant to ensure its safe handling and containment.

Accepted drilling wastes are stored in storage tanks on site, the bins are then transferred to the bin washing area for cleaning before reuse. The bin washing area is designed in such a way to ensure that all wash water drains down towards the collection sump, thus preventing contamination of surrounding soil and groundwater. The wash bay area is fully bounded to provide additional containment where required. The lightly contaminated water is retained within the area and fed into a sump, where first phase separation is allowed to develop with the highly contaminated phase being returned to the storage tanks for thermal processing. The separated and clean water phase is then reused in the bin washing process. The quantity of wastewater generated is dependant on the quantities of LTOBM cuttings received on site.

PROCESSING DRILLING WASTE

The treatment of cuttings is carried out using a TCC-RotoMill thermal plant. The drilled cuttings are fed into the TCC-RotoMill where, using mechanical energy, they are typically heated to temperatures ranging between 240ºC and 260ºC. At these temperatures the liquid phases (oil and water) are flash evaporated before the vapours are passed through a cyclone to remove any fine overblown particles. Once these are removed, evaporates go first through an oil condenser where the oil is recovered for reuse and then to a steam condenser where the water is also recovered.

The mud cutting powder after thermal treatment is fed from the mill and retained. This powder is both fine and dry and has hydrocarbon content typically less than 0.1%. The quantities of recovered materials are dependent on the constituent quantity of materials within the LTOBM cuttings received on site.

Unloading and transportation of powder

The recovered powder is conveyed into bulk containers, where water is then added to dampen the powder. Powder is then transported off site in sealed and covered bulk containers for final disposal in an officially approved disposal site. The selected site is Onyx Landfill.

Unloading and transportation of oil

Recovered oil is transferred from silo storage to Road Bulk Tanker for reuse in the mud plant.

Unloading and disposal of water

The recovered water is used for dampen the recovered powder down.

3.8.3 Non-Hazardous Liquid Wastes

Non-hazardous liquid wastes generated due to offshore operations are classified as domestic wastewater and industrial wastewater.

Domestic Wastewater (Sewage)

Domestic wastewater is divided into two separate systems; namely, the grey water and the black water. The grey water is discharged overboard via a pontoon down comer. The black water is processed by non-biological type sewage treatment units. As for supporting vessels, the sewage is treated onboard and the treated water is disposed to the sea.

Any discharge will be done at a distance not less than four nautical miles from the shore (as indicated in Annex I of Law 4 amended by Law 9).

Industrial Wastewater

Wastewater generated due to offshore drilling operations can be highly contaminated with oil. Any spilled liquids to the drill ship are contained; and these liquids are collected in skimmer/separator tanks and are disposed of as required on a case by case basis.

Kiwi A-1X is an exploratory drilling well, and thus the wastewater generated includes:

- Spent and surplus Water Based Mud (WBM) fluids will be released to the open sea;
- Clean area run-off water from deck areas and helideck (will be treated in the same manner used for domestic wastewater); and
- Water maker reject will be released to the open sea.

3.8.4 Hazardous Liquid Wastes

Hazardous liquid wastes generated due to offshore operations include used LTOBM, used oil generated from engine oil changes, and liquid chemicals. These wastes will be stored appropriately and labelled with contents then transported in adequate containers onshore.

Any hazardous chemical wastes are to be accompanied by their corresponding Material Safety Data Sheets (MSDS). Chemicals are stored separately in tightly sealed containers/drums, which are labelled clearly with the type of hazard. Wastes are then collected by the Waste Management Contractor, analysed, and transported to final disposal.

3.8.5 Medical Wastes

Small amounts of medical waste are expected to be generated which may include bandages, syringes, sterilizing agents and blood contaminated material. Any used syringes or sharp-edged medical tools are disposed in specially designed sharps-container while all other medical waste is disposed off in plastic bags. Medical wastes are segregated, collected onshore and transported through an authorized waste handler to a hospital incinerator for incineration. The expected amount of medical wastes to be produced is approximately 5 kg per month.

3.9 Waste Management

Statoil will ensure that all wastes generated are correctly identified, and stored pending collection/transfer for re-use, recovery, recycling, treatment and/or disposal in an environmentally sound manner. All reasonable steps are to be taken to minimize both quantities and hazards of waste generated. In addition, proper waste segregation will be maintained at all times. Generated waste will be identified, classified and documented.

The following measures shall be implemented in order to reduce waste amounts generated:

- Utilize Dryer and Centrifuges (recover fluids and reducing waste volumes);
- Vacuum cleaning of pits, drill-floor, shakers, pump room etc. (reducing fluid waste volumes);
- Displacement procedure (reducing fluid waste volumes);
- Cement spacer design to achieve a more visible interface between the different fluids (reducing chemical consumption and reducing fluid waste volumes);
- Pit management (reduced chemical consumption, discharges and fluid waste volumes). Mud contractor is responsible for the planning process; and
- Liquid additive system and batch mixer (reducing fluid waste volumes).
- Optimization of shaker screen selection to improve solids control
- Optimization of drilling fluids to reduce dilution factor (reduce the use of chemicals)

The general categories of waste and their corresponding management type are summarized in Table 3-17. The Waste Management Plan is presented in Appendix 7, which includes a Total Fluid Management Plan, waste segregation and a waste management flow diagram.

Table 3-17 Wastes Types and Their Management

Waste Type	Recommended Management Type	Inland/Onshore Management Facility
Non-Hazardous Solid Waste		
Domestic/General Wastes	Recycle / Disposal (20% / 80%)	Onyx Landfill
Plastics	Recycling/Disposal	Onyx transfer station, Alex
Paper	Paper factory	Onyx transfer station, Alex
Tires	Recycled	Onyx transfer station, Alex
Wood	Recycled	Onyx transfer station, Alex
Scrap Metal	Recycled	Onyx transfer station, Alex
Hazardous Solid Waste		
Filters and Hydrocarbons contaminated wastes	Disposal after treatment	To be determined by WM Contractor as part of the WMP
Empty Chemical drums	Cleaned then Crunched/Recycled	
Cartridges and Computers	Recycle	
Batteries	Partially Recycled	Onyx Landfill
Lithium Batteries	Disposal	Nasreya Landfill
Solid Chemicals	Treatment and disposal according to MSDS	Nasreya Landfill
Low Toxicity Oil Based Mud (Cuttings)	Thermal Desorption	TWMA

Waste Type	Recommended Management Type	Inland/Onshore Management Facility
Non-Hazardous Liquid Waste		
Industrial wastewater such as: • Spent and surplus Water Based Mud (WBM) fluids, • clean area run-off water from deck areas and helideck, and • water maker reject.	Released to Open Sea	Released to Open Sea
Domestic Wastewater	Treated	Offshore, it is treated and discharged to sea. Onshore, it is collected and sent to Treatment facility
Cooking Oil	Recycling Factory	Reuse/Recycle
Hazardous Liquid Waste		
Liquid Chemicals	Treatment and disposal according to MSDS	Nasreya Landfill
Industrial wastewater, like: Slops, Brine & Oily water	Treatment and dumping at Industrial wastewater facility	Nasreya Landfill
Used Oil	Refinery – Recycling	Nasreya Landfill
Medical Waste		
Medical Waste	Incineration	Hospital incinerator

3.10 Safety Equipment

Complete sets of personal protection equipment (PPE), including hard hats, gloves, protective clothing, safety glasses, masks, boots shall be provided.

First aid kits, chemical eye wash stations and fire extinguishers shall be appropriately provided and used in accordance with normal operating standards.

3.11 Policy for Environmental Protection

Statoil in accordance to its HSE policy is dedicated to conducting business in a manner that protects communities. The health and safety of employees, their families, neighbours and the communities in which they operate are the highest priorities for the company. Safety and environmental responsibility are an integral part of Statoil projects worldwide, and these characteristics result in improved quality in every aspect of operations. Statoil adheres to a policy and philosophy set out by the corporation. Statoil will review its operations on a random or as needed basis, and will take the necessary measures to ensure the public, land, air and water at project neighbouring cities are protected from adverse impacts.

4. AREA OF INFLUENCE

This section shall identify both the direct and indirect areas of influence and provide the necessary information for the assessment of the potential impacts on the environment. The identification of the influenced area shall be executed in accordance with Statoil Egypt's standards and policies, the relevant guidelines of the Egyptian Environmental Affairs Agency, Egypt's National Oil Spill Contingency Plan and industry best practice as identified by the International Maritime Organization (IMO); or other similar international practices.

4.1 Defining Area of Influence

The area of influence, as defined by Statoil, is the areas directly influenced by exploratory operations and activities, and the areas indirectly influenced by exploratory operations and activities in case a blow out defined by a probability higher than 10% of being hit by a possible oil spill.

Direct causes of influence comprise: activities on onshore base including an area of 1 km radius, navigation routes and activities on drill ship covering an area of radius equivalent to 500 meter. **Indirect cause of influence** is limited to oil spills hitting/reaching the shoreline. Figure 4-1 defines the area of influence for the project.

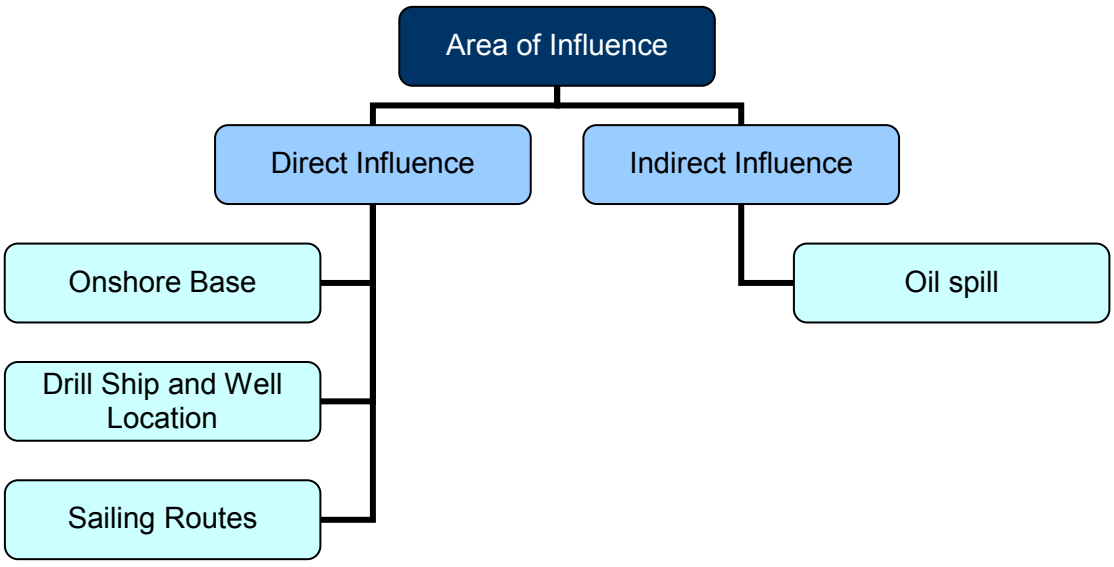

Figure 4-1 Definition of Area of Influence

4.2 Direct Area of Influence

As mentioned above, the direct causes of influence comprise: activities on onshore base including an area of 1 km radius, navigation routes and activities on drill ship covering an area of radius equivalent to 500 meter.

An image of the identified direct area of influence is depicted in Figure 4-2.

The remainder of this section shall focus on identifying the indirect area of influence, as the direct areas of influence have already been strictly identified and agreed upon.

Figure 4-2 Direct Area of Influence

4.3 Indirect Area of Influence

Indirect cause of influence is limited to oil spills hitting/reaching the shoreline. The probabilities of possible shorelines to be polluted due to a blowout event from Kiwi A-1X have been computed using Applied Science Associates' surface and subsurface trajectory and fates models. As per Kiwi A-1X's environmental risk assessment study, the probability split between surface and subsurface events is 10% and 90%, respectively.

4.3.1 Surface Modelling

OIL SPILL SCENARIO

This section shall discuss surface oil spill scenarios for well blowout. The location of the spill is Kiwi A-1X at coordinates 32º 15' 32.54" N – 28º 38' 45.04"E with the continuous release of 18800 Sm3/d of RINGHORNE 2001 oil, over a spill duration of 16 days.

MODEL USED

The model used for this scenario is ASA's OILMAP modelling system 2010. The modelling approach incorporates both trajectory and fates modes for the oil spill scenarios. The model shall have the functions, which are to:

- predict oil trajectory for the instantaneous release of oil from Kiwi A-1X;
- demonstrate the most likely affected beaches by the oil spill; and
- indicate the probabilities of oiling the shorelines.

All fates and trajectory modelling have been conducted by Petro Environmental Services Company (PESCo). For a more detailed discussion of the development of the model and its inputs, refer to Appendix 6A.

OIL SPILL SIMULATIONS

The model was run first in stochastic and subsequently in trajectory and fates modes for all spill scenarios. The stochastic mode generates multiple simulations within a time window to determine the most likely paths released oil would follow under the influence of winds and currents. Once a worst case for each oil spill scenario is identified, the trajectory and fates mode is then used to evaluate the impact.

STOCHASTIC MODEL RESULTS

Predictions for the surface advection of the well blowout scenario show that typically over the course of 500 simulations, the maximum probability of surface oil from the release hitting any

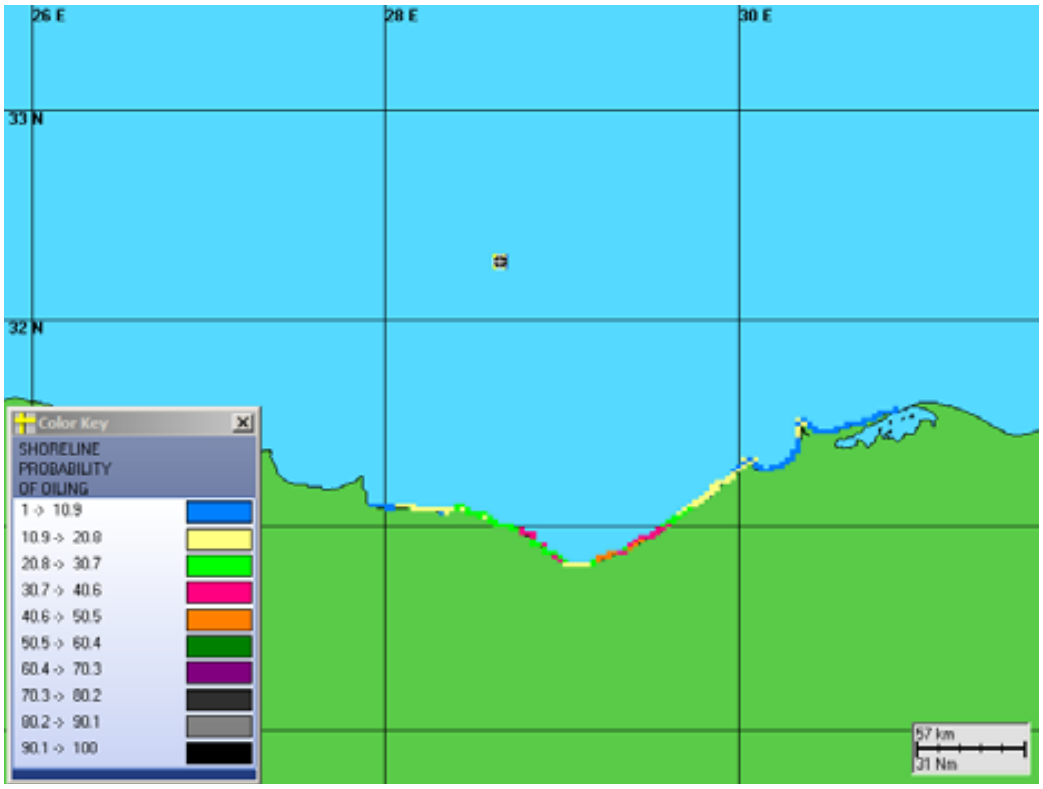

Figure 4-3 Probability of Shoreline Oiling

TRAJECTORY AND FATE MODEL RESULTS

The worst case trajectory and fates simulations predictions for the surface advection of the continuous release of 18800 Sm^3/d of RINGHORNE 2001 over a spill duration of 16 days during the Spring season (March) within offshore site jurisdiction spill site show that, 37% (112,072 Sm^3) of the oil is predicted to remain on the surface, 8% (25,246 Sm^3) of the oil is predicted to reach the shore and 54% (163,361 Sm^3) is predicted to evaporate. Subsequently, 0.04% (117 Sm^3) of the oil is predicted to become entrained in the water column by the end of the simulation. Figure 4-4 illustrates the oil path and shorelines affected by the oil spill.

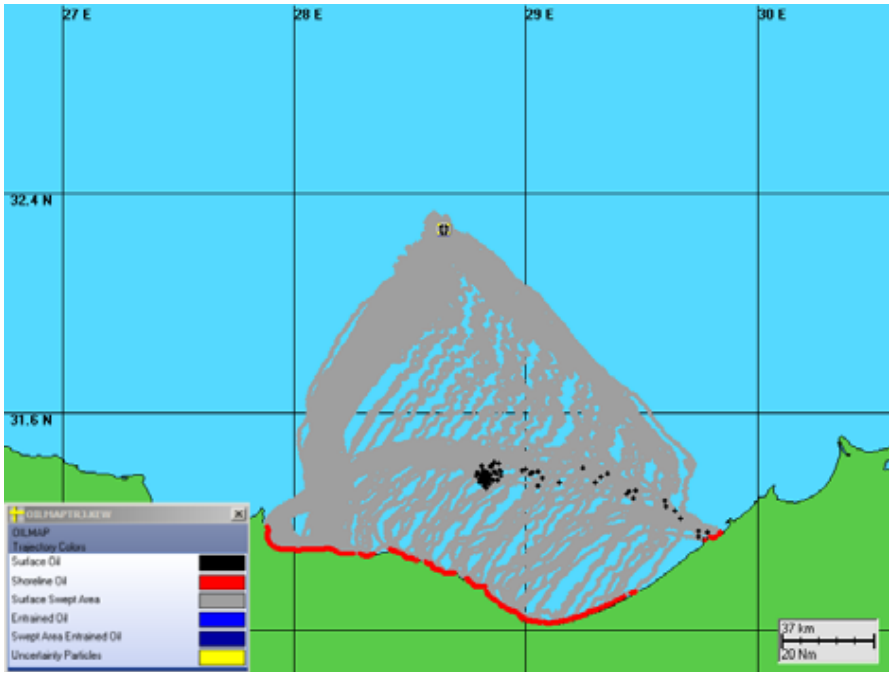

Figure 4-4 Trajectory Model of Worst Case Scenario

4.3.2 Subsurface Modelling

Oil Spill Scenario

This section shall discuss subsurface oil spill scenarios for well blowout. The location of the spill is Kiwi A-1X at coordinates 32º 15' 32.54" N – 28º 38' 45.04"E with the continuous release of 7100 Sm^3/d of crude oil, over a spill duration of 98 days (see Appendix 6B).

Model Used

OILMAP blowout model was used to reproduce the dynamic and complex processes of a seabed blowout and the SIMAP 3D oil fates model to predict the extent and timing of surface, shoreline and water column oiling. To determine risks of various resources being oiled, multiple model runs and environmental conditions were run in SIMAP using a Monte Carlo stochastic approach. The stochastic simulations provide insight into the probable behaviour of potential oil spills under the environmental conditions expected to occur in the study area. "Worst case" scenarios were identified from the stochastic model results and simulated using the trajectory and fate model of SIMAP. The "worst case" scenarios were defined by the simulation that has the greatest:

- Shoreline area oiled with an average thickness greater than 1 µm (Dull Brown Sheen);
- Water surface oiled, as the sum of area covered by more than 0.01 µm (Sheen) times duration of exposure; and

- Volume of subsurface oil (entrained in the water column) 120 days after the initial release.

The trajectory and fate simulations provide a time history of oil weathering over the 120-day duration of the simulations, for oil on the water surface, oil on the shoreline, and the exposure of total hydrocarbons entrained in the water column.

OIL SPILL SIMULATIONS

When the oil reaches the water surface, Egyptian maritime waters has a probability of 75-100%, of being oiled by a colourless/silver sheen Figure 4-5. The Egyptian shoreline has a 90-100% probability of being oiled just south of the well Figure 4-6. In the western Mediterranean, the maritime waters of Libya, Egypt, Israel, Lebanon, Syria, Turkey, Greece and Cyprus has a 10-25% chance of being oiled by a colourless/silver sheen or thicker of oil.

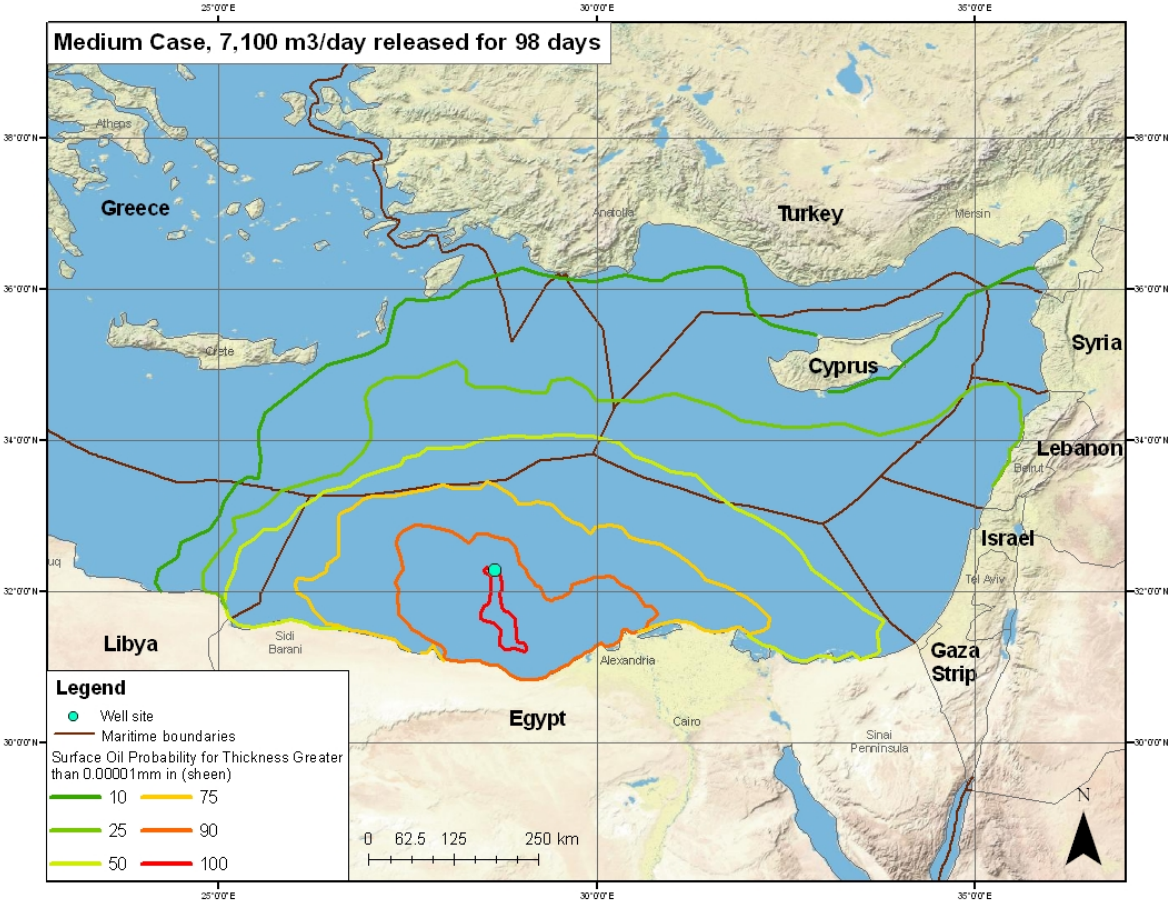

Figure 4-5 Probability Distribution of Oil on Water Surface

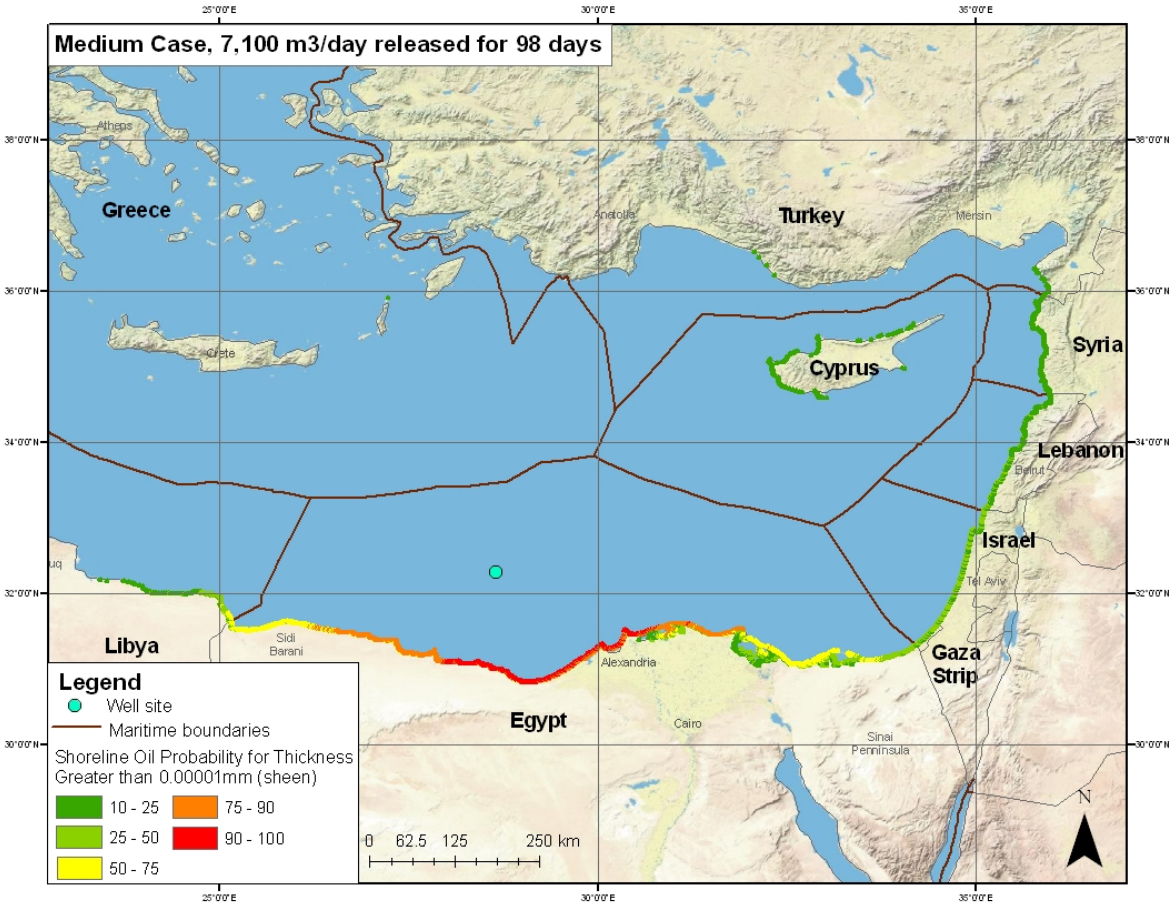

Figure 4-6 Probability Distribution of Oil on Shorelines

4.3.3 Identification of Indirect Area of Influence

As previously defined, the indirect area of influence is the area indirectly influenced by exploratory operations and activities in case of a blowout event defined by surface oil thickness greater than 0.01 µm (sheen) and shoreline oil thickness greater than 1 µm (dull brown sheen), with a probability higher than 10% of being hit by a possible oil spill.

The shaded area in Figure 4-7 outlines the overall indirect area of influence, resulting from both surface and subsurface models. The indirect area of influence in the event of a blowout should not be interpreted as including all areas depicted in Figure 4-4 and Figure 4-7; rather, spilled oil would impact discrete areas of the sea surface and shorelines within the overall impact envelope depending on prevailing met-ocean conditions at the time of the spill.

For the sea surface release, the area of potential oiling is largely restricted to Egyptian territorial waters although some egress into Libyan territorial waters to the west could be expected.

For the seafloor release, a far larger sea surface area is at risk of oiling including the territorial waters and shorelines of Greece, Turkey, Cyprus, Syria, Lebanon, Israel, Gaza Strip and Egypt.

The indirect area of influence is presented without taking into account the effects of oil spill response measures. The oil spill response will reduce the amount of oil spreading from the release site and is expected to significantly reduce the areal extent of the area of influence.

This EIA study will only address the indirect area of influence within the Egyptian territories. Other indirect area of influence than those covered in this EIA report will be studied in a separate report, "Desktop Screening Report" (455/EJ6172-000-EN-REP-08).

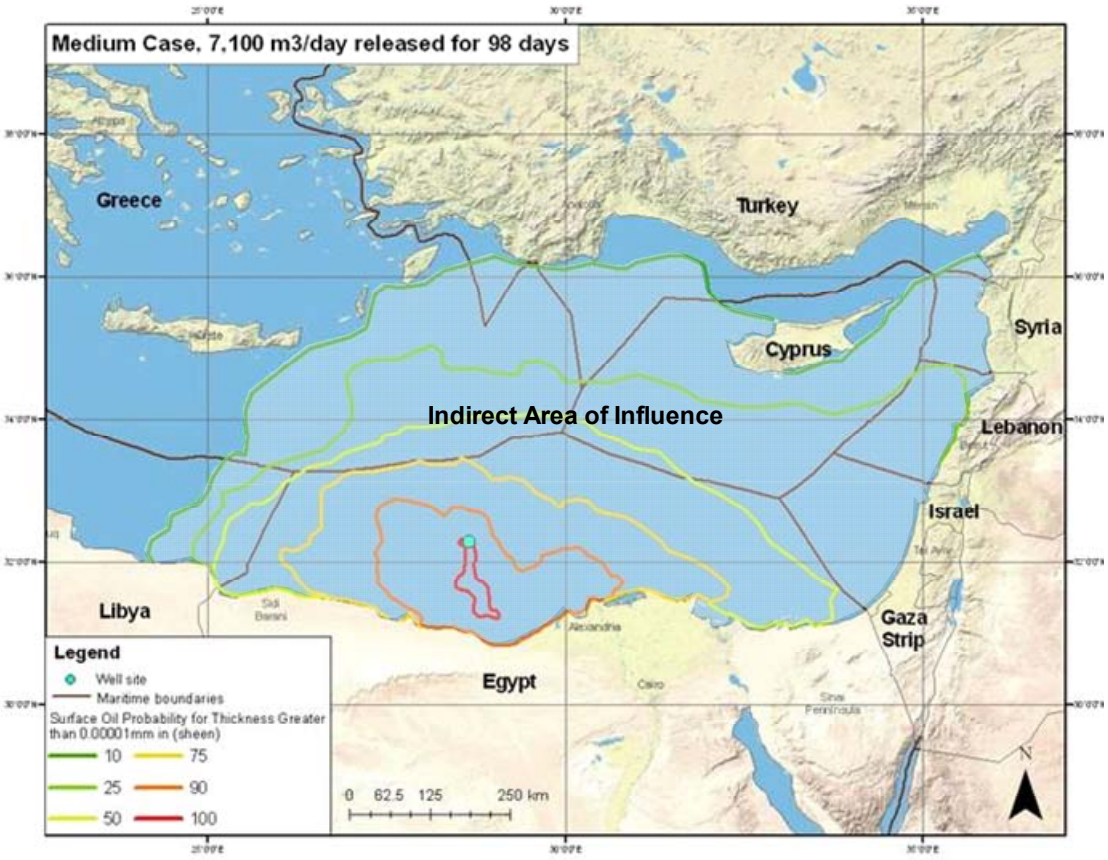

Figure 4-7 Indirect Area of Influence

5. DESCRIPTION OF THE DIRECT AREA OF INFLUENCE

5.1 Introduction

The description of the area of influence shall be split into two sections: a description of the direct area of influence and a description of the indirect area of influence. The relevant data for Abu Qir and the offshore well location shall be described in this section concerning the direct area of influence; whereas the relevant data for the remaining part of the Egyptian north coast shall be discussed in the indirect area of influence section.

The remaining indirect area of influence describing 100 km of the eastern Libyan coast, Gaza, Israel, Lebanon, Syria, western Cyprus, 50km of Turkey's southeast coast and Greece's southeast waters shall be covered in the Desktop Screening Report (455/EJ6172-000-EN-REP-08). The environmental and socio-economical resources within the Egyptian waters are described in detail, whereas the resources outside the Egyptian waters are described based on the screening study.

5.2 Air and Climate

The following context describes the available air and climatic information for the Mediterranean coast of Egypt and meteorological data recorded at El Dabaa concession nearby the well location located at (32°16'12"N 28°33'60"E) approximately 140 kilometres north of El Dabaa at the Egyptian coast. Relative humidity and the rain fall data were obtained from El Dabaa meteorological station located on the Egyptian north coast (28°28′ 13.09″E 30°55′46.88″N).

Ambient air quality data was obtained from Alexandria monitoring stations located at about 170 km from the well location; those are the nearest ambient air quality monitoring stations to the well location. Moreover available air quality data from previous WorleyParsons baseline studies conducted at El Dabaa area will be presented. The baseline study was conducted during 2009 for the primary air pollutants for five days average. All meteorological and air quality data locations are shown in Figure 5-1.

Figure 5-1 Location of "Kiwi A-1X" Relevant to Meteorological and Air Quality Data Locations

5.2.1 Climate

The climate of the northern part of Egypt is described as typically Mediterranean, "with dry mild summers and fair, cool and wet winters". Because of the proximity to the Mediterranean and northern lakes and the prevailing north-easterly wind, the summer heat, so typical of the rest of Egypt, is tempered and the summer in this area is most agreeable (Eid, El Marsafawy, and Ouda, 2006). The climate of the deltaic coastal belt of Egypt is an extension of that of the western Mediterranean coast. Winds are generally light but violent dust storms and sand pillars are not rare. El-Khamsin winds blow occasionally for about 50 days during spring and summer (Zahran and Willis, 2008).

5.2.2 Temperature

According to meteorological data obtained from the European Centre for Medium-Range Weather Forecasts (ECMWF), The maximum recorded temperature in El Dabaa concession over a period of 12 years (i.e. 1996-2008) varies from 22ºC in January to 31.6ºC in September. The minimum recorded temperature measured in El Dabaa over a period of 12 years varies from 7.2ºC in February to 23.7ºC in August.

Table 5-1 and Figure 5-2 present the monthly mean maximum and minimum temperatures recorded at El Dabaa concession nearby the well location.

Table 5-1 Mean Temperatures Recorded at EL Dabaa Concession

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum (ºC)	7.7	7.2	8	11.2	15.9	19.1	22.9	23.7	20.6	17.5	13.2	10.8
Mean (ºC)	15.4	15	16.2	17.8	20.5	23.9	26.2	27	25.7	23.3	20.3	17.2
Maximum(ºC)	22	22.3	25.4	24.5	26.3	29.4	31.2	31.2	31.6	29.2	29.2	22.9

Source: European Centre for Medium-Range Weather Forecasts (sampling period 1996 -2008) (Statoil data)

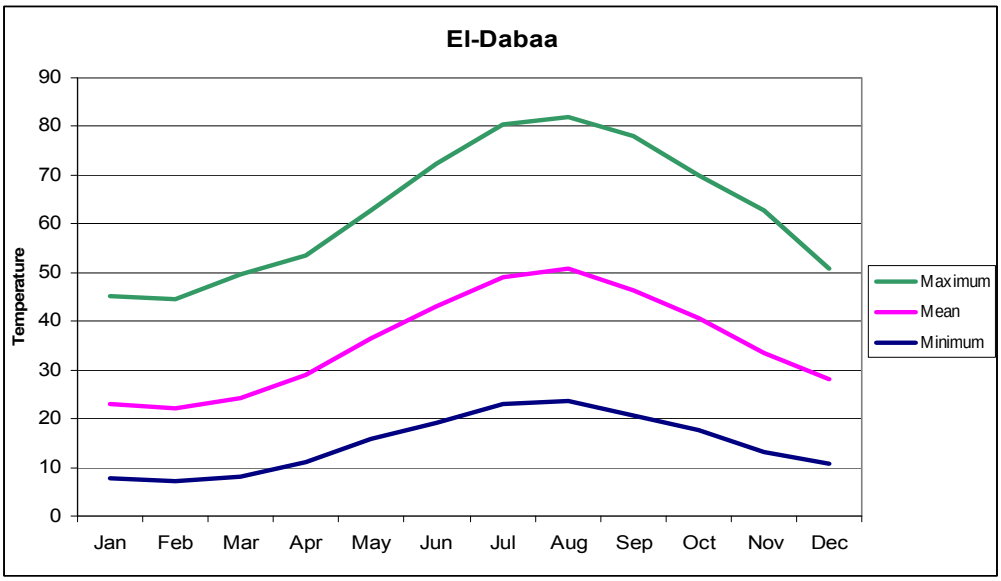

Figure 5-2 Monthly Minimum, Mean and Maximum Temperature (ºC) at El Dabaa concession during the Period 1996-2008

According to meteorological data extracted from the weather base website, Table 5-2 shows the average maximum and average minimum temperature data in Alexandria measured over a period of 20 years and indicates the lowest and highest recorded temperature.

Table 5-2 Air Temperature Records in Alexandria

Parameter (°C)	Yearly Average	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average Temperature	20	13	13	16	19	21	24	26	26	25	23	18	15
Average High Temperature	24	17	18	20	23	26	28	28	30	28	27	23	19
Average Low Temperature	16	10	10	11	14	17	20	22	23	22	18	15	11
Highest Recorded Temperature	42	27	30	33	38	42	40	41	36	37	37	32	28
Lowest Recorded Temperature	2	2	2	3	7	7	13	17	17	15	12	5	2

source: http://www.weatherbase.com, accessed 11- 2010

5.2.3 Rainfall

The average annual number of days with precipitation in Alexandria is 44. Table 5-3 indicates the average monthly rainfall in Alexandria over 20 years.

Table 5-3 Average Number of Days with Precipitation

Parameter	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average Rainfall in Alexandria (mm)	54.9	26.6	12.9	4.2	1.5	-	-	0.3	1.0	9.3	33.1	55.6
Average number of days with Precipitation in Alexandria (over 20 year period)	10	9	5	2	1	1	-	-	1	2	5	8

Source: http://www.weatherbase.com (sampling period of 20 years - accessed July 2010) and WorleyParsons database.

5.2.4 Relative Humidity

According to meteorological data obtained from Alexandria governorate, the average relative humidity measured varies between 57% in April in the evening and 82% in June and July in the morning. Table 5-4 represents the monthly mean relative humidity at Alexandria governorate.

Table 5-4 Mean Relative Humidity Recorded at Alexandria Governorate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Relative Morning Humidity (%)	78	78	79	78	80	82	82	81	78	81	79	79
Relative Evening Humidity (%)	62	59	59	57	58	60	64	64	61	62	62	63

Source: http://www.weatherbase.com – accessed July 2010

5.2.5 Fog, Smoke/Haze, Vision Obstruction, and Dew Point

Table 5-5 provides details on the average number of foggy days in Alexandria. The average number of days with smoke/haze and vision obstruction is also listed. These different parameters have been recorded over 20 years. The average monthly dew point in Alexandria was 13°C over 16 years.

Table 5-5 Number of Days with Fog, Smoke/Haze and Vision Obstruction in Alexandria

Parameter	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Number of days with fog	5	5	6	5	5	3	3	3	5	8	7	7
Number of days with smoke/haze	2	2	2	2	2	2	1	1	1	1	2	2
Number of days with vision obstruction	8	9	9	9	7	5	4	4	5	9	9	10

Source: http://www.weatherbase.com – accessed July 2010

5.2.6 Air Quality

Important parameters in the assessment of air quality impacts include atmospheric stability (used to categorise the rate at which an air plume will disperse) and the mixing layer height, which is the height above ground at which ground-based emissions will eventually be dispersed once thorough mixing occurs. In general, the mixed layer height will increase during the day as the sun deepens the turbulent layer near the ground. The depth of the mixed layer will also increase as wind speeds increase due to the generation of turbulence. Thus, mixed layer depth is heavily influenced by wind speeds and surface roughness, and is an important consideration for determining the dispersion of ground based emissions into the atmosphere.

There are no data available for air quality at the vicinity of the well location. However Table 5-6 presents the average recorded values from Alexandria monitoring stations in 2006. Comparing the recorded values with the ambient air limits of the Egyptian standards shows that in 2006 the recorded levels were below the limits set.

Table 5-6 Ambient Air Quality in Alexandria Monitoring Stations

Pollutant	Average Recorded Value in 2006	Average Period	Egyptian Standard (Law 4/1994) ($\mu g.m^{-3}$)
Sulphur Dioxide (SO_2)	11.55	1 year	60
Nitrogen Oxides (measured as NO_2)	42.61	1 year	40 - 50[1]
Carbon Monoxide (CO)	1970	8 hrs	10 000
Ozone (O_3)	36.2	8 hrs	120
Thoracic particles (PM 10)	88.6	1 year	70

Source: Annual Air Quality Report in Egypt for year 2006, EEAA

Moreover available air quality data from previous WorleyParsons baseline studies conducted at El Dabaa area is presented. The baseline study was conducted during 2009 for the primary air pollutants, five days average values are presented in Table 5-7.

[1] World Health Organization (WHO) Air Quality Standard for Nitrogen Oxides

Table 5-7 Ambient air quality data recorded over five days in El Dabaa during October 2009

Parameter	Concentrations (µg.m^{-3})	Egyptian Limits for 24 hrs exposure (µg.m^{-3})
Sulphur dioxide (SO2)	15.27	150
Carbon monoxide (CO)	680	10 000
Nitrogen dioxide (NO2)	11.1	150
Thoracic particles (PM10)	51.33	150

Source: WorleyParsons Baseline study performed in El Dabaa during October 2009

5.2.7 Natural Hazards

Tsunamis and severe storms are the potential natural hazards that can affect the project, especially the drilling equipment and offshore facilities. However one disastrous tsunami takes place in the Mediterranean region every century on average (Anton Micallef 2009). Historical occurrences of Tsunami in the Mediterranean never hit the project area as can be seen in Figure 5-3.

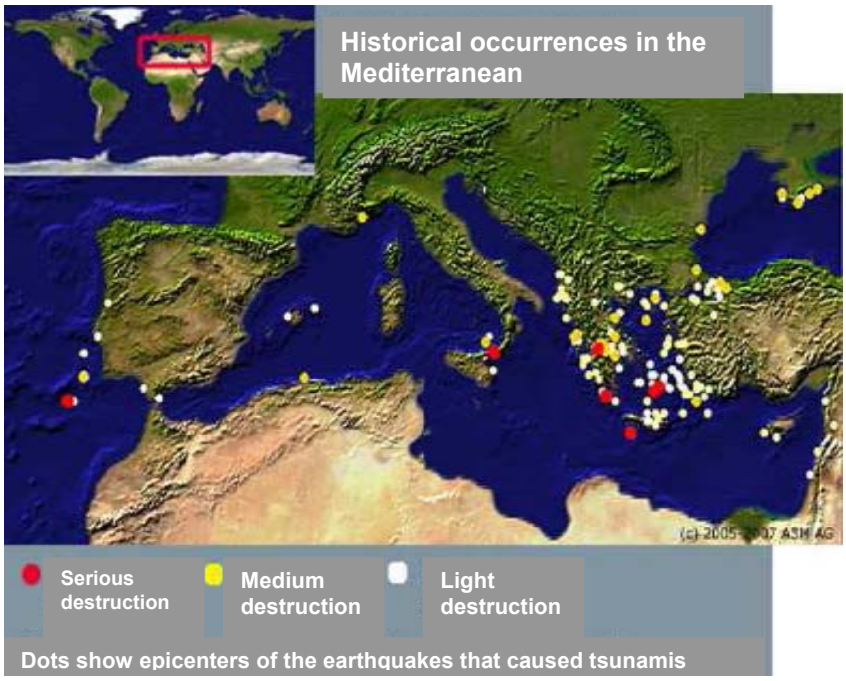

Figure 5-3 Historical Occurrences of Tsunami in the Mediterranean

Source: www.tsunami-alarm-system.com (2010)

5.3 Water

5.3.1 Oceanographic Characteristics

The bottom topography of Abu Qir bay which is located on the western flank of the Nile delta is undergoing a dynamic process of change since the completion of the Aswan High Dam. The local Admiralty chart (number 2681) shows the 5 m contour occurring at approximately 500 m offshore and the 10 m contour at approximately 4 - 5 km offshore. From there the seabed slopes gently offshore for approximately 35 km, with a typical gradient of 1:650 to the 100 m contour as seen in Figure 5-4. This gradient increases to 1:100 over the next 11 km to the 200 m contour (Entec, 1999).

Source: http://amcg.ese.ic.ac.uk/index.php?title=File:Med_GEBCO_bathy.png

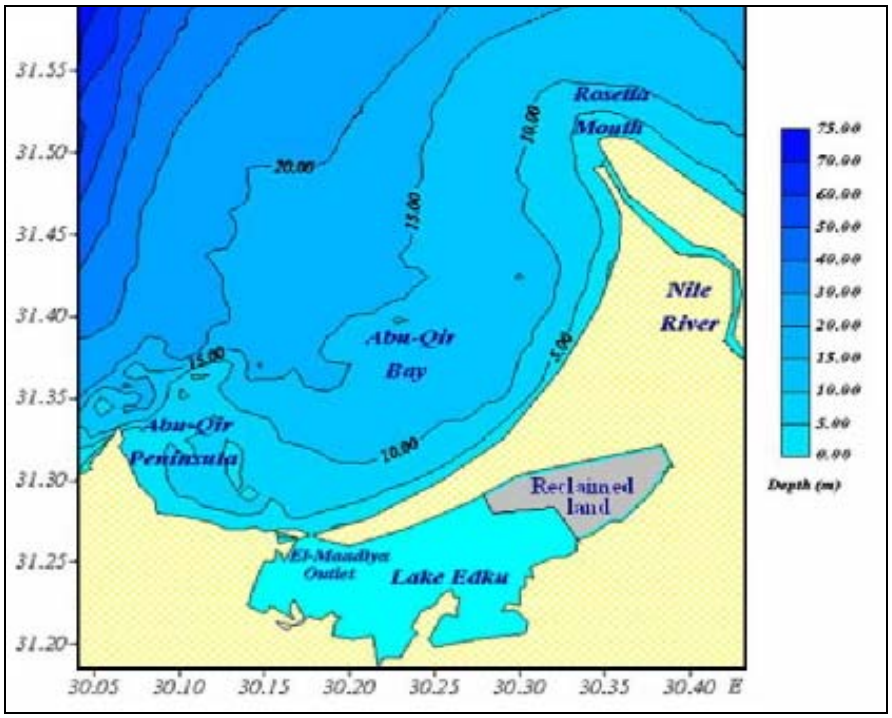

Figure 5-4 Bathymetric map of Abu-Qir Bay

TEMPERATURE

According to EEAA marine survey in 2010, the highest water temperature along the Egyptian Mediterranean Sea was recorded in El-Nubaria and El-Gamel areas (EIMP, March 2010). A study conducted offshore Ras El Hekma area (50 km to the west of El Dabaa) to measure the physical and biological parameters for the marine environment, showed that open water surface temperatures vary from 14-18°C in winter, reaching a maximum 25°C in summer (WorleyParsons database for the area).

SALINITY

Salinity varies between 35.81 to 38 g.L^{-1}, rising to 39 g. L^{-1}at some locations in the Mediterranean Sea during summer months (WP database for the area and EEAA 2010 marine survey). Areas of lower water salinity are reported where water discharge occurs. Salinity varies considerably according to the proximity of fresh or brackish water discharge points. Salinity in both El Dabaa concession and Abu Qir bay is generally high. According to a study conducted offshore Ras El Hekma area (50 km to the west of El Dabaa) to measure the physical and biological parameters for the marine environment, the salinity in the area ranges between 34 and 40% (parts per thousand), with surface salinities reaching a maximum in summer, which may be a result of increased evaporation (WorleyParsons database for the area).

CURRENT

Current data were recorded from measurements at El Dabaa concession at position 32°15'18.91"N, 28°39'57.05"E, which is approximately one kilometre away from the well location. The data was collected over the period from 16 October 2009 to 28 January 2010 at different depths as shown in Table 5-8**.** The mean current speed was as high as 19.5 cm.s^{-1} near the water surface and it decreased as water depth increases to reach a value of 1.9 cm.s^{-1}. The maximum current speed was recorded at a depth of six meters below the mean sea level (MSL) and the minimum was at a depth of 2 000 m below MSL with a value of 6 cm.s^{-1} (Statoil data).

Table 5-8 Maximum and mean current speed at El Dabaa Concession

Depth below MSL(m)	Maximum Current Speed (cm s^{-1})	Mean Current Speed (cm s^{-1})
6	83	19.5
14	76	19
26	68	18.1
38	60	16.8
50	53	15
106	30	8.8
206	18	5.2
326	13	3.5
600	10	3.2
1 000	11	3.4
2 000	6	1.9

Depth below MSL(m)	Maximum Current Speed (cm s^{-1})	Mean Current Speed (cm s^{-1})
2 671	7	3.3

As for Abu Qir bay the current speed has the magnitude of the range from 11- 27 cm/sec. Also there is a region of convergence in southeasterly part of the Bay. Due to the accumulation of the water inside the Bay the water level rises by about 3.5 cm in the southeastern part. In case of the Northerly wind the current direction at the surface is changed from southward to southwesterly current. The region of convergence is moved to the southern part of the Bay. The range of current speed at the surface has the same magnitude from 11 to 27 cm/sec.

WAVES

The available wave data for El Dabaa concession from the European Centre for Medium-Range Weather Forecast (ECMWF) that covers the period from 5 December 1996 to 5 December 2008 shows that the maximum wave height could reach a value of 6.2 m in February; whereas, the average wave height is ranging between 0.8 to 1.4 m as seen in Figure 5-5.

A study conducted offshore Ras El Hekma area (50 km to the west of El Dabaa) to measure the physical and biological parameters for the marine environment showed that over 90% of the offshore waves within the area occur from a 225°N through north to 45°N (south-west to north-east). For the remaining time, wave conditions were considered either calm or from directions outside this range.

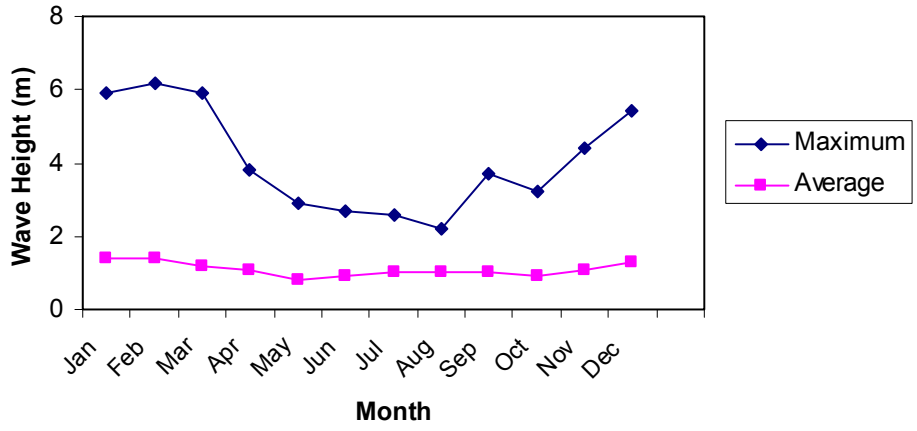

Figure 5-5 Monthly Mean and Average Wave Height at El Dabaa Field during the Period 1996-2008

TIDES

Tides at Alexandria are almost negligible, fluctuating between 20 and 40 cm. This, combined with the steep slope of the sea bed, results in a narrow littoral zone. During spring tides with an offshore wind, a wider area of the littoral zone may become exposed. The same is true also on ledges or gently sloping rocks.

5.3.2 Marine Water Quality

A marine survey was carried out in during 2009 by the EEAA in order to monitor the water quality in the Egyptian Mediterranean Sea. Thirty monitoring stations were selected near the residential and industrial areas in addition to some reference stations along the Mediterranean coast two of them is in Abu Qir area (West Abu Qir and east Abu Qir)

PHYSICAL PARAMETERS

During the year 2009 the results of EEAA Mediterranean water quality survey located in transect 2 showed that DO results ranged from 4.5 to 8 mg $.L^{-1}$ in west Abu Qir and ranged between 5.5 to 6.5 mg $.L^{-1}$.

BACTERIOLOGICAL WATER QUALITY

Microbial contamination and human health risks are often related to urban wastewaters. The most important eutrophication hot spots in the Mediterranean often coincide with coli form bacterial hot spots.

A bacteriological survey for the Abu Qir east and west monitoring stations showed that the count of Bacteria total coli form varied between 800/ 100 ml for Abu Qir east to 10000/100ml in Abu Qir west While the count of E Coli varied between 105/ 100 ml to Abu Qir east 1000/100ml Abu Qir west.

CHEMICAL PARAMETERS

CHLOROPHYLL

The concentrations of chlorophyll (higher than 6 microgram L^{-1}) in west Abu Qir monitoring station varied between 6 microgram $.L^{-1}$ and 2.2 microgram $.L^{-1}$ while the recorded concentration in Abu Qir east varied between 2 microgram $.L^{-1}$ and 1.5 microgram $.L^{-1}$

AMMONIA (NH4-N)

The latest marine survey by EEAA in 2009 showed that ammonia concentration varied between 0.012 and 0.008 mg L^{-1} in Abu Qir west and between 0.018 and 0.007 mg L^{-1} in Abu Qir east

Total Nitrogen (TN)

The average concentration of total nitrogen varied between 0.15 micromole L-1 and 0.08 micromole L-1 in Abu Qir west and between 0.17 and 0.006 mg L-1 in Abu Qir east station according to EEAA marine survey results in 2009.

5.3.3 Sediment Quality

The grounds of El Dabaa offshore are characterized by silty sand intermingled with pebbles. Heavy metal contamination can be an issue, with the main metals of concern in the Mediterranean Sea being mercury, lead, chromium, copper and zinc, together with cadmium.

The sediment type distribution in Abu Qir bay depends principally on the distance from the River mouth; the hydrodynamic force and the bottom topography are the other factors that tend to redistribute the surface layer of the thick sedimentary column formed by the Nile River through thousands of years. In general, the Nile sediments cover most of the bay area since the Nile River was the main source of sediments (Quelennec and Kruk, 1976).

5.4 Marine Ecology and Biodiversity

The flora and fauna of the coastal waters are affected by the depth of the water and available food sources. In the Mediterranean Sea the biodiversity is relatively lower than in the Red Sea with primary food sources such as planktonic fauna and flora being limited. According to Bouchet and Taviani (1992), the offshore deep Mediterranean fauna is characterized by i) high degree of eurybathic species (fauna that live across wide depth ranges); ii) absence (or low representation) of typical deep-water groups, such as macroscopic foraminifera (*Xenophyophora*), glass sponges (*Hexactinellida*), sea- cucumbers of the order *Elasipodida*, primitive stalked sea-lilies (*Crinoidea*) and tunicates (sea-squirts) of the class *Sorberacea* (Pérès, 1985; Monniot and Monniot, 1990); and iii) the number of endemism (26.6% of species in the Mediterranean fauna: Ruffo, 1998) declines with increasing depth, with comparatively low endemism below 500 m.

The compiled data of El Dabaa sites suggest the low abundance and biodiversity of marine organism both fauna and flora at the project area. This could be attributed to the deep water where there is no light and the possibility of finding photosynthetic plants is diminished. The literature suggests a limited meiofauna counts within the organic sediment with no other suggestions for sensitive area or habitats where sponge growth is limited only to the coastal area to 200 m (Biomapegypt.org, 2009).

5.4.1 Plankton

The south-eastern Mediterranean is considered poor in the number of phytoplankton (Oligotrophic), this is particularly along the Egyptian Mediterranean Coast west of Alexandria between El Hammam and El Sallum. The inshore neritic zone lying in front of the Nile delta is usually more fertile due to the eutrophication effect of the Nile water and land drainage. At the

offshore; however, the density of phytoplankton remains at more or less constant lower values for the whole area.

5.4.2 Benthic Species

Macrobenthic fauna are those organisms which inhabit the bottoms of aquatic environments either marine or freshwater. They are large enough to be seen with the naked eyes (> 500µm). They play an important role in the food web of aquatic communities. These organisms feed mostly upon detritus, sedimentary phytoplankton and zooplankton or on each other.

They also act as a good source of organic matter after their death and decay. Larval stages of most benthic fauna occurring in the plankton serve as a good source of food for many pelagic fishes. They comprise a diversity of animal groups; among them are Oligochaeta, Polychaeta, Crustacea, Mollusca and some aquatic insects. Most of them serve as a diet for many fishes.

The population density of benthos is fairly high in El Dabaa offshore concession, dominated by *polychaetes* which constitute about 37% of the total benthos at El Dabaa. The most common *polychaetes* are *Hermodice*, *Eunice* and *Aphrodite*. *Ascidians* flourish well in these grounds and are mainly represented by *Cytoditus* and *Archidistoma*. *Crustaceans* particularly *Synalpheus* which live as a parasite on sponges is also found frequently. The *echinoderms Echinus*, *Cedaris* and *Asteropecten* were also recorded in few numbers (Anon, 1992).

5.4.3 Fish and Prawns

Mullet, sardine, squid, tuna and mackerel represent the major pelagic species caught in the area under consideration. Sea bass, groupers, snappers, and shrimp represent the major demersal species caught. Purse seine, surface and bottom trawler, gill net and long lines are the major fishing methods used offshore.

5.4.4 Sea Turtles

The Mediterranean coast of Egypt was surveyed to determine the location of marine turtle nesting and feeding grounds. The surveys were carried out by Max Kasparek covering the area from Alexandria to El-Salum (1993) and Michael Clarke & Andrew Campbell covering the whole Egyptian Mediterranean coastline (2000). It was found that turtles nest on the Mediterranean coast of the Sinai peninsula, primarily to the east, in the region surrounding the resort town of El Arish. On the other hand , limited circumstantial evidence of nesting was found in the western region between Alexandria and the Libyan border, nesting activity in this area was negligible. Thus the presence of turtles at the concession area is unlikely to be recorded (Kasparek, m. 1993 and Clarke, M., *et al*. 2000). The drilling area is not considered particularly important to sea turtles, although turtles may be present. A relatively low population density is anticipated in comparison to favoured coastal breeding, feeding and nesting areas.

5.4.5 Marine Mammals

At least nine species of marine mammals are recorded from the Egyptian Mediterranean water. These include eight cetaceans (dolphins and whales) and one pinniped (seals). The drilling area is not considered particularly important to marine mammals, although marine mammals may be present.

5.4.6 Concession Area Sensitivity

Considering the fact that the Mediterranean Sea is more or less an unproductive sea, especially after the cessation of the Nile flood waters, this may be one of the reasons explaining the low diversity of the Mediterranean Sea, especially in terms of benthic organisms and demersal fisheries (*i.e*. living near or on the sea bed). Corals and coral reefs are rare ecosystems in the Mediterranean Sea. It should be also noticed that the well-developed sea grass beds, bivalves and gastropods are found mainly in the shallow areas and coastal lagoons.

5.5 Human Environment

5.5.1 Population Profile

According to government statistics, Egypt's population has grown by more than 20% in the past decade and has doubled in the last 30 years. The population, including those living abroad, reached around 76.6 Million in 2006 and one Egyptian baby was born every 23 seconds during the year 2006.

The total population in Alexandria governorate is estimated to be 3888263 Capita (Alexandria governorate environmental profile, 2007). The total population in Abu Qir area is 40357 capita (CAPMAS-Alexandria subordinates, 2008).

5.5.2 Area Profile

Alexandria governorate is considered to be one of the largest urban centres on the Egyptian coast of the Mediterranean. The governorate has a total length of approximately 90 kilometers in the north western part of the Nile delta. It is bordered in the north by the Mediterranean Sea and in the South by Mariout Lake, in the East by Abu Qir bay and Edku city and in the West by Sedi Krer area (Alexandria environmental profile, 2007). East Abu Qir and West Abu Qir are one of the main neighbourhoods in Al-Montaza district in Alexandria governorate. They are located at the Northern tip of Alexandria as shown in Figure 5-6.

AREA

As for Alexandria governorate, the total area is 2299.77 km^2 and the populated area is 1675.5 km^2 representing 73 % of the total area (Figure 5-7). The population density in 2006 was estimated to be 1.63 thousand capita per km^2 (Alexandria environmental profile, 2007).

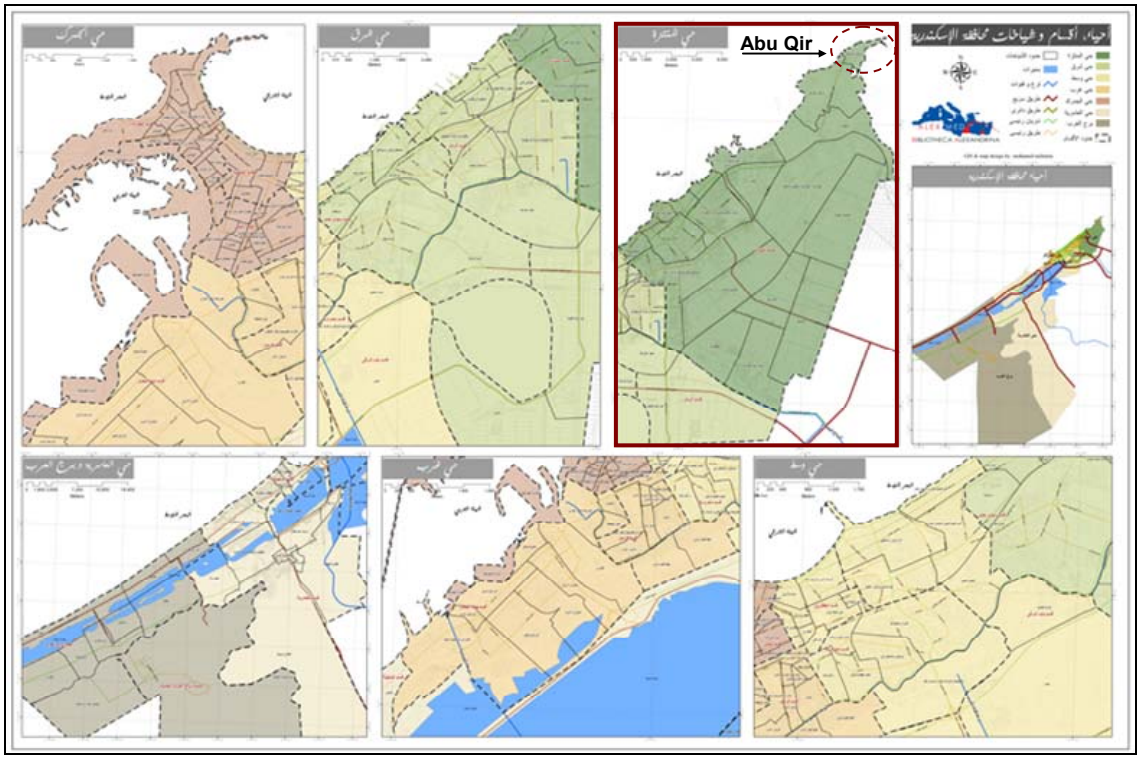

Figure 5-6 Alexandria governorate districts

Source: Alexandria governorate study, 2006

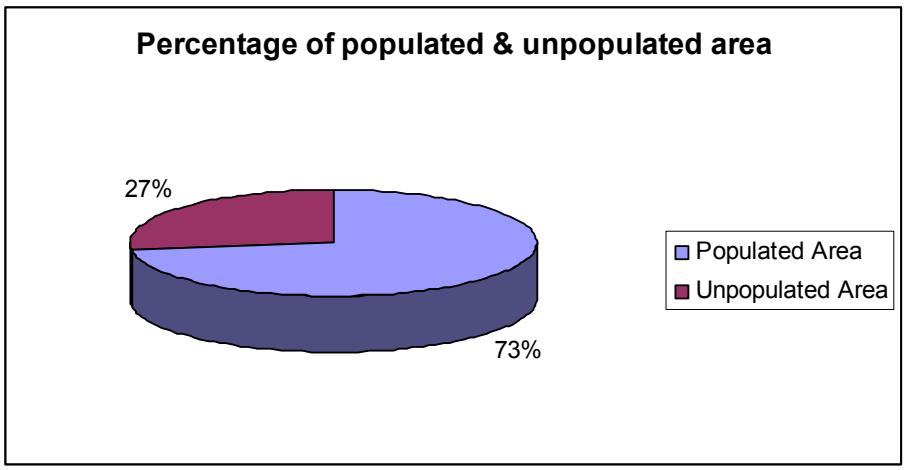

Figure 5-7 Percentage of Populated and Unpopulated Areas in Alexandria governorate

5.5.3 Social Services Profile

HEALTH

According to CAPMAS 2008, the numbers and rates of birth, death and natural increase in Egypt recorded was 19 58124 for the birth with a rate 26.6%, 45 0126 for death with a rate of 6.15 and the natural increase recorded was 15 07998 with a rate 20. (Rates are calculated per 1 000 of population).

According to CAPMAS report in 2008, Alexandria Governorate has 104 918 births with a birth rate of 25.2 and 31 935 death with 7.7 rate. The natural population increase is 72 983 with a rate of 17.5. As for the health services, Alexandria governorate has 30 hospitals and health care units, 18 main first aid centres, 180 pharmacies, 67 units for intensive care and 25 health offices.

EDUCATION

In 1966, illiteracy in Egypt was estimated at more than 70%; in 1995, it dropped to 48.6% (males, 36.4%; females, 61.2%). In 2006, illiteracy rate was 29.64% in Egypt, and 19.5% in Alexandria Governorate. According to CAPMAS-Alexandria subordinates (2008), there are 5420 persons in Abu Qir area who are illiterate. The 5420 persons are divided as follows based on gender; 2319 males and 3101 females. Further information is provided in Table 5-9.

Table 5-9 Educational levels within Abu Qir area

	Illiterate	Read and write	Illiterate erase	Intermediate			University Degree and Above
				Below	Inter.	Above	
Abu Qir	5420	3544	74	6908	11124	1146	5967

Source: (CAPMAS- 2008)

HOUSING

According to the 1996 local census, there were about 9.6 million apartments and 4.5 million rural homes throughout the country. Approximately 2.6 million units were built between the years of 1981 and 1999, and yet housing shortages were an issue. The number of slum areas are1201, housing over eleven million people (statistical book 2008). In order to deal with the housing shortage problem, the government encouraged rural housing activities on non-fertile soil and efforts have been made to provide low-rent housing in towns. Despite these efforts, Egypt's housing shortage remains acute, with about one million units required in urban areas. Housing construction was a major priority of development plans in the 1980s, but it was considered likely that it would take many years for Egypt's housing deficit to be met. Currently the greatest shortage is in low-cost housing (Nations Encyclopaedia 2006-2).

Table 5-10 presents housing types and the number of each in Abu Qir based on number of families.

Table 5-10 Building distribution in Abu Qir

	Apartment	Villa	Rural house
Abu Qir	10044	31	5

Source: CAPMAS-Alexandria subordinates, 2008

INFRASTRUCTURE

POTABLE WATER

There is a recorded 10416 families that are connected to the governmental water network which represents 99.99% of the total number of families in Abu Qir area.

ENERGY

The number of families that subscribe to the electricity network in Abu Qir is 10397. A reported 43 families depend on other sources of energy (*e.g.* kerosene).

SANITATION

There are 37858 persons in Abu Qir area who are connected to the governmental wastewater network and 352 persons depend on septic tanks in the area; nevertheless, there are 27 persons who are not connected to any kind of wastewater networks (CAPMAS- Alexandria subordinates, 2008).

LANDFILLS

There are three recycling facilities in Alexandria to produce organic fertilizers. There are two landfills in Alexandria, Borg El Arab and Alam Nayel. Borg El Arab landfill has a total capacity of 15 years with a rate of 1.5 million ton/cell/year. As for the Alam Nayel landfill, the total capacity is estimated to be 1.3 million m^3. There is a dedicated landfill for medical waste in Moharram Baek (Alexandria environmental profile, 2008). El Naserya landfill has a total area of 37 feddans and is used for non organic hazardous solid waste including; insoluble metal salts, inorganic wastes from ceramics industry containing heavy metals, ash from heavy fuel oils, inert oxides, metallurgical slag, dry solid heavy metal waste and contaminated soil (Nasreya, 2010).

5.5.4 Economic Services Profile

Egypt's economy primarily relies on five sources of income: tourism, remittances from Egyptians working abroad and foreign aid, revenues from the Suez Canal, agriculture and oil. World Bank data suggests that almost 50% of Egypt's GDP in 2000 was generated by the service sector. Since

the 1990s the shift to a free market economy and the adoption of economic reforms and structural adjustment has produced mixed results.

Reviewing the economic performance of Egypt should always take into account its fast growing population, which according to some estimates may exceed 100 million people by 2020; this continues to place a burden on its limited resources, increasing unemployment and poverty. According to official estimates, unemployment measured 11% in 2004 compared to 9.2% in 1991/1992. To control unemployment, Egypt will need to achieve a sustained real GDP growth rate of at least 6% per year. The economy has to generate between 600 000 and 800 000 new jobs each year in order to absorb new entrants onto the labour force (CIA 2007). Additional information about economic performance indicators is provided in Table 5-11.

Table 5-11 Egypt Economic Performance

Economic performance	Value
GDP (PPP US$ billions)	442.6
GDP per capita (PPP US$)	5400
GDP per capita annual growth rate (%)	6.9

Source: CIA, 2009

Alexandria governorate economic activity depends on different industries, tourism as well as agriculture. The main industrial activities in Alexandria governorate are as follows: textile industry, chemical industry, and food industry (Alexandria environmental profile, 2007).

TOURISM

The tourism industry is one of the most important sectors in the economy in terms of high employment and incoming foreign currency. Egypt offers tremendous cultural heritage and natural beauty. Since 1992 some terrorist actions have affected this sector negatively; recent government efforts to crack down on terrorism have sought to counter this trend. Figure 5-8 illustrate the nearest touristic beaches to the proposed well location.

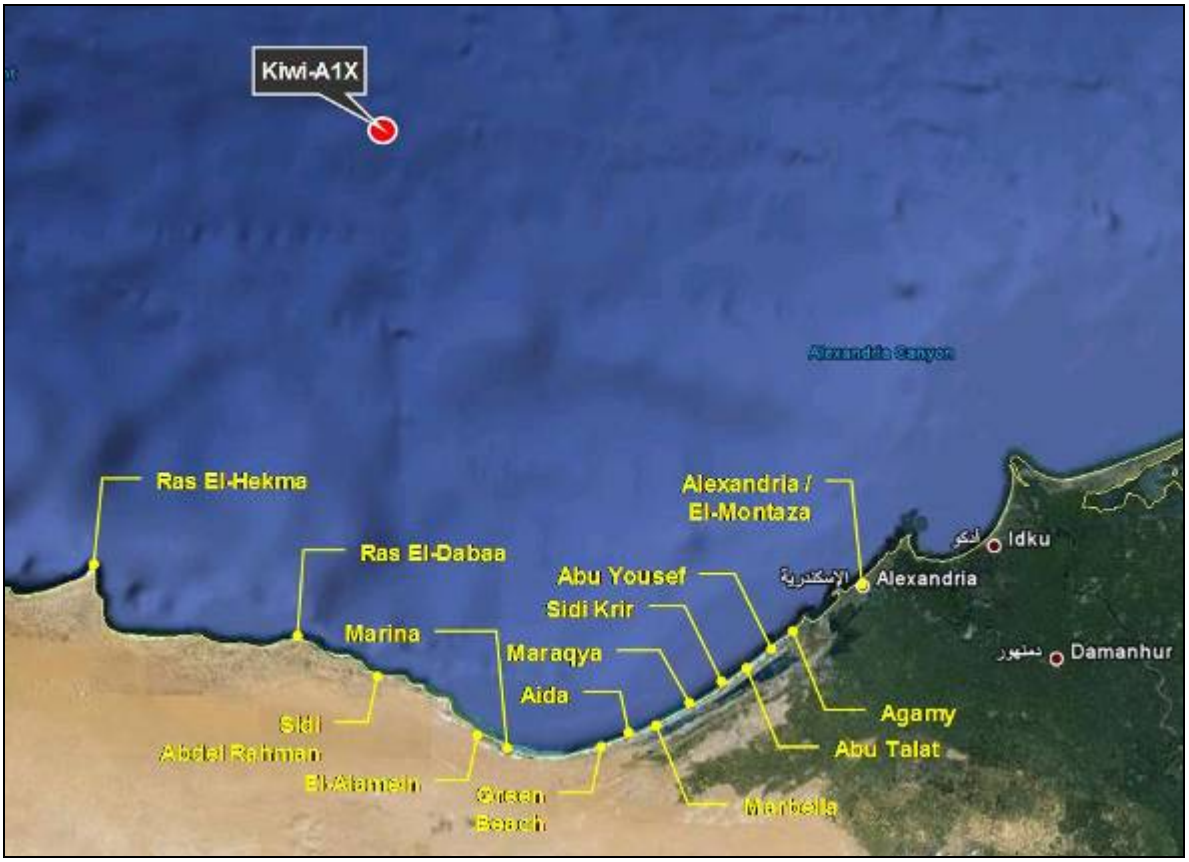

Figure 5-8 Touristic Beaches Nearest to Kiwi A-1X

Alexandria has always been the main summer destination in Egypt, attracting more than one million visitors during the summer months. Accommodation facilities available for summer visitors to Alexandria are typically its many hotels and rental apartments.

Table 5-12 Hotels in Alexandria

Category (stars)	number
5	6
4	7
3	12
2 or less	21
Under classified	4

Source: Alexandria Governorate study, 2008

FISHING AND FISH INDUSTRY

Fishing is considered to be one of the main activities in Alexandria governorate as the fish production ranged between 9524 to 14341 tons in the period between 1995 to 2004. There are two main sources of this production, the Mediterranean Sea which contributes to almost 60% of the total production and Mariot Lake. There are 75 fish farms in the governorate (Alexandria environmental profile, 2007).

The project is unlikely to impact the fisheries industry in Egypt as the main fishing activities is restricted to the coastal area and limited to depth of 200m (GAFRAD, 2006)

OIL AND GAS

Egypt is a significant non-OPEC energy producer. The Suez Canal and the Sumed Pipeline are two Egypt is a significant non-OPEC energy producer. The Suez Canal and the Sumed Pipeline are two routes for Arabian Gulf oil, making Egypt's geographic location a strategic focal point in world energy markets (CSME, 2001). There are four major Oil and Gas ports in Egypt; Sidi Kerir, Ras Shukheir, Suez, and Ain Sukhna. In 2008 the proved oil reserve was estimated at 3.7 billion bbl and natural gas reserve was estimated at 1.656 trillion m^3. Oil production estimated in 2007 was 664,000 bbl/day and natural gas production estimated in the same year to be 47.5 billion m^3 (CIA, 2009).

MAJOR OIL AND GAS FIELDS IN THE AREA

- Gas Fields: Abu Madi, Abu Qir/North Abu Qir (see Figure 3-2 and Figure 5-9).
- Pipelines (capacity): Sumed pipeline.
- Oil Refineries (crude oil capacity): Cairo Petroleum Refining Company, El-Nasr – Petroleum Company, El-Mex Alexandria Petroleum Company, and Suez Oil Processing Company (CSME 2001).
- El Alamein oil terminal used for loading crude oil from the Abu Gharadig, Razzak and El Alamein-Yedma fields.

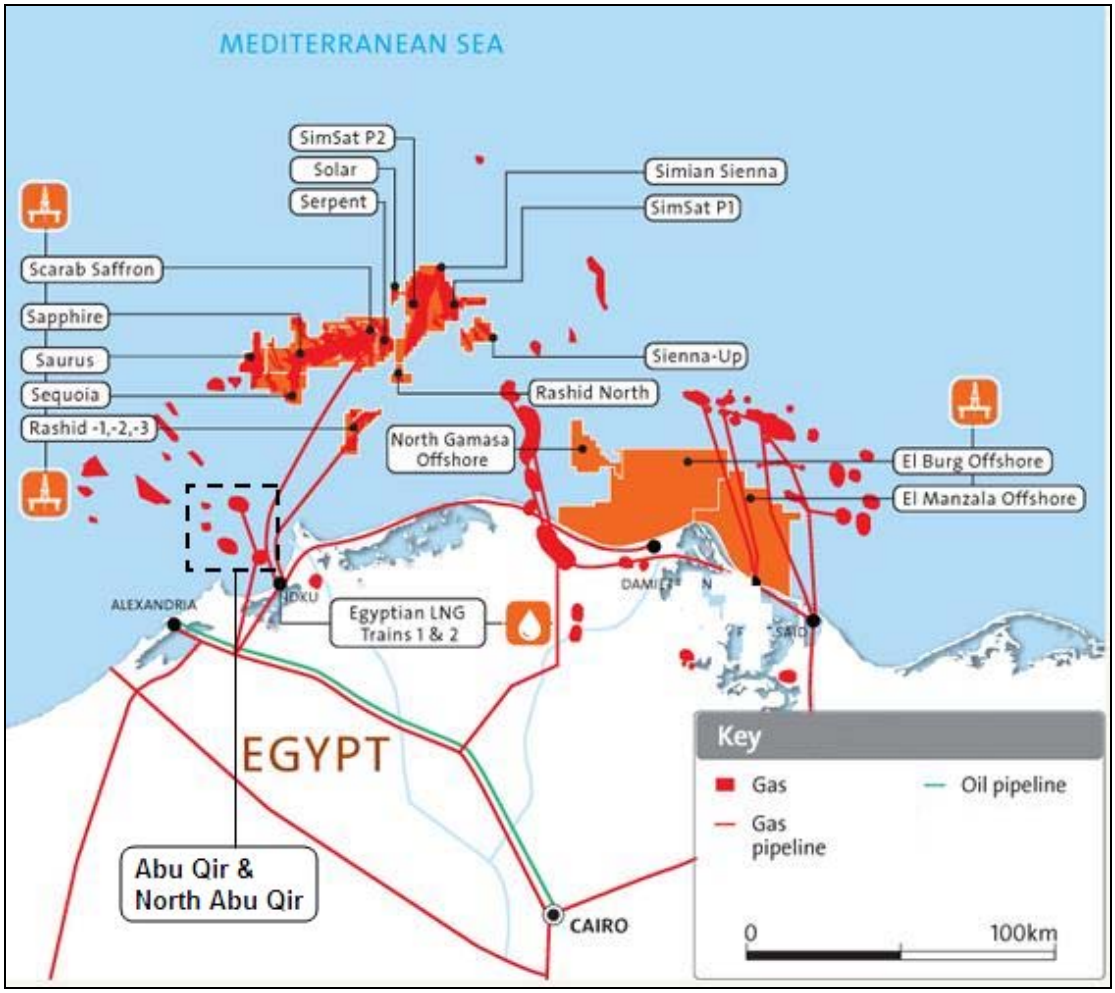

Figure 5-9 Major Gas Fields North of Abu Qir

AGRICULTURE

The total area of cultivated land in Alexandria governorate is estimated to be around 1621000 feddans. The most common crops in Alexandria are wheat, olives, apple, onion and cloves (Alexandria environmental report, 2007).

INDUSTRY

According to the CIA country fact report 2009, industry contributed to 37.6% % of the country's GDP in 2008. Alexandria governorate is mainly an industrial city as its industrial production represents about 40% of the total production of Egypt. In and around Alexandria City, numerous industrial establishments operate. These include textile, food processing, oil refining, chemicals, metals, leather, cement, heavy industry and other industrial sectors (see Figure 5-10).

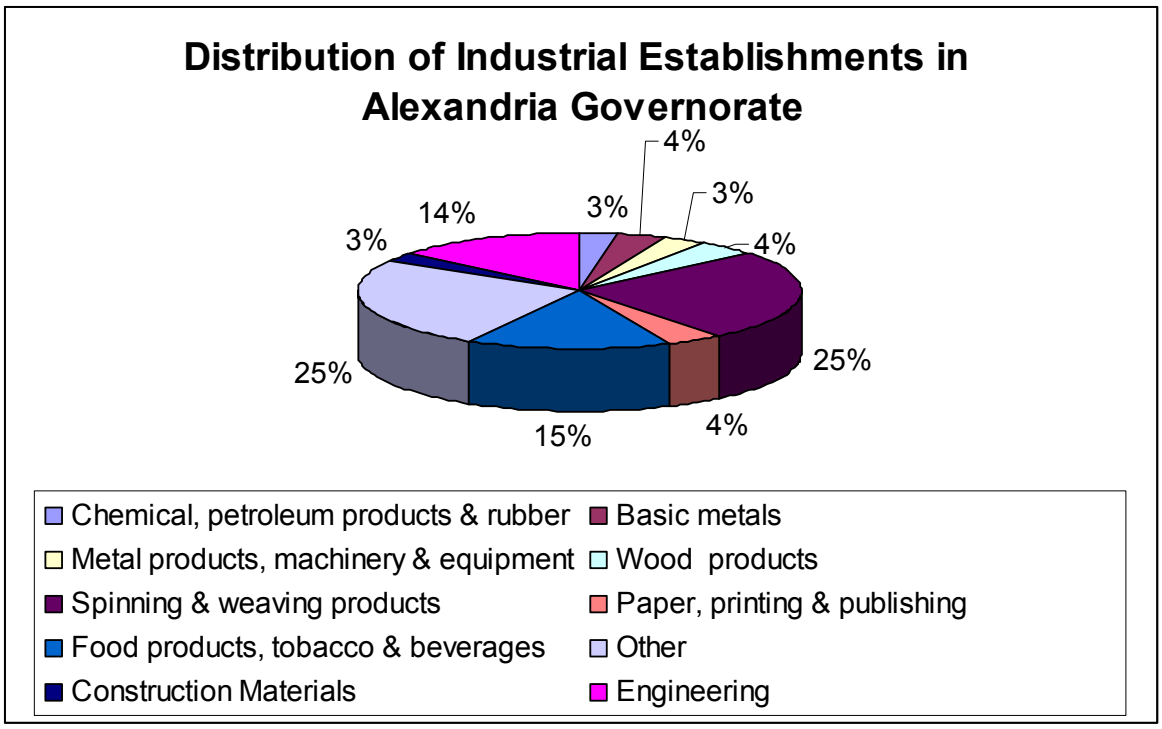

Figure 5-10 Distribution of Industrial Establishments in Alexandria Governorate

Source: Alexandria governorate environmental profile, 2007

5.5.5 Archaeological Profile

There area a number of important archaeological sites in Abu Qir bay. Some of these sites are submersed. The inland monuments constitute a set of 9 forts ruins and the restored recognized monument of Qait-Bay Castle, and “Sidi Abdel Razek” shrine. Figure 5-11 shows the location of most important archaeological sites along the bay. The archaeological sites submerged under the western part of Abu Qir bay are an attractive salvage operation for marine archaeologists and would also stimulate the tourist industry. The following famous submarine archaeological remains exist under Abu Qir Bay:

CANOPUS AND HERAKLEION CITIES

Ruins of the ancient cities of Canopus and Herakleion, dated from Greek to Byzantine times, were discovered at depths of 6-7 m in the western part of Abu Qir bay (Toussoun, 1934; Bernard, 1970; Stanley et al., 2001). Artifacts have been recovered in recent times by fishermen from the bay, and the sites were first explored by hardhat divers in 1933 (Toussoun, 1922). The Canopus and Herakleion were positioned west of the mouth of the old Niles’s Canopic branch. This branch was one of the seven distributaries that flow in this region west of Edku inlet between 600 BD and 300 AD. The Canopic branch was navigable and its water was received from the Rosetta branch. Of

these seven distributaries, five have since silted up, leaving the present-day Rosetta and Damietta branches. These sites are 1.6 and 5.4 km, respectively, east of the Abu Qir headland. At each site, ruins were found over an area exceeding 0.5 km2.

Recent investigations using side-scan sonar have recorded large features such as walls, bases of temples, columns and statues. According to Bernard (1970) structures in Canopus at the time were still positioned close to the shore until the early seventh century. The temples and walls remained exposed for another century, until after 731 AC.

According to Said (2002) assessment the two cities had disappeared gradually and not suddenly (due to neither floods nor earthquakes). The disappearance came gradually due to the erosion and processes by current and waves across 400 years same as the old Burullus.

BONAPARTE'S FLEET

On 1st August 1798 the British naval units commanded by Admiral Nelson sank most of Napoleon's flotilla at Abu Qir Bay. The remains of the fleet particularly the Napoleon's flagship (L'Orient) are visible underwater in calm sea. Submerged remains are cannons, guns, anchors, coins, cups (Morcos, 1997).

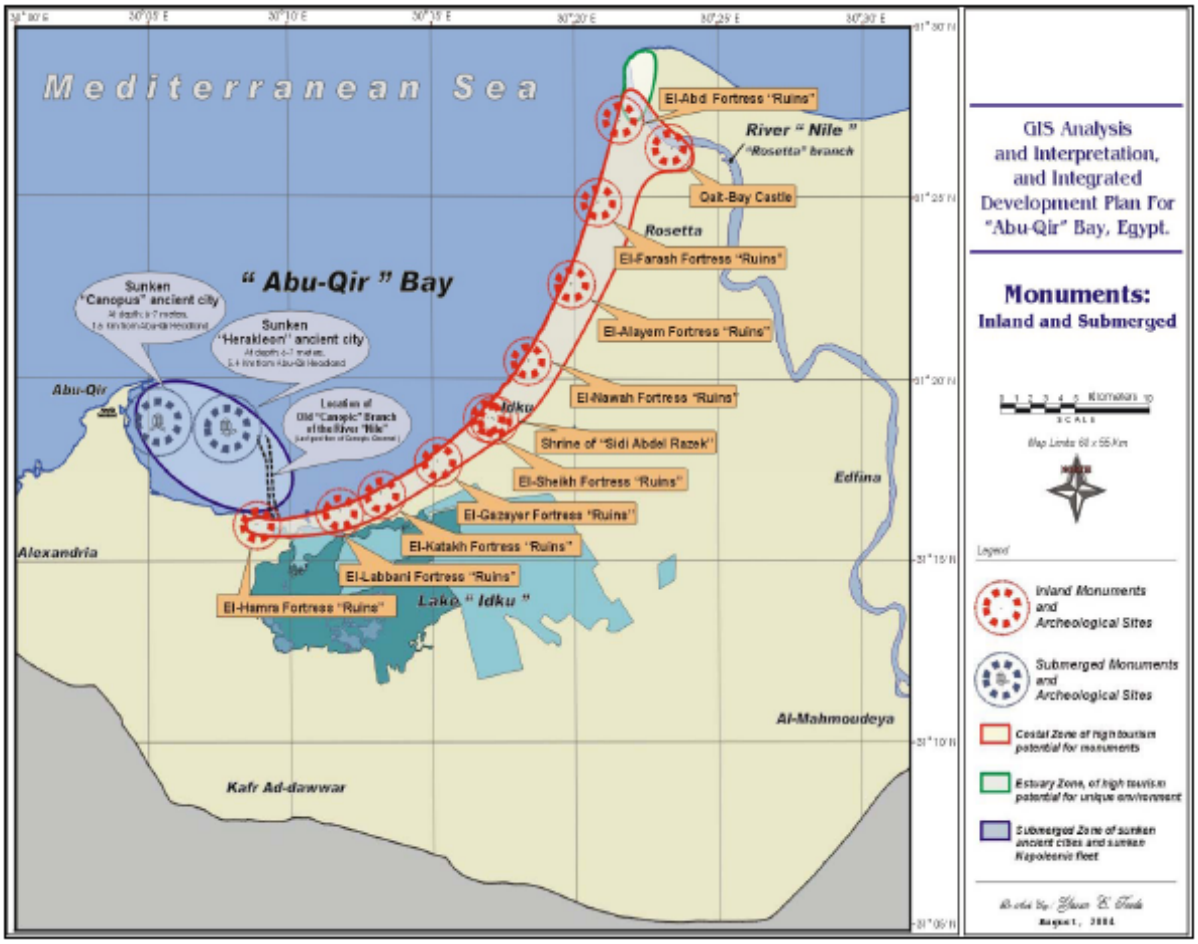

Figure 5-11 Archaeology in Abu Qir bay

6. DESCRIPTION OF THE INDIRECT AREA OF INFLUENCE

Although the indirect area of influence covers the eastern Mediterranean, only the Egyptian waters and coastline are described in this section. The rest of the indirect area of influence is described based on a desktop screening study in Appendix 9. This section provides the environmental and socio-economic baseline data for the indirect area of influence concerning the Egyptian north coast. Since the Egyptian north coast extends over 900 km, it has been divided into four transects according to geography, land use and nature of coastline (see Figure 6-1). The following provides a description of each transect:

- Transect 1 stretches from Salloum to Abu Qir (excluding Abu Qir) due to its desert-like nature and touristic activities;
- Transect 2 covers the delta area between Abu Qir and Damietta;
- Transect 3 extends from Damietta to Port Said due to the similarity in economic activities; and
- Transect 4 covers the North Sinai.

Regional information such as climate, temperature, rainfall, etc. has been presented in general; while specific information such as air and water quality, shoreline sensitivity, protectorates, etc. has been presented for each transect separately.

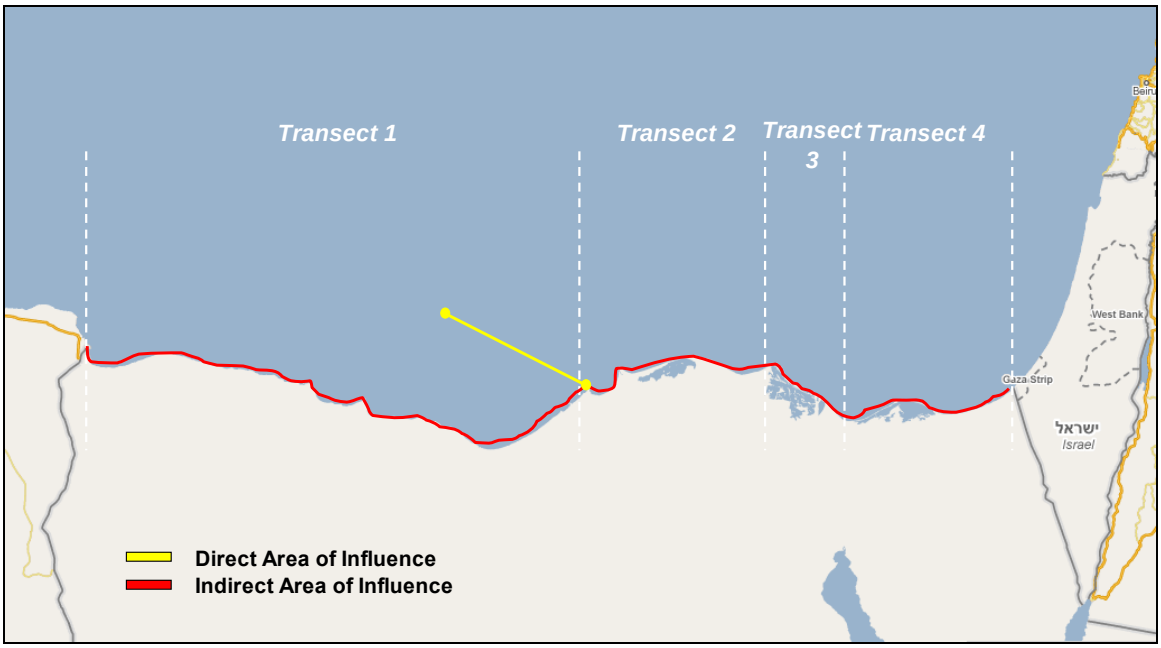

Figure 6-1 Transects of the Egyptian North Coast

6.1 Air and Climate

Egypt is located in the hyper-arid regions of North Africa and West Asia astride the Sahara and Arabian Desert with annual rainfall in most parts of less than 50mm.

According to the aridity index P/ETP (P = precipitation and ETP = potential evapotranspiration, calculated by Penman's formula), the arid regions are classified to hyperarid (P/ETP< 0.03) and arid (P/ETP = 0.03 – 0.20). These classes are, in turn, subdivided according to the mean temperature of the coldest month and that of the hottest month of the year. Consideration is also given to the time of rainy period relative to the temperature regime. On these bases, four climatic provinces in Egypt are distinguished.

The available climatic information for the Mediterranean coast of Egypt will be described; moreover the ambient air quality profile will be drawn based on the Egyptian environmental affairs agency (EEAA) air quality monitoring station data.

6.1.1 Climate

The Mediterranean climate is a special type of climate that describes a regime of hot summer drought and winter rain in the mid-latitudes, north of the subtropical climate zone. This climate occurs most noticeably in the regions around the Mediterranean, from where the climate gets its name, but also in coastal areas of California, South Africa and southern parts of Australia.

Despite the fact that the coast of Egypt is semi-arid, its climate can be considered Mediterranean. The weather is highly seasonal in nature and is strongly related to high-pressure systems that extend towards the North Atlantic, Eurasia and Africa (Birot and Dretschk, 1956; Wigley and Farmer, 1982; Bucht and El Badry, 1986). Local and regional climatic conditions have a significant impact on the dispersion of pollutants in the atmosphere.

According to the Food and Agriculture Organization (FAO), the climate of Egypt is governed mainly by its location in the North-Eastern part of Africa, on the margin of the Sahara, the largest desert in the world. The latitudinal position, between 22° and 32° N, lies in the sub-tropical dry belt, although conditions on the northern coast are ameliorated by the presence of the Mediterranean Sea.

Throughout most of the year the hot, dry tropical continental air masses dominate, but during the winter period air masses of both tropical maritime and polar maritime origin make brief incursions into Egypt from the north, and frequently bring rain.

TEMPERATURE

According to the FAO[2], the mean annual temperatures in Egypt are high and register between 20 and 25°C. Major variations occur between summer and winter temperatures, as well as between coastal and interior locations. Along the coast and project area mean maximum temperatures vary from 18°C to 19°C in January and from 30°C to 31°C in July and August. For monitoring stations

[2] http://www.fao.org/ag/Agl/swlwpnr/reports/y_nf/egypt/home.htm

at Alexandria, Cairo, Port Said, Minya, Kharga, and Aswan, the mean minimum temperatures show variations from 9°C to 11°C in January and from 21°C to 25°C in July and August (FAO).

RELATIVE HUMIDITY

The relative humidity is affected mainly by the relative proximity to the Mediterranean and the Red Sea. The lowest records are those of inland locations of the arid and hyperarid provinces and the highest ones are those of locations closer to the Mediterranean coast and in the Nile Delta within the arid province (e.g. mean minimum 60% and mean maximum of 72 % in Damanhur). The lowest records of relative humidity are generally those of late spring, whereas the highest records are those of late autumn and early winter.

RAINFALL

According to FAO, the rainy season is the winter period from October to May when the depressions follow their southern tracks over the Mediterranean region. Most of the precipitation is associated with the warm and cold fronts of these systems. Many of the fronts are weak by the time they reach Egypt and rainfall is light and showery. Rainy periods usually last for one to four days.

Annual rainfall, which varies considerably at a local level, falls mainly between early October and March. Significant precipitation is limited to the coastal belt, especially in the north-west; Alexandria receives 150 to 200 mm of rain per year. From Alexandria eastwards, annual totals decline to about 80 mm at Port Said and 70 mm at El-Arish, near Egypt's eastern border. Rainfall decreases rapidly south of the coast. In general, three rainfall belts may be distinguished in Egypt:

1) The Mediterranean coastal belt,

(2) middle Egypt with latitude 30° N as it's southern boundary,

(3) upper Egypt. The first and second belts have a winter rainfall

(Mediterranean regime), the rainy season extends from November to April, though mainly concentrated in December and January. These belts correspond roughly to the attenuated and accentuated arid provinces of northern Egypt, where the average annual rainfall ranges from 100 to 150 mm in the attenuated arid province, and from 20 to 100 mm in the accentuated arid province. It extends rather south along the Gulf of Suez to Lat.26° N due to the orographic influence of the Red Sea coastal mountains. The third belt is almost rainless; it corresponds roughly to the hyper arid provinces. Rain at this belt is not an annually recurring incident; 10mm may occur once every ten years. The rainfall increases gradually to the North until reaches about 20mm at the borders with the arid province (at Giza).

One of the major features of rainfall in arid and semi arid regions other than being scanty, is its great temporal variability, average deviation of annual precipitation from the mean, expressed as percentage of the mean, is greatest in the hyper arid provinces (e. g. Siwa 83 %). In the arid province the percentage variability is 65 % at Giza which is close to the hyper arid provinces.

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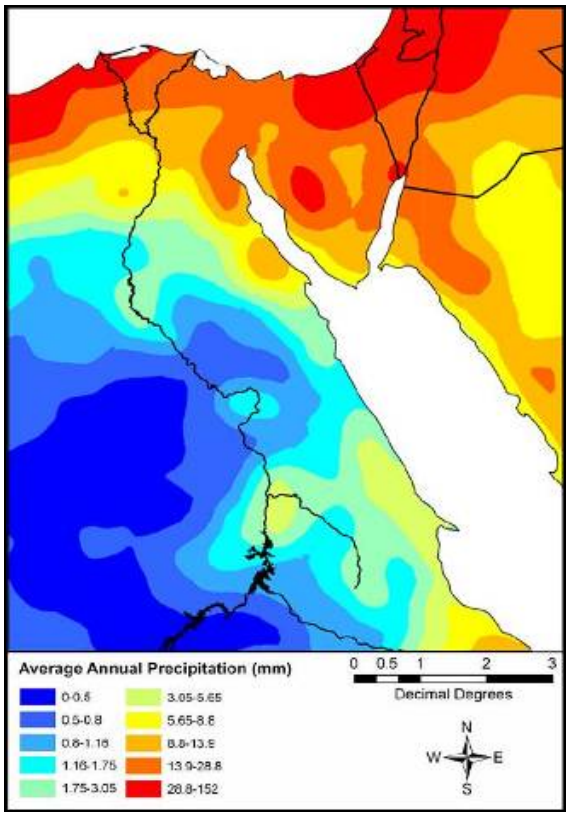

Figure 6-2 Mean Annual Precipitation in Egypt

THUNDERSTORMS

Thunderstorms occasionally affect the Egyptian coastal area, accompanied by sustained winds of 43 to 60 knots for short periods and instantaneous wind gusts in the range of 70 to 90 knots (WorleyParsons database). These thunderstorms occur particularly between October and May and are less frequent in the summer and early autumn (WorleyParsons database). Table 6-1 represents the expected thunderstorms.

Table 6-1 Expected Thunderstorms

Local Thunderstorms Name	Expected Date	Probable Duration (days)
1. Nawat El-Salib	End of September	3
2. Nawat El-Salib	Mid-End of October	3
3. Nawat El-Maknasa	End of November	3
4. Nawat Kasim	Beginning of December	3
5. Nawat El-Feida	End of December	2
6. Nawat El-Ghotas	Beginning of January	3
7. Nawat El-Feida El-Kubra	Mid January	5
8. Nawat El-Karam	End of January	2
9. Nawat El-Shams	Beginning of February	5
10. Nawat El-Hosoum	Beginning of March	8
11. Nawat El-Shams El-Koubra	Mid-End of March	2
12. Nawat Aowa	End of March	6
13. Nawat El-Khamasin	April	Variable
14. Nawat El-Nokta	Mid July	Variable

Source: WorleyParsons database

WIND

The normal wind regime along the Mediterranean coast of Egypt is controlled by various atmospheric conditions that occur on a seasonal basis. The wind regime is highly uniform throughout the coastal zone of Egypt and is dominated by north-westerly and northerly winds for most of the year. For only a few days during spring, transient changes in this rather stable wind pattern occur, with hot desert wind blowing from the south, southeast or southwest. This wind

(Khamasin) often blows as sand storms of hot desert wind covering vast areas of the Egyptian desert, including the Mediterranean coastal area.

6.1.2 Air Quality

Ambient air quality in Egypt is monitored continuously through the national ambient air quality net work which contains 78 monitoring station spread all over Egypt. The majority of these stations is concentrated in greater Cairo area which include Cairo and three neighbouring areas. The data presented in this report is collected from all the near Mediterranean cost stations in four governorates.

Alex university ambient air quality monitoring station, Abu Qir, Damietta, and Port Said air quality monitoring stations are considered the nearest ambient air quality monitoring stations to the area of influence as presented in Figure 6-3

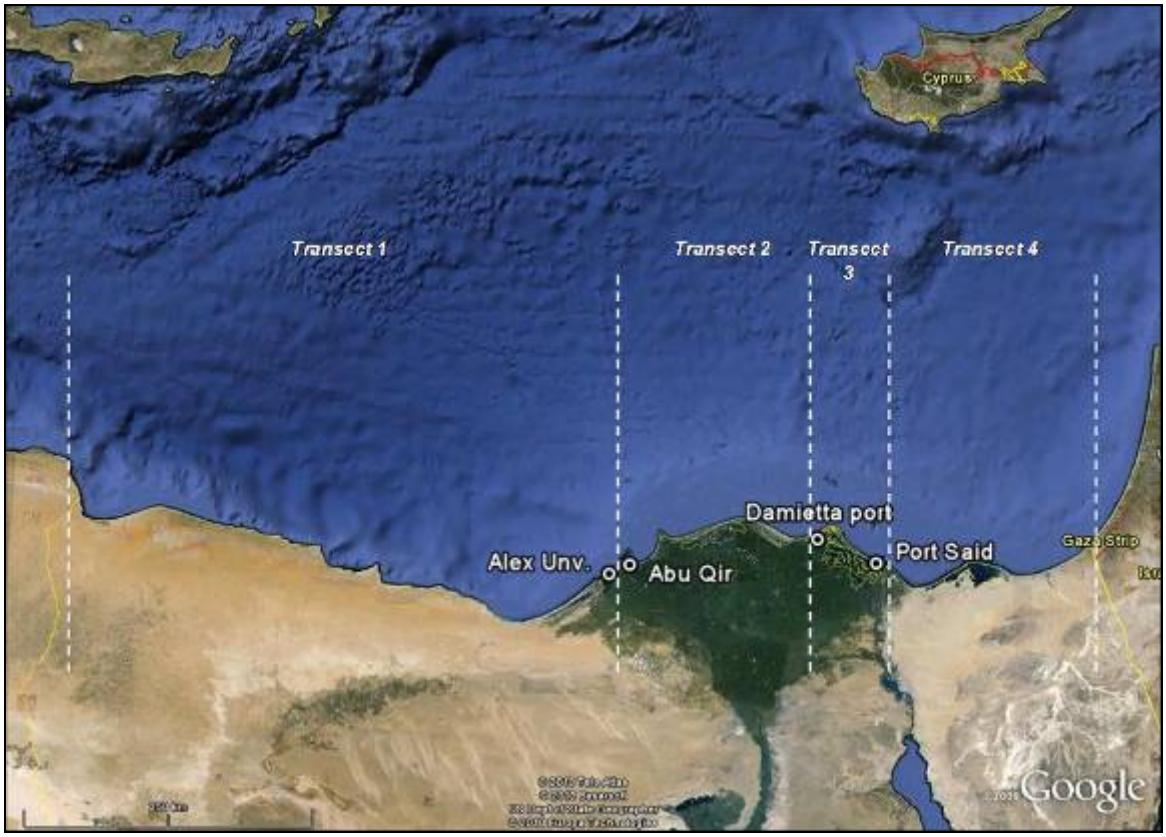

Figure 6-3 Location of the nearest air quality stations to the area of the influence

TRANSECT 1

The monthly average concentrations of NO_2 obtained from data recorded at the Alex University monitoring station during the period of 2008 are presented in Table 6-2. Figure 6-4 presents a

The monthly average concentrations of NO_2 recorded in 2008 at Alex University monitoring station were below the limit set by the WHO.

Table 6-2 Monthly NO_2 Conc. recorded at Alex. University monitoring station during 2008

Month	NO_2 concentration ($\mu g.m^{-3}$)
Jan-08	14.7
Feb-08	17.5
Mar-08	15.0
Apr-08	11.8
May-08	13.5
Jun-08	21.3
Jul-08	20.1
Aug-08	11.3
Sep-08	18.3
Oct-08	10.8
Nov-08	25.3
Dec-08	24.1

The maximum concentration was recorded during November (25.3 $\mu g.m^{-3}$) while the minimum concentration was recorded during august (11.3 $\mu g.m^{-3}$)

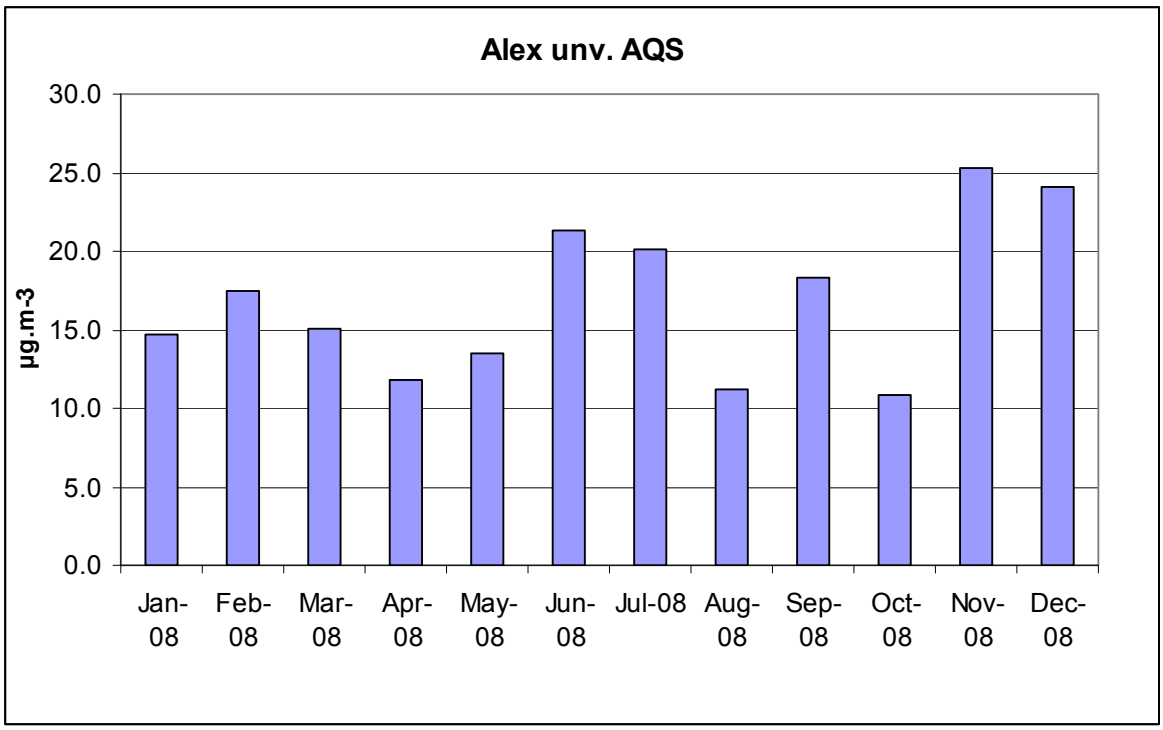

Figure 6-4 Monthly NO_2 Conc. recorded at Alex. University monitoring station during 2008

TRANSECT 2

The monthly average concentrations of NO_2 obtained from data recorded at the Abu Qir monitoring station during the period of 2008 are presented in Table 6-3. Figure 6-5 presents a histogram showing the monthly average concentrations variation of NO_2. There is no maximum acceptable value set by law 4/1994 for the annual average concentration of NO_2; however, the World Health Organization (WHO) has set a limit of 50 $\mu g.m^{-3}$.

The monthly average concentrations of NO_2 recorded in 2008 at Abu Qir monitoring station were below the limit set by the WHO.

Table 6-3 Monthly NO_2 Conc. recorded at Abu Qir monitoring station during 2008

Month	NO_2 concentration ($\mu g.m^{-3}$)
Jan-08	23.4
Feb-08	16.1
Mar-08	15.5
Apr-08	12.7
May-08	14.0
Jun-08	21.3

Month	NO_2 concentration ($\mu g.m^{-3}$)
Jul-08	19.4
Aug-08	11.4
Sep-08	11.7
Oct-08	10.3
Nov-08	26.1
Dec-08	26.4

The maximum concentration was recorded during November (26.4 $\mu g.m^{-3}$) while the minimum concentration was recorded during august (11.4 $\mu g.m^{-3}$).

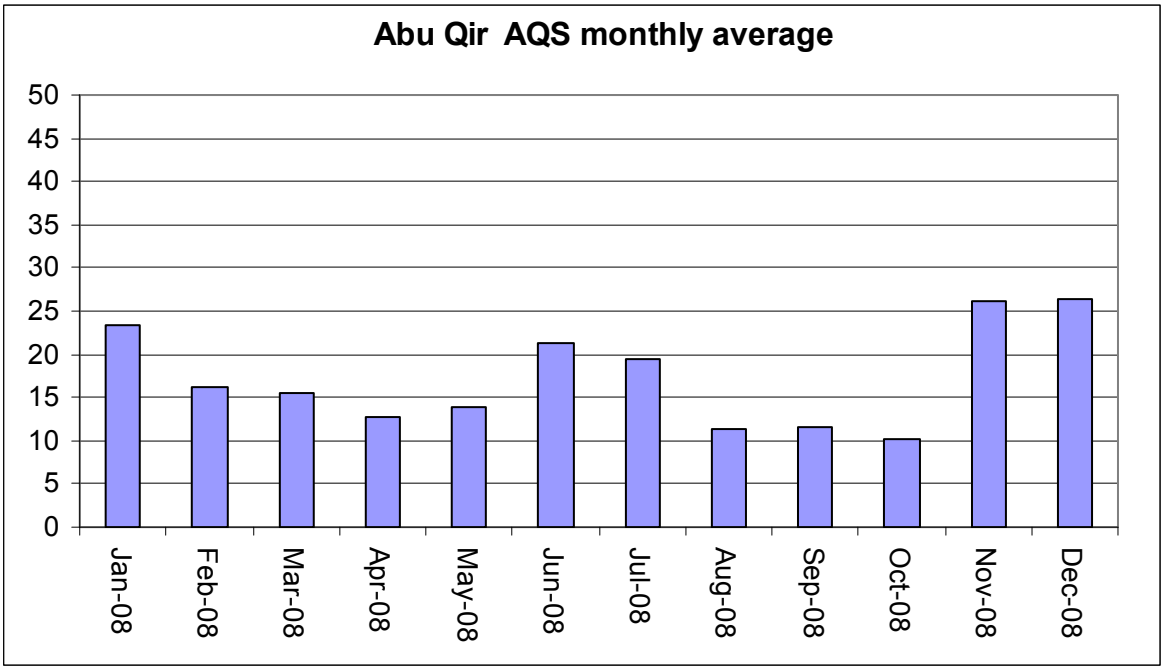

Figure 6-5 Monthly NO_2 Conc. recorded at Abu Qir monitoring station during 2008

TRANSECT 3

Damietta port air quality monitoring station was recently established (April 2009), the monthly average concentrations of NO_2 and PM_{10} obtained from data recorded at the monitoring station during the period of 2009 are presented in Table 6-4 and

Table 6-5. Figure 6-6 and Figure 6-7 present a histogram showing the monthly average concentrations variation of NO_2 and PM_{10}. There is no maximum acceptable value set by law 4/1994 for the annual average concentration of NO_2; however, the World Health Organization (WHO) has set a limit of 50 $\mu g.m^{-3}$. Concerning PM_{10} the annual acceptable limit stated in the Egyptian environmental law is 70 $\mu g.m^{-3}$.

The monthly average concentrations of NO_2 recorded in 2009 at Damietta monitoring station were below the limit set by the WHO.

Table 6-4 Monthly NO_2 Conc. recorded at Damietta monitoring station during 2009

Month	NO_2 concentration ($\mu g.m^{-3}$)
Jan/2009	-
Feb/2009	-
Mar/2009	-
Apr/2009	19.2
May/2009	20.1
Jun/2009	29.3
Jul/2009	11.6
Aug/2009	24.1
Sep/2009	31.8
Oct/2009	33.0
Nov/2009	27.1
Dec/2009	19.8

The maximum concentration was recorded during October (33.0 $\mu g.m^{-3}$) while the minimum concentration was recorded during July (11.6 $\mu g.m^{-3}$).

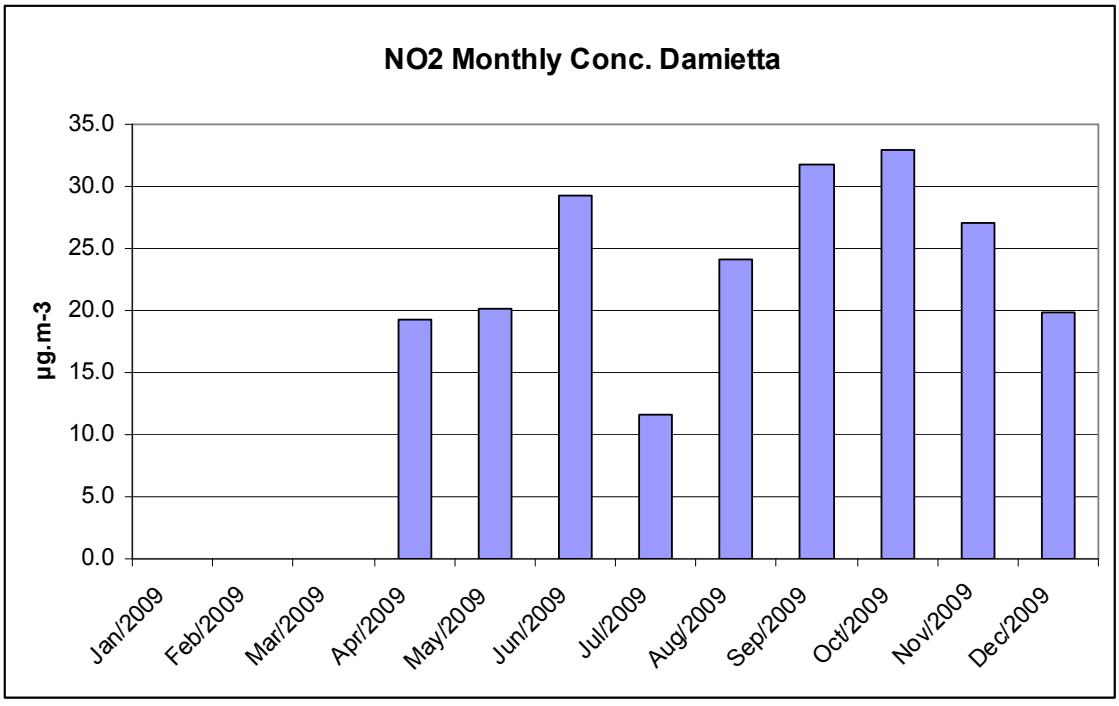

Figure 6-6 Monthly NO_2 Conc. recorded at Damietta monitoring station during 2009

Similarly the monthly average concentrations of PM_{10} recorded in 2009 at Damietta monitoring station were below the limit set by the Egyptian Environmental Law.

Table 6-5 Monthly PM10 Conc. recorded at Damietta monitoring station during 2009.

Month	PM_{10} concentration ($\mu g.m^{-3}$)
Jan/2009	-
Feb/2009	-
Mar/2009	-
Apr/2009	60.8
May/2009	59.4
Jun/2009	55.3
Jul/2009	68.2
Aug/2009	49.3
Sep/2009	44.2
Oct/2009	60.9
Nov/2009	56.3
Dec/2009	55.1

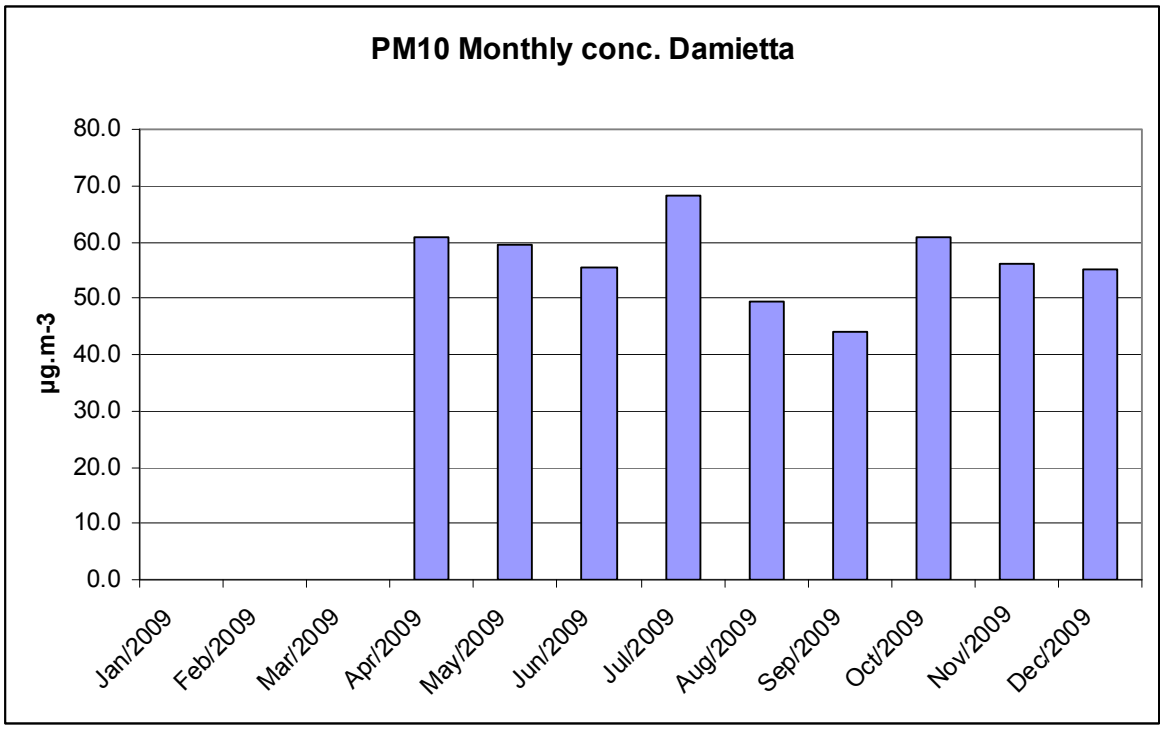

Figure 6-7 Monthly PM_{10} Conc. recorded at Damietta monitoring station during 2009

The maximum concentration was recorded during for PM_{10} July (68.2 µg.m^{-3}) while the minimum concentration was recorded during September (44.2 µg.m^{-3})

The monthly average concentrations of SO_2 obtained from data recorded at Port Said monitoring station during the period of 2008 are presented in Table 6-6 and Figure 6-8.

Figure 6-7 presents a histogram showing the monthly average concentrations variation of SO_2. The acceptable value set by law 4/1994 for the annual average concentration of SO_2 is 60µg.m^{-3}.

The monthly average air concentrations of SO_2 recorded in 2008 at Port Said monitoring station were below the limit set by the Egyptian environmental law.

Table 6-6 Monthly SO_2 Conc. recorded at Port Said monitoring station during 2008

Month	SO_2 concentration(µg.m^{-3})
Jan-08	15.7
Feb-08	14.0
Mar-08	16.2
Apr-08	17.3
May-08	13.6
Jun-08	
Jul-08	17.0
Aug-08	18.4
Sep-08	12.4
Oct-08	13.6
Nov-08	8.5
Dec-08	9.3

The maximum concentration was recorded during August (18.4.0 µg.m^{-3}) while the minimum concentration was recorded during December (9.3 µg.m^{-3})

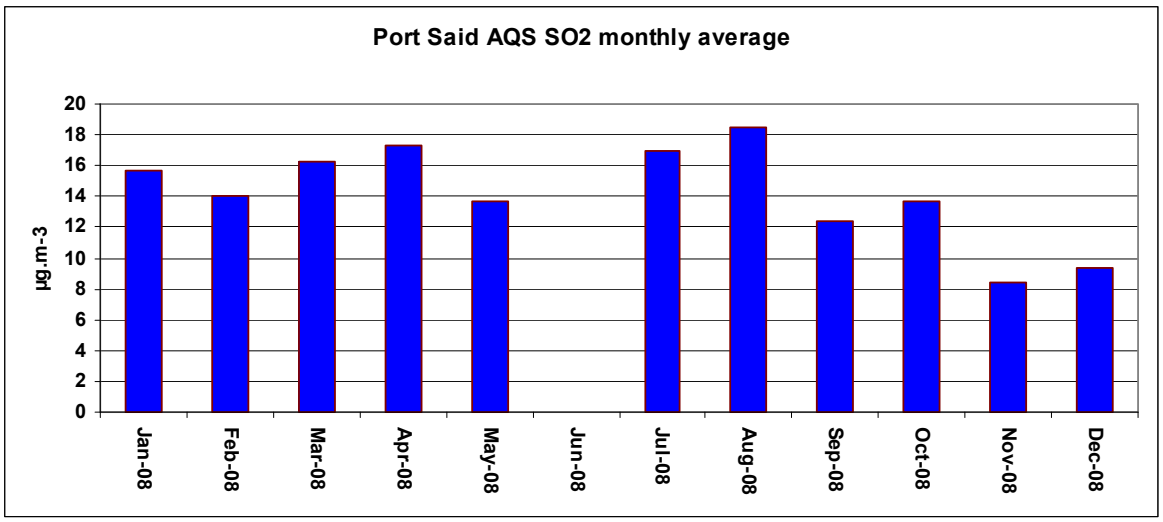

Figure 6-8 Monthly SO_2 Conc. recorded at Port Said monitoring station during 2008

TRANSECT 4

There are no ambient air quality monitoring stations in the 4th transect thus no recorded ambient air quality data for the sea side area from port said to El Arish however the nearest representative ambient air quality monitoring station to the 4th transect is located in Port said city. Port Said ambient air quality data is discussed previously in transect 3.

6.2 Land

6.2.1 Geology

The geology of the Mediterranean is complex, involving the break-up and then collision of the African and Eurasian plates and the Messinian Salinity Crisis in the late Miocene when the Mediterranean dried up. The geodynamic evolution of the Mediterranean Sea was provided by the convergence of European and African plates. This process was driven by the differential spreading along the Atlantic ridge, which led to the closure of the Tethys Ocean and eventually to the Alpine orogenesis. However, the Mediterranean also hosts wide extensional basins and migrating tectonic arcs, in response to its land-locked configuration (Robertson *et al*., 1998).

Following Tethyan rifting and opening of the Mediterranean in the Jurassic, prominent Cretaceous mixed clastic and carbonate shelf edges aggraded vertically along a steep fault-bounded shelf-slope break. This "hinge line" in northern Egypt exerts the fundamental control on reservoir distribution in Tertiary age strata. In the late Eocene, northern Egypt was tilted toward the Mediterranean during regional uplift associated with the opening of the Gulf of Suez and Red Sea rifts. Drainage systems shed reservoir quality sediments northward in a series of forced regressions. These regressions culminated in the be-heading of the youngest deltas by sub-aerial

erosion during the sea level low-stand associated with the Messinian salinity crisis. Early Pliocene transgressions deposited a thick sealing interval over the low-stand Messinian valley networks. Renewed deltaic deposition began at approximately 3.8 million year (J.C Dolson *et al*. 2005).

The steep structural hinge line and faulted continental shelf created a large amount of accommodation space with relatively minor pro-gradation of depositional systems. As a result, the primary play consists of slope-channel fairways in all levels. The Plio-Pleistocene systems are the shallowest targets in the basin that hold the majority of proven reserves. Future large reserve growth will come from the Pre-Messinian strata (J.C Dolson *et al*. 2005).

6.2.2 Sediment Quality

The sediments derived from the River Nile are the weathering products of the African basic and metamorphic rocks. They have a characteristic granulometric, mineral and chemical composition reflecting their origin. The sediment logical analysis of the Nile alluvium revealed that these sediments consist of 25% sand, 43% silt and 32% clay. The dominant sediment forming minerals are the feldspars, Quartz, Pyroxenes amphiboles, iron oxides (opaque minerals) and clay minerals. Other heavy minerals are found in minor amounts such as Zircon, tourmaline, monozite and garnet (Emelyanov et.al., 1978).

6.2.3 Physical profile of the coastline

The Egyptian coast was divided over 33 maps - presented within the ERA study (455/EJ6172-000-EN-REP-07) - extracted from satellite imagery of the coast, Transect 1 was represented within 18 of these maps. More than 80% of the coast length is almost equally divided between the sandy and rocky nature, while the rest of the coast length is made up of man-made coastal structures, and only a minor part composed of lagoons.

Transect 2 was represented within six of the maps. The maps showed the coast in Transect 2 to be mainly composed of sandy beaches with rare appearances of rocky coast and even smaller sections of man-made coastal structures.

Transect 3 was represented within four maps. The study of the maps representing Maps indicated a transect dominated by man-made coastal structures and an equivalent length of sandy beaches, while the length of rocky coast is almost half of the length sandy beaches.

Transect 4 was represented within seven maps, within this transect the coast is purely dominated with sandy beaches, while rocky coast only occupies about one-tenth of the length and a negligible length of man-made coastal structures.

6.3 Water Quality

6.3.1 Characteristics

The Mediterranean Sea covers an area of some 2.5 million km^2 with an average depth of 1.5 km and a volume of 3.7 million km^3. The Mediterranean stretches a width of 3,800 km, from west to east, and has a maximum N-S distance of 900 km between France and Algeria. It comprises two main basins, the western and the eastern basins. The basins are connected principally by the Strait of Sicily, 150 km wide and at most about 400 m deep. The eastern basin covers an area of 1.65 million km^2 at the sea surface and the western basin covers an area of some 0.85 million km^2, making it approximately half the size of that of the eastern basin (United Nations Environment Programme, 1996).

The Mediterranean Sea is connected to the Atlantic Ocean by the Strait of Gibraltar, which has a 15 km wide sill with a maximum depth of 290 m, and to the Sea of Marmara (and thus the Black Sea) by the Dardanelles Strait which has a width between 1.3 km and 7 km and an average depth of 55 m. Since the end of the 19th century, the Mediterranean Sea has been connected to the Red Sea by the Suez Canal. The connection of the Mediterranean Sea and the North Atlantic Ocean, via the Strait of Gibraltar has allowed some species, especially the naturally migratory ones to become common to the Mediterranean and the eastern Atlantic (United Nations Environment Programme, 1996).

The Mediterranean coast of Egypt is located in the eastern basin of the Mediterranean Sea. The Egyptian Mediterranean coast has a narrow coastal belt that extends between Sallum eastward to Rafah for about 970 km. The deltaic coast along the Mediterranean Sea is divided into three sections: western, middle, and eastern section. The middle section of the deltaic coast is between Abu Qir and Port Said along a distance of 180 km (Mashaly, 2001).

The Mediterranean Sea is characterized by the following:

- It is an enclosed sea, which leads to a slow replacement of the sea water from the Atlantic and, to a much lesser extent, from the Black Sea; hence the means for the Mediterranean region to leave a very strong "imprint" (as very high salinity, due to high evaporation) on its sea water.
- Small drainage basin - coastal mountains slope steeply into the sea, creating a generally limited natural fresh water supply; a very narrow littoral zone, a narrow continental shelf which leads to low volume of shelf sea water, hence a limited amount of marine resources, living and non-living, within easy reach of the human populations on land.
- Great basin depth - is essentially an obstacle to nature in the renewal of the sea water in these basin depths, and for anthropogenic uses in the exploitation of the resources thereof. These depths are used as a place to dump waste materials, and coupled with waste from various activities including natural resource exploration; this is leading to the process of degradation of the deep water.

- The high volcanic and seismic activity in the eastern Mediterranean is a probable risk to the human population and to the natural resources of the region, but on the other hand it plays an important role in the biogeochemical cycles of the main elements on which life and human survival depend in subtle, long-term ways.
- Evaporation greatly exceeds precipitation and river runoff in the Mediterranean, a fact that is central to the water circulation within the basin. Evaporation is especially high in its eastern half, causing the water level to decrease and salinity to increase eastward (Wikipedia, 2009).
- Micro tidal: the reduced potential for dilution and dispersion of dissolved and particulate wastes occurs due to the tidal range which is typically less than 50 cm (European Environment Agency, No.4/2006).
- Oligotrophy: poor in nutrients, low primary production, low phytoplankton biomass and poor development of higher levels of the food chain, including low fish production. Oligotrophy increases from west to east. Primary production in the open sea is considered to be phosphorus limited in contrast to nitrogen limitation in most of the world's oceans (European Environment Agency, No.4/2006).

6.3.2 Water Balance of the Mediterranean Sea

The water balance of the Mediterranean is maintained by the input of water from the Atlantic Ocean (at the surface through the Strait of Gibraltar), from the Sea of Marmara (also at the surface, through the Dardanelles), from rivers and direct runoff from the land, and from rainfall to replace the loss due to evaporation. Table 6-7presents the Mediterranean Sea water balance.

Table 6-7 Mediterranean Water Balance

Inputs (km^3)		**Losses (km^3)**	
Rainfall & melting snow	1 100	Evapo-transpiration	580
River discharges (South)	56	Evaporation	20
River discharge (North)	29	Run-off to the Oceans	505
Effluent Discharges	85	Water use	165
Total	**1 270**	**Total**	**1 270**

Source: WorleyParsons database

The residence time of the water is often cited to be about 80 years which is actually the time it would take to fill the “empty" Mediterranean with the incoming water from the above-mentioned sources. However, it may be safely assumed that some of the incoming water that finds its way into the basin depths may take 100-300 years to return to the Atlantic Ocean or the Sea of Marmara, whereas some of it may exit in only few decades. There are thus factors favouring the acquisition of typical Mediterranean water characteristics. Local or sub-regional circulation patterns are therefore of considerable importance in determining the local state of the marine environment.

6.3.3 Oceanographic Characteristics

BATHYMETRY

The Mediterranean Sea is divided into two parts, Eastern and Western. The Eastern Mediterranean Basin has a depth over 3200m off Marsa Matruh in western Egypt and 4000m to the southeast of Rhodes. Mean depth is about 2000m. The depths are reached abruptly, with steep continental slopes and limited continental shelf. The Eastern Mediterranean is subdivided into two major depressions. These are: the Ionian Basin, in which maximum depth is 5120m, and the Levantine Basin where maximum depth is 4384m (Figure 6-9).

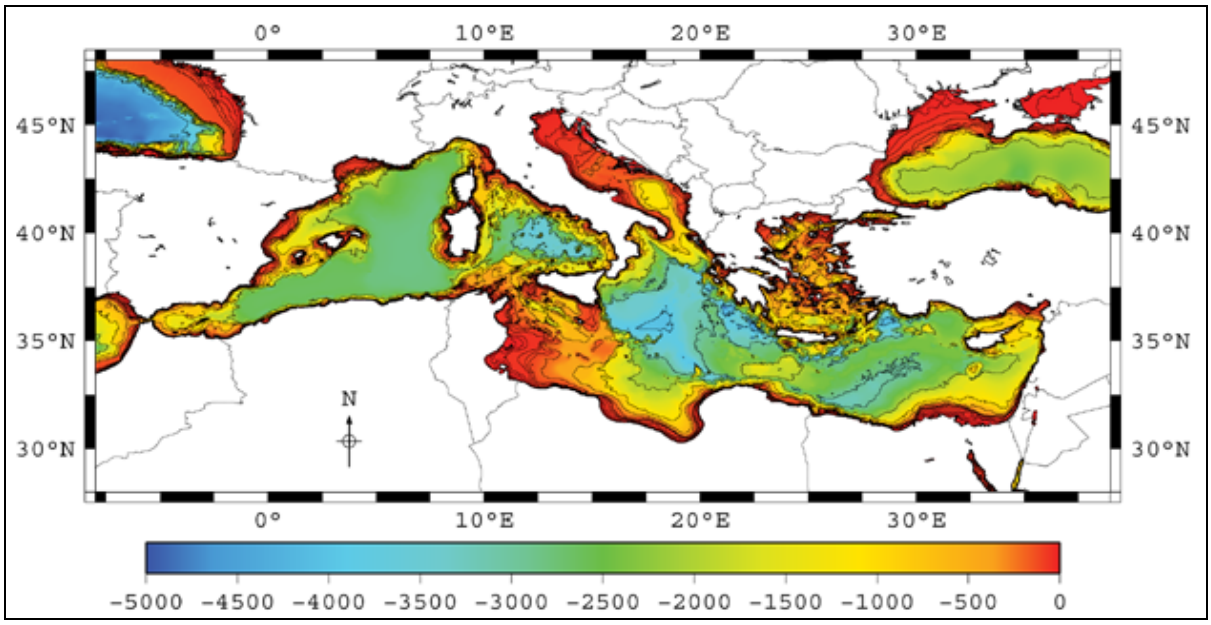

Figure 6-9 Bathymetric map of Mediterranean Sea

Source: http://amcg.ese.ic.ac.uk/index.php?title=File:Med_GEBCO_bathy.png

TEMPERATURE

Areas of the Mediterranean closer to the equator are hotter in temperature. The Gulf of Sidra, off the coast of Libya, has the highest water temperatures of about 88 °F (31°C) in August, followed by the Gulf of Iskenderun with 86°F (30°C). The extreme north of the Adriatic has the lowest surface temperatures; the mean temperature in February falls to 41°F (5°C) in the Gulf of Trieste, and ice occasionally forms in winter.

Source: http://www.newworldencyclopedia.org/entry/Mediterranean_Sea

SALINITY

Salinity varies between 35.81 to 38 g.L^{-1}, rising to 39 g. L^{-1}at some locations in the Mediterranean Sea during summer months (WP database for the area and EEAA 2010 marine survey). Areas of lower water salinity are reported where water discharge occurs. Salinity varies considerably according to the proximity of fresh or brackish water discharge points. Salinity in both El Dabaa concession and Abu Qir bay is generally high. According to a study conducted offshore Ras El Hekma area (50 km to the west of El Dabaa) to measure the physical and biological parameters for the marine environment, the salinity in the area ranges between 34 and 40% (parts per thousand), with surface salinities reaching a maximum in summer, which may be a result of increased evaporation (WorleyParsons database for the area).

CURRENT

Surface currents within the Eastern Mediterranean are generally weak with an anticlockwise gyre. The direction of inshore currents is variable, being influenced by local wind patterns, with easterly currents dominating. Figure 6-10 illustrates the depth distribution and main currents in the Mediterranean Sea.

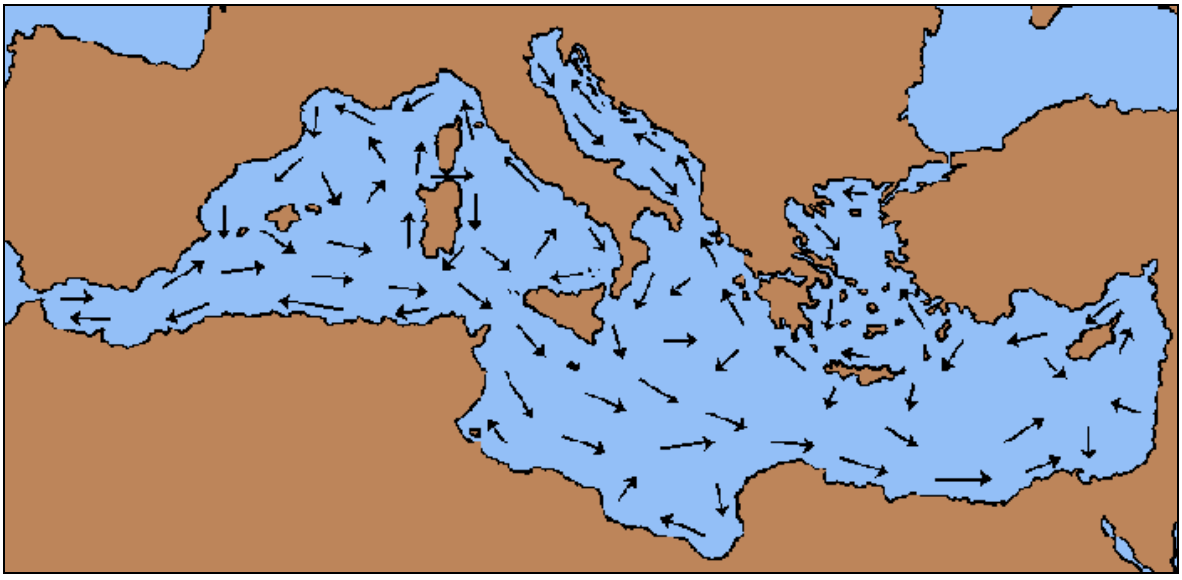

Figure 6-10 Physiography of the Mediterranean Sea (depth distribution and main currents)

Source: EEA; UNEP/GRID Warsaw

According to available regional data from WorleyParsons database for the area, the current speed generally varies between 2 and 20 cm.s^{-1}, and rarely reaches values up to 35 cm.s^{-1}. Current direction is mostly eastward and south eastward, occasionally toward the west or southwest for the current passing near the coast. The seasonal variability of current direction and speed is strongly controlled by the wind in the region. The studies also outlined seasonal current patterns as follows:

- In early winter (December), the SE currents became directed more towards the east with a tendency toward the east along the coast, with a speed ranging from 3 to 20 cm.s^{-1}. These currents are generated from the SW winds.
- In winter (January to February) currents are mainly directed towards the SE with an eastward current close to the shore. Their velocities range between 3 and 20 cm.s^{-1}. In that time winds are usually blown from the NW and SW;
- During spring, currents continue to be south-easterly;
- Throughout the summer (June to August), the SE currents are still observed, generated due to the prevailing NW winds
- During autumn (September to November) surface currents are SE directed from the offshore region toward the coast with speed up to 25 cm.s^{-1}

WAVES

As shown in Figure 6-11, offshore wave heights in the Mediterranean Sea mostly range from 0.5 m to 1.5 m and rarely exceed two meters height. Offshore waves occur from a South-West to North-East direction (225°N – 45°N) whilst near shore wave directions are predominantly from the North-West (295°N – 335°N).

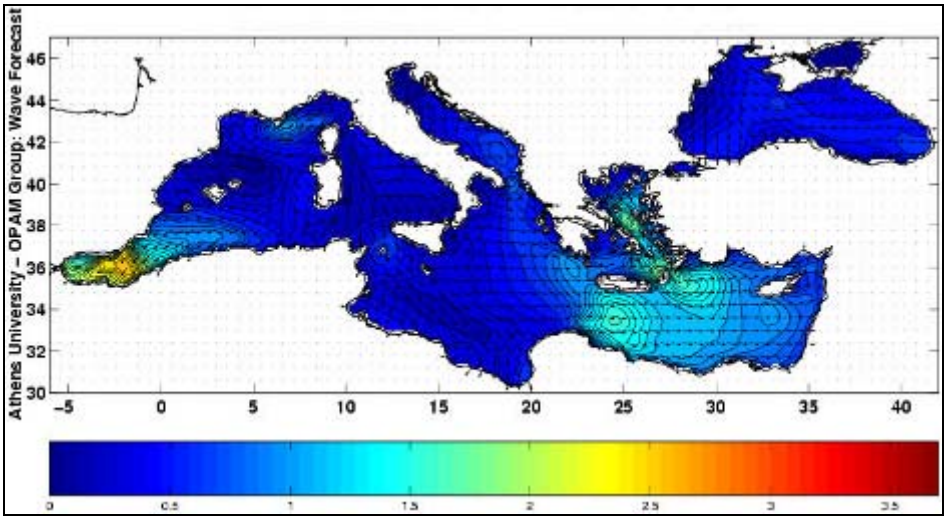

Figure 6-11 Wave Height (m) and direction in the Mediterranean Sea

Source: Provided data by Statoil

TIDES

Tidal amplitudes in the Egyptian Mediterranean Sea are small, with dominant semi-diurnal components. The narrow continental shelf prevents tidal amplification along the coasts, making these small tidal movements even more difficult to observe on the Egyptian coast. The main effect

of tidal oscillations is on the dynamics of the lagoon outlets. On average, spring tides and storms should coincide about twice a year (WorleyParsons database).

SEA LEVEL RISE

Mean sea level at Alexandria and Rosetta is around 0.3 m and 0.2 m respectively above chart datum. The effects of climate change on sea level have been the subject of considerable research effort, and recent work by the United Nations Environment Programme (UNEP) indicates that sea level changes of between +16 cm and +50 cm might be expected along the Egyptian Mediterranean coast over the course of the next century.

Potential impact of sea level rise: Nile Delta. Rising sea level would destroy weak parts of the sand belt, which is essential for the protection of lagoons and the low-lying reclaimed lands in the Nile delta of Egypt (Mediterranean Sea). The impacts would be very serious: One third of Egypt's fish catches are made in the lagoons. Sea level rise would change the water quality and affect most fresh water fish. Valuable agricultural land would be inundated. Figure 6-12 shows the past, present and expected sea level trends.

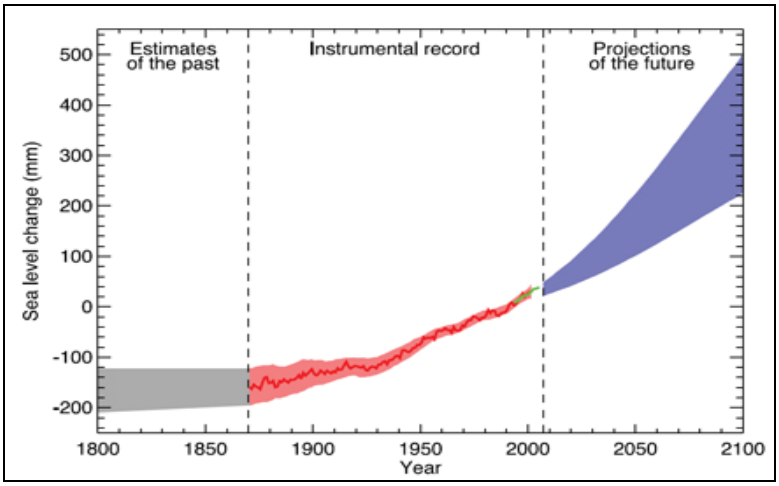

Figure 6-12 Past, Present and Predicted Sea Level Trends

6.3.4 Marine Water Quality

A marine survey was carried out in during 2009 by the EEAA in order to monitor the water quality in the Egyptian Mediterranean Sea. Thirty monitoring stations were selected near the residential and industrial areas in addition to some reference stations along the Mediterranean coast. In this study, the coast was divided into four segments as follows:

- West: Extending from El-Salum (Me1) to west Nubaria drain (Me8)
- Alexandria: Extending from Hanovel (Me9) to El-Maadia (Me25)

- Delta: Extending from Rashed 1 (Me29) to east El-Gamel (me40)
- East: Extending from Port Said (Me41) to Rafah (Me 47a)

Table 6-8 and Figure 6-13 shows the names and codes of the monitoring stations.

Table 6-8 Names of monitoring stations and their codes

Name	Code	Name	Code
Sallum	Me1	Sedi Gaber	Me17b
Matrouh	Me2	Montazah	Me19
Bagosh	Me4a	West Abu Qir	Me20
Marina	Me6	East Abu Qir	Me21
Sedi Krer	Me7a	Power station	Me23
Nubaria	Me8	El-Maadia	Me25
Hanovil	Me9	Rashid 1	Me29
Betash	Me10	Rashid 2	Me31
Dekhila	Me10a	El-Borg	Me33
Max	Me11	Damietta	Me35
East port	Me12	El-Gamel West	Me39
NIOF	Me14	El-Gamel East	Me40
East side of the east port	Me15	Port Said	Me 41
West side of the east port	Me16	Arish	Me44
Shatby	Me17a	Rafah	Me47a

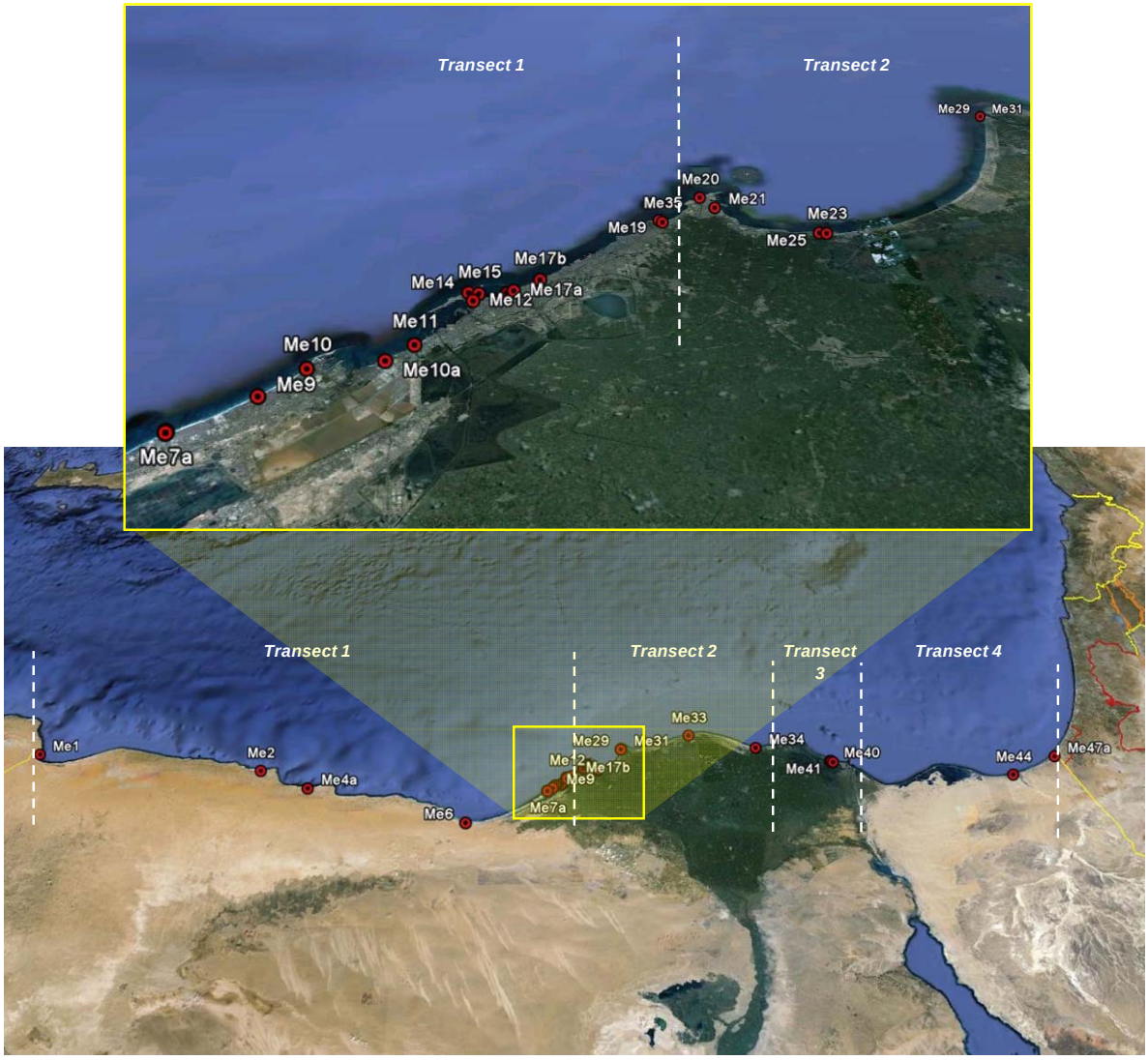

Figure 6-13 Water Monitoring Stations Along The Egyptian Coast

TRANSECT 1

Marine water quality monitoring stations located within transect 1 is presented in table, 17 monitoring station out of total 30 monitoring stations located in the first transect from El-Salum to Abu Qir. As presented in Table 6-9.

Table 6-9 Marine water quality monitoring stations located in transect 1

Number	Name	Code
1	El-Salum	Me1
2	Matrouh	Me2
3	Bagosh	Me4a
4	Marina	Me6
5	Sedi Krer	Me7a
6	Nubaria	Me8
7	Hanovil	Me9
8	Betash	Me10
9	Dekhila	Me10a
10	Max	Me11
11	East port	Me12
12	NIOF	Me14
13	East side of the east port	Me15
14	West side of the east port	Me16
15	Shatby	Me17a
16	Sedi Gaber	Me17b
17	Montazah	Me19

PHYSICAL PARAMETERS

During the year 2009 the results of EEAA Mediterranean water quality survey located in transect 1 showed that DO results ranged from 8 to 3.5 as for the pH values, the EEAA marine survey showed that it ranged between 7.78 and 8.15 which are within normal limits in all the 30 stations.

BACTERIOLOGICAL WATER QUALITY

Microbial contamination and human health risks are often related to urban wastewaters. The most important eutrophication hot spots in the Mediterranean often coincide with coli form bacterial hot spots.

A bacteriological survey for the first transect showed that the count of Bacteria total coli form varied between 10/ 100 ml to 12000/100ml conducted at 17 monitoring stations along the Mediterranean Sea by EEAA in 2009. While the count of E Coli varied between 5/ 100 ml to 18000/100ml.

CHEMICAL PARAMETERS

CHLOROPHYLL

High concentrations of chlorophyll (higher than 6 microgram L^{-1}) were recorded in NIOF monitoring station (11.9 microgram $.L^{-1}$) and the lowest concentration was recorded in El-Salum(1microgram $.L^{-1}$)

AMMONIA (NH4-N)

The latest marine survey by EEAA in 2009 showed that ammonia concentration varied between 0.095 and 0.005 mg L^{-1} in east port and El-Salum.

TOTAL NITROGEN (TN)

The average concentration of total nitrogen varied between 0.29 micromole L^{-1} at NIOF and 0.5 mille gram. L^{-1} at Marina station according to EEAA marine survey results in 2009.

TRANSECT 2

Marine water quality monitoring stations located within transect 2 is presented in Table 6-10, seven monitoring stations out of total 30 monitoring stations located in the second transect from Abu Qir to Damietta.

Table 6-10 Marine water quality monitoring stations located in transect 2

Number	Name	Code
1	West Abu Qir	Me20
2	East Abu Qir	Me21
3	Power station	Me23
4	El-Maadia	Me25
5	Rashid 1	Me29
6	Rashid 2	Me31
7	El-Borg	Me33

PHYSICAL PARAMETERS

During the year 2009 the results of EEAA Mediterranean water quality survey located in transect 2 showed that DO results ranged from 8 to 3.7 as for the pH values, the EEAA marine survey showed that it ranged between 7.78 and 8.15 which are within normal limits in all the 30 stations.

BACTERIOLOGICAL WATER QUALITY

Microbial contamination and health risks are often linked to urban wastewater. The most important eutrophication hot spots in the Mediterranean often coincide with coliform bacterial hot spots.

A bacteriological survey for the second transect showed that the count of Bacteria total coli form varied between 100/ 100 ml to 8000/100ml conducted at 7 monitoring stations along the Mediterranean Sea by EEAA in 2009. While the count of E Coli varied between 8/ 100 ml to 100/100ml.

CHEMICAL PARAMETERS

CHLOROPHYLL

High concentrations of chlorophyll (higher than 6 microgram L^{-1}) were recorded in ElMedaia monitoring station (11.5 microgram $.L^{-1}$) and the lowest concentration was recorded in Abu Qir west (1.8 microgram $.L^{-1}$)

AMMONIA (NH4-N)

The latest marine survey by EEAA in 2009 showed that ammonia concentration varied between 0.085 and 0.007 mg L^{-1} in EL Medaia and Abu Qir west.

TOTAL NITROGEN (TN)

The average concentration of total nitrogen varied between 0.27 micromole L^{-1} at ElMedaia and 0.9 mille grams. L^{-1} at Rasheed2 station according to EEAA marine survey results in 2009.

TRANSECT 3

Marine water quality monitoring stations located within transect 3 is presented Table 6-11, three monitoring station out of total 30 monitoring stations located in the second transect.

Table 6-11 Marine water quality monitoring stations located in transect 3

Number	Name	Code
1	Damietta	Me35
2	El-Gamel West	Me39
3	El-Gamel East	Me40

PHYSICAL PARAMETERS

During the year 2009 the results of EEAA Mediterranean water quality survey located in transect 3 showed that DO results ranged from 7.3 to 5.8 as for the pH values, the EEAA marine survey showed that it ranged between 7.78 and 8.15 which are within normal limits in all the 30 stations.

BACTERIOLOGICAL WATER QUALITY

Microbial contamination and health risks are often linked to urban wastewater. The most important eutrophication hot spots in the Mediterranean often coincide with coliform bacterial hot spots.

A bacteriological survey for the third transect showed that the count of Bacteria total coli form varied between 8000/ 100 ml to 10000/100ml conducted at 3 monitoring stations along the Mediterranean Sea by EEAA in 2009. While the count of E Coli varied between 100/ 100 ml to 7000/100ml.

CHEMICAL PARAMETERS

CHLOROPHYLL

High concentrations of chlorophyll (higher than 6 microgram L^{-1}) were recorded in El Gameel West monitoring station (15.9 microgram $.L^{-1}$) and the lowest concentration was recorded in Damietta (4 microgram $.L^{-1}$)

AMMONIA (NH4-N)

The latest marine survey by EEAA in 2009 showed that ammonia concentration varied between 0.01 and 0.03 mg L^{-1} in El Gamel West and Damietta.

TOTAL NITROGEN (TN)

The average concentration of total nitrogen varied between 0.26 micromole L^{-1} at El Gamel east and 0.1 mille gram. L^{-1} at Damietta station according to EEAA marine survey results in 2009.

TRANSECT 4

Marine water quality monitoring stations located within transect 4 is presented Table 6-13, three monitoring station out of total 30 monitoring stations located in the second transect.

Table 6-12 Marine water quality monitoring stations located in transect 4

Number	Name	Code
1	Port Said	Me 41
2	Arish	Me44
3	Rafah	Me47a

PHYSICAL PARAMETERS

During the year 2009 the results of EEAA Mediterranean water quality survey located in transect 4 showed that DO results ranged from 7 to 4 as for the pH values, the EEAA marine survey showed that it ranged between 7.78 and 8.15 which are within normal limits in all the 30 stations.

BACTERIOLOGICAL WATER QUALITY

Microbial contamination and human health risks are often related to urban wastewaters. The most important eutrophication hot spots in the Mediterranean often coincide with coli form bacterial hot spots.

A bacteriological survey for the fourth transect showed that the count of Bacteria total coli form varied between 80/ 100 ml to 2000/100ml conducted at 3 monitoring stations along the Mediterranean Sea by EEAA in 2009. While the count of E Coli varied between 10/ 100 ml to 100/100ml.

CHEMICAL PARAMETERS

CHLOROPHYLL

High concentrations of chlorophyll (higher than 6 microgram L^{-1}) were recorded in Port Said monitoring station (14 microgram $.L^{-1}$) and the lowest concentration was recorded in Rafah (1 microgram $.L^{-1}$)

AMMONIA (NH4-N)

The latest marine survey by EEAA in 2009 showed that ammonia concentration varied between 0.036 and 0.004 mg L^{-1} in Port Said and Rafah.

TOTAL NITROGEN (TN)

The average concentration of total nitrogen varied between 0.3 micromole L^{-1} at Port Said and 0.1 mille gram. L^{-1} at Rafah station according to EEAA marine survey results in 2009.

6.3.5 Marine Ecology and Biodiversity

The benthic or bottom-feeding fauna is also greatly influenced by the type of bottom. Thus a sandy or silty bottom is suitable for certain species of echinoderms, molluscs and polychaetes, while hard bottom suits different species.

The waters depth and available resources determine the presence of flora and fauna of the coastal waters. South-eastern Mediterranean has limited primary food sources such as planktonic fauna and flora. The invertebrate fauna of the south-eastern Mediterranean is also relatively less abundant but includes a variety of mollusks (the largest group inshore), echinoderms and

polychaetes (the largest group offshore). Other invertebrates, including sponges, bryozoans, and crustaceans are also found in this zone. Four species and one sub-species of commercially important sponges have been recorded: *Spongia officinalis adriatica*, *S. officinalis mollissina*, *S. agarcinia*, *S. zimocca*, and *Hippos pongia communis*. Among the vertebrates of the Egyptian Mediterranean coastal zone there are over 350 species of fish of which about 43 are Indo-Pacific species that may have migrated through the Suez Canal. Eight species of marine mammals have been recorded and additionally, it is highly possible that the rare Monk Seal (Monachus monachus) may be found, as suitable habitat for it occurs west of Marsa Matruh and it is still occasionally found in Libya not far from the Egyptian border.

PLANKTON

The connections of the Mediterranean Sea and Red Sea (the Suez Canal) along with the construction of the Aswan Dam are both man made changes that have had significant impacts on the marine environment of the Egyptian Mediterranean coast. Such changes have consequently affected both the biodiversity and productivity of the southeast Levantine basin and Egyptian waters. Most investigations on zooplankton populations in Egyptian Mediterranean waters concerned numerical abundance, seasonal distribution, and species composition in coastal waters. The subsequent unexpected decrease of the seasonal outflow of nutrient-rich Nile water into the sea after the construction of the Aswan Dam has contributed to the dramatic changes in the biological and physico-chemical characteristics of the southeast Mediterranean environment off the Egyptian coast (Zakaria, 2006).

With Regard to the near-bottom zooplankton, Scotto di Carlo *et al*. (1991) reported the existence of homogenous copepod assemblages from the deep Mediterranean (600-2500 m), with no differences in faunal composition, and higher copepod biomass in the Western basin than in the Eastern basin. Due to the relatively warm temperature (13-14.5ºC) of deep Mediterranean waters, one might expect low biomass levels of near-bottom zooplankton. For instance, the biomass of near-bottom deep-sea zooplankton (10 m above the sea bed) was anomalously lower in the deep Red Sea (where the temperature of deep water reaches 22 ºC) than in the typical oceanic regions, a trend attributable to increased decomposition rates of organic matter in a warm water mass (IUCN, 2004).

The average annual standing crop of zooplankton sharply dropped from 28 750 individuals.m^{-3} in 1962 to 3 723 individuals.m^{-3} in 1966, 1 685 individuals.m^{-3} in 1970 - 1971, and a minimum of 1 206 individuals.m^{-3} in 1984-1985. The drop is a result of decreased fertility in the area after construction of the Aswan High Dam.

The phytoplankton community along the Egyptian Mediterranean coast comprises about 204 species and varieties and is represented mostly by diatoms and to a much lesser extent, dinoflagellates and silicoflagellates. Scattered specimens of chlorophytes and cyanophytes are also scarcely met with (Hussein, 1977).

BENTHIC SPECIES

Mediterranean benthic communities in the coastal region are often strongly influenced by human activities. Communities are diversified, principally on account of the infinite variety of environmental conditions found in the Mediterranean. Benthic communities differ according to the nature of the bottom (soft or hard). Depending on whether they are established on soft-bottomed or on rocky substrates, benthic communities are subjected to well-characterized and dominant environmental factors. Human modifications result in immediate repercussions.

MEIOFAUNA

Meiofauna is defined as the fauna sieved through0.062 mm mesh, smaller than macrofauna, inhabiting the interstitial space of sediments. In general, meiofauna abundance is dominated by nematodes, with important fractions of harpacticoid copepods and polychaetes. In the Western Mediterranean, the meiofauna is dominated by nematodes (92.4%).

Nematode biodiversity below 500 m in the Eastern Mediterranean is lower than in other equally deep sediments worldwide, and even lower than within a Mediterranean canyon at 1500 m depth (Danovaro et al., 1999). Below 500 m depth in the Eastern Mediterranean, the contribution of bacteria to organic matter degradation is significant (bacteria represent 35.8% of the living biomass, Danovaro *et al*., 1995) and the bacterial to meiofauna biomass ratio is very high (20 times, Danovaro *et al*., 1999; 2000); in the Western Mediterranean it is lower (2.5 times). The combination of low primary production and bacterial dominance of secondary production in the east is also of significance as it could account for the low fisheries production (Turley *et al*., 2000).

MACROFAUNA

In the deep Mediterranean, macrofauna biomass (*i.e* animals sieved through 0.3-1mm mesh size) varies considerably across areas (Pérès, 1985) and also seasonally. Macrofaunal abundance and biomass decrease generally with depth, and most likely also, as in meiofauna, along a west-east gradient. Close to submarine canyons or other areas of local high productivity, macrofauna biomass may increase. Macrofaunal density in the Mediterranean is about 1/10 of the densities reported for the Atlantic at comparable depths (Cosson *et al*., 1997; Flach and Heip, 1996).

The small average size of species (most animals between 0.5 and 10 mm) seems to be a characteristic of the deep Mediterranean macrofauna. As a consequence, the deep Mediterranean features a more marked decrease in the biomass than in the density of macrobenthos with depth (Pérès, 1985).

The diversity and distributional patterns of the swimming macrofauna (suprabenthos or hyperbenthos) have been studied in the western (Cartes and Sorbe, 1996, 1999; Cartes *et al*. 2003), and, to a lesser extent, the eastern Basin (Madurell and Cartes, 2003).

FISH AND PRAWNS

Fisheries, as important economical and biological resources, represent a major contribution to the biological characteristics of the area under consideration.

According to a study of Parsons Brinckerhoff (2002), the eastern Mediterranean around the Nile delta although having declined fish stocks in recent years has historically supported large populations of pelagic fish, namely the sardine family. Both Burullus lagoon and the mouth of the Rosetta Branch of the Nile play a significant role in nurturing of sea bass, mullet and other fish.

Spawning of sardine is also believed to occur through out the area from May to August, with the peak season occurring in June and July. Other migratory or demersal species exist all the year round, depending on the circumstances. Between the months of April and September, the area off the entire delta to a depth of 100 m is considered important for shrimp spawning, May to August being the major spawning period. Larger, more valuable prawns may, however, migrate into deeper water to breed. Cuttlefish (*Sepia sp.*) spawning areas have been noted between Ashtum, Gamessa and the entrance to Lake Burullus, but it is likely that much of the shallow inshore area around Rosetta is suitable for *Sepia sp.* spawning.

The main fishing ground used by Egyptian vessels is the continental shelf off the Nile Delta, and may extend to the eastern side of Port Said and rarely to the western side of Alexandria. The continental shelf is narrow in the east and west comparable to the wider central Delta region. The seabed is flat, mostly muddy to sandy along the middle and eastern coast. Limited grounds for trawling are available on the western coast. Inshore fisheries are widespread, with artisanal fishermen along the coast (FAO).

Non-indigenous species reach the Mediterranean mainly through the Suez Canal. It is believed that about 350 species have reached the Mediterranean from the Red Sea. Even though they are largely confined to the Levant basin, some are found further west. Some of these species, especially herbivorous fish and shrimps, are changing the species composition of benthic communities in the eastern Mediterranean, replacing endemic species in the fish catches.

The construction of the Suez Canal caused extensive faunistic changes in the eastern Mediterranean Sea. Of the 430 (or more) species of marine fishes identified from the Mediterranean coast of Israel and its immediate neighbourhood, 100 species are circumtropical-cosmopolitan; the remaining species belong to the Atlanto-Mediterranean fauna. Many of them are found also in the Indo-Pacific and Red Sea regions. Thus summing up the Red Sea and cosmopolitan fishes in the eastern Mediterranean, there are 56 species (among 39 families) which constitute about 13% of all the ichthyofauna identified in this region (Salzburg, April 1999**)**.

Fish population densities are lower in the Mediterranean, due to the oligotrophic characteristics of the Mediterranean Sea. A characteristic feature of Mediterranean deep-sea megafauna is the numerical importance (in terms of abundance and number of species) of decapod crustaceans which, together with fish, are the dominant taxa in deep Mediterranean assemblages.

SEA TURTLES

Three species of sea turtles are known from the area (especially in the front of Delta): the Green Turtle, *Chelonia mydas*, the Loggerhead Turtle, *Caretta caretta*, and the Leatherback Turtle, *Dermochelys coriacea* (Figure 6-14). The Green and Loggerhead Turtles breed sporadically along the Egyptian coast. The Leatherback has not been known to nest in Egyptian waters and is, indeed, the rarest of the three species (Biomapegypt.org, 2009). According to the World Conservation Unions' (IUCN) Red List all three species are listed as 'threatened'. They have been also listed by the Mediterranean Protocol as threatened species.

Caretta caretta	***Chelonia mydas***	***Dermochelys coriacea***

Figure 6-14 Marine Turtles in Mediterranean Sea

A satellite tracking study conducted to determine the post-reproductive migration of 6 female green turtles after nesting in northern Cyprus revealed that 5 out of 6 turtles visited Egyptian waters, suggesting that Egypt is an important foraging and wintering area (Nada, 2001).

LOGGERHEAD TURTLE (CARETTA CARETTA)

This is the most abundant turtle in the Mediterranean Sea and is thought to nest commonly in the area of Greece, Turkey and Israel as well as Italy, Sicily, Corsica and Sardinia. Loggerheads are carnivorous and the juveniles are known to feed among seagrass beds. They are often highly migratory. Data on loggerhead populations of Egypt and Israel are rare but Loggerheads are known to breed on many parts of the Egyptian Mediterranean coast.

GREEN SEA TURTLE (CHELONIA MYDAS)

Little nesting occurs in the Mediterranean, though there are known colonies in Turkey and Cyprus. They feed extensively on seagrass and sometimes on algae and are highly migratory.

LEATHERBACK (DERMOCHELYS CORIACEA)

Leatherbacks are not known to nest in the Mediterranean but are sometimes seen offshore. They are highly pelagic and not usually coastal. Leatherbacks can dive very deep and feed on soft-bodied animals such as jellyfish and tunicates.

MARINE MAMMALS

At least nine species of marine mammals are recorded from the Egyptian Mediterranean water. These include eight cetaceans (dolphins and whales) and one pinniped (seals).

Cetacean recorded from the Mediterranean waters of Egypt fall into four families. Five dolphins (family is Delphinidae) belonging to five genera, as shown in Figure 6-15, regularly occur in the Egyptian Mediterranean waters (ACCOBAMS, 2008). These are:

- *Deiphinus deiphis* (common dolphin);
- *Globicephala melaena* (pilot whale);
- *Grampus griseus* (Risso's dolphin); and
- *Stenella coeruleoalba* (Striped dolphin)

Delphinus delphis

Globicephala melas

Grampus griseus

Stenella coeruleoalba

Figure 6-15 Dolphins in the Egyptian Mediterranean Waters

Several records of the Fin Whale *Balaenopteroptera physalus* a Balaen whale are known from different parts of the Egyptian Mediterranean coast. The most recent records is of a dead individual found on a sandy beach west of Alexandria in 1988, the monk seal *Monachus monachus* found on the coast between Matruh and Al Alameen in 1989 and recently Humpback whale in Lake Burullus in 2007) (ACCOBAMS, 2008).

Other cetaceans recorded from the Egyptian Mediterranean waters is the sperm whale *Physter macrocephalus* (family physeteridae) and the Cuvier's beaked whale *Ziphius carvirostris* (family Ziphiidae; ACCOBAMS, 2008) shown in Figure 6-16.

Balaenoptera physalus	*Ziphius cavirostris*	*Physeter macrocephalus*

Figure 6-16 Marine Mammals in the Egyptian Mediterranean Waters

SEA BIRDS

Birds contribute significantly to Egypt's biodiversity as they inhabit the different range of habitats present in the country. Egypt's positioning serves as a crucial migration route between Eurasia and Africa. Such locality allows for millions of birds to migrate through the country every spring and autumn. Since many birds migrate to Egyptian wetlands during the winter, these are designated as internationally important wintering grounds for water birds. A total of 16 globally threatened species occur in the country, of which seven have a particular reliance on Egypt.

According to EEAA, three wetland protectorates were established on the Egyptian Mediterranean coast specifically for the conservation of birds and their habitats; two of them were also declared as RAMSAR sites.

The North Egyptian coast is important for both resident birds, particularly water birds in the lagoonal and saltmarsh areas, and for migratory birds, especially passage migrants en route between Africa and Europe/Asia. An autumn migration of raptors and storks occurs over the Mediterranean, concentrated in two flyway paths: the Strait of Gibraltar and the north Egyptian coast. Many nature reserves have been set up in such areas to protect the bird populations. Terns and other sea birds are reported from the Sinai coast.

6.3.6 Surface Water

TRANSECT 1

No lakes or surface water bodies are located in Transect 1.

TRANSECT 2

Lake Burullus lies in Transect 2 and is located in the Northern Coast East of Alexandria. It is situated northeast of Rosetta branch of the River Nile. It is about 460 square kilometres, and it is considered the second largest natural lake in Egypt tends 10 km in length and from 6-17 km in width.

Lake Burullus is a brackish water lake in the Nile Delta in Egypt. It is considered to be a site of International importance for birds under the Ramsar Convention. Agriculture drainage water accounts for 97% of the total inflow to the lake (3.9 billion m3 per year), followed by rain water (2%) and groundwater (1%). 16% of the lake's water evaporates and 84% flows to the sea. According to a Biodiversity Report of the Egyptian Environmental Affairs Agency 33 species of fish, 23 species of reptiles, 112 species of birds, and 18 species of mammals live in and around the lake. Fish species declined from 52 recorded at the beginning of the 20th century, mostly due to the inflow of agricultural drainage into the lake resulting in lower salinity.

Al Burullus Lake is prevailed with a number of environments; most important of them are salt swamps and sand plains. High sand dunes cover the lake coasts. Therefore, it is considered a natural location of 135 kinds of land and water plants. Moreover, it is convenient for receiving the migrating wild birds.

TRANSECT 3

Lake Manzala lies in Transect 3 and it is a brackish lake, sometimes called a lagoon, in northeastern Egypt on the Nile Delta near Port Said and a few miles from the ancient ruins at Tanis. It is the largest of the northern deltaic lakes of Egypt, as of 2008 it is 47km long and 30km wide.

Lake Manzala is long but quite shallow. Although Lake Manzala's unaltered depth is only four to five feet, alterations to the depth were made during the construction of the Suez Canal to allow the Canal to extend 29 miles lengthwise along the lake and its bed is soft clay.

Port Said was established adjacent to Lake Manzala during the nineteenth century to support canal construction and related travel.

Lake Manzala served as a significant source of inexpensive fish for human consumption in Egypt, but pollution and lake drainage have reduced the lake's productivity. In 1985 the lakes fishery was an open area of 89,000 ha and employed roughly 17,000 workers. By 2001, Lake Manzala had lost approximately 80 percent of its former area through the effects of drainage efforts.

TRANSECT 4

The only major surface water body in North Sinai is Lake Bardawil. Bardawil is a Ramsar Site, although no protection has been granted at the national or local level. Lake Bardawil is a shallow (50-300 cm deep), hyper-saline lagoon occupying much of the Mediterranean coast of Sinai. It is separated from the sea by a sandbar that varies in width between 100 m and 1 km. Lake Bardawil is about 90 km long, and 22 km wide (at its widest). It covers an area of about 700 km^2.

The lake shore is mainly bare sand, with scattered saltmarsh and mudflats. The sandy lake-bottom is covered by scattered patches of algae *Ruppia*. Originally, Bardawil was connected to the sea via one small natural inlet at its eastern extremity (Bughaz Zaranik), usually becoming inundated with seawater only during winter when storms often breached the unstable sandbar. During summer, most of the lake was isolated from the sea and water evaporated, leaving behind large areas of sabkha. Several man-made inlets have been dredged along the sandbar since 1905 in an effort to allow the permanent inundation of the lagoon and maintenance of salinity levels suitable for the development of fisheries. Today, there are two man-made inlets (Bughaz I, II), which are continually being blocked through sedimentation.

Bardawil is the source of an important local fishery, producing over 2,500 tonnes annually, mostly of the high-value saltwater fish *Sparus auratus* and *Mugil* sp., and employing some 3,000 fishermen. Fishing is suspended between January and May, in order to allow fish stocks to recuperate.

Lake Bardawil is of moderate importance for wintering waterbirds. The importance of Bardawil as a stop-over and staging site has not been investigated thoroughly, but there are indications that at least a portion of the massive numbers of migrants passing through Zaranik, particularly in autumn, utilize some of the habitats available at the lake. Diversity of breeding species is very low. However, two of the six species known to breed in the immediate vicinity of the lake, *Sterna albifrons* and *Charadrius alexandrinus*, occur in internationally important numbers. (Bird Life International website, 2010)

6.3.7 Shoreline Sensitivity

A full survey of the Egyptian coastline was conducted by the Egyptian Environmental Affairs Agency (EEAA) in 1996 to determine the environmentally sensitive areas to be used in Egypt's National Oil Spill Contingency Plan.

Over the past 20 years, the Egyptian north coast has undergone an upswing in the recreational and tourism development sectors. Currently, almost the whole coast strip is covered with tourist villages from Alexandria to the east and Marsa Matruh to the west.

The next sections illustrate the sensitivity maps of each transect.

TRANSECT 1

As evident from Figure 6-17, this transect has long been low in biodiversity. Furthermore, with the vast development projects along the coast, the area's biodiversity has degraded even more. The turtle nesting areas and sea grass most probably do not exist anymore.

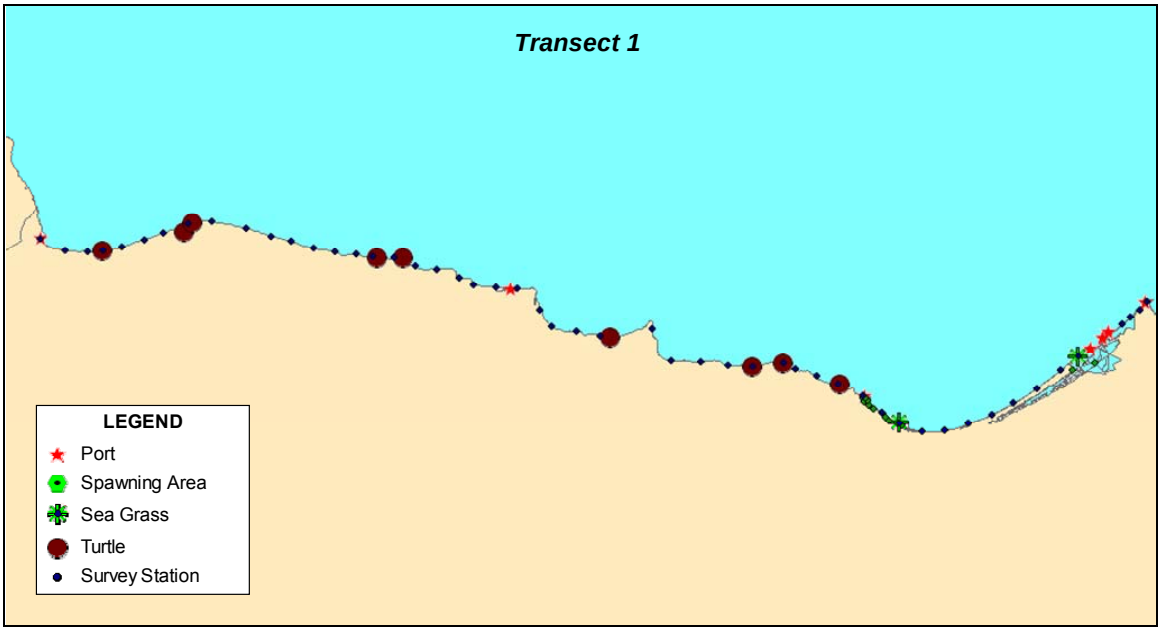

Figure 6-17 Sensitivity Map of Transect 1 (Source EEAA, 1996)

TRANSECT 2

As shown in Figure 6-18, it is evident that this transect is a rich spawning area due to the presence of Lake Burullus, which is a habitat to 25 fish species. The turtle nesting area most probably does not exist anymore.

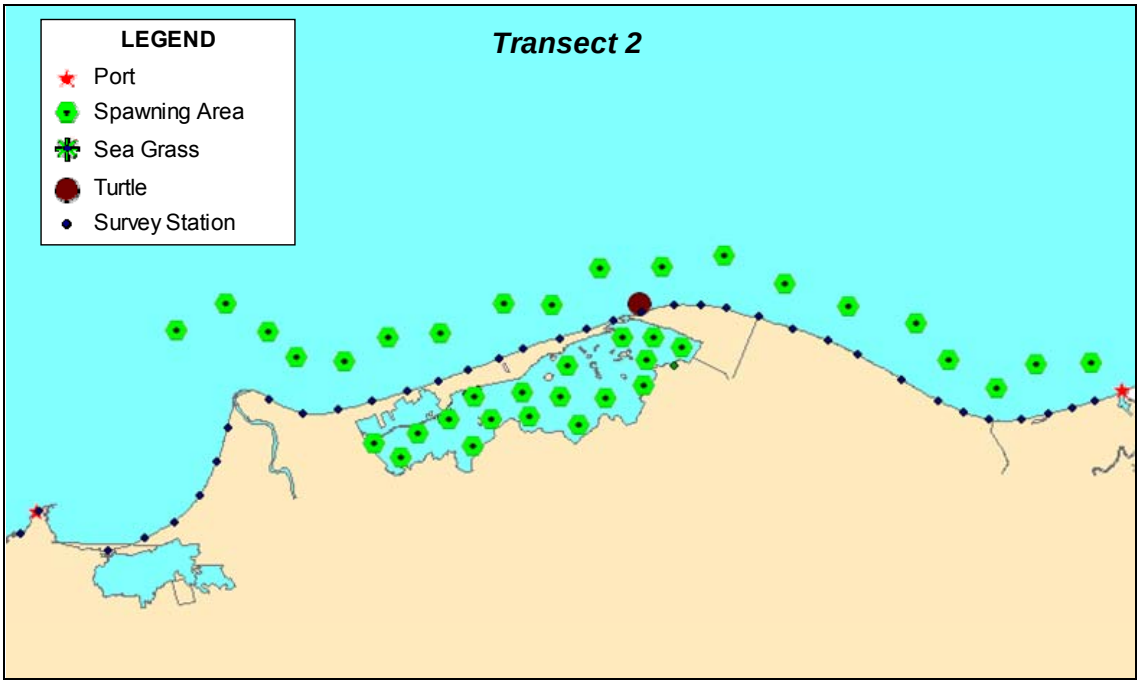

Figure 6-18 Sensitivity Map of Transect 2 (Source EEAA, 1996)

TRANSECT 3

As illustrated in Figure 6-19, it is evident that this transect is also a rich spawning area due to the presence of Lake Manzala. The turtle nesting area most probably does not exist anymore.

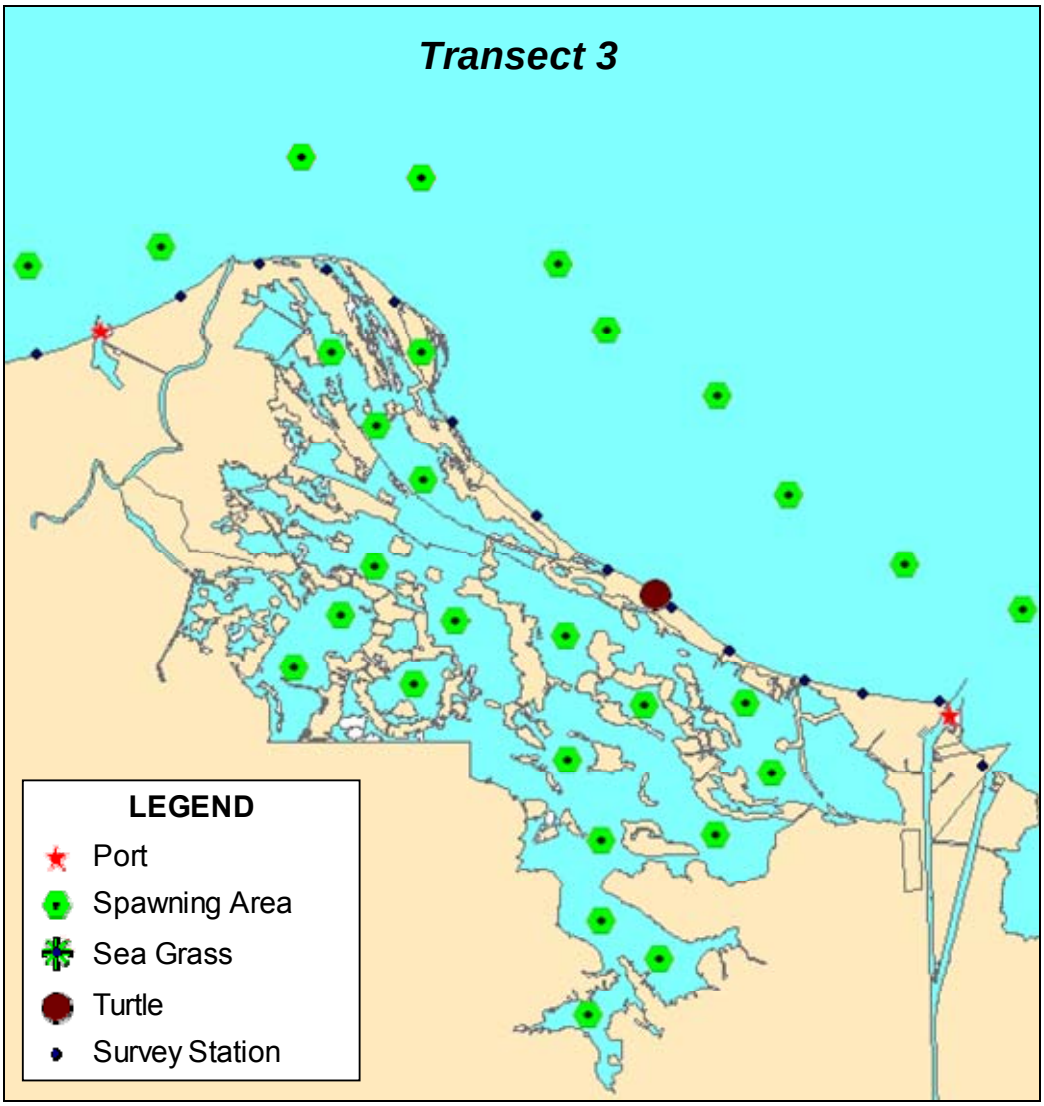

Figure 6-19 Sensitivity Map of Transect 3 (Source EEAA, 1996)

TRANSECT 4

Figure 6-20 shows the sensitivity areas of transect 4. This transect is also a rich spawning area due to the presence of Lake Bardawil. The three turtle nesting areas to the east most probably do not exist anymore. However, the two turtle nesting areas in Lake Bardawil and Zaranik Protectorate still exist today.

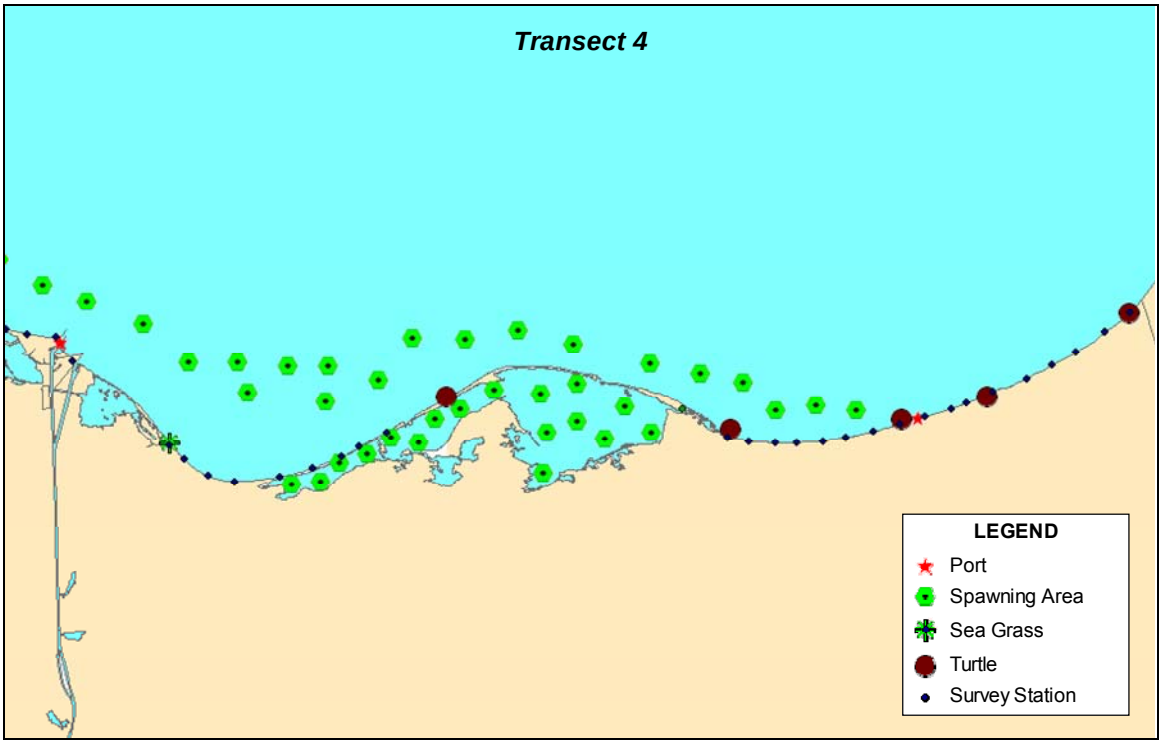

Figure 6-20 Sensitivity Map of Transect 4 (Source EEAA, 1996)

6.3.8 Onshore Natural Protectorates on the Egyptian Mediterranean Sea Coasts

There are five existing coastal protectorates on the Egyptian Mediterranean sea coasts three of them are wetland protectorates (Zaranik, Ashtoum El-Gameel and Burullus), one of them is a marine protectorate (El-Salum); while Elomayed protectorate is as biosphere protected area. Also there are two proposed protectorates (future protectorates) Ras El-Hekma and EL-Showeila on the western coasts of the Egyptian Mediterranean Sea as shown in Figure 6-21.

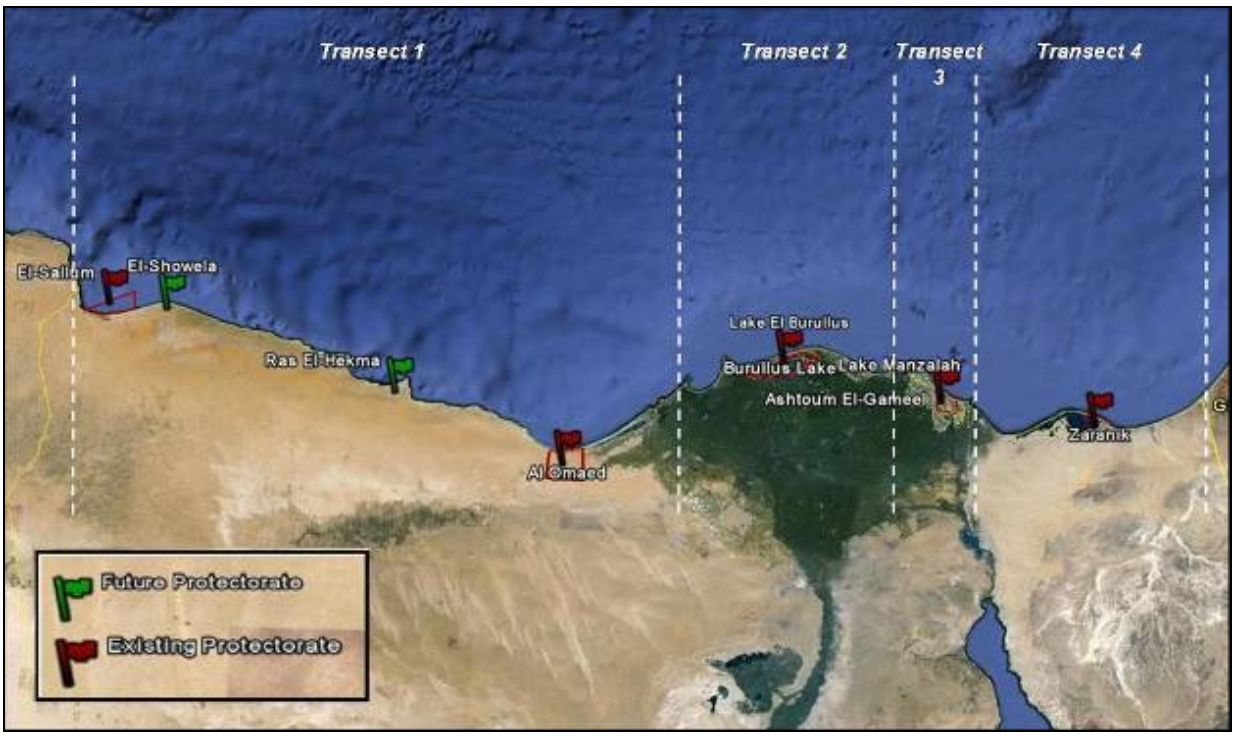

Figure 6-21 Illustrates Onshore Protectorates on the Egyptian Mediterranean Coast

Protectorates are ordered according to their distance to the well location as shown in Table 6-13.

Table 6-13 Distances of the Protectorates from Kiwi A-1X Well

Protectorate	Distance from Kiwi A-1X well
Ras El-Hekma protectorate	137 km
El-Omayed protectorate	165 km
El- Burullus protectorate	198 km
EL-Showeila protectorate	267 km
El-Salum protectorate	292 km
Ashtoum El-Gameel protectorate	338 km
Zaranik protectorate	452 km

As mentioned before, due to the possibility of oil spill that may threaten the environmentally sensitive areas that extend along the Egyptian Mediterranean Sea, the following section will cover the relevant data about the existing protectorates laying on the Mediterranean cost. Figure 6-22 shows the nearest existing and future protectorates along the Mediterranean Sea.

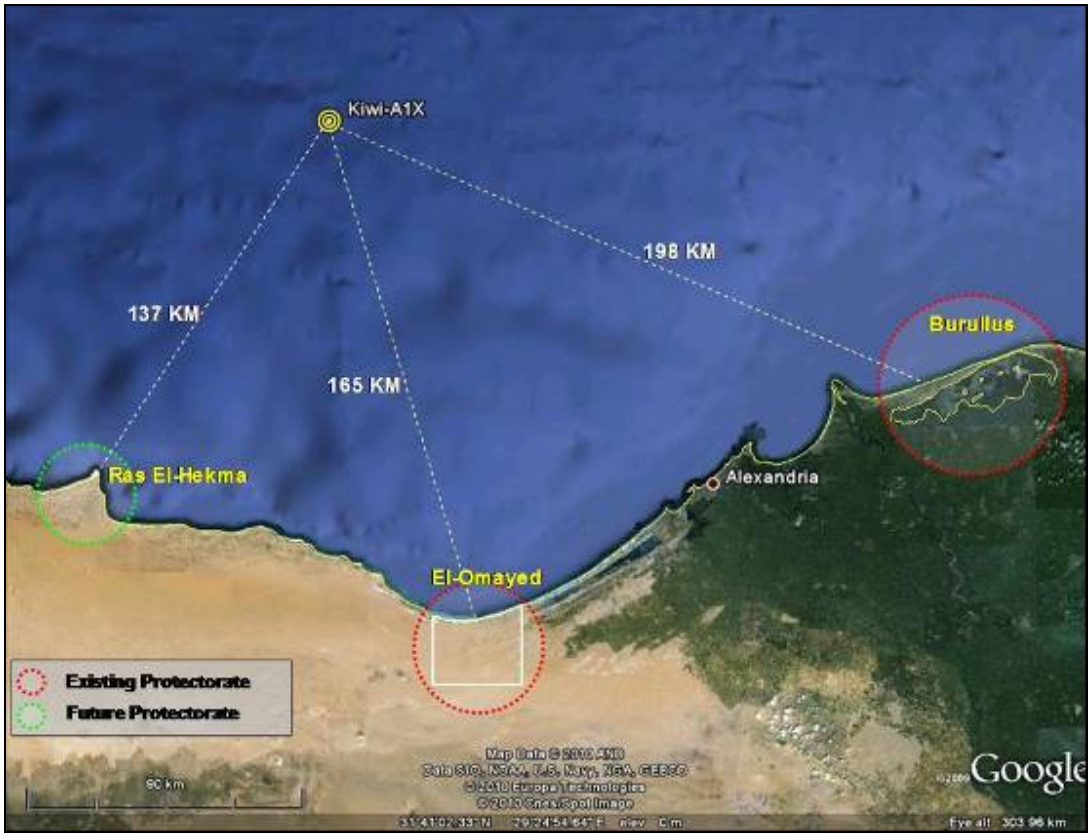

Figure 6-22 The Nearest Protectorates

TRANSECT 1

RAS EL-HEKMA PROTECTED AREA

Ras El-Hekma protectorate is one of the future protectorates that are not yet declared, there are not available data about this protectorate at the stage of developing the project.

EL-OMAYED NATURAL PROTECTED AREA

Table 6-14 El-Omaed protectorate basic information

Date of announcement	1986
Area	705 Km^2
Type	Desert Area and vital peripheral
Altitude	Sea level to +110 m

Governorate	Marsa Matrouh

The Omaed is situated in the Mediterranean coastal desert region of north western Egypt, 7 km south of Omaed village and 80km west of Alexandria. The site is situated on the Mediterranean Sahara coast, extending inland along the Gebel Mariut-Khashm El-Eish Depression of the western desert. Geological formations are essentially Quaternary and Tertiary in origin. The coast consists of Holocene beach deposits and sand dune accumulations. The pink oolitic limestones are of Pliocene-Pleistocene origin. The topographic relief is characterised by Pleistocene fossil rich white limestones forming successive undulations running more or less parallel to the coast. These undulations are in the form of calcareous rocky ridges (ancient dunes) alternating with depressions and varying in height from 10 to 60m.

Five main habitat types exist at Omaed and these include: a) coastal calcareous dunes; b) inland ridges with relict soils; c) saline marsh depressions; d) non-saline depressions; and also e) inland plateaux (Ayyad and Ghabbour, 1986). The soils are generally sandy with a high percentage of calcium carbonate (Abdel-Razik *et al*., 1984).

The flora is characterized by *xerophytic steppic* vegetation of the Saharan Mediterranean region (Ayyad and Ghabbour, 1986) as shown in Figure 6-23. The typical associations consist of *Thymelaea hirsutae* with *Noaea mucronata* (wet variant dominated by *Asphodelus microcarpus* and dry variant by *Achillea santolina*) or *Anabisis articulata* with *Suaeda pruionosa* (El Ghonemy and Tadros, 1970; Ayyad and Ghabbour, 1986). Dune vegetation consists of *Ammophila arenaria, Euphorbia paralias, Pancratium maritimum, Elymus fancrus, Crucianella maritima, Echinops spinosissimus* and *Thymelaea hursuta* on young dunes, whilst there are communities of *Crucianella maritima* and *Ononis vaginalis* on the older dunes (Ayyad and Ghabbour, 1986).

Nile Tamarisk, *Tamarix nilotica*, by the seashore

Typical landscape of the Diffa Plateau

Sea grasses in the inshore waters

Inland diverse vegetation

Figure 6-23 Vegetation and Landscape of El-Omaed Protectorate

The inland siliceous sands are dominated by communities of *Urginea maritima*, *Plantago albicans* and *P. squarrosa*. The shallow soiled inland ridges are more often characterized by either *Thymelaea spp* and *Gymnocarpos decadrum* communities or by associations of *Plantago albicans* and *Asphodelus microcarpa*. The halophilous vegetation, typical of saline and marsh habitats, is dominated by *Salicornia fruticosa, Cressa cretica, Atriplex halimus, Juncus rigidus, Arthrocnemum glaucum* and *Limonium echioides*. In relatively deep water and under higher salinity conditions are also *Suaeda monoica, Limoniastrum monopetalum, Aeluropus lagopoides, Salsola tetrandra* and *Frankenia revoluta*. In areas with deep water and low salinity are communities of *Atriplex halimus, Hammada scoparia* and *Anabasis articulata* (Ayyad and Ghabbour, 1986). The inland plateau vegetation includes *Artemisia monosperma* and *Hammmada elegans* associations (calcareous soils), *Anabasis articulata* and *Hammada scoparia* (shallow degraded soils) and *Suaeda pruinosa* and *Salsola tetrandra* communities (saline soils) (Ayyad and Ghabbour, 1986; El Ghonemy and Tadros, 1970).

Studies showed that some types of wild plants that grow in the protectorates have economic and medical benefits since there are about 70 species that can used for medical and therapeutical purposes like squall, wormwood, plantain, wood, sorrel. There are also 60 species that can be used for different purposes including fuel like buckthorn and boxthorn, as source of oils and soap like Ghoul Henna, as a human food like onion, for landscaping like Dirsesh-shaayib for manufacturing ropes and roofs like Boos reed, and for pasturing like Dabaagh and Tafwa. There are about 40 species of plants that have important environmental roles such as detaining sand and building new layers (EEAA website, 2010).

The mammals at Omaed include dorcas, a number of gerbils., the east Mediterranean endemic mole-rat, red fox, hare and the North African endemic fat sand rat. There are 50-70 bird species including kestrel (*Falco tinnunculus*) and quail (*Coturnix coturnix*) and between 7-13 reptile and amphibian species such as horned viper (*Cerastes cerastes*) and also the tortoise *Testudo graeca*. Common insects are represented by the families *Terrebrionidae, Scarabaeidae* and *Carabidae* (Figure 6-24). There are also records of sand roach *Heterogamia syriaca* and harvester ants (Ayyad and Ghabbour, 1986).

		
Kestrel(*Falco tinnunculus*)	Horned viper	Dorcas

Figure 6-24 Different Animals of El-Omaed Protectorate

EL-SHOWEILA PROTECTED AREA

El-Showela protectorate is one of the future protectorates that are not yet declared, there are not enough data about this protectorate at the stage of developing the project.

EL-SALUM PROTECTORATE

Table 6-15 El-Salum protectorate basic information

Date of announcement	2010
Area	382.8 Km^2
Type	Marine
Governorate	Marsa Matrouh

El-Salum area is part of the western Mediterranean coastal region (or Western Marmarica). This area is especially unique and of urgent conservation priority because of its high natural value, and also because it is the only section of the western Mediterranean coast of Egypt which is still fairly intact and undeveloped (IUCN, 2010).

The importance of El-Sallum area is due to its marine, terrestrial and coastal resources as well as the unique geographical features such as sand dunes. The area is also known for its local residence and their unique cultural heritage and knowledge. El-Sallum was announced as a marine protectorate in 2010, making it the first marine protectorate along the Egyptian Mediterranean Sea. The protectorate is divided into marine and coastal parts. Most of the protectorate is offshore. The

Figure 6-25 El-Salum protectorate location

The protected area entails unique habitats and geographical features including tidal flats, sand dunes, ridges, salt depressions, and coastal plains; in addition to sensitive marine ecosystems, including seagrass meadows, shallow and intermediate depth marine habitats.

The area includes exceptional biodiversity, which is supported by diverse habitats and ecosystems. The landscape-seascape interaction, on the other hand, provides extraordinary scenic views that do not exist elsewhere in Egypt. The mountainous ridges located to the North of El-Sallum bay are believed to support the Mediterranean Monk seal, a critically endangered marine mammal.

The diversity in habitats and ecosystems supports many species and species of global concerns, for instance:

- Over 160 species of resident and migratory avifauna, many of which are of international concern,
- Over 30 species of reptiles and amphibians, some of which are endangered,
- Over 30 species of mammals, some of which are endangered, or critically endangered,
- 57 species of marcobenthic organisms belonging to 7 phyla.

- At least 55 commercial marine species including molluscs, crustaceans, and fish.

There are also 5 marine species of special and global concern. Two species are listed on Annex II of Barcelona (SPA) convention, these are: Ophidiaster ophidianus (*echinoderms)*, and Pinna nobilis of (*mollusca*). In addition to three species which are listed on Annex III, species whose exploitation is regulated: *Hippospongia communis* (which is also listed on Annex II); and *Spongia zimocca* and *Spongia officinalis*. Nesting Loggerhead Turtles (*Caretta caretta*) have also been recorded in the area, which may provide this species with significant feeding grounds (IUCN, 2010 and Medpan, 2010) (Figure 6-26).

The Bedouin communities comprise 70% of the total population of El-Sallum, they belong to two main tribes. The Bedouin population of the area has a unique cultural heritage and traditional knowledge, which the protectorate targets to preserve and support.

Major economic activities include crops agriculture on rainfall such as watermelons, black grapes, figs, olives, cucumbers, tomatoes, and wheat. The population also depends on herding animals such as goats, sheep, cows, and camels. Other economic activities include hunting of wildlife, handicrafts, trade, governmental employment, small industries, and fishing. The tourism industry has only been recently introduced to the city of Sallum, and the labor force involved in tourism sector is still a small fraction of the total labor force. One of the aims of the proposed protected area is to promote and encourage ecotourism (Medpan, 2010).

Mediterranean Monk Seal(*Monachus monachus*)

Loggerhead Turtles (*Caretta caretta*)

Figure 6-26 Marine species in El-Salum protectorate.

TRANSECT 2

EL-BURULLUS PROTECTED AREA

Table 6-16 El-Burullus protectorate basic information

Date of announcement	1998
Area	460Km^2
Type	wetlands protected area
Altitude	Sea level to +10 m
Governorate	Kafr El-Sheikh

The Burullus Protected Area is situated in the northern part of the Nile Delta, in a central position between the Damietta (Domiat) Branch to the east, and the Rosetta (Rasheed) Branch to the west. The Protectorate includes the entire area of Lake Burullus with its numerous islets, as well as the sand bar separating the Lake from the Mediterranean Sea, with a shoreline of about 65 km. The total extent of the Protected Area is 460 km^2 (Table 6-16 and Figure 6-27).

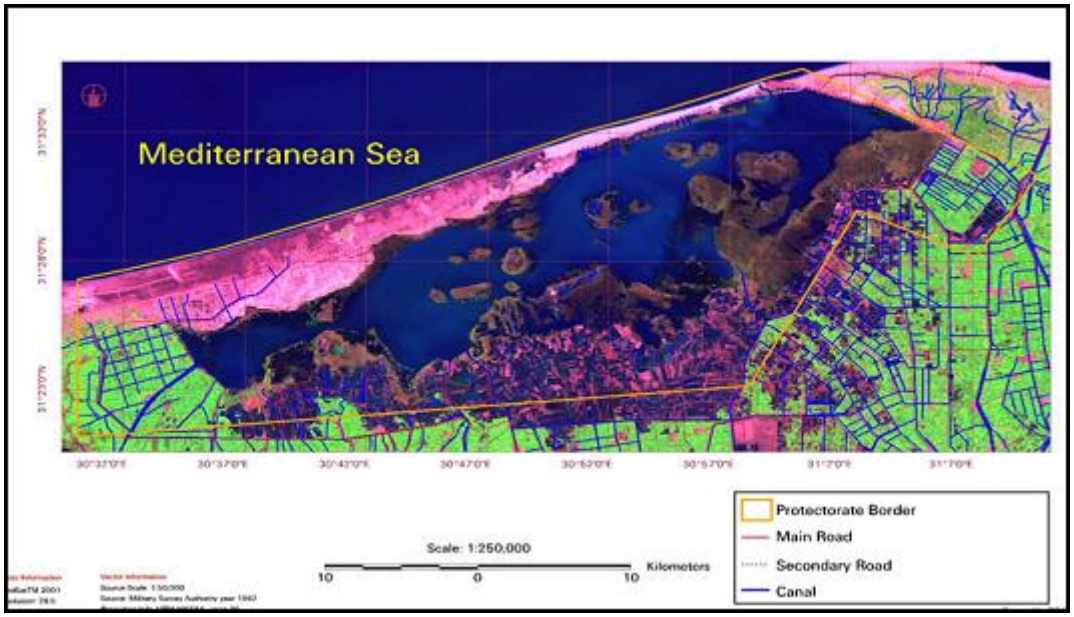

Figure 6-27 Burullus protectorate location

The Protected Area is virtually rectangular, with its northern boundary determined by the sea. Its limits are 31° 36' N 30° 33' E in the north-west, 31° 36' N 31° 07' E in the north-east, 31° 22' N 30° 33' E in the south-west and 31° 22'N 31° 07' E in the south-east. Lake Burullus is centered between the five principal coastal lagoons of northern Egypt. To its east are Lake Manzala and Lake Bardawil, to its west are Lake Idku and Lake Mareotis. The Lake comprises a body of water (410

Km^2). The area decreased during the last 50 years due to land reclamation at its southern stretches. The average volume of water in the Lake is about 328 million m^3. Nine agricultural drains of the Delta farmlands discharge into the Lake some 3.9 billion m^3 of water per year; most of this water flows to the sea through the Bughaz.

The Lake embraces some 50 islets; the largest is Kawm El-Akhdar. These small islets provide habitat for a rich diversity of plants and animals including birds. The inlet (Bughaz) is the direct connection between the Lake and the Mediterranean. It is around 250 m. long, more than 50 m. wide at places, and 50-200 cm deep. It is the site of the mouth of the (now vanished) Sebennetic branch of the Delta. (EEAA website, 2010).

Burullus Protected Area encompasses a wide range of natural habitats including: inshore marine waters, brackish and fresh lagoon waters, sandy shores, salt marshes, sand dunes rich in flora, islets within the Lake, mud flats, hyper-saline, fresh water swamps and reed beds. Several man-made wetlands are also found in the protectorate including fish farms, saltpans, canals and drains carrying water from irrigated fields. The gradient between the brackish (southern) part of the lake and marine waters provides a unique zone where many marine and fresh water organisms flourish.

Lake Burullus is separated from the Mediterranean Sea by a 65 Km long sand bar. The middle section of the bar is narrow and is penetrated by an inlet (Bughaz) that connects the sea with the lake. The Lake is a registered Ramsar site, and is identified as an IBA by the Birdlife International.

The sand bar includes the two most threatened habitats in the protectorate: the sand dunes and the salt marshes. These habitats support some of the highly threatened species found along the Mediterranean coast of Egypt. No less than 51 plant and 13 mammal species have been recorded in these habitats. The salt marshes are of major importance for two subspecies of birds, the Lesser Short-toed Lark (*Calandrella rufescens nicolli*) and *Motacilla flava pygmaea*), endemic to Egypt. The brackish and fresh waters of the Lake are the most important habitat types in the protectorate as they support all fishing activities as well as being important for large populations of waterfowl.

Some of the islets in Lake Burullus (*e.g*. El-Kom El-Akhdar and Dechimi) harbor the largest numbers of species of flora and fauna, and are characterized by high species and microhabitat diversities. About 89 species of plants, and many birds, mammals and reptiles have been recorded on these islets. They also include many of the rare and unique species which are of limited distribution elsewhere in the region.

53 species of birds recorded in Burullus Protected Area in 2000 and an additional list of 93 species recorded in previous surveys. Burullus is home to six bird subspecies endemic to Egypt. They include little green bee-eater, laughing dove and Egyptian swallow. Eight species are fairly common in Egypt. However, five species and subspecies considered rare occur at Burullus Protected Area, such as; Bar-tailed Godwit, Pied Avocet and Jack Snipe (Figure 6-28).

		
Jack Snipe	Pied Avocet	Bar-tailed Godwit

Figure 6-28 Some bird types commonly found in Burullus

The present fish population in Lake Burullus consists of 25 species, 15 of which live in fresh or brackish water. Of the remaining 10 species, four (*Sparus aurata, Johnius hololepidotus, Solea solea* and *Liza saliens*) are of purely marine origin and have invaded the Lake for some time. The remaining six species (*Aphanus fasciatus, Atherina mochon, Anguilla anguilla, Mugil cephalus, Liza ramada* and *Gambusia affinis*) belong to a separate group of obligatory migrants which spend their adult life in the brackish water of the Lake and migrate to the sea for spawning.

There are 22 species of reptiles and amphibians in Burullus Protected Area. The isolated population of Audouin's Shink Sphenops sepsoides deserves a special mention. This specie is a widespread Saharan inhabitant of sandy biotopes and is common elsewhere in Egypt. This population is under threat as a result of habitat destruction by removing sand dunes. The relict population of Javelin Sand Boa (*Eryx jaculus*) is under a similar threat, compounded by intense collection pressure as a pet. According to the IUCN Red List of Threatened Animals (IUCN 2000), there are 5 globally threatened reptile species occurring in Egypt. Two of these are recorded in Burullus Protected Area: Loggerhead Turtle (*Caretta caretta*) and the Green Turtle *(Chelonia mydas*).

A total of 197 species of flowering plants have been recorded in Burullus (100 annuals and 97 perennials), including 11 hydrophytes and one species of water ferns (Azolla filiculoides). With 35 species (or 18% of the total number), the grasses are the predominant component of the species composition in the Protectorate.)

Burullus also houses 7 species of neophytes, which had invaded some phytogeographical regions of Egypt, including the Nile Delta. These species include; Azollaceae, Chenopodiaceae and Gramineae. Eleven species of hydrophytic flowering plants and one species of water ferns exist in Burullus, including; Azollaceae, Hydrocharitaceae, Onagraceae and Ceratophyllaceae.

There are 6 sites of historical importance within the Protectorate: El-Dakhla, Mastroah, Dichimi, El-Maklooba, El-Maksaba and El-Sahareeg. The total area of all these sites has been estimated at around 202 feddans. Inspection of the remnants of monuments seems to indicate that heaps of old Pharaonic and Graeco-Roman monuments are abundant.

TRANSECT 3

ASHTOOM EL-GAMIL AND TENIS ISLAND PROTECTED AREA

Table 6-17 Ashtoom El- Gamil protectorate basic information

Date of announcement	1988
Area	180 Km^2
Type	Wetland protected area and a natural restricted area for birds
Governorate	Port Said

The protectorate is seven kilometers West Port Said city and it includes El-Gameel inlet and Ashtoom El-Gameel. The boarders of the protectorates are Manzala Lake from the south and the Mediterranean Sea to the north. The protected Area includes the bays of El Gamil and Ashtoon El Gamil and Al Manzala lagoon.

The importance of the protectorate is due to the fact that it is considered to be a main stop for the migrating birds during fall and spring seasons to get the needed food and rest. It is also used as a wintering and breading place for a significant number of migrating birds. In addition Manzala Lake is an important natural source for sea fish. The main purpose for creating this protected area was the protection of gravid fish and fry during their passage in and out of Manzala, through El Gamil inlet. There is a proposal to increase the size of this protected area to encompass larger, more important parts of Lake Manzala (BirdLife international, 2010).

Lake Manzala has the largest area among the Delta lakes. The location of the lake is unique as there are four governorates that overlook it (Port Said, Damietta, Sharqia and Daqahlia), and it is also located between Nile branch from the west and Suez Canal from the east. The lake is connected to the Mediterranean Sea by a number of inlets. The most important inlets are New El-Gameel and Old El-Gameel inlets. The amount of water that the lake receives from the Mediterranean Sea is controlled by gates at the new inlet. The lake is generally rectangular in shape, about 60 km long and 40 km wide and has an average depth of 1.3m.

The three main habitats are reed-swamps, saltmarshes and sandy areas. The reed-swamps of Phragmites and Typha, with associated submerged water-plants (e.g. *Potamogeton* and *Najas*), are found extensively in the less saline portions of the lake in the south and west and fringing many islands. Salt marshes of *Juncus* and *Halocnemum* occur on the northern (coastal) margins of the lakes and some islands. Sand formations are occupied by several plant communities, *e.g.* coastal dunes. Open water and mudflats are also important habitats for birds. Large areas in the north-west of the lake have been turned into fish-farms, while much of the southern part of the site has been divided into large plots and drained, in preparation for its conversion to agricultural use.

The lake is rich with the biodiversity; however, there are strong evidence showing that the total area of the lake is decreasing over time. In the late 18 century the total area of the lake was estimated to

be around 750 thousand feddan; nevertheless, this area dropped in the mid 90's to 1200 km^2. This decrease may be explained by the drying of the lake for reclamation. This decrease in area led to a decrease in fish production over the years. Consequently the different types of birds that live in the vicinity of the lake are negatively affected as they depend on fish as a main source of food.

The largest part of Lake Manzala accommodates *Phragmites*, Giant reed, Papyrus and other plants. The extension of lake Manzala as well as its versatile environment which includes shallow water , race ways, alluvial spots as well as floating plants islands (Arabic name MARAHA) qualify the lake to be an important refuge and wintering area for birds.

Manzala is by far the most important wetland for wintering waterbirds in Egypt, holding a total of 233,901 waterbirds in winter 1989/90. This represented about 40% of all waterfowl counted throughout Egypt's wetlands that winter and included the world's largest concentrations of wintering *Larus minutus* and *Chlidonias hybridus*.

The most important birds harboring Manzala Lake are *Aythya farina, Anas acuta, Anas clypeata, Anas crecca, Egretta garzetta, Platalea leucorodia, Phoenicopterus rubber, Numenius spp*, *etc*. (see Figure 6-29). Also, the wintering birds of Lake Manzala include Grebes, Cormorants, Herons, Flamenco, Ducks, Gulls, Storks, terns and Vultures. About 35 species are known to breed, including *Ixobrychus minutus, Egretta garzetta, Ardeola ralloides, Porphyrio porphyrio, Sterna albifrons, Charadrius alexandrinus, Vanellus spinosus, Glareola pratincola, Caprimulgus aegyptius, Ceryle rudis and Acrocephalus stentoreus*. Many of these birds are captured and hunted during the hunting season.

Aythya farina

Egretta garzetta

Platalea leucorodia

Figure 6-29 Some birds types in Manzala Lake

It is worth noting that some of the birds species are threatened by extinction such as *Anas platyrhynchos platyrhynchos, Aytha fuligula, Tadorna tadorna, Porphyrio porphyrio madagascariensis, Streptopelia decaoclo decaoclo, Ixobruchus minutus minutus, Pelecanus rufecens , Phoenicopterus ruber roseus, Egretta garzetta garzetta, Ciconia ciconia*, as well as other birds protected by international agreements signed by Egypt. Table 6-18 shows some of the key species in Lake Manzala and their numbers.

Table 6-18 Key bird species in Lake Manzala

Species	Season	Units
Northern Shoveler (*Anas clypeata*)	winter	individuals
Squacco Heron (*Ardeola ralloides*)	breeding	breeding pairs
Great Egret (*Casmerodius albus*)	winter	individuals
Egretta garzetta	winter	individuals
Great Cormorant (*Phalacrocorax carbo*)	winter	individuals
Little Tern (*Sterna albifrons*)	breeding	breeding pairs
Common Redshank (*Tringa totanus*)	winter	individuals
Purple Swamphen (*Prophrio porphyrio*)	breeding	breeding pairs
Pied Avocet (*Recurvirostra avosetta*)	winter	individuals
Kentish Plover (*Charadrius alexandrinus*)	winter	individuals
Slender-billed Gull (*Larus genei*)	winter	individuals
Little Gull (*Larus minutus*)	winter	individuals

Source: BirdLife International website, 2010

TRANSECT 4

ZARANIK PROTECTED AREA

Only one protectorate lies in North Sinai; Zaranik Protected Area. Its basic information is outlined in Table 6-19.

Table 6-19 Zaranik protectorate basic information

Date of announcement	1985
Area	230 Km^2
Type	Wetland protected area and a natural restricted area for birds
Altitude	Sea level to +30 m
Governorate	North Sinai

Zaranik Protected Area is located at the eastern end of Lake Bardawil on the Mediterranean coast of Sinai. The Protected Area is bordered from the north by the Mediterranean, from the south by the main Qantara - El Arish road, from the east by tourist development areas, and from the west by Lake Bardawil (Figure 6-30). Because of the large number of migratory water birds passing through and utilizing the habitats of the area, Zaranik and the whole of Lake Bardawil have been designated by Egypt under the RAMSAR convention as a RAMSAR site. The area now is also recognized as an Important Bird Area (IBA) because of its global significance for bird conservation. Several internationally endangered and threatened species (such as Corncrake (*Crex crex*), and marine turtles) are known from the area. (EEAA website, 2010)

The principal feature in the Protected Area is the Zaranik lagoon, an eastern extension of Lake Bardawil. The lagoon is separated from the Mediterranean by a narrow sand barrier. Water is exchanged with the sea, through several branches in the sand barrier which form the only natural connection between Lake Bardawil and the sea. Numerous islets are scattered throughout the lagoon, while extensive muddy intertidal flats fringe its shores. Altitude ranges between sea level and about 30 m at the high sand dunes which dominate the landscape in the southern part of the Protected Area.

Figure 6-30 Zaranik Protectorate Map (Location, Boundaries and Main Road)

Zaranik includes many types of habitat; sea inlet, benthic sea grasses, saltmarshes, sand sheets, mud flats, sand dunes, lake islands, coastal plain. The coastal plain between the lagoon and the Mediterranean includes the most sensitive threatened habitats: sand dunes and saltmarshes. The dunes are habitat to 13 mammalian species, 12 herpetofauna 61 insect species and many birds. The salt marshes are habitat to 11 mammalian species, many halophytes, insects and herpetofauna.

There is considerable faunal diversity at Zaranik Protected Area. Many other endangered species are recorded in the sand dunes of Zaranik. Collectively, the reserve is habitat to more than 770 species, 54 of which are threatened and 2 of which are endemic. To-date eleven terrestrial mammal species and at least two bats have been recorded from the Protected Area. The most common of these are the Lesser Gerbil (*Gerbillus gerbillus*), the Lesser Jerboua (*Jaculus jaculus*) and the Long-eard Hedgehog (*Hemiechinus auritus*), which live in sandy habitats. The Fat Sand Rat (*Psammomys obesus*) is a common inhabitant of salt marches, and is unique amongst the mammals of the area in being diurnal. The Fennec Fox (*Fennecus zerda*) has been occasionally recorded in the sand dunes, which it shares with another rare and exquisite predator: the Sand Cat (*Felis margarita*). Bottle-nosed Dolphins (*Tursipso truncates*) are the commonest marine mammals observed off shore Zaranik. It is often seen very close in shore and some times even enters the Zaranik Boughaz (Figure 6-31). Two endangered marine turtles: The Green Turtle (*Chelonia mydas*) and Loggerhead Turtle (*Caretta caretta*), are known to nest on the sandy beaches of Zaranik. The protected area represents the most important site for marine turtle nesting on the entire Egyptian Mediterranean. The Economically important fish species include, Githead Sea Bream (*Sparus aurata*), Grey Mullet (*Mugil cephalus*), Sea Bass (*Dicenttarchus labrax*) and Sole (*Solea solea*).

Sand Cat (*Felis margarita*)

Bottle-nosed Dolphins (*Tursipso truncates*)

Fennec Fox (*Fennecus zerda*)

Figure 6-31 Marine and terrestrial mammals in Zaranik

Birds are prominent and diverse. About 270 bird species have been recorded in the Protected Area. Most of these are migratory or wintering species. Only eight species are known to breed regularly. Zaranik is most famous for the spectacular autumn migration of water birds which pass through and rest in the area in vast numbers (peak August and September). Most numerous of all is the Garganey (*Anas querquedula*). Up to 200,000 of this species has been counted on passage during autumn at Zaranik. Other prominent waterfowl species that pass through the area include herons, gulls, terns, waders and White Pelican (Figure 6-32).

The resident and breeding avifauna is limited. There are; however, internationally significant numbers of Kentish plover (*Charadrius alexandrinus*) and Little Tern (*Sterna albifrons*) breeding at

Zaranik and Lake Bardawil. This is the only site where Avocet (*Recurvirostra avosetta*) breeds in Egypt. The Creasted Lark (*Galerida cristata*) is a common resident found in areas with good vegetation cover, while the Hoopoe Lark (*Alaemon alaudipes*) is a prominent resident associated with sand dune habitat. Several endangered and rare species are known to occur regularly at Zaranik, most prominent of these are Corncrake (*Crex crex*), Audouin's Gull (*Larus audouinii*) and Pallied Harrier (*Cricrus macrourus*).

		
Garganey (*Anas querquedula*)	Slender Billed Gull	Cormorant (*Phalacrocorax carbo*)

Figure 6-32 Some birds species in Zakanik

To-date, 22 species of reptiles has been recorded from Zaranik. The Saharan Fringe-toed Lizard (*Acanthodactylus longipes*) is the most common species in the Protected Area. It inhabits sand dunes, where it shares its habitat with a number of sand dwelling species such as the Sand Fish (*Scincus scincus*) and the Diademed Sand Snake (*Lytorhynchus diadema*). Oliver's Lizard *(Mesalina oliviri*) and the Ocellatus Skink (*Chalcides ocellatus*) are species associated with vegetated microhabitats. Tracks often reveal the activity of nocturnal species, such as Audouin's Skink (Sphenops sepsoides), Petri's Gecko (*Stenodatylus petrii*) and the Sand Viper (*Cerastes vipera*) (the only venomous snake in the Protected Area). Savigni Agama (*Trapelus savignyi*) is a species whose world range is almost restricted to northern Sinai for which Zaranik Protected Area provides an important conservation opportunity.

Vegetation is generally sparse, although reasonably diversified. It is dominated in the salt marches by a few species e.g. (*Halocnemum strobilaceum, Salicornia fruticosam, Mesembryanthemum forsskalii, Frankevia revolutal*), which occur in the most saline areas adjacent to the lagoon, often in thick patches. The succulent (*Zygophyllum album*) shrubs found on higher and less saline ground are the most common throughout the Protected Area. The salt-tolerant bush (*Nitaria retusa*) has a patchy distribution and bears sweet red berries which are savored by some birds. The attractive (*Cistanche Phelypaea*) is widespread and parasitizes the roots of many plants. On the sand dunes the flora diversity is greater. The prominent species here are the two grasses (*Stipagrostis scoparia*) and (Panicum turgidum).

There are a number of archaeological sites within the limits of the Protected Area. One of these is Ostarkine, a site of an ancient Roman settlement located on Felusyat Island (a name derived from the Arabic words Felus, meaning "money", in reference to the coins often found by locals in the area in the past). The other is composed of remains of two Byzantine churches. Numerous fragments of pottery belonging to various historical periods are scattered throughout the Protected Area. This is because the area falls along a very important historical trade route linking Egypt with the East, through which hundreds of thousands of voyages have taken place throughout history leaving behind them pottery and other remains. There are also ruins of Khan el-Khuaynat, a medieval inn used by pilgrims on the road to Makkah.

6.3.9 Human Environment

Figure 6-33 Egyptian governorates on the Mediterranean coast

Figure 6-33 shows the Egyptian Mediterranean coastline. There are seven governorates along the Mediterranean coastline, Marsa Matrouh, Alexandria, Al Behira, Kafr El Shekh, Damietta, Port Saied and North Sinai with a total population of 14110794 capita. Table 6-20 shows the basic information about these governorates. There are some common industrial activities among the governorates including fishing industry and tourism.

Table 6-20 Basic information of governorates

Governorate	Capital	Total area (km^2)	Total population	Percentage of total population (%)
Marsa Matrouh	Marsa Matrouh	166560	332424	2.3
Alexandria	Alexandria	2299.77	4195146	29.7
Damietta	Damietta	910	1123734	8
Port Saied	Port Saied	134496	580275	4.1
North Sinai	Al Aresh	27564	352852	2.5
Al Behira	Damanhor	9826	4849281	34.4
Kafr El Shekh	Kafr El Shekh	3437	2677082	19

Source: CAPMAS, 2008

HUMAN DEVELOPMENT AND POVERTY INDEX

Since 1990 the United Nations Development Programme Human Development Report (UNDP-HDR) has published each year the human development index (HDI) that looks beyond Gross Domestic Product (GDP) to a broader definition of well-being. The HDI provides a composite measure of three dimensions of human development: living a long and healthy life (measured by life expectancy), being educated (measured by adult literacy and enrolment at the primary, secondary and tertiary level) and having a decent standard of living (measured by purchasing power parity, PPP, income) (UNDP 2006-1). According to UNDP- HDR for 2006, the HDI for Egypt is 0.702, which gives Egypt a rank of 111th out of 177 countries with available data.

According to UNDP- EHDR for 2008, Port Saied governorate has the highest HDI in Egypt with a value of 0.753. More information about the different governorates HDI is provided in Table 6-21.

Table 6-21 Egypt Governorates' Human Development Index

HDI value	Life expectancy at birth (years)	Adult Literacy rate (+15)	Combined primary, secondary and tertiary gross enrolment ratio (%)	GDP per capita (PPP US$)
1.**Port Saied** (0.753)	1. **Port Saied** (72.3)	1. **Port Saied** (81.9)	1. **Port Saied** (70.4)	1. **Port Saied** (6317.3)
2. Suez (0.751)	2. Suez (71.9)	2. Suez (81.4)	2. Suez (75.3)	2. Suez (5790.9)
4. **Alexandria** (0.738)	4**. Alexandria** (71.6)	4. **Alexandria** (79.7)	4. **Alexandria** (72.7)	4. **Alexandria** (5407.8)
5. Cairo (0.737)	5. Cairo (71.4)	5. Cairo (80.7)	5. Cairo (67.3)	5. Cairo (5700.5)
13. **Behera** (0.713)	13. **Behera** (71.1)	13. **Behera** (62.5)	13. **Behera** (67.7)	13. **Behera** (7773.6)
15. Giza (0.705)	15. Giza (69.1)	15. Giza (72.7)	15. Giza (71.5)	15. Giza (5140.7)
20. Menia (0.682)	20. Menia (68.9)	20. Menia (57.0)	20. Menia (72.9)	20. Menia (6317.7)
22.Fayoum (0.669)	22.Fayoum (69.1)	22.Fayoum (57.3)	22.Fayoum (68.2)	22.Fayoum (5282.9)

Source: EHDR, 2008

POPULATION PROFILE

Table 6-22 shows the population profile of each governorate.

Table 6-22 Population in governorates

Governorate	Males	Females	Total
Marsa Matrouh	173024	159400	332424
Alexandria	2150128	2045018	4195146
Damietta	572761	550973	1123734
Behera	2484404	2364877	4849281
Kafr El Sheikh	1351740	1325342	2677082
Port Saied	296619	283656	580275
North Sinai	182234	170618	352852

AREA PROFILE

Table 6-23 shows the details of total area and populated percentage of each.

Table 6-23 Area profile of governorates

Governorate	Total area (km^2)	Populated area (%)
Marsa Matrouh	1665600	3
Alexandria	2299.77	73
Damietta	910	73.5
Behera	9826	66.3
Kafr El Sheikh	3466.7	100
Port Saied	134496	98.2
North Sinai	289920	7.2

ADMINISTRATIVE DIVISIONS

Marsa Matrouh governorate encompasses of 8 districts (Markaz). The districts are Marsa Matrouh, El-Hammam, El-Sallum, El Dabaa, Sedi Barrany, Siwa, Marina El-Alamen and North coast. Number of rural local units is 56 and the number of affiliated villages is 98. There are 39 villages that are outside local units and 241 hamlets (Marsa Matoruh environmental profile, 2007).

Alexandria governorate encompasses of 8 neighbourhoods, El-Montazah, Sharq, Wasat, El-Gomrok, Gharb, El-America, Borg El-Arab city and Borg El-Arab district (Alexandria environmental profile, 2007). Damietta governorate is divided into 4 districts 10 cities, 47 rural units and 85 villages. Behera governorate has 15 cities and 5980 villages. As fir Kafr El Sheikh, it has 10 cities and 206 villages. Port Saied governorate has two cities with seven neighbourhoods (Al Zohoor, Al Monakh, Al Arab, Al Dawahi, Al Sharq, Al Ganob, Bor Fouad) . North Sinai has six cities and 84 villages.

HEALTH SERVICES PROFILE

The health services spread throughout the seven governorates vary from public hospitals, health units and health integration. According to Marsa Matrouh governorate report, there are seven public hospitals, two private sector hospitals and 242 working physicians in 2006. Alexandria governorate has 30 hospitals and health care units, 18 main first aid centres, 180 pharmacies, 67 units for intensive care and 25 health offices. Damietta has 12 public hospitals, eight specialized hospitals and 17 private hospitals. Behera has one educational hospital, 16 central hospitals and 12 specialized hospitals as well. In Kafr El Sheikh Governorate, the total number of public hospitals is 12, the number of specialized hospitals is six and there are 26 health integration hospitals.

Port Saied governorate has three public hospitals, four specialized hospitals and 25 private hospitals. North Sinai has four public hospitals and two specialized hospitals as well as six health integration hospitals.

ECONOMIC SERVICES PROFILE

There are a number of common industrial activities among the seven governorates such as fishing and tourism. The following section will be covering the main economic activities in each governorate.

TOURISM

One of the main economic activities for the seven governorates is tourism due to the fact that they are considered to be the most famous destination for Egyptians in the summer. Table 6-24 shows the details of hotels and resorts in some of the governorates.

Table 6-24 Hotels and Resorts status in some of the governorates

Governorate	5 stars	4 stars	3 stars	2 stars or less	Under classification
Marsa Matrouh	0	0	13	12	7
Alexandria	6	7	12	21	4
Damietta	0	0	2	20	1

Governorate	5 stars	4 stars	3 stars	2 stars or less	Under classification
Kafr El Sheikh	0	0	0	1	1
North Sinai	1	0	3	1	5

INDUSTRY

There are 16 recorded industrial establishments and 523 handicraft workshops in Marsa Matrouh governorate. Alexandria governorate is mainly an industrial city as its industrial production represents about 40% of the total production of Egypt. In and around Alexandria City, numerous industrial establishments operate. These include textile, food processing, oil refining, chemicals, metals, leather, cement, heavy industry and other industrial sectors. The economic activity in Damietta governorate depends on small production units run by the private sector. Damietta won fame for its handicraft industries including furniture carpentry, dairy products, fish processing, oil and soaps, pressed woods "DMF", rice mills and grain grinder (Damietta governorate study, 2008). There are 55 establishments in North Sinai governorate; their main activities are chemicals, building products, metal products as well as food products. As for Kafr El Sheikh Governorate, the number of industrial establishments is over 360 establishments. The main activities include food products, metal products and building materials. Behira governorate the number of industrial establishments reaches 8130 establishments. The main industrial activities are food products, paper products and wood products as well. There are ten industrial zones including the free-zone in Port Saied. The main industries in the governorate are textile and chemicals as well as the petrochemical industry.

AGRICULTURE

Cultivation is concentrated in the Nile and Delta regions, and less than 3% of total land area is cultivated. According to the CIA country fact report 2009, agriculture contributed to 13.4% % of the country's GDP in 2008.Agriculture accounts for 20 % of GDP and 36 % of total employment. Table 6-25 shows the total area of cultivated land and common crops in each governorate.

Table 6-25 Agriculture profile of the Mediterranean coast governorates

Governorate	Total cultivated area (feddan)	Common crops
Marsa Matrouh	9030	wheat, figs, dates, olives and barley
Alexandria	1621000	wheat, cloves, onion, apple and olives
Behera	1557000	Rice, wheat, bean and cotton
Kafr El Shekh	554000	Rice, cotton wheat, beans and beetroot

Dameitta	108800	Rice, wheat, beet and bean
Port Said	135000	Rice, vegetable, wheat and corn
North Sinai	119400	Peach and olive

FISHING AND FISH INDUSTRY

Egypt has a long coastline, extending for about 2,500 km, together with a continuous continental shelf of about 53,000 km^2 bordering the country on the north along the Mediterranean Sea coast and to the east along the Red Sea, with the Suez and Aqaba Gulfs. Egypt also has various inland resources. These include: the Nile River with many irrigation canals; five northern coastal lagoons opening to the Mediterranean Sea; two opening to the Suez Canal and two closed lakes.

There are 9 fisheries centres along the coast with 4 developed fishing ports in Alexandria, Meaddea, Damietta and Port Said. The fishing fleet in 2001 was composed of 1 137 trawlers, 937 boats using longline and hooks, 632 using trammel and gill nets and 238 purse seiners. The average crew of a trawler is 6–8, with 17–23 on a purse seiner, while other boats operate with a crew of 2 or 3.

Landings in Mediterranean Sea represent about45 percent of the total marine catch. About 40 percent of the landings were from purse seiners' working day and night along the Mediterranean Coast.

About 75 percent of the catch landed is at Damietta, Port Said and Meaddea, where about 50 percent of the fleet and 60 percent of the total number of fishermen are based. Damietta has the biggest fishing fleet in the Mediterranean at Ezbat El-Borg, which accounts for half of Egypt's fishing fleets.

Furthermore, fishing is considered to be one of the main activities in Alexandria governorate as the fish production ranged between 9524 to 14341 tons in the period between 1995 and 2004. There are 75 fish farms in the governorate (Alexandria environmental profile, 2007).

Ezbet El Borg alone hosts more than 60% of the fishing fleets in Egypt. Damietta has also a big arsenal for building ships. Many important economic changes have taken place in Damietta since the opening of Damietta port in 1986 that operates interchangeably with Alexandria port, to promote containers transfer. The port is by far the deepest in Egypt except for Dekhela port, and is big enough to receive giant vessels (Damietta governorate study, 2008).

7. PROJECT JUSTIFICATION AND ANALYSIS OF ALTERNATIVES

As passed in the "Guidelines for the Egyptian Environmental Impact Assessment" issued by EEAA, the concept of alternatives to a proposed project extends to location, design, fuels, raw materials, and technology selection; construction techniques, phasing, operating, and maintenance procedures. The "no action" alternative or –drilling the well- is also considered in order to demonstrate environmental conditions without it.

For the concerned project, the alternatives that will be considered are no action, location, drilling mud and drilling technology.

7.1 The "No Action" Alternative

This alternative represents the environmental benefit obtained in case the project is not implemented in comparison to the case of implementing it. However, when the different project activities are evaluated, it can be concluded that the implementation of the project will not lead to significant environmental changes during or after carrying out the project; furthermore, the duration of carrying out of the project will be so short. The main purpose of conducting the environmental impact assessment studies for new projects is to support not to hinder development activities in Egypt through identifying both negative and positive impacts of the projects along with protecting the resources against deterioration or depletion through identifying and analyzing its environmental impacts as well as applying mitigation measures. Hence, carrying out exploratory drilling activities may be important and might lead to a discovery that can have high positive impacts to country.

7.2 Reasons for Choosing the Drilling Location

The Dabaa offshore concession is a major oil/gas reservoir in the deep Egyptian waters in the Mediterranean. The exact location of the Kiwi A-1X well was determined based on a detailed seismic survey of the project area in addition to geological information and studies describing the underlying rock structure.

7.3 Drilling Mud Alternatives

Drilling mud is one of the basic tools in the exploration and drilling processes, hence it is an important aspect that must be determined in early planning stages. The most common drilling mud types are the Water Based Mud (WBM), Oil Based Mud (OBM), Low Toxicity Oil Based Mud (LTOBM) and Synthetic-based drilling Mud (SBM). The type of drilling mud used whilst drilling is dependent on the geological properties (i.e. well bore stability) in the area of the drill site.

The drilling mud to be used for Kiwi A-1X will be a Pump and Dump (PAD) WBM and low toxicity mineral oil based LTOBM. WBM will be released with the drilling cutting to the seabed. All of the

components of the WBM are non-toxic to marine organisms at the dilution reached shortly after discharge.

LTOBM that has the same drilling performance characteristics of both oil based mud and mineral oil. The LTOBM is most often used on offshore rigs because it has the properties of an oil-based mud, but the toxicity of the fluid fumes are much less than OBM. This is important when men work with the fluid in an enclosed space such as an offshore drilling rig. Furthermore, LTOBM is popular in most offshore drilling areas because of their environmental acceptance.

7.4 Alternative Drilling Technology

There are two types of basic offshore drilling platforms, the movable drilling rig and the permanent drilling rig. The former is typically used for exploration purposes, while the latter is used for the extraction and production of oil and/or gas. A variety of movable rigs is used for offshore drilling including drilling barges, jack-up rigs, submersible rigs and semi-submersible rigs. Drilling barges are used in shallow, quiet waters such as lakes, wetlands, and large rivers. They are not suitable for locations with strong currents or winds and strong wave action. Jack-up rigs and submersible rigs are much less affected by wind and water current than drilling barges; nevertheless, they are also employed in shallow waters. One of the most common movable offshore drilling rigs is the semi-submersible rig. This type of rigs provides a stable and safe working platform in deeper and more turbulent offshore environments, and also when high reservoir pressures are expected.

The final type of movable drilling rig is the drill ship. These are ships designed to carry drilling platforms great distances offshore and in ultra deep waters (*i.e*. greater than 2300 m). A drilling platform and derrick are located in the middle of a large, open area of the ship, and the drill is extended through the ship to the drilling template (USACE, 2010).

Jack-up platforms are typically used in water depths up to 400 feet (120 m), although some designs can go to 550 ft (170 m) depth. Fixed platforms are economically feasible for installation in water depths up to about 1 700 ft (520 m).

Compliant towers are designed to sustain significant lateral deflections and forces, and are typically used in water depths ranging from 1 500 to 3 000 feet (460 to 910 m). Semi-submersibles can be used in water depths from 200 to 10 000 feet (60 to 3 000 m). Drill ships can drill in water depths up to 12 000 ft (3 700 m).

The DISCOVERER AMERICAS is a single hull, dual derrick, dynamically-positioned (DP) drill ship owned and managed by Transocean; it will be used for Kiwi A-1X offshore well in water depth of 8 875 ft (2 705 m). It is a DP drill ship and has no anchors; it is kept in position by a “DNV DYNPOS-AUTRO” DP and is not subjected to the heaving motion of the sea. It will be operated to high technological standards resulting in minimal environmental impacts.

8. ENVIRONMENTAL IMPACTS FROM PLANNED EVENTS

8.1 Environmental Impact Assessment Procedure

The main objective of the Environmental Impact Assessment (EIA) is to examine, analyse and assess the planned project activities' effects on the baseline conditions as described in Section 4 of this document. An EIA should assist in ensuring environmentally and socially sound management of the project during its entire lifetime.

The impact assessment process starts with a focusing procedure to identify the key environmental and social features from the baseline information detailed in Section 4. This focusing identifies the key biological, physical and human components of the project area.

The potential positive and negative changes resulting from the defined project activities are then predicted for the study area and for the entire project lifecycle. These predicted changes (impacts) are then evaluated using a significance ranking process.

An outline of the impact assessment procedure is as follows:

- Identification of the valued receptors;
- Identification of the key project activities;
- Impact evaluation; and
- Significance ranking.

8.1.1 Valued Receptors

A Valued Receptor (VR) can be defined as any part of the environment or society that is considered important by the developer, operator, general public, or any non-governmental or governmental organisation involved in the assessment process. Importance is determined on the basis of cultural values and/or scientific and public concern.

The VRs are selected depending on the identification of pathways linking important environmental components with the totality of the project's activities, and are fundamental to the process of the EIA. The VRs are also selected following consultation with the EEAA, local discussions and based on the expertise of the project team.

Based on literature investigations, Egyptian regulations/guidelines (mainly Law 4/1994) and VRs suspected to be of concern, the project team formulated a list of environmental aspects (project activities) to assist in the establishment of a framework for analysis of all impacts that may arise from this offshore activity.

Based on our assessment of the environmental and social conditions in the study area, the VRs identified for this project are listed by category in Table 8-1.

Table 8-1 VR identification

Category	VR	Importance	VR Categorization
Air and Climate	Air Quality	Good air quality is required for health	Medium
	Climate	Effect on climatic change	Medium
Land	Sediment Quality	Host of benthic communities	Medium
	Coastal Features	Sustainability issues, local use, cultural values, and health implications for all users	High
Water	Seawater Quality	Effect on local use (fisheries, transportation, etc) Health implications for all users, marine ecology and biodiversity	Medium
Marine Ecology and Biodiversity	Phytoplankton and Zooplankton	Biodiversity value; sustenance and shelter for fauna. Importance for secondary producers.	Medium
	Deep Sea Benthic Communities	Biodiversity value	Low
	Fisheries	Biodiversity value; economic use to community	Medium
	Marine Mammals	Biodiversity value and international conservation	High
	Sea Turtles	Biodiversity value and international conservation status	High
	Sea Birds	Biodiversity value	Medium
Human Environment	Local labour force	Employment opportunities (positive impact)	Medium
	Population (drill ship and vessels' crew)	Health and safety of crew avoiding injuries or loss of lives	High
	Artisanal Fishery	Source of income for population	Medium
	Commercial Fishery	Source of income for population	Medium
	Tourism	Source of income for population	High
	Economic Activities	Community welfare	Medium

Category	VR	Importance	VR Categorization
	Shipping Traffic	Commerce and foreign trading	Medium

Each valued receptor is categorised in terms of its perceived environmental and social value, taking into account local, national or international designations and legal protection status, if appropriate. Based on these considerations the environmental and social value is allocated a category of low, medium or high (Table 8-2).

Table 8-2 VR Categorisation

VR CATEGORISATION	L	M	H
Environmental and social values	1	2	3

- **Low** - a VR containing no designations or features of public value.
- **Medium**- a VR containing local designations and/or features of local public value.
- **High** – a VR containing national/international designations and/or legally protected features.

8.1.2 Project Environmental Aspects

The project description provided in Section 3 of this document has been summarised into key environmental aspects that will occur throughout the life of the project. An environmental aspect is an element of the project's activities that can interact with the environment. The key project activities associated with the offshore exploration are presented in Table 8-3.

Table 8-3 Project Activities / Environmental Aspects

Project Component	Project Activities
Mobilisation Phase	Staffing
	Procurement
	Drill ship movement
Drilling Phase	Supporting vessels movement
	Drill ship operations
	Waste disposal and discharge
	Helicopter operations

Project Component	Project Activities
Demobilisation Phase	Drill ship movement
Accidental (non-routine) Events	Inappropriate waste disposal
	Leaks and minor spills
	Vessel collision (Fuel spill)
	Explosion and Fire
	Well Blowout

Following selection of the environmental aspects, the potential impacts resulting from the proposed exploration activities can be predicted. An environmental impact can be considered as a change to the environment due to human activity and such change can be positive or negative.

8.1.3 Impact Evaluation

The significance of each potential impact will depend on the VR category and the project activities. The impact evaluation will be conducted using two sets of criteria, described respectively as basic and supplementary (Bojórquez - Tapia *et al*., 1998).

The basic criteria for defining an impact include:

- Magnitude: describes the quantity of the resource (VR) potentially affected by the activity.
- Spatial extent: the geographical area over which the impact is experienced.
- Duration: the length of time over which the impact will be experienced. An impact may be present only while an activity is active, or it could persist long after the activity has ceased, in which case the duration may be regarded as the time the VR needs to recover from the effect.

Each potential impact is evaluated by applying descriptors to each of the above criteria, based on qualitative or, to the extent possible, quantitative evaluation, as follows.

The magnitude of impact is allocated one of the following categories:

Very Low (1)	A very small proportion of the VR is affected.
Low (2)	A small proportion of the VR is affected.
Moderate (3)	A moderate proportion of the VR is affected.

High (4)	A large proportion of the VR is affected.
Very High (5)	A very large proportion or all of the VR is affected.

The spatial extent of impact is allocated one of the following categories:

Nil (0)	no effect.
Very Low (1)	local scale impact in the immediate area of the activity.
Low (2)	local impact in the study area.
Moderate (3)	regional scale impact.
High (4)	national scale impact.
Very High (5)	global scale impact.

Duration of impact is described by one of the following categories:

Nil (0)	no effect.
Very Low (1)	less than one year.
Low (2)	one to five years.
Moderate (3)	five to ten years.
High (4)	greater than ten years.
Very High (5)	irreversible.

The relative importance of each criterion, as illustrated in Table 8-4, will be evaluated on a scale from zero to five, and expressed as follows: Nil (N), Very Low (VL), Low (L), Moderate (M), High (H), and Very High (VH).

The highest figure is assigned to an impact when there is uncertainty about the criteria, so as to reduce the chance of underestimating an impact (i.e., the precautionary principle is applied), thereby minimising risk (Crowfoot *et al.* 1990).

Table 8-4 Basic Impact Index

BASIC IMPACT INDEX	N	VL	L	M	H	VH
Magnitude	0	1	2	3	4	5
Spatial Extent	0	1	2	3	4	5
Duration	0	1	2	3	4	5

The Basic Impact index is obtained by the weighted average of these three values, to obtain a whole number between 0 and 5. The magnitude's weight is twice that for spatial extent and duration.

8.1.4 Impact Significance Assessment

The final impact significance is the result of the combination of the Total Impact Index and the VR categorisation, as shown in Table 8-5 where impact significance may result in one of the following classes: Insignificant (IN), Minor (MI), Moderate (MO) or Major (MA).

Table 8-5 Impact Significance

	Total Impact Index					
VR Categorisation	N	VL	L	M	H	VH
L	IN	IN	IN	MI	MO	MA
M	IN	IN	MI	MO	MA	MA
H	IN	MI	MO	MA	MA	MA

Those impacts rated as minor, moderate or major are considered to require mitigation measures in order to eliminate the impact or, where this is not possible, to reduce their significance ranking to minor or insignificant. These mitigation measures are set out in Section 7 of this EIA report.

8.2 Predicted Impacts

Environmental and social impacts are caused by environmental aspects and can have a direct impact on the environment, contribute indirectly to a larger environmental change, or be cumulative. This section reviews each of the VRs potentially affected and discusses the predicted impacts that may result from the environmental aspects listed above.

8.2.1 Predicted Impacts during Mobilisation Phase

The mobilisation phase includes drill ship mobilization from the Gulf of Mexico and supporting vessels movement from Abu Qir base to the “Kiwi A-1X” well. The impacts arising from mobilization phase are associated with staffing, procurement, drill ship and supporting vessels transit.

STAFFING

Employment for local personnel might result from the need of onboard crew. The impact of generating short-term employment opportunities is expected to be positive on the local labour force.

PROCUREMENT

Although key equipment is expected to be on the drill ship, other supplies will be required during the 96.7 days offshore. Purchasing fuel, food and auxiliary equipment result in a positive impact on the local market. These purchases, which may or may not take place, have not yet been quantified. The impact is expected to be positive.

DRILL SHIP DOCKING AND TRANSIT

BALLAST WATER

The VRs potentially affected by ballast exchange during the mobilisation phase include seawater quality, phytoplankton, zooplankton, fisheries, marine mammals, sea turtles, and artisanal and commercial fishery.

Ballast water exchange might pose an ecological, economic and health threat due to the introduction of foreign species into the local marine environment. Organisms small enough to pass through a ship's ballast water intake ports and pumps include bacteria and other microbes, small invertebrates and eggs, cysts and larvae of various species. In the absence of predators, these organisms might develop and prosper as invasive species threatening the receiving environment.

Ballast water might also contain oily traces. An increase in or introduction of pathogens might affect the reproductive phases of plankton. Oily traces could pose a risk of toxicity to marine life and sea turtles, and in turn, cause loss in fishing activities.

The decrease of water quality by the introduction of bacteria, oily waters and toxins and the effect of introduced pathogens can be considered minor due to the very low magnitude and duration of the impacts. However, impacts on marine mammals and sea turtles are considered moderate due to these VRs being highly sensitive.

WASTE DISPOSAL

Routine waste disposal will comply with International Convention of Marine Pollution (MARPOL) regulations and best practices. No hazardous waste will be disposed unless a non-routine waste disposal event occurs (see non-routine events). Routine disposal of biodegradable waste (sanitary waters, grey waters and other organic materials, e.g., food scraps) is acceptable offshore (beyond 12 NM). However, an impact might arise from an increase of biological oxygen demand (BOD) and the release of faecal bacteria, causing disturbance to planktons, marine mammals, sea turtles, and

fisheries. The impact of routine waste disposal on water quality, planktons and fisheries is expected to be minor due to its very low magnitude and duration.

The impact of waste disposal on marine mammals and sea turtles is considered to be moderate due to their high sensitivity.

Use of Engines, Generators and Other Machinery

Drill ship movement during transit involves the emission of diesel engine exhaust which affects air quality and contributes to global climate change. The degradation of air quality and the impact on climate change by the emission of pollutants from diesel engines is expected to be minor.

Marine mammals, sea turtles and fisheries are affected by offshore noise produced by machinery. Considering the very low magnitude and duration of the impact of noise produced by vessel movements from Abu Qir base towards the well location, its expected impact is considered to be minor.

However, similarly to the impacts of ballast water and waste disposal, the impacts of use of engines and generators on marine mammals and sea turtles are considered to be moderate due to their high sensitivity.

Navigation

The navigation route of the drill ship from the Gulf of Mexico to the well location may occupy potential fishing areas and, therefore, prevent or decrease artisanal and commercial fishing even during the brief mobilisation period.

The navigation route of the drill ship may also disrupt normal shipping routes. The expected impact of the drill ship's navigation route on fishing and shipping routes is considered to be minor.

All predicted impacts during mobilisation phase are presented in Table 8-6.

Table 8-6 Predicted Impacts during Mobilisation Phase

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
Mobilisation Phase	Staffing	Local labour force	Employment generation	Medium	Very Low	Low	Very Low	POSITIVE
	Procurement	Economic activities	Possibility of contribution to local market	Medium	Low	Low	Very Low	POSITIVE
	Drill Ship Ballast Exchange	Seawater Quality	Decrease of water quality as a result of release of bacteria, oily waters and toxins	Medium	Low	Low	Very Low	MI
		Phytoplankton and Zooplankton	Introduction of foreign species, pathogens and toxins	Medium	Very Low	Low	Very Low	MI
		Fisheries	Reducing the source of food (plankton)	Medium	Very Low	Low	Very Low	MI
		Marine Mammals	Disturbance to Marine Mammals	High	Very Low	Low	Very Low	MO
		Sea Turtles	Disturbance to turtles	High	Very Low	Low	Very Low	MO
		Artisanal and Commercial Fishery	Catch loss	Medium	Very Low	Low	Very Low	MI
	Drill Ship Waste	Seawater quality	Decrease of water quality by disposal of organic waste	Medium	Low	Low	Very Low	MI

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
Mobilisation Phase	Disposal	Phytoplankton and Zooplankton	Decrease in Planktons	Medium	Very Low	Low	Very Low	MI
		Fisheries	Decreased water quality	Medium	Very Low	Low	Very Low	MI
		Marine Mammals	Disturbance to Marine Mammals	High	Very Low	Low	Very Low	MO
		Sea Turtles	Disturbance to turtles	High	Very Low	Low	Very Low	MO
	Drill Ship Use of engines, generators and machinery	Regional / Local air quality	Degradation of local air quality	Medium	Low	Low	Very Low	MI
		Contribution to climate change	Emission of greenhouse gases	Medium	Very Low	Low	Very Low	MI
		Fisheries	Disturbance to fish by vessel noise	Medium	Very Low	Low	Very Low	MI
		Marine Mammals	Disturbance to mammals by vessel noise	High	Very Low	Low	Very Low	MO

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
Mobilisation Phase		Sea Turtles	Disturbance to turtles by vessel noise	High	Very Low	Low	Very Low	MO
	Drill Ship Navigation	Artisanal Fishery and commercial Fishery	Occupation of a potential fishing area	Medium	Very Low	Low	Very Low	MI
		Shipping Routes	Disruption of normal shipping routes	Medium	Very Low	Low	Very Low	MI

8.2.2 Predicted Impacts during Drilling Phase

Drill Ship positioning and Supporting Vessels Movement

Drill ship Positioning

As the drill ship has no anchors; it is kept in position by a DNV DYNPOS-AUTO dynamic positioning system (DP). This DP system consists of 6 x Rolls Royce Aquamaster 7,000 HP fully azimuth thrusters which are computer controlled. The computer continuously determines the exact location of the vessel from special sensors on the drilling unit and acoustic transponders which are placed on the seabed at the well location; the thrusters are actuated automatically when necessary to maintain the vessel precisely on station. Since the ship has no anchors, there will be no impact on seafloor sediments or benthic species through positioning phase.

Ballast exchange

The impact of exchanging ballast water offshore is considerably small. Invasive species that might be carried to a distant location have less chance to prosper in the open sea than in the more nutrient rich coastal areas. The introduction of alien species is less likely in the case of this drilling operation because the vessel will be continuously navigated offshore. The impact that might result from ballast exchange during the drilling operations would be due to the release of oily traces and toxins from the ballast hold.

The VRs that could be affected include: water quality, plankton, fisheries, marine mammals, sea turtles and fishing activities. The impact of ballast exchange during the operational phase of the proposed drilling operations on the VRs listed above is expected to be minor, except for marine mammals and sea turtles being moderate due to their high sensitivity.

Waste Disposal

The drilling crew and the supplies needed to conduct the operations will unavoidably generate sanitary, grey water and domestic waste proportional to the onboard population. The proposed waste disposal plan will comply with MARPOL and other applicable regulations.

Therefore, no hazardous waste is to be discarded at sea. MARPOL accepts the disposal of food scraps and sanitary waters from vessels under certain conditions and beyond a minimum distance from the nearest shoreline. As noted previously for the mobilisation phase, the waste allowable for disposal at sea during the drilling operations is exclusively limited to biodegradable matter; although an impact might occur due to the release of faecal bacteria and an increase in BOD.

The VRs potentially affected by organic matter disposal include: water quality, plankton, fisheries, marine mammals, sea turtles and fishing activities.

The impact that can be caused as a result of routine waste disposal is the decrease of water quality, as BOD and faecal bacteria increase. This impact on water quality is expected to be minor.

A decrease in water quality could result in a reduction in dissolved oxygen and an increase in turbidity affecting visibility and light penetration depth. Therefore, routine biodegradable waste disposal has affects on plankton, fisheries, marine mammals and sea turtles by depleting their environment of dissolved oxygen and visibility. Impacts from waste disposal are expected to be minor for plankton, fisheries and fishing activities; while it is considered to be moderate for marine mammals and sea turtles.

Use of Engines, Generators and Equipment

Air quality is considered a VR in any area due to the links between air quality and quality of life for population and local flora and fauna. A further consideration is the importance of cumulative effects of air quality degradation that may be manifested over a wider area (e.g. global warming and climate change). Typical exhaust gases, particulate emissions and pollutants from transportation/supporting vessels, drilling equipment (engines and generators), helicopter, logging and other support equipment include CO, NO_x, SO_2 and CO_2 as well as Volatile Organic Compounds (VOC) and other vapour emissions from fuels or chemicals. The impact from operational emissions on local air quality and climate change is expected to be minor.

A vessel engine produces strong low-frequency sounds, up to 50 Hz (MMS, 2004), that affect marine mammals and marine turtles. Noise from supporting vessel traffic and helicopter over flights may elicit a startle response from marine turtles, but the effects are probably temporary and sub-lethal (Minerals Management Service, 1998). The effect of noise from the vessels' engines on marine life (turtles and mammals) is expected to be moderate.

Navigation

The presence of supporting vessels in fishing areas may prevent and/or disturb artisanal and commercial fishing. This effect is expected to be minor for both artisanal fishing and commercial fishing.

Normal navigation traffic along shipping routes could be disrupted during the operational stage. This effect is expected to be minor.

Drill Ship Operations

Drilling, Casing, Cementing and Coring

Noise

Manmade sounds have been observed to cause behavioural responses in marine organisms. Noise from the drill ship and machinery will range from 80-117 dBA in air. Noise attenuates in air by 6 dBA for every doubling of distance, so that even the loudest noise will be reduced to 80 dBA

or less within 1 km. Noise emissions will have significant impact on project workers, but will be low for fishing vessels and other ships in the local area. Noise emissions will have no effect onshore due to project's remote location.

Underwater noise generated by drilling activities will be transmitted through water (Minerals Management Service, 1998). Drilling operations often produce noise that includes strong tonal components at low frequencies. Sound and vibration paths to the water are either through the air or risers. This noise will cause localized disturbance to marine life in proximity to the drilling location. The impact from ballast exchange on marine mammals and sea turtles is expected to be moderate, while on all other VRs is expected to be minor.

Planktons

Planktonic organisms are not likely to be significantly affected by use of the drill ship. This impact can be considered minor.

Fisheries

Some fish use sound to detect predators and preys, to establish general orientation to the environment, to participate in courtship and mating, to alert others of territorial and individual presence, and to maintain schooling and aggregation. Underwater anthropogenic sounds at levels of 60 to 80 dB re 1 µPa mask the sounds used by fish during normal acoustic behaviour (MMS, 2004). The impact on fisheries through all activities of operational phase is expected to be minor.

Marine Mammals

The marine environment receives limited light. Typically, light penetrates to a depth of 60 m and visibility is reduced due to attenuation. The deeper environment receives little or no light. As an adaptation to these conditions, marine mammals have developed complex auditory systems which aid them in processing the surrounding environment and emit sounds for the purposes of communication and echolocation (environmental sounds cues).

The effects of drilling-induced noise on marine mammals may include modified behaviour to feeding, breeding, and migratory regime. Behavioural changes may generally include such trends as retreat from noise source, but also in some circumstances attraction to the source itself. In general, mammals have a highly developed and highly specialised hearing system, and there is evidence that noise levels in excess of 90 dBA can cause a behavioural response including escape from the immediate area or high stress. However, available data are not conclusive (Moulton & Richardson, 2000) and often misinterpreted. There is a lack of definitive evidence regarding the effects of drilling operations on marine mammals; however, the most likely outcome is modified behaviour, which may generally include retreat from the noise source. However the project area is unlikely to harbor important fish species due to limited food resources as planktons or sea grasses as the depth reaches more than 2500 m in the drilling area.

Therefore, the impact to marine mammals caused by the drilling activities can be classified into two major effects: physiological damage and behavioural changes or disruption of communication.

Physiological effects and behavioural changes or disruption of communications caused to marine mammals are expected to be moderate.

Sea Turtles

The noise of the drilling rigs is expected to cause behavioural changes and even physiological damage to sea turtles in close range. Although there have been a limited number of studies on sea turtle hearing and the available data are not comprehensive, those data show that sea turtles can detect moderately low frequency sounds (Ridgway *et al.*, 1969 and Lenhardt *et al.*, 1985, as cited in Moulton and Richardson, 2000). Sea turtles may be able to localise the direction from which an underwater sound is being received (Lenhardt *et al*. 1983 in Moulton and Richardson 2000). The wide response reactions of sea turtles to noise from drilling operations include: avoiding the entire drilling area to the extent that they move to less preferred habitat, to avoiding only the immediate area around the drilling rig and vessels or exhibiting no appreciable avoidance. The drilling area is not considered particularly important to sea turtles, although turtles may be present. A relatively low population density is anticipated in comparison to favoured coastal breeding, feeding and nesting areas. However, causing avoidance reactions or disturbance during mating season, which takes place offshore, could cause concern for species that have vulnerable or endangered status. The production of behavioural changes on sea turtles is expected to be moderate.

Sediment Quality and Benthic Communities

Disturbance of the seafloor sediments will occur during the drilling operations, this is not expected to affect sediment quality; however, because contaminated sediments are highly unlikely to be present. No known sensitive benthic communities, such as seagrass habitats (the water is too deep) or areas of hard rock bottom (not present), therefore the impact on sediment and benthic communities is short termed, localized and expected to be minor.

Artisanal and Commercial Fishery

Although no conclusive studies have been conducted to quantify catch losses during drilling operations, few artisanal fishing vessels travel beyond 40 km from shore. The impact to the artisanal fishery and commercial fishery is expected to be minor.

Sea Birds

The noise of the drill ship is expected to cause nuisance and disturbance to sea birds. However, this impact is considered to be insignificant.

DISCHARGE OF DRILL CUTTINGS

WBM drill cuttings are the fragments of rock resulting from drillings and carried to the surface with the drilling fluids. The principal concern with cuttings is the oil or other mud constituents that adhere to or are mixed with cuttings (Minerals Management Service, 1998). Synthetic-based cuttings will not be discharged into marine water or any surface water and will shipped onshore for processing and treatment.

The VRs potentially affected by disposal of WBM drill cuttings during the drilling operation include: water and sediment quality, plankton, fisheries, marine mammals and sea turtles. This impact is expected to be moderate.

Discharges of WBM drill cuttings can result in the covering of seafloor that provides habitat for some benthic organisms. However no known sensitive benthic communities, such as seagrass habitats (the water is too deep) or areas of hard rock bottom (not present), will be covered. In addition, no known areas of substantially contaminated sediment will be affected. This impact would be short-term, local, and of minor significance.

Effects on fish will be similar to those described above. Planned and accidental discharges are likely to be quickly managed and unlikely to adversely affect water column species. Oil spills may occur from drilling, but free-swimming fish are rarely at risk from oil spills (Minerals Management Service, 1998). Many fish species are believed to hear, as well as produce, sounds. Certain species are able to hear localised sounds in moderate frequencies. Available evidence might suggest that behavioural changes for some fish species may be no more than a nuisance factor (McCauley, 1994 ; National Ocean Office, 2005) with exhibited effects being localised and transitory, and any displacement of pelagic or migratory fish insignificant at a population level (cited by National Oceans Office, 2005).

WASTE DISPOSAL

Wastewater sources include: drill deck drainage, domestic wastewater, grey waters from showers and sinks and industrial wastewater.

Drill deck drainage from rain runoff and wash down of the drill ship is usually contaminated with oil and grease, and a number of hazardous chemicals and trace metals in low concentrations (Minerals Management Service, 1998). Drill deck wash down will be collected in a sump, treated to meet discharge requirements and discharged to sea. Generally, it is unlikely that drill deck drainage will negatively impact surface water resources if managed correctly.

Domestic wastewater will be produced from catering and accommodation. The drill ship is equipped with a complete sewage and drainage system including wastewater treatment units. Generated sewage is disposed to the sea after treatment according to local regulations (as indicated in Annex I of Law 4/1994). Generally, it is unlikely that grey water will negatively impact surface water resources if managed correctly.

However, if industrial wastewater generated due to offshore drilling operations contains a high proportion of oils or other disposed chemicals, then the potential risk for negative impact increases. An oil-water separator is used to reduce the oil content to acceptable levels by the local regulations (Law 4/1994 Annex I) and international conventions (MARPOL Annex IV).

Other potential discharges include grey water from showers and sinks. Grey water will be discharged to the sea, and will have no effect on water quality. Discharges will be rapidly assimilated and dispersed.

The VRs potentially affected by inadequate waste disposal during the drilling operations include: water and sediment quality, plankton, deep sea benthic communities, fisheries, marine mammals, sea turtles, and artisanal and commercial fishery.

Discharges of WBM drill cuttings and wastewater will result in the covering of seafloor that provides habitat for some benthic organisms. No known sensitive benthic communities, such as seagrass habitats (the water is too deep) or areas of hard rock bottom (not present), will be present. In addition, no known areas of substantially contaminated sediment will be affected. This impact on sediment quality would be short-term, local, and of minor impact; while the impact on deep sea benthic communities would be insignificant.

Drainage and Discharges

Drill ship deck drainage from rain runoff, miscellaneous leakage and spills and wash down of the drill ship is usually contaminated with oil and grease, and a number of hazardous chemicals and trace metals in low concentrations (Minerals Management Service, 1998). Drill deck wash down will be collected in a sump, treated to meet discharge requirements and discharged to sea. Generally, it is unlikely that drill deck drainage will negatively impact surface water resources if managed correctly.

Domestic wastewater (grey water) will be produced from catering, and accommodation. The drill ship and operating vessels are equipped with a complete sewage and drainage system including wastewater treatment units. Generated sewage is disposed to the sea after treatment at a distance not less than four nautical miles from the shore (as indicated in Annex I of Law 4/1994). Generally, it is unlikely that grey water will negatively impact surface water resources if managed correctly.

However, if industrial wastewater generated due to offshore drilling operations contains a high proportion of oils or other disposed chemicals, then the potential risk for negative impact increases. An oil-water separator is used to reduce the oil content to acceptable levels by the local regulations (Law 4/1994 Annex I) and international conventions (MARPOL Annex IV).

Other potential drilling discharges include grey water from showers and sinks, leaks, spills during fuel transfers, spills of drilling products, and discharges resulting from support vessels operations. Grey water will be discharged to the sea, and will have no effect on water quality. The discharge of other materials will also not result in any significant impacts on marine water quality because concentrations of toxic materials in those wastes will be zero or very low and the discharged volumes will be low. Discharges will be rapidly assimilated and dispersed.

Helicopter Operations

Noise from supporting helicopter over flights may elicit a startle response from marine turtles, but the effects are probably temporary and sub-lethal (Minerals Management Service, 1998). Marine and coastal birds, including breeding, migratory and wintering populations are unlikely to be adversely affected by the project facilities and activities. Some minor disturbance and temporary

displacement may occur as a result of helicopter traffic. The effect of noise from the use of helicopters on marine life (fish, turtles, mammals, and birds) is expected to be moderate.

All predicted impacts during the operational phase are presented in Table 8-7.

Table 8-7 Predicted Impacts during Drilling Phase

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
Operational Phase	Supporting Vessels Movement (Ballast exchange and waste disposal)	Water Quality	Decrease of water quality as a result of release of bacteria, oily waters and toxins	Medium	Low	Low	Very Low	MI
		Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton	Medium	Very Low	Low	Very Low	MI
		Fisheries	Reducing the source of food (plankton)	Medium	Very Low	Low	Very Low	MI
		Marine Mammals	Disturbance to Marine Mammals	High	Very Low	Low	Very Low	MO
		Sea Turtles	Disturbance to turtles	High	Very Low	Low	Very Low	MO
		Artisanal and Commercial Fishery	Catch loss	Medium	Very Low	Low	Very Low	MI

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
Operational Phase	Supporting Vessels Movement, (Use of engines, generators, and machinery)	Regional / Local air quality	Degradation of local air quality	Medium	Very Low	Low	Very Low	MI
		Contribution to climate change	Emission of greenhouse gases	Medium	Very Low	Low	Very Low	MI
		Fisheries	Disturbance to fish by vessel noise	Medium	Very Low	Low	Very Low	MI
		Marine Mammals	Disturbance to mammals by vessel noise	High	Very Low	Low	Very Low	MO
		Sea Turtles	Disturbance to turtles by vessel noise	High	Very Low	Low	Very Low	MO
	Supporting Vessels Navigation	Artisanal Fishery and commercial Fishery	Occupation or disturbance to potential fishing areas	Medium	Very Low	Low	Very Low	MI
		Shipping Routes	Disruption of normal shipping routes	Medium	Very Low	Low	Very Low	MI
		Regional / Local air quality	Degradation of local air quality	Medium	Low	Very Low	Very Low	MI

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
Operational Phase	Drill ship operations (drilling, casing, cementing and coring)	Climate	Global warming	Medium	Low	Very Low	Very Low	MI
		Sediment quality	Disturbance of sea bed and decrease sediment quality	Medium	Moderate	Very Low	Very Low	MI
		Seawater quality	Decrease of water quality	Medium	Moderate	Very Low	Very Low	MI
		Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton	Medium	Low	Very Low	Very Low	MI
		Deep Sea Benthic Communities	Disturbance/damage	Low	High	Very Low	Very Low	MI
		Fisheries	Disturbance/damage	Medium	Low	Very Low	Very Low	MI

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
Operational Phase	Drill ship operations (drilling, casing, cementing and coring)	Marine Mammals	Noise causing behavioural changes and disruption of communication Disturbance and nuisance to Marine Mammals	High	Low	Very Low	Very Low	MO
		Sea Turtles	Noise causing behavioural changes and disruption of communication Disturbance and nuisance to Turtles	High	Low	Very Low	Very Low	MO
		Sea birds	Nuisance and disturbance	Medium	Very Low	Very Low	Very Low	IN
		Sediment Quality	Disturbance and decrease in sediment quality	Medium	Moderate	Very Low	Very Low	MI

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
Operational Phase	Waste disposal (discharge of WBM drill cuttings and drainage of wastewater)	Seawater Quality	Decrease in water quality	Medium	High	Very Low	Very Low	MO
		Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton	Medium	Moderate	Very Low	Very Low	MI
		Deep Sea Benthic Communities	Disturbance/damage	Low	Moderate	Very Low	Very Low	IN
		Fisheries	Disturbance/damage	Medium	Moderate	Very Low	Very Low	MI
		Marine Mammals	Disturbance and nuisance, behavioural changes, and avoidance reactions	High	Moderate	Very Low	Very Low	MO

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
Operational Phase	Waste disposal (discharge of WBM drill cuttings and drainage of wastewater)	Sea Turtles	Disturbance and nuisance, behavioural changes, and avoidance reactions	High	Moderate	Very Low	Very Low	MO
		Artisanal and Commercial Fishery	Disturbance to potential fishing areas causing catch loss	Medium	Low	Very Low	Very Low	MI
	Helicopter operations	Marine Mammals	Disturbance and nuisance, behavioural changes, avoidance reactions, and disruption of communication	High	Low	Very Low	Very Low	MO
		Sea Turtles	Disturbance and nuisance, behavioural changes, avoidance reactions, and disruption of communication	High	Low	Very Low	Very Low	MO
		Sea Birds	Disturbance and nuisance, behavioural changes, avoidance reactions, and disruption of communication	Medium	High	Very Low	Very Low	MO

8.2.3 Predicted Impacts during Demobilisation Phase

The demobilisation phase entails drill ship and vessels transit from the concession area to the receiving port, Abu Qir, the disposal of accumulated waste, ballast water exchange and personnel demobilisation and return travel.

The impacts to be realised during this phase are similar to those impacts resulting from the mobilisation phase with the following exceptions: 1) No procurement will be conducted; 2) waste disposal and recycling will be required.

Waste disposal and recycling are expected to follow protocols respecting the environment; therefore, any adverse impact derived from waste disposal can be considered a non-routine event (i.e., inappropriate waste disposal), since it would not be performed according to plan.

To avoid repetition, the description of these impacts and their associated aspects are not reproduced here.

9. PREDICTED IMPACTS OF ACCIDENTAL (NON-ROUTINE) EVENTS

Non-routine events include all incidents that were not planned and which may result in an accident. Events related to drilling operations include inappropriate wastewater and garbage discharge, leaks and minor spills, vessel collision, explosion or fire and well blowout as seen as non-routine events could negatively impact a number of VRs, including seawater and sediment quality, air quality, plankton, benthic communities, fisheries, sea turtles, marine mammals, sea birds, coastal features, tourism and the artisanal and commercial fishing industries.

Subsurface well blowout is considered to be the worst case scenario for the non-routine events. Considering its consequences, a separate Environmental Risk Assessment (ERA) study (455/EJ6172-000-EN-REP-07) has been conducted to present an assessment of the potential environmental impacts due to non-routine events of the Kiwi A-1X drilling programme on marine and coastal resources and concentrating on the well blow-out event.

The risk assessment has been made through the undertaking of a number of tasks:

- Identification of environmental hazards
- Identification of the zone of potential impact (ZPI)
- Identification of resources within the ZPI
- Assessment of potential effects
- Assessment of residual risk

The ERA study discusses the non-routine marine discharges that could occur from the drill ship, the supply vessel or helicopters. The ERA study also includes oil types potential spill volumes as shown in Table 9-1.

Table 9-1 Indicative Oil Spill Volumes for Kiwi A-1X Operations

Source	Incident	Potential Location	Oil Type		Potential Volume, m^3
Drill Ship	Blowout	Drilling site	Crude	Seafloor release	695 800(1)
				Sea surface release	204 800(2)
Fuel spill	Tank failure	Drilling site	Diesel		259
	Transfer error	Drilling site	Diesel		1

Source	Incident		Potential Location	Oil Type	Potential Volume, m^3
	Lube spill	Drum loss	Drilling site	Lube oil	0.2
		Transfer error	Drilling site	Lube oil	0.025
	Mud loss	During transfer	Drilling site	SBM	1
		Drilling	Drilling site	SBM	493
		Well control	Drilling site	SBM	18
Helicopter	Crash		Any	Aviation fuel	1.23
Supply Vessel	Collision (1 fuel tank)		Port/coast	Diesel	305
	Grounding (total loss)	Fuel	Any	Diesel	159
		Cargo	Any	Diesel	609
		Cargo	Any	SBM	1 793
	Fuelling		Port	Diesel	<0.1

(1) Based on a 98 day release @ 7,100m^3 / day (medium case) (ASA, October 2010)

(2) Based on a 16 day release @ 12,800m^3 / day (medium case) (PESCo, September 2010)

The ERA determined the initial probability for a blowout event to occur from Kiwi A-1X to be $2.4x10^{-3}$. The study identified the sea surface and coastal zones that could be impacted in case of a blowout event, without taking into consideration the initial probability of the event to occur. The ERA also identified the resources within the zone of potential impact focusing on natural protectorates and identified the type of the coastline through a series of GIS layers that have been produced by visually digitising the boarder of the coastal strip for the entire coastline of Egypt.

The ERA study also identified the potential effects, remedial strategies, and assessment of residual risk for oil impact on identified resources within the potential zone of impact. For further information and details on the ERA study please refer to the project deliverable (455/EJ6172-000-EN-REP-07).

The non-routine events that could occur during each project phase are listed below:

Mobilisation Phase:

a) Inappropriate Waste Disposal

b) Leaks and Spills

c) Vessel Collision

d) Explosion or Fire

Drilling Phase:

e) Inappropriate Waste Disposal

f) Leaks and Spills

g) Vessel Collision

h) Explosion or Fire

i) Well blowout

Demobilisation Phase:

j) Inappropriate Waste Disposal

k) Leaks and Spills

l) Vessel Collision

m) Explosion or Fire

All potential non-routine events are further described below:

INAPPROPRIATE WASTE DISPOSAL

During project phases there can be an impact caused by inappropriate waste disposal. Disposal of hazardous waste can be a concern for health issues in the population and the effect on fish and other marine life.

The impacts from inappropriate waste disposal is expected to be insignificant with regards to sediment quality and benthic communities; and moderate on seawater quality, planktonic life, fisheries and fishing activities. On the other hand, inappropriate waste disposal may have major impacts on marine mammals and sea turtles, as disposing non-permitted (toxics or non-hazardous) waste offshore, might affect marine life causing toxicity or simply cause mortality by ingestion of plastics.

LEAKS AND MINOR SPILLS

During the mobilisation and demobilisation phase, accidental releases of fuel or hazardous substances could occur during transfer of materials or fuel between supporting vessels and the drill ship. Health issues might arise from spreading of toxins and polluted water at the port. During drilling operations, the main risk is from drilling fluid losses due to inadequate sealing or casing.

An offshore accidental spill or rupture of a tank onboard containing potentially contaminating liquids or other wastes may be of significant volume to escape from the vessel and reach marine waters.

Accidental releases of chemicals (e.g. fuel, solvents, metals, and chlorine) could have negative impacts on a number of VRs including: air quality, water quality, plankton, fisheries, marine mammals, sea turtles and artisanal and commercial fishing industries. Hazardous substances persist at sea, accumulate on the lower levels of the trophic pyramid and bio-magnify in organisms at the upper levels. Toxins might eventually be ingested by people in the case of polluted crustaceans and fish.

Accidental spills can involve a number of different substances and sources:

- Hydrocarbon (diesel) or other hazardous substances resulting from fuel transfer
  - Diesel is usually transferred to a vessel from land-based transfer lines. In the event of a transfer line break, the worst-case spill will be the volume of the transfer line times a contingency factor of three. This factor allows for shutdown times. Diesel is a low fire hazard. Although “combustible” it has a flash point above 38ºC (100º F).
- Drilling fluid losses
  - Accidental loss of LTOBM during drilling operations, rupture of onboard chemical tanks/lines and/or malfunction of onboard solid control system may be sources of drilling fluid loss.

Despite the high magnitude of leaks and minor spills, the extent and duration of the impacts are very low. With the exception of marine mammals and sea turtles which are majorly impacted due to their high sensitivity, the expected impacts of leaks and minor spills on the other VRs are expected to be moderate.

VESSEL COLLISION

The supply vessel contains 768 m^3 (203,000 gallons) of fuel oil and may also contain diesel fuel as cargo for the drill-ship, oil-based mud and lubricating oils (both for on-vessel use and as cargo for the drill-ship). Collisions of the supply vessel may occur within the port or at sea. Groundings or severe collisions may result in the loss of the entire fuel and cargo contents of the supply vessel. Although these spills are expected to be larger than the leaks and minor spills discussed above, these spills are not as major as well blow-out (discussed below).

In the event of a collision between the supporting vessels/drill ship and another vessel, the worst-case scenario would be the sinking of the vessels and the resulting loss of fuel plus other hazardous substances into the marine environment.

Significant impact is expected if collision occurs, resulting in high-risk consequences including fatalities.

Considering the worst case scenario where the drill ship looses all its diesel fuel oil (36,000 bbls) and no offshore oil spill response operations take place, the oil slick is expected to reach shore. Diesel is a light fuel, causing its lighter constituents to evaporate rapidly. Generally, 60% of spilled diesel will

evaporate. Evaporation of the diesel slick will affect air quality in the region but only for a short time. The impact of a diesel spill on air quality is expected to be moderate.

Diesel spill will also have a moderate impact on plankton, fisheries and fishing activities as the thin sheen of diesel floating on the water surface will not block out sunlight completely and its duration will be very low.

A diesel spill, however, may cause a major impact on seawater quality, coastal features, marine mammals, sea turtles and tourism in the area due to these VR's high sensitivity and magnitude.

EXPLOSION OR FIRE

In the event of engine explosion, the main VRs affected would be the crew onboard the vessel with fatal consequences. Fire produced by an explosion or fire resulting from spilled diesel or hydrocarbons during fuel transfer may also engulf parts of the supporting vessels and drill ship. The impact from explosion or fire on the crew onboard is major.

Fires have a negative impact on air quality and climate. Fires generally emit carbon monoxide, sulphur dioxide, nitrogen dioxide, ozone, and particulate matter. Fires are expected to have a moderate impact on air quality and climate, and hence, sea birds.

Fires may occur on the water surface as a result of spilled oil during oil transfer operations. In this case, the fire will affect seawater and sediment quality, plankton, fisheries, marine mammals, sea turtles and fishing and shipping activities. These fires will have a major impact on seawater quality, marine mammals and sea turtles as they often emerge on the sea surface. The other VRs will be moderately impacted by the fires.

WELL BLOWOUT

Well blow-out is considered to be the worst case scenario for oil spills.

As identified by PESCo, the worst case scenario considering Statoil's operational parameters would be a blow out of 18 800 m^3 of RINGHORNE2001 oil over spill duration of 16 days during the month of October. According to the surface oil spill trajectory model run by PESCo, only 13.637% (41,020 Sm^3) of the oil will reach the shore. About 215 km of shoreline is predicted to be hit by the oil spill, affecting the area between Agamy and Ras El-Hekma.

According to the sub-surface oil spill trajectory model run by ASA the indirect area of influence includes: about 100 km of the eastern Libyan coast, the Egyptian north coast, Gaza, Israel, Lebanon, Syria, western Cyprus, about 50 km of Turkey's southeast coast and Greece's southeast waters.

The area that shall be studied in this section is limited to the Egyptian territories. The remaining indirect area of influence other than the Egyptian coast shall be covered in a desktop screening study (455/EJ6172-000-EN-REP-08).

In the event of well blowout, the main VRs affected would be air quality, sediment quality, water quality, plankton, benthic communities, fisheries, sea mammals, sea turtles, sea birds, fishing activities, coastal features, tourism, shipping traffic and crew onboard the drill ship with fatal consequences. It should be noted that in assessing impacts on the VR's, a conservative assumption has been made that the resources will be present within the 91% - 100% probability zone and therefore, the likelihood of impacts will always be high (i.e. a high probability of oil being present outweighs a low probability).

In general, all the impacts resulting from a well blowout could be catastrophic; however, the use of both ERP and OSRP should keep the probability of the event low and prevent contaminants from reaching the coast.

Each VR is discussed in greater detail below.

Air Quality

Well blow-out may result in significant reduction in air quality only on a local scale (in the immediate vicinity of the environmental aspect resulting in the impact) due to the evaporation of light hydrocarbon constituents. This impact is expected to be moderate.

Sediment Quality

Heavy constituents of the released hydrocarbon will settle on the seabed. These constituents are persistent in the environment and may cause irreversible effects. The expected impact of a well blow-out event on sediment quality is expected to be major.

Phytoplankton and Zooplankton

Phytoplanktons are plants in the sea, and thus, need light for photosynthesis. If the floating oil slick blocks out light, planktonic photosynthesis will cease. Planktonic life will decrease in density and the production of oxygen for fish and aquatic life will be reduced. The magnitude of a well blow-out on planktons is very high and to a moderate extent, thus making its impacts major.

Water Quality

Water contamination through the release of hydrocarbons may lead to bioaccumulation or even bio-magnification of the toxic hydrocarbon through the food chain.

As alluded to in the phytoplankton section, phytoplankton and water quality are tightly related. It is important to realize that the blocking of sunlight by a large oil slick will reduce photosynthesis in the sea, resulting in lower oxygen concentrations and large carbon dioxide concentrations. This, in turn, reduces seawater quality.

Well blow-out is expected to have a major impact on water quality.

DEEP SEA BENTHIC COMMUNITIES

As stated above in the sediment quality section, heavy constituents of the released hydrocarbon will settle on the seabed. These constituents are persistent in the environment and may cause irreversible effects. Benthic organisms generally live in close relationship with the substrate bottom; many of which are permanently attached to the bottom. Due to their weak motility and sessile nature, benthic organisms are considered bio-indicators of seabed quality. The greatest levels of toxicity will affect filter feeders and benthos in the larval and embryonic stages.

The expected impact of a well blow-out event on deep sea benthic organisms is expected to be moderate.

FISHERIES

Fish may be exposed to spilled fuel in different ways. Species could come into direct contact and the gills might become contaminated; the water column could contain toxic and volatile components of oil that might be absorbed by their eggs, larvae, and juvenile stages; and they could consume contaminated food sources. Fish that are exposed to hydrocarbons may suffer from changes in heart and respiratory rate, enlarged livers, reduced growth, fin erosion, a variety of biochemical and cellular changes, and reproductive and behavioural responses. Chronic exposure to some chemicals found in oil may cause genetic abnormalities or cancer in sensitive species.

Well blow-out is expected to have a major impact on fisheries.

MARINE MAMMALS

Marine mammals are vulnerable to fuel spills because of their amphibious habits and dependence on air (Etkin 1997 and Neff 1981). Some marine mammals live and migrate in small pods while others exist in large localised colonies. The impact of a spill will vary depending on the season and may affect a few individuals or large colonies.

Well blow-out is expected to have a major impact on marine mammals.

SEA TURTLES

Although surprisingly robust when faced with physical damage, sea turtles are highly sensitive to chemical contamination (Shigenaka 2003). Sea turtles are vulnerable to the effects of hydrocarbon at all stages of life - from eggs, post-hatchlings, juveniles, and adults in near shore waters. Several features of sea turtle biology and behaviour place them at particular risk, including a lack of avoidance behaviour, indiscriminate feeding and large pre-dive inhalation. Hydrocarbon exposure effects include increased egg mortality and developmental defects, juveniles, and adults; and negative impacts to skin, blood, digestive and immune systems, and salt glands.

Well blow-out is expected to have a major impact on sea turtles.

ARTISANAL AND COMMERCIAL FISHERY

The impact of a well blow-out on artisanal and commercial fisheries would be a decrease in catchments. However, experience from even major spills has shown that potentially long-term effects on wild fish stocks are mitigated by the normal over-production of eggs helping to compensate for any localised losses.

Irrespective of the actual fish stock contamination level, a loss of market confidence can develop if the public is unwilling to purchase marine products from the region. Bans on the fishing and harvesting of marine products may be imposed following a major spill to maintain market confidence and to protect fishing gear and catches from contamination.

From the perspective of the fishing industry, loss of income would likely result from a major spill regardless of the extent of contamination. Hence, the expected impact of well blow-out on artisanal and commercial fishery is major.

COASTAL FEATURES

Although Kiwi A-1X well is located 140 km offshore El-Dabaa District, the maximum probability of surface oil from the spill hitting any particular point onshore is 50.5% (PESCo, 2010). The extent of damage would be governed by the volume and properties of the contaminant released the meteorological conditions and the rapidity of response.

The Egyptian north coast is characterized by a boom in the real estate and touristic industries. Several cities, towns, harbours and ports are located on Egypt's Mediterranean coastline. The northern coast is also an important environmental asset to Egypt, as there are five existing protectorates and two future ones.

Furthermore, the seas surrounding the more than 2,000 year old city of Alexandria have been witness to numerous important historical events. Alexander the Great, the Ptolemaic dynasty and Cleopatra VII as well as Napoleon and Nelson are famous names connected with this region. UNESCO has been interested for more than 40 years in the preservation and protection of the underwater sites in Alexandria (UNESCO, 2010). There is over 2,500 pieces of stonework of archaeological interest such as columns of all sizes, column bases and capitals, sphinxes, statues, and some immense blocks of granite which, given where they lie, certainly came from the famous lighthouse that are scattered about in an area of 2.5 hectares.

Considering the presence of several cities, ports, environmental protectorates and archaeological features in the northern coast of Egypt, coupled with the irreversible effects of shoreline pollution, the expected impact of a well blow-out on coastal features is major.

TOURISM INDUSTRY

The developing tourism industry in the north coast, especially coastal tourism, and the associated economic activities might be affected directly by a well blow-out due to a decrease in landscape

quality or indirectly by the development of negative perceptions by potential tourists. The expected impact of a well blow-out on the tourism industry is major.

Shipping Traffic

With the presence of the Suez Canal and several ports (e.g. Port Said, Damietta, and Alexandria) in the region, vessel traffic is considered high. The presence of a large oil slick resulting from a well blow-out may alter navigation routes and disrupt both local and international shipments. However, the duration of the oil slick on the water surface is short, as it will eventually hit the shoreline. The impact of a well blow-out on shipping traffic is considered to be moderate.

Onboard Crew

A well blow-out could result in injury or the potential loss of human life.

Using the same impact significance methodology as in Section 8, the predicted impacts resulting from non-routine events are summarized in Table 9-2.

Table 9-2 Predicted Impacts during Accidental (Non-Routine) Events

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
Accidental (non-routine) events	Inappropriate Waste Disposal	Sediment Quality	Decrease in sediment quality	Medium	Very Low	Very Low	Very Low	IN
		Seawater Quality	Decrease in seawater quality	Medium	Moderate	Low	Very Low	MO
		Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton	Medium	High	Very Low	Very Low	MO
		Deep Sea Benthic Communities	Disturbance/damage	Low	Moderate	Very Low	Very Low	IN
		Fisheries	Disturbance/damage	Medium	High	Very Low	Very Low	MO
		Marine Mammals	Disturbance and nuisance, behavioural changes, and avoidance reactions	High	High	Very Low	Very Low	MA

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
		Sea Turtles	Disturbance and nuisance, behavioural changes, and avoidance reactions	High	High	Very Low	Very Low	MA
		Artisanal and Commercial Fishery	Disturbance and pollution to potential fishing areas causing catch loss	Medium	High	Very Low	Very Low	MO
	Leaks and Minor Spills	Air Quality	Decrease of Air quality due to evaporation of gases	Medium	Low	Low	Very Low	MI
		Seawater Quality	Decrease of Seawater quality	Medium	High	Low	Very Low	MO
		Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton	Medium	High	Low	Very Low	MO
		Fisheries	Disturbance/damage	Medium	High	Low	Very Low	MO
		Marine Mammals	Disturbance, nuisance, and behavioural changes	High	High	Low	Very Low	MA
		Sea Turtles	Disturbance, nuisance, and behavioural changes	High	High	Low	Very Low	MA
		Artisanal Fishery and Commercial	Disturbance and pollution to potential fishing areas causing	Medium	High	Low	Very Low	MO

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
		Fishery	catch loss					
	Vessel Collision (Fuel Spill)	Air Quality	Decrease of Air quality due to evaporation of gases	Medium	Moderate	Low	Very Low	MO
		Seawater Quality	Decrease of Seawater quality	Medium	High	Moderate	Low	MA
		Coastal Features	Shoreline pollution	High	High	Moderate	Low	MA
		Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton	Medium	High	Low	Very Low	MO
		Fisheries	Disturbance/damage	Medium	High	Low	Very Low	MO
		Marine Mammals	Disturbance, nuisance, and behavioural changes	High	High	Low	Very Low	MA
		Sea Turtles	Disturbance, nuisance, and behavioural changes	High	High	Low	Very Low	MA
		Artisanal Fishery and Commercial Fishery	Disturbance and pollution to potential fishing areas causing catch loss	Medium	High	Low	Very Low	MO

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
		Population (drillship and vessels' crew)	Injuries or loss of lives	High	High	Very Low	Very Low	MA
		Tourism	Disturbance to touristic destinations	High	Moderate	Low	Low	MA
		Shipping Traffic	Changing routes of navigation	Medium	Moderate	Low	Very Low	MO
	Explosion or Fire	Air Quality	Decrease of Air quality due to evaporation of gases	Medium	High	Moderate	Very Low	MO
		Climate	Effect on climatic change	Medium	Very Low	Very High	Very High	MO
		Sediment Quality	Decrease in sediment quality	Medium	Moderate	Low	Very Low	MO
		Seawater Quality	Decrease of seawater quality	Medium	High	Moderate	Low	MA
		Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton	Medium	High	Low	Very Low	MO
		Fisheries	Disturbance/damage	Medium	High	Low	Very Low	MO
		Marine Mammals	Disturbance, nuisance, behavioural changes and	High	High	Low	Very Low	MA

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
			subjection to physical damage					
		Sea Turtles	Disturbance, nuisance, behavioural changes and subjection to physical damage	High	High	Low	Very Low	MA
		Sea Birds	Disturbance, nuisance, behavioural changes and subjection to physical damage	Medium	High	Low	Very Low	MO
		Artisanal Fishery and Commercial Fishery	Disturbance and pollution to potential fishing areas causing catch loss	Medium	High	Low	Very Low	MO
		Population (drill ship and vessels' crew)	Injuries or loss of lives	High	High	Low	Very Low	MA
		Shipping Traffic	Changing routes of navigation	Medium	High	Low	Very Low	MO
	Well Blowout	Air Quality	Decrease of Air quality due to evaporation of gases on the regional level.	Medium	High	High	Low	MA
		Sediment Quality	Decrease in sediment quality	Medium	High	High	Very High	MA

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
		Seawater Quality	Decrease of seawater quality	Medium	High	High	Low	MA
		Coastal Features	Shoreline pollution	High	High	High	Very High	MA
		Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton	Medium	Very High	High	Very Low	MA
		Deep Sea Benthic Communities	Disturbance/damage	Low	Moderate	High	High	MA
		Fisheries	Disturbance/damage	Medium	High	High	Low	MA
		Marine Mammals	Disturbance, nuisance, behavioural changes and subjection to physical damage	High	High	High	Low	MA
		Sea Turtles	Disturbance, nuisance, behavioural changes and subjection to physical damage	High	High	High	Low	MA
		Sea Birds	Disturbance, nuisance, behavioural changes and subjection to physical damage	Medium	High	High	Very Low	MA
		Artisanal Fishery and Commercial	Disturbance and pollution to potential fishing areas causing	Medium	High	High	Low	MA

Project Component	Aspect	VR	Impact	VR Sensitivity	Magnitude	Extent	Duration	Significance
		Fishery	catch loss					
		Population (drill ship and vessels' crew)	Injuries or loss of lives	High	Moderate	High	Very Low	MA
		Shipping Traffic	Changing routes of navigation	Medium	High	High	Very Low	MA
		Tourism	Disturbance to touristic destinations	High	High	High	Low	MA

10. DESCRIPTION OF MITIGATION MEASURES

This section of the report is dedicated to the detailed description of suggested mitigation measures and procedural actions for expected adverse impacts resulting from the proposed offshore exploration well. These measures/procedures are meant to be considered and adopted as appropriate by Statoil and its contractors during all phases of the proposed project in order to address potential impacts as identified and classified in Section 6 of this document.

Generally, the main objective of the Mitigation Plan and Environmental Management and Monitoring Plan (EMMP) sections is to reduce the significance of impact of the project to an acceptable level for all the project aspects and interrelations with the receiving ecosystem.

Consideration of mobilisation, drilling and demobilisation requirements should be addressed during the planning phase of any operation or project. Careful planning will help avoid difficulties when the activities are finished and demobilisation from the area is taking place. Appropriate design and preparation can ensure that future liability towards the site is kept to a minimum.

Table 10-1, Table 10-2 and Table 10-3 summarize the mitigation measures for all VRs in each project phase. The following subsections detail recommended mitigation measures/procedures only for VRs having moderate or major impacts as referred to in Section 6 of this document.

10.1 Mitigation Measures during Mobilisation/Demobilization Phase

Most impacts during the mobilisation and demobilisation phases are minor, with no major impacts. Marine mammals and sea turtles are the only VRs expected to be exposed to moderate impacts. Thus, the most of the following recommended mitigation measures are concerning marine mammals and sea turtles.

10.1.1 Drill Ship Ballast Exchange

During the mobilisation stage, the drill ship will come from Gulf of Mexico and supporting vessels will travel from Abu Qir to the venue. Ballast water exchange might pose an ecological threat due to the introduction of foreign species into local marine environment; ballast water may also contain oily traces. Potential impacts can be mitigated by:

- Avoiding taking or disposing water at known sensitive, breeding or nesting areas;
- Minimizing uptake of organisms into ballast water tanks. Avoiding ballast water uptake in shallow and turbid areas, e.g. where propellers can stir up sediment, and avoiding uptake at night when many organisms migrate vertically to feed, reduces the number of organisms that enter ballast water tanks;

- Removing ballast sediment. Routine cleaning of ballast water tanks and removal of sediment in mid-ocean or at specific facilities provided in port reduces the number of organisms that are transported;
- Avoiding unnecessary discharge of ballast water. Where uptake and discharge of ballast water within an area demanded, water taken up in another area should not be discharged if avoidable.

10.1.2 Drill Ship Waste Disposal

Some mitigation measures that may be applied during drilling that would alleviate the effects of drill ship waste disposal would be to:

- Implementation of Waste Management Plan at all times; and
- Avoid disposal of litter/waste overboard, especially plastic bags and non-organic wastes.

10.1.3 Drill Ship Use of Engines, Generators and Machinery

Exhaust emissions are the major potential sources of impact on the air and climate of the area. The expected emissions originating from the engines, generators and machinery are CO, CO_X, NO_X and SO_X. As for the particulate matters emissions, it is not expected that they will have a long term impact on the atmosphere due to the short duration of the project activities. Moreover, different marine species may be disturbed by the noise generated from engines and machinery.

To prevent or reduce air pollution and impact on climate and reduce marine species disturbance to a minimum accepted level, it is recommended that the following management and control measures are adopted by Statoil during the proposed activities:

- Minimise unnecessary journeys and adopt a policy of switching off machinery and equipment when not in use;
- Regular inspection and maintenance of vessel engines and equipment should be made; and
- Consider a choice of machinery, equipment, vehicles and materials that are fuel-efficient as part of the purchasing procedure;

10.1.4 Company Communication Strategy

Providing information to local concerned authorities (administrators of the Marine and Port Department and the Department of Fisheries) regarding the location and timing of the drilling activities will have a positive impact on the ability to adjust navigation routes for the duration of the drilling programme. The probability of potential accidents, such as vessel collisions, may be considerably reduced, especially in the case of artisanal fishing vessels that are without radio contact. Conducting the company communication programme is expected to have a positive impact.

Table 10-1 Mitigation Measures during Mobilization/Demobilization Phase

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
Staffing	Local labour force	Employment generation	No mitigation needed.	POSITIVE	N/A
Procurement	Economic activities	Possibility of contribution to local market	No mitigation needed.	POSITIVE	N/A
Drill Ship Ballast Exchange	Seawater Quality	Decrease of water quality as a result of release of bacteria, oily waters and toxins	Ballast intake/discharge to take place in same place, where possible. Avoid ballast discharge in environmentally sensitive areas. Avoid ballast discharge in shallow waters, where possible. Strictly avoid discharge of contaminated ballast. Routine cleaning of ballast water tanks. Avoiding unnecessary discharge of ballast water.	MI	IN
	Phytoplankton and Zooplankton	Introduction of foreign species, pathogens and toxins		MI	MI
	Fisheries	Reducing the source of food (plankton)		MI	MI
	Marine Mammals	Disturbance to Marine Mammals		MO	MO
	Sea Turtles	Disturbance to turtles		MO	MO
	Artisanal and Commercial Fishery	Catch loss		MI	MI

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
Drill Ship Waste Disposal	Seawater quality	Decrease of water quality by disposal of organic waste	Implementation of Waste Management Plan at all times. Avoid disposal of litter/waste overboard, especially plastic bags and non-organic wastes.	MI	IN
	Phytoplankton and Zooplankton	Decrease in planktons		MI	MI
	Fisheries	Decreased water quality		MI	MI
	Marine Mammals	Disturbance to marine mammals		MO	MO
	Sea Turtles	Disturbance to turtles		MO	MO
Drill Ship Use of engines, generators and machinery	Regional / Local air quality	Degradation of local air quality	Minimise unnecessary journeys and adopt a policy of switching off machinery and equipment when not in use. Regular inspection and maintenance of vessel engines and equipment should be made. Consider a choice of machinery,	MI	IN
	Contribution to climate change	Emission of greenhouse gases		MI	MI

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
			equipment, vehicles and materials that are fuel-efficient as part of the purchasing procedure. Vessels and equipment should be well maintained to minimize unnecessary emissions and leaks.		
	Fisheries	Disturbance by vessel noise	Minimise unnecessary journeys and switch off vessel engines and machinery when not in use.	MI	MI
	Marine Mammals			MO	MO
	Sea Turtles			MO	MO
Drill Ship Navigation	Artisanal Fishery and commercial Fishery	Occupation of a potential fishing area	Adopt Company Communication Strategy Minimise unnecessary journeys. Avoid fishing areas and shipping routes. Implementation of Communications Plan.	MI	MI
	Shipping Routes	Disruption of normal shipping routes		MI	MI

10.2 Mitigation Measures during Drilling Phase

10.2.1 Supporting Vessels – Navigation, Ballast Exchange and Waste Disposal

During the operational stage, the supporting vessels will travel from Abu Qir to the proposed well location. Ballast water exchange might pose an ecological threat due to the introduction of foreign species into local marine environment; ballast water may also contain oily traces. Potential impacts can be mitigated by:

- Conducting the company communication programme;
- Providing information to local concerned authorities;
- Ballast intake/discharge to take place in same place, where possible;
- Avoid ballast discharge in environmentally sensitive areas;
- Avoid ballast discharge in shallow waters, where possible;
- Strictly avoid discharge of contaminated ballast;
- Routine cleaning of ballast water tanks;
- Avoiding unnecessary discharge of ballast water;
- Implementation of Statoil's HSE technical and professional requirements;
- Implementation of WMP; and
- Waste disposal to comply with MARPOL.

Ballast exchange and waste disposal may also result into catch loss. This impact can be reduced by the following procedures:

- Regulations and best practices;
- Sewage water to be treated on onboard treatment facility before discharging into sea;
- Discharge of permissible wastes into sea to be strictly offshore;
- Implementation of the Statoil IA guidelines and the Egyptian Environmental legislations and standards.

10.2.2 Supporting Vessels – Use of Engines, Generators and Machinery

Exhaust emissions are the major potential sources of impact on the air and climate of the area. The expected emissions originating from the machines and equipments are CO, CO_X, NO_X and SO_X. Particulate matters may also arise related to the movement of vessels from Abu Qir Base to Kiwi A-1X

well. However, it is not expected that these emissions will have a long term impact on the atmosphere due to the short duration of the project activities.

To prevent or reduce air pollution and impact on climate to a minimum accepted level, it is recommended that the following management and control measures are adopted by Statoil during the drilling activities:

- Comply with the requirements of the Egyptian Environmental Law on accepted levels of exhaust emissions;
- Monitoring and reporting consumption and emission figures in accordance with the EEAA Standards and Guidelines for Emissions Monitoring;
- Choose energy sources/fuels for heavy equipment that produce the least amount of CO_2 and SO_2;
- Apply International good practice and established Statoil standards to operations particularly in emissions reporting; and
- Implementation of Statoil's HSE technical and professional requirements.

Furthermore, to minimize noise pollution of engines and machinery, it is recommended to minimise unnecessary journeys and adopt switch off engines when not in use.

10.2.3 Drill Ship Operations (drilling, casing, cementing and coring)

The impacts of the different drill ship operations on climate and air quality can be reduced by the following mitigation measures:

- Comply with the requirements of the Egyptian Environmental Law on accepted levels of exhaust emissions;
- Monitoring and reporting consumption and emission figures in accordance with the EEAA Standards and Guidelines for Emissions Monitoring;
- Choose energy sources/fuels for heavy equipment that produce the least amount of CO_2 and SO_2;
- Apply International good practice and established Statoil standards to operations particularly in emissions reporting;
- Engines and machinery are to be used to a minimum level and to be switched off when not in use; and
- Implementation of Statoil's HSE technical and professional requirements.

The following mitigation measures can be applied to minimize the drilling operations impacts on water and sediments quality as well as marine species;

- Implementation of Statoil's HSE technical and professional requirements;
- Applying International good practice and established Statoil standards to operations;
- Continuous monitoring of pipeline pressures and fluid flow; and
- Routine inspection and maintenance of drilling equipment.

10.2.4 Waste disposal (discharge of WBM drill cuttings and drainage of wastewater)

The discharge of both WBM drill cuttings and drainage of wastewater to the sea has a number of negative impacts on the marine life. These impacts can be minimized by applying the following mitigation procedures:

- Using only water based drilling mud and low toxicity chemicals, where possible;
- Implementation of Statoil's HSE technical and professional requirements;
- Implementation of WMP;
- Sewage water to be treated on onboard treatment facility before discharging into sea;
- Discharge of permissible wastes into sea to be strictly offshore;
- Prevent unsuitable disposal of waste;
- Maximise the re-use of materials;
- Establish the Best Practicable Environmental Option for storage, treatment, transfer and disposal of waste materials;
- Implementation of the Statoil IA guidelines and the Egyptian Environmental legislations and standards;
- Applying International good practice and established Statoil standards to operations; and
- Waste disposal to comply with MARPOL regulations and best practices.

10.2.5 Helicopter Operations

To prevent or reduce noise pollution produced by helicopter activities and its impacts on marine mammals, sea turtles and sea birds to a minimum accepted level, it is recommended that the following control measures are adopted:

- Adopt effective logistical planning and coordination to minimise unnecessary journeys;
- Avoid low aviation where possible; and
- Avoid flying over migratory routes.

Table 10-2 Mitigation Measures during Drilling Phase

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
Supporting Vessels Movement (Ballast exchange and waste disposal)	Water Quality	Decrease of water quality as a result of release of bacteria, oily waters and toxins	Ballast intake/discharge to take place in same place, where possible. Avoid ballast discharge in environmentally sensitive areas. Avoid ballast discharge in shallow waters, where possible. Strictly avoid discharge of contaminated ballast. Routine cleaning of ballast water tanks. Avoiding unnecessary discharge of ballast water. Implementation of Statoil's HSE technical and professional requirements. Implementation of WMP. Waste disposal to comply with MARPOL	MI	IN
	Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton		MI	MI
	Fisheries	Reducing the source of food (plankton)		MI	MI
	Marine Mammals	Disturbance to Marine Mammals		MO	MO
	Sea Turtles	Disturbance to turtles		MO	MO

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
	Artisanal and Commercial Fishery	Catch loss	regulations and best practices. Sewage water to be treated on onboard treatment facility before discharging into sea. Discharge of permissible wastes into sea to be strictly offshore. Implementation of EMMP (Section 9 of this EIA).	MI	MI
Supporting Vessels Movement, (Use of engines, generators, and machinery)	Regional / Local air quality	Degradation of local air quality	Comply with the requirements of the Egyptian Environmental Law on accepted levels of exhaust emissions. Monitoring and reporting consumption and emission figures in accordance with the EEAA Standards and Guidelines for Emissions Monitoring. Choose energy sources/fuels for heavy equipment that produce the least amount of CO_2. Apply International good practice and established Statoil standards to operations particularly in emissions reporting.	MI	MI
	Contribution to climate change	Emission of greenhouse gases		MI	MI

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
			Implementation of Statoil's HSE technical and professional requirements.		
	Fisheries	Disturbance by vessel noise	Minimise unnecessary journeys and adopt switch off engines when not in use.	MI	MI
	Marine Mammals			MO	MO
	Sea Turtles			MO	MO
Supporting Vessels Navigation	Artisanal Fishery and commercial Fishery	Occupation or disturbance to potential fishing areas	Minimise unnecessary journeys and switch off vessel engines when not in use. Avoid fishing areas and shipping routes.	MI	IN
	Shipping Routes	Disruption of normal shipping routes	Implementation of Communications Plan.	MI	MI
Drill ship operations (drilling, casing, cementing	Regional / Local air quality	Degradation of local air quality	Comply with the requirements of the Egyptian Environmental Law on accepted levels of exhaust emissions. Monitoring and reporting consumption and emission figures in accordance with the EEAA	MI	IN
	Climate	Global warming		MI	IN

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
and coring)			Standards and Guidelines for Emissions Monitoring. Choose energy sources/fuels for heavy equipment that produce the least amount of CO_2. Apply International good practice and established Statoil standards to operations particularly in emissions reporting. Engines and machinery are to be used to a minimum level and to be switched off when not in use. Implementation of Statoil's HSE technical and professional requirements.		
	Sediment Quality	Disturbance of sea bed and decrease sediment quality	Implementation of Statoil's HSE technical and professional requirements. Applying International good practice and established Statoil standards to operations. Continuous monitoring of pipeline pressures and fluid flow.	MI	MI
	Seawater Quality	Decrease of water quality		MI	MI

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
	Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton	Routine inspection and maintenance of drilling equipment.	MI	MI
	Deep Sea Benthic Communities	Disturbance/damage		MI	MI
	Fisheries	Disturbance/damage		MI	IN
	Marine Mammals	Noise causing behavioural changes and disruption of communication Disturbance and nuisance to Marine Mammals		MO	MI

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
	Sea Turtles	Noise causing behavioural changes and disruption of communication Disturbance and nuisance to Turtles		MO	MI
	Sea birds	Nuisance and disturbance		IN	IN
Waste disposal (discharge of	Sediment Quality	Disturbance and decrease in sediment quality	Using only water based drilling mud and low toxicity chemicals, where possible. Implementation of Statoil's HSE technical and professional requirements. Implementation of WMP.	MI	MI
	Seawater Quality	Decrease in water quality		MO	MI

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
WBM drill cuttings and drainage of wastewater)	Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton	Sewage water to be treated on onboard treatment facility before discharging into sea. Discharge of permissible wastes into sea to be strictly offshore. Prevent unsuitable disposal of waste. Maximise the re-use of materials. Establish the Best Practicable Environmental Option for storage, treatment, transfer and disposal of waste materials. Implementation of EMMP (Section 9 of this EIA). Applying International good practice and established Statoil standards to operations. Waste disposal to comply with MARPOL regulations and best practices.	MI	MI
	Deep Sea Benthic Communities	Disturbance/damage		IN	IN
	Fisheries	Disturbance/damage		MI	MI
	Marine Mammals	Disturbance and nuisance, behavioural changes, and avoidance reactions		MO	MI
	Sea Turtles	Disturbance and nuisance, behavioural changes, and avoidance reactions		MO	MI

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
	Artisanal and Commercial Fishery	Disturbance to potential fishing areas causing catch loss		MI	IN
Helicopter operations	Marine Mammals	Disturbance and nuisance, behavioural changes, avoidance reactions, and disruption of communication	Minimise unnecessary journeys. Avoid hovering and low aviation. Avoid migratory routes.	MO	MI
	Sea Turtles			MO	MI
	Sea Birds			MO	MI

10.3 Mitigation Measures for Accidental (Non-Routine) Events

Accidental and non-routine events pose the greatest impacts on the operating staff and the surrounding environment. All identified VRs are affected either moderately or majorly. The following methods are presented to reduce/minimise the impacts of each aspect.

10.3.1 Inappropriate Waste Disposal

All waste handling and disposal must follow the project's Waste Management Plan (WMP). Although TWMA has been awarded as waste contractor, Statoil have the responsibility to monitor and ensure the safe handling of all its waste.

Mitigation of risks regarding all waste types discussed in Section 3 fall under the following measures:

- Implementation of WMP;
- Applying international good practice and established Statoil standards to operations;
- Implementation of Statoil's HSE Management and Risk Management;
- Implementation of Statoil's HSE technical and professional requirements;
- Establish the "Best Practicable Environmental Option" for storage, treatment, transfer and disposal of waste materials;
- Comply with the requirements of the Egyptian Environmental Law;
- Waste disposal to comply with MARPOL regulations and best practices;
- Implementation of EMMP (Section 9 of this EIA); and
- Ensure trained and competent staff in waste management.

10.3.2 Leaks and Minor Spills

Principal risks to the marine environment arise from small to medium sized leaks and spills. Leaks and minor spills are defined as small spills resulting from the following activities:

- Diesel fuel bunkering operations;
- Ship to ship transfer operations;
- WBM/LTOBM leakage during drilling activities; and
- Topple or rupture of topside oil/chemical storage tanks.

These risks can be minimised through:

- Applying International good practice and established Statoil standards to operations;

- Implementing Statoil's HSE Management and Risk Management;
- Implementing Statoil's HSE technical and professional requirements;
- Conducting regular risk reduction reviews on facilities;
- Developing Oil Spill Response Plan (OSRP);
- Developing Ship Onboard Pollution and Environmental Protection (SOPEP) manual for vessels;
- Ensure availability of sorbent material and/or necessary oil spill response equipment onboard drill ship and vessels;
- Inspecting and maintaining storage tanks, transfer lines, pipelines, etc;
- Training staff in transfer operations and oil spill response; and
- Conducting regular oil spill drills and exercises.

10.3.3 Vessel Collision (Fuel Spill)

Providing information to local concerned authorities (administrators of the Marine and Port Department and the Department of Fisheries) regarding the location and timing of the drilling activities, and granting their approval to commence the drilling programme will have a positive impact on the ability to adjust navigation routes for the duration of the drilling programme. The probability of potential accidents, such as vessel collisions, may be considerably reduced, especially in the case of artisanal fishing vessels that are without radio contact. Conducting the company communication plan is expected to have a positive impact. More detailed mitigation measures are provided in Table 10-3.

10.3.4 Explosion or Fire

Statoil is to follow rigid HSE and fire fighting management practices to ensure minimal damage in the event of onboard explosion or fire. Regular inspection and maintenance of engines and machinery may reduce the risks of explosion or fire. Furthermore, conducting risk reduction reviews help identify operational risks to the facility. Statoil shall be proactive in identifying risks related to fire and other HSE issues, while taking necessary measures to reduce the risks. Regular fire fighting training and drills shall ensure personnel readiness and competency in case of such event. Table 10-3 provides a more detailed listing of recommended mitigation measures to reduce the risks of explosion or fire.

10.3.5 Well Blowout

Well blowout is considered to be the worst case scenario for oil spills. In general, all the impacts resulting from a well blowout could be catastrophic; however, The implementation of the HSE standards during the design and planning phase and during the operations should keep the

probability of the event low, while the implementation of the OSRP will reduce the consequences of such an event and reduce the possibility of the containments from reaching the coast.

To seal, control and monitor oil and gas wells during extreme erratic pressures and uncontrolled flow emanating from a well reservoir during drilling, a blowout preventer (BOP) is installed on the drill ship with additional control measures to reduce the probability of failure. Blowout preventers are critical to the safety of crew, company assets and environment, and to the monitoring and maintenance of well integrity; thus blowout preventers are intended to be fail-safe devices. Routine inspection and maintenance of the BOP shall be maintained at all times.

Routine inspections and reviews shall also be conducted on the drill ship as a whole. Conducting regular risk reduction reviews of the facilities shall help prevent or minimize spills.

Applying international good practice and Statoil standards to operations, HSE and risk management are essential elements in the reduction of well blowout probability and impacts. The development of an OSRP based on predetermined scenarios and trajectory modelling results is also necessary in order to comply to national and international requirements. The OSRP shall outline the strategies, oil spill equipment and management necessary to respond to an oil spill. Thus, the OSRP shall include training programs and oil spill drills and exercises to include well blowout scenarios.

The OSRP that has been developed for this project is inserted in Appendix 6. The main elements of this OSRP are: strategy, actions and operations, and a data directory. The strategy of the OSRP identifies the roles and responsibilities of the different personnel and entities involved in an oil spill incident. The strategy is based on a tiered system and a risk assessment that takes into consideration the potential sources, sizes, types of hydrocarbon and spill scenarios. The action and operations outlines all emergency procedures and information required to activate an effective response mechanism. The data directory contains support information for the execution of the procedures. Section 13 discusses the OSRP in further detail.

A summary of the mitigation measures for a blowout is presented in Table 10-3, and a more detailed discussion of the mitigation measures related to well blowout events shall be discussed in the next section.

Table 10-3 Mitigation Measures during Accidental (Non-Routine) Events

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
Inappropriate Waste Disposal	Sediment Quality	Decrease in sediment quality	Applying International good practice and established Statoil standards to operations. Implementation of Statoil's HSE Management and Risk Management. Implementation of Statoil's HSE technical and professional requirements. Establish the Best Practicable Environmental Option for storage, treatment, transfer and disposal of waste materials. Comply with the requirements of the Egyptian Environmental Law. Implementation of WMP. Waste disposal to comply with MARPOL regulations and best practices. Implementation of EMMP (Section 9 of this EIA).	IN	IN
	Seawater Quality	Decrease in seawater quality		MO	MI
	Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton		MO	MI
	Deep Sea Benthic Communities	Disturbance/damage		IN	IN
	Fisheries	Disturbance/damage		MO	MI
	Marine Mammals	Disturbance and nuisance, behavioural changes, and avoidance reactions		MA	MO

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
Inappropriate Waste Disposal	Sea Turtles	Disturbance and nuisance, behavioural changes, and avoidance reactions	Trained and competent staff in waste management.	MA	MO
	Artisanal and Commercial Fishery	Disturbance and pollution to potential fishing areas causing catch loss		MO	MI
Leaks and Minor Spills	Air Quality	Decrease of Air quality due to evaporation of gases	Applying International good practice and established Statoil standards to operations. Implementation of Statoil's HSE Management and Risk Management. Implementation of Statoil's HSE technical and professional requirements. Conducting regular risk reduction reviews on facilities. Development of Oil Spill Response Plan (OSRP). Development of Ship Onboard Pollution and Environmental Protection (SOPEP) manual.	MI	MI
	Seawater Quality	Decrease of Seawater quality		MO	MI
	Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton		MO	MI
	Fisheries	Disturbance/damage		MO	MI
	Marine Mammals	Disturbance, nuisance, and behavioural changes		MA	MO
	Sea Turtles	Disturbance, nuisance, and behavioural changes		MA	MO

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
	Artisanal Fishery and Commercial Fishery	Disturbance and pollution to potential fishing areas causing catch loss	Availability of sorbent material and/or necessary oil spill response equipment onboard drill ship and vessels. Routine inspection and maintenance of storage tanks, transfer lines, pipelines, etc. Trained and competent staff in transfer operations and oil spill response. Regular oil spill drills and exercises.	MO	MI
Vessel Collision (Fuel Spill)	Air Quality	Decrease of Air quality due to evaporation of gases	Providing information to local concerned authorities. Applying International good practice and established Statoil standards to operations. Implementation of Statoil's HSE Management and Risk Management. Implementation of Statoil's HSE technical and professional requirements. Establish communications with all entities that	MO	MI
	Seawater Quality	Decrease of Seawater quality		MA	MO
	Coastal Features	Shoreline pollution		MA	MO
	Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton		MO	MO
	Fisheries	Disturbance/damage		MO	MO

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
	Marine Mammals	Disturbance, nuisance, and behavioural changes	might be influence by project activities. Implementation of Communications Plan. Routine inspection and maintenance of navigation equipment. Trained and competent staff.	MA	MO
	Sea Turtles	Disturbance, nuisance, and behavioural changes		MA	MO
	Artisanal Fishery and Commercial Fishery	Disturbance and pollution to potential fishing areas causing catch loss		MO	MO
	Population (drill ship and vessels' crew)	Injuries or loss of lives		MA	MO
	Tourism	Disturbance to touristic destinations		MA	MO
	Shipping Traffic	Changing routes of navigation		MO	MI
Explosion or Fire	Air Quality	Decrease of Air quality due to evaporation of gases	Applying International good practice and established Statoil standards to operations. Implementation of Statoil's HSE Management	MO	MO
	Climate	Effect on climatic change		MO	MO

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
	Sediment Quality	Decrease in sediment quality	and Risk Management. Implementation of Statoil's HSE technical and professional requirements. Regular inspection and maintenance of engines and machinery. Conducting regular risk reduction reviews on facilities. Trained and competent staff in fire fighting. Regular fire drills.	MO	MI
	Seawater Quality	Decrease of seawater quality		MA	MO
	Phytoplankton and Zooplankton	Decrease in density of Phytoplankton and Zooplankton		MO	MO
	Fisheries	Disturbance/damage		MO	MO
	Marine Mammals	Disturbance, nuisance, behavioural changes and subjection to physical damage		MA	MO
	Sea Turtles	Disturbance, nuisance, behavioural changes and subjection to physical damage		MA	MO
	Sea Birds	Disturbance, nuisance, behavioural changes and		MO	MO

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
		subjection to physical damage			
	Artisanal Fishery and Commercial Fishery	Disturbance and pollution to potential fishing areas causing catch loss		MO	MI
	Population (drill ship and vessels' crew)	Injuries or loss of lives		MA	MO
	Shipping Traffic	Changing routes of navigation		MO	MO
Well Blowout	Air Quality	Decrease of Air quality due to evaporation of gases	Applying International good practice and established Statoil standards to operations.	MO	MO
	Sediment Quality	Decrease in sediment quality	Implementation of Statoil's HSE Management and Risk Management.	MA	MO
	Seawater Quality	Decrease of seawater quality	Implementation of Statoil's HSE technical and professional requirements.	MA	MO
	Coastal Features	Shoreline pollution	Routine inspection and maintenance of BOP.	MA	MO
	Phytoplankton	Decrease in density	Conducting regular risk reduction reviews on	MA	MO

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
	and Zooplankton		facilities. Development of Oil Spill Response Plan (OSRP), to include well blowout scenario. Development of Ship Onboard Pollution and Environmental Protection (SOPEP) manual. Availability of sorbent material and/or necessary oil spill response equipment onboard drill ship and vessels. Trained and competent staff in drilling and oil spill response. Regular oil spill drills and exercises, to include well blowout scenario.		
	Deep Sea Benthic Communities	Disturbance/damage		MA	MO
	Fisheries	Disturbance/damage		MA	MO
	Marine Mammals	Disturbance, nuisance, behavioural changes and subjection to physical damage		MA	MO
	Sea Turtles	Disturbance, nuisance, behavioural changes and subjection to physical damage		MA	MO
	Sea Birds	Disturbance, nuisance, behavioural changes and subjection to physical damage		MA	MO
	Artisanal Fishery and Commercial	Disturbance and pollution to potential fishing areas		MA	MO

Aspect	VR	Impact	Mitigation Measure(s)	Significance before Mitigation	Significance after Mitigation
	Fishery	causing catch loss			
	Population (drill ship and vessels' crew)	Injuries or loss of lives		MA	MO
	Shipping Traffic	Changing routes of navigation		MA	MO
	Tourism	Disturbance to touristic destinations		MA	MO

11. STAKEHOLDER IDENTIFICATION AND CONSULTATION

11.1 Introduction

The main objective of this section is to identify the groups of key stakeholders, both geographically and administratively, that Statoil will need to engage with the community to build good relationships during the various stages of activities and support successful future development.

Stakeholder engagement is an umbrella term encompassing a range of activities and interactions over the life of a project.

When engaging the stakeholder, it is important to consider the following points:

- Designing the engagement strategies in line with the needs of respective projects.
- Engaging with stakeholders from the start enables a proactive cultivation of relationships that can serve as “capital during challenging times”.
- Small projects with minimal impacts may only need to focus on the information disclosure and communication side of the spectrum.

11.2 Stakeholder Identification

The following categories of stakeholders were identified through desk-based research and past WorleyParsons experience in stakeholder information and consultation in the region:

- **Authorities**: Elected and appointed authorities at the national, regional and local level;
- **Local residents**: Local communities, project affected people (PAP), vulnerable subgroups (e.g. disabled people, ethnic minorities, elders, women, and children);
- **Local businesses**: People with agricultural interests (farmers) or other professional occupations (fishermen), local business establishments and associations;
- **Non-governmental organisations (NGOs)**: International, national and local non-governmental organisations (NGOs), particularly those with an interest in environmental and social issues within the study area;
- **Other interested groups**: Chambers of commerce, media, educational institutions, religious institutions, etc.;
- **Peer companies**: Egyptian national petroleum and gas companies.

Authorities	**Local authorities**
	▪ El-Dabaa city council ▪ Information Centre
	▪ Social Affairs Unit (El-Dabaa) ▪ Agricultural Land Protection Agency ▪ Department of Social Security Affairs ▪ Department of Women's Affairs ▪ Educational Authority ▪ Health Department ▪ Investment Department ▪ Planning Department ▪ Product Families Department
	Regional Environmental and Social Government Agencies
	▪ Marsa Matrouh and Alexandria Governorate: the governorate environmental office which administratively belongs to the governorate but technically follows EEAA. ▪ Omyeid Protectorate
	National Government
	▪ Egyptian Environmental Affairs Agency (EEAA) in Cairo ▪ Regional Branch Office (RBO) in Alexandria ▪ Abu Qir Base/Port Authority

	▪ General Authority for Fish Resources Development (GAFRD) ▪ Ministry of Water Resources and Irrigation (incl. Coastal Research Institute and Shore Protection Authority) ▪ Ministry of Health ▪ Ministry of Housing ▪ Ministry of Marine Transport ▪ National Centre for State Land Use
Local residents	▪ Local residents of El-Dabaa community ▪ Local residents of Abu Qir community
	▪ Local villages councils (Gamema , Swaney Gaberm ,El-Sharnabia, El-Harabee, Gallalmm El-Gofferah, Sidi Shabeebm, Zawyet El-Awamam , Al-Zaytoon, Fokka, Awlad Alwaney, Ghazallah and Swaney Samalloos)
Local businesses	▪ Tourism industry ▪ El-Dabaa farmers and Fishermen ▪ Abu Qir employees and fishermen
	▪ Other fishermen in the coastal waters in the vicinity of the proposed site location: Abu Qir port fishermen and employees and others
NGOs	▪ El-Dabaa Development Association ▪ Charity association for Haj & Omra - El-Dabaa ▪ Slaeh charity organization, El-Dabaa
Other interested groups	▪ Universities and other academic groups: Alexandria university faculties and institutes in Alexandria governorate ▪ International, national, regional, and local media ▪ Trade associations, industrial bodies ▪ Security forces: coast guards, army bases and police ▪ Labour unions

Petroleum and Gas Industry	▪ Egyptian Natural Gas Holding Company (EGAS)
	▪ Egyptian General Petroleum Corporation (EGPC**)**
	▪ Major Foreign Oil Company Involvement in Egypt : BP, Shell

11.3 Stakeholder Analysis

Stakeholder analysis has been conducted using Mendelow's Power-Interest Grid. This method uses a qualitative scale ("low" and "high") to evaluate the level of Stakeholder power and interest on the proposed project. It should be noted that this scale is not intended to rank the importance of Stakeholders; the intention of this scoring is only to give an overview of the spectrum of relationships between Statoil and its Stakeholders.

Power of a Stakeholder on the project was evaluated on the basis of the following criteria:

- Direct power (e.g. those who could directly influence project success);
- Indirect power (e.g. those who could pose unforeseen risks and distractions to operations); and
- No power.

Interest of a Stakeholder on the Project was evaluated on the basis of the following criteria:

- Positive interest (e.g. those who benefit from the project);
- Negative interest (e.g. those who are harmed by the project); and
- Not affected.

The stakeholder analysis categorizes the stakeholders according to their power and interest. The categories are as follows:

- **High power, but low interest (Group A)**: Keep satisfied and try to create positive relationships;
- **High power and high interest (Group B)**: Manage closely and ensure good working relationships with these Stakeholders; invest in engagement processes to understand concerns and develop solutions;
- **Low power and low interest (Group C)**: May need limited monitoring. Provide access to general channels of information and feedback; and
- **Low power, but high interest (Group D)**: Vulnerable Stakeholders. Keep informed on a regular basis.

Based on these results, a Stakeholder Management Strategy could be developed.

Stakeholder	Priority
▪ Egyptian Natural Gas Holding Company (EGAS) ▪ Egyptian Environmental Affairs Agency (EEAA) in Cairo ▪ Regional Branch Office (RBO) in Alexandria ▪ Marsa Matrouh and Alexandria Governorates ▪ Omyeid Protectorate ▪ Abu Qir Base/Port Authority	High

11.4 High Priority Stakeholders

11.4.1 Egyptian Environmental Affairs Agency (EEAA)

According to the environmental Law 4/1994, the mandate of the Egyptian Environmental Affairs Agency (EEAA) is to protect and promote the environment. It is established within the cabinet of Ministers. The agency is a public entity, currently affiliated to the Ministry of State for environmental Affairs with an independent budget. EEAA operates Regional Branch Offices (RBO) in some governorates of Egypt. EEAA formulates the national policy and lays down the necessary plans for protecting and promoting the environment. It follows up the implementation of such plans in coordination with the competent administrative authorities. It also has the authority to implement some pilot projects.

It recommends taking the necessary legal procedures to adhere to regional and international conventions related to the environment and prepares the necessary draft laws and decrees required for the implementation of such conventions.

Moreover, the EEAA sets criteria and procedures for mandatory EIAs of projects, approves EIAs and monitoring programmes, and inspects the environmental registers during project operation. The EEAA has the authority to take action against violators of these criteria and conditions.

11.4.2 Egyptian Natural Gas Holding Company (EGAS)

EGAS was established in 2001 by the Ministry of Petroleum as the main body for handling the natural gas chain of activities in Egypt. EGAS has put to the top of its priorities the protection of people, assets and the environment, and has made these of equal importance to the development of resources. EGAS has set principles to realise its objectives, such as compliance with legislation relevant to its activities; achievement of continual improvement in the field of safety and environment; supervision and follow up of safety and environmental activities within EGAS and EGAS-affiliated companies; investigation and analysis of incidents to prevent recurrence; review of risk and environmental assessments; and securing a safe working environment by providing necessary training and awareness among its employees. EGAS is the authority responsible for all gas-related operations, including exploration, implementation of gas projects and transportation, evaluation and approval all upgrading plans for gas handling facilities, management, supervision and follow up of operations and maintenance activities of all gas pipelines and the national gas network, and revision of all natural gas agreements and contracts.

11.4.3 Matrouh and Alexandria Governorates

The governorates have the responsibility for implementation, monitoring and enforcement of the national laws. They are also responsible for the specification of a land to serve as a landfill for dumping of any waste materials either industrial or domestic. EEAA is responsible for the establishment of regional offices in each governorate. These offices, in coordination with the governorate, shall undertake the requirement and evaluation of the projects proposed to be established in the governorate. It is worth mentioning that the governorates have the right to refuse the establishment or operations of any project within its boundaries whenever it finds that the project can seriously affect the residents or drastically consume its natural resources.

11.4.4 Omyeid Protectorate

The protectorates have the responsibility for the management of protection of nature and preservation of biodiversity in coordination with concerned and responsible authorities, planning of running and monitoring of natural protectorates, encouraging and follow up of new individual initiatives, implementation of international agreements and conventions on biodiversity, and public awareness about regulations and means of nature protection.

11.4.5 Abu Qir Supply Base Authority

All the offshore drilling operations will be supported from Abu Qir Supply Base, a few kilometres east of Alexandria on the Mediterranean coast of Egypt, and it is a part from Abu Qir Naval Base and Port of Abu Qir. Abu Qir Naval Base, which is run by the Egyptian Navy and so, is very secure and well managed in true military fashion.

11.5 Stakeholders Consultation

The stakeholder consultation meetings were conducted in the period from 25-26 October 2010. This consultation was conducted by a team from WorleyParsons and Statoil Egypt with stakeholders in Marsa Matrouh and Alexandria governorates including EEAA Regional Branch Office (RBO), protectorates and governorate officials.

As illustrated in the Stakeholders Identification and Consultation report (455/EJ6172-000-EN-REP-02), these participants were indentified as high priority stakeholders. Table 11-3 shows information about the stakeholder consultation meetings attendances.

Stakeholder	Name	Contact Details	Statoil Rep.	WP Rep.	Date of Meeting
• EEAA's Regional Branch Office (RBO) in Alexandria ▪ RBO Technical Office Director ▪ Coastal Water Quality Department Director ▪ Coastal Zones Department Director ▪ Laboratory Director • Omyeid Protectorate Director	Mr. Hosam Mahmoud Mr. Mohamed A. Shindy Eng. Esam Hashem Saad Zamel Mr. Tamer Saber Ismaeil	03 3020691 0107644323 0124738403 0181329400 0175955181	Ahmed Osman 0168842023	Ehsan Elhady 0107964242	25 Oct. 2010
• Alexandria Gov. Environmental Office Director	Dr. Sameh Reyad	033900741			
• Marsa Matrouh Gov. Environmental Office Deputy Manger • Marsa Matrouh Fisheries Association Director	Mr. Taher Moftah Eng. Mahmoud El Atreisy	0181329400 0103467522			26 Oct. 2010

The consultation meetings were based on structured interviews methodology that took into consideration Statoil requirements, described in the Stakeholders Identification and Consultation report. Handouts with the needed information about both Statoil and the proposed project were

distributed to the participants. The main objective of the stakeholder consultation was to identify the project activities, phases and schedule in addition to introduce Statoil Egypt Company to the stakeholders.

It is worth mentioning that Statoil had already been awarded the EEAA approval on the proposed project before conducting the consultation meetings. According to the Egyptian law, Statoil is not obliged to conduct stakeholders consultation after EEAA approval; nevertheless, the consultation meetings were conducted out of Statoil commitment to the local community and belief in the importance of open communication between the company and the potentially affected groups, making it one of the pioneer companies in the oil and gas field in Egypt that takes such proactive action.

The overall outcomes of the consultation meetings were positive and promising. The participants showed support to the project in the current stage as well as future stages; moreover, the meetings managed to open channels of communication and cooperation between the local authorities and Statoil. The overall participants' feedback on the project was positive.

12. ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

The purpose of this section is to gather the recommended mitigation measures identified in Section 10 to enable the preparation of an integrated Environmental Management and Monitoring Plan (EMMP) that can be used during operational activities to ensure impacts to the environment are monitored and kept to an absolute minimum. This is not an exhaustive plan, but only sets the framework. "*Environmental Management is a tool for an organisation to keep aware of the interactions that its products and activities have with the environment and to achieve and continuously improve the desired level of environmental performance.*" (Fredericks, *et. al*, 1995)

Every EMMP is designed for a particular operation and organisation and there is no single model that would apply to all types of industrial, commercial or institutional development. As per Statoil's Impact Assessment Guidelines (GL0386), monitoring activities should focus on:

- progress with the implementation of the Project Management Program/Action Plan;
- key impacts of the project (on workers, communities and natural environment as identified in this EIA);
- compliance with laws and regulations; and
- tracking any significant deviations from the original project description (sites, technical concepts, estimated emission and discharge volumes).

Establishing clearly defined performance indicators should be considered.

The baseline established in this EIA shall be used for subsequent monitoring of impacts. The monitoring program should aim to monitor direct, secondary and cumulative impacts. The affected communities' perceptions of project risks should be taken into account when designing the Monitoring Program. A monitoring program could also be an important part of management of liabilities as it aims to identify and verify the extent of negative impacts from the project.

Follow up activities should in many cases also include regular site visits, reporting, community and stakeholder engagement, independent internal verification and audits or external supervision. For projects with significant impacts that are diverse, irreversible, or unprecedented, the need for using qualified and experienced external experts to verify monitoring information should be considered.

Understanding the business impact and contribution to the community and surrounding environment throughout the lifetime of operations is fundamental to ensuring good stakeholder relations, a continued license to operate and the sustainability of our business. For learning purposes, an extended monitoring program to monitor, track and measure both beneficial and adverse impacts throughout the lifecycle of the project should be considered for key projects.

Statoil has established a commitment/action register to ensure that all actions/measures and commitments are identified and followed up.

13. EMERGENCY AND OIL SPILL RESPONSE PLANS

This section describes Statoil's Emergency Response Plan (ERP) and its Oil Spill Response Plan (OSRP). Statoil's ERP explains the Line 2 emergency response organisation for operations, and defines organisation, responsibilities and general routines to be adopted. On the other hand, Statoil's OSRP explains the procedures to coordinate and respond to oil spill situations in compliance to national and international regulations. This OSRP has been developed based on the surface and subsurface trajectory and fates models.

13.1 Statoil's Emergency Response Plan (ERP)

13.1.1 Objectives

The objective of this plan is to establish a common understanding of the task, roles and responsibility of operational management duty if an Emergency situation should occur at the Kiwi A-1X project at El-Dabaa offshore concession.

13.1.2 Emergency Response Procedures

Country Manager in Egypt is in overall command to handle any Emergency situation at Line 1 (Discoverer Americas drill ship) during the operation at El-Dabaa. The responsibility of the Country Manager starts when the drill ship crosses the Egyptian waters.

Emergency Commander at Cairo office's 2.line is delegated to lead the emergency organization on behalf of the Country manager.

Project Manager in Houston is responsible to establish a duty system throughout the drilling operation from spudding and until finish the operation at Egyptian shelf. The candidates for this position should have good knowledge of the operation. This duty organization should, upon request from the Egypt Emergency organization, give technical support in emergency situations.

If any emergency situation occurs, GOM Operation duty manager shall on request from 2.line Cairo office muster in dedicated emergency room in Houston office and report directly to the Project duty officer in Egypt.

In order to handle the situation as efficient and smooth as possible, communication between 1.line, GOM Operation duty manager and 2.line shall be in line with the principle of proactive emergency leadership.

In this respect there will be technical and operational issues that in some context only will involve GOM and 1.line. Still if any major decision are influencing the emergency situation this should be taken in cooperation with and by 2.line Cairo office.

When the project duty officer or the duty officer in Cairo office receives a notification from Line 1, he/she will then decide to mobilize the ER team in consultation with the ER Commander. In this situation an emergency situation has been declared and GOM Operations duty manager will report to the project duty officer in Egypt.

13.1.3 Emergency Response Organisation and Notifications in Emergencies

Figure 13-1 illustrates emergency organisation for notifications related to incidents on the Discoverer Americas. Notification will go from Line 1 on the Discoverer Americas to the Project Duty Officer.

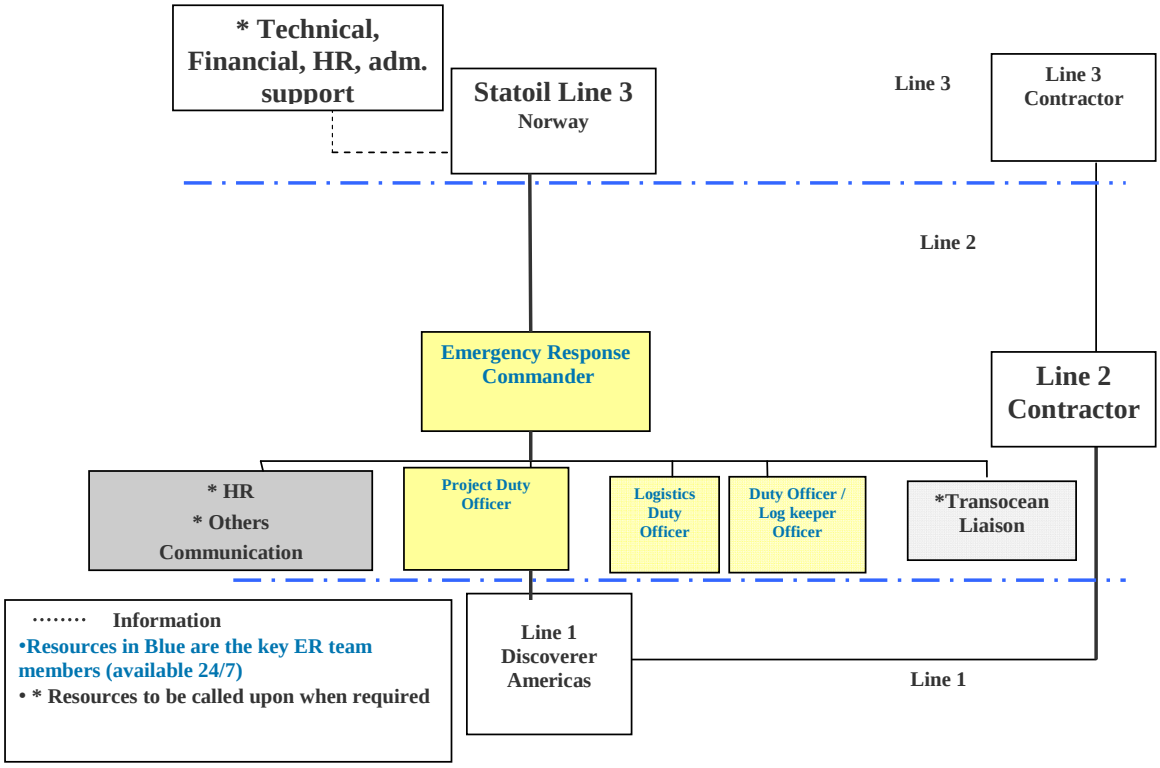

Figure 13-1 Emergency Organisation in Case of an Incident on the Discoverer Americas Rig

Figure 13-2 illustrates emergency organisation for notifications related to incidents from the contractors. In any project-related emergency, the notification will go from line 1 to the Duty Officer.

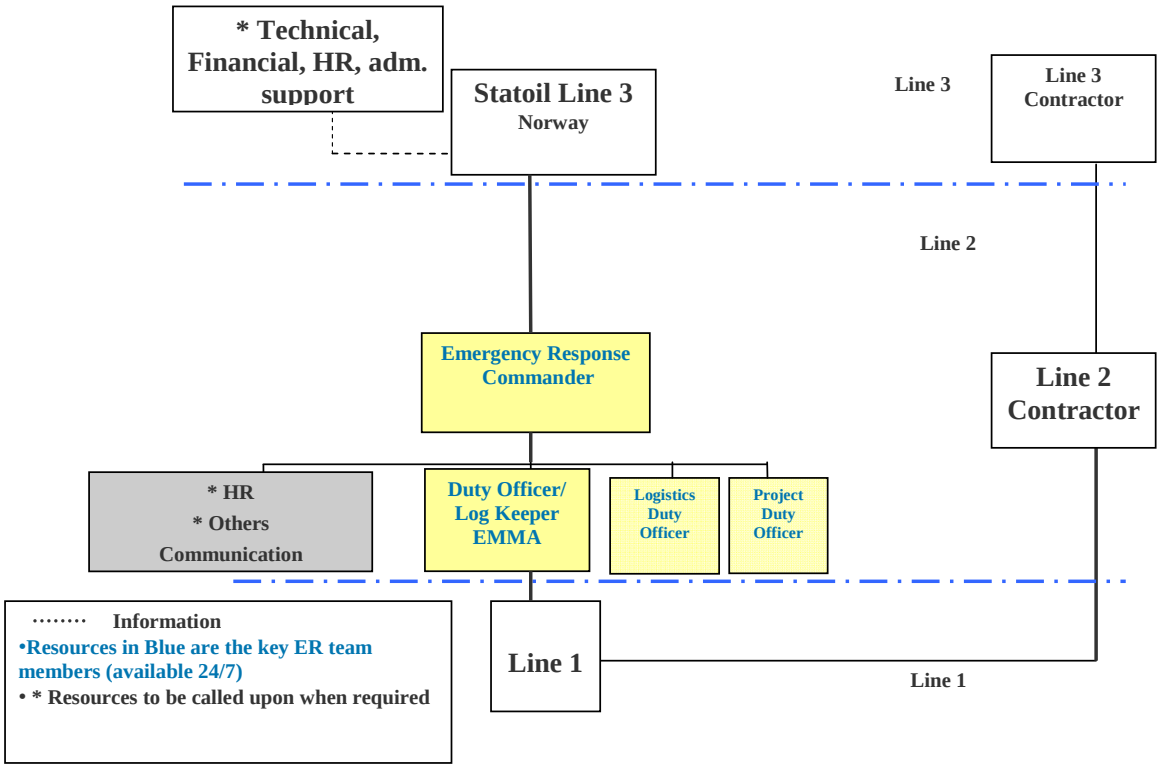

Figure 13-2 Emergency Organisation in Case of an Incident Related to Contractors

13.1.4 Roles and Responsibilities

EMERGENCY RESPONSE COMMANDER (ER COMMANDER)

- Consider mustering- decide if needed;
- Inform and communicate with the Duty Officer;
- Notify:
    - 3.line/Statoil HQ, Norway;
    - Country Manager; and
    - Egyptian authority (EGAS, EEAA, EGPC and Military) can delegate this task to the Duty Officer.
- After the initial incident notification to the Project Duty Officer and assembling in the ERC, is the single point of contact with Statoil 1.line representative/place of incident. This role can be delegated if found feasible; and
- Consider need for Liaison from Vendor/Transocean to attend Cairo ERC.

DUTY OFFICER / LOG KEEPER

- Receives notifications from project contractors (vessel contractors, Abu Qir Base, PAS Helicopter contractor), except from the Discoverer Americas;
- Inform and communicate with the ER Commander;
- Communicate with the local support organisation (Search and Rescue –SAR, Hospitals, authorities); and
- Communicate with the local Medical Consultant in medical emergency situations.

PROJECT DUTY OFFICER

- Receives the initial incident notification from Statoil Lead Drilling Supervisor onboard the Discoverer Americas and communicates the situation status to the Emergency Response Commander;
- Notify and communicate with Drilling Superintendent on duty in Houston;
- Notify and communicate with Transocean duty rig manager in Cairo;
- If requested by Emergency Response Commander, be a single point of contact with Statoil 1.line representative onboard the Discoverer Americas;
- Ensure information flow between Project in Houston, Drilling supervisor and ER Commander performing well;
- Provide engineering support on request;
- Provide well control expertise on request;
- Overall responsible for finalizing report from the incident; and
- Carry out tasks as requested by ERC.

LOGISTICS DUTY OFFICER

- Notify and communicate with relevant contractors, such as:
    - Statoil representative at the BP base at Abu Qir;
    - PAS for helicopters;
    - ER vessels; and
    - PESCO (in case of an oil spill).
- Ensure that appropriate contracts are established through the use of resources, as well as the control of these;

- Provides and maintains an updated POB list through the PTS system;
- Establish cooperation with BP base regarding need for extra vessel services;
- Make an overview over of the relevant area with the relevant geographical information, resources and weather condition;
- Coordinating oil spill response action with the ER Commander, Duty officer, PESCO and OSR; and
- All ongoing supply activities with helicopters, supply vessels, ER vessels, etc. shall be followed up and logged in EMMA.

13.2 Oil Spill Response/Contingency Plan (OSRP)

This OSRP has been inserted in Appendix 6 and is designed to guide Statoil Egypt personnel and contractors through the processes required for appropriate oil spill response in the event of a hydrocarbon release associated with exploration and appraisal drilling operations.

This plan applies within the coastal area of El-Dabaa encompassing the proposed exploration well Kiwi A-1X, covering response strategies for surface and subsurface OSTM.

The worst-case scenarios (for both surface and subsurface oil) depicted in this plan has identified adequate countermeasures that are designed for higher risk levels. The residual risk is in line with industry accepted standard ALARP.

The plan details a three tiered response strategy that conforms to national and international legislative requirements, taking into account:

- The spill risk associated with the operation;
- The nature of the hydrocarbons that could be spilt;
- The prevailing meteorological and hydrographical conditions; and,
- The environmental sensitivity of the surrounding areas.

In order to ensure best industry practices are upheld, this plan has been written in the format stipulated by the Oil Pollution Preparedness, Response and Co-operation Convention (OPRC 90) legislation. The convention, adopted by the International Maritime Organisation (IMO) is aimed to mitigate the consequences of major oil pollution incidents involving, in particular, ships, offshore units, sea ports and oil handling facilities.

Within Egyptian territorial waters, the requirement to have an OSRP for Offshore Installations has been formalised in the Egyptian Environmental Law 4 of 1994 (Law 4/94).

The oil spill contingency plan has been prepared in accordance with the Guidance Note to Operators of Offshore Oil & Gas Installations (including pipelines) as prepared by the Department

of Trade and Industry (DTI) who are responsible for applying the regulations to offshore oil and gas operations on the UK continental shelf and approval of offshore oil and gas installation OSRP.

The Egyptian Environmental Affairs Agency (EEAA) are responsible for applying the regulations to offshore oil and gas operations on the Egyptian Block #9 El-Dabaa area and approval of offshore oil and gas installation OSRP's.

13.2.1 Plan Format

The plan is written in three distinct sections:

Section 1: Strategy

This section illustrates the purpose and scope of the plan, concentrating on the field geographical location and area of jurisdiction. It clearly defines the roles and responsibilities of individuals, statutory and non-statutory organizations in the event of an incident.

A site-specific risk assessment identifies the potential sources, sizes, types of hydrocarbon and spill scenarios allowing for the identification and classification of a specific tiered spill category.

Furthermore, it assesses the biological and economic resources that may be at risk, taking into account the behaviour and likely direction oil will travel once spilt onto the sea surface.

This enables the most appropriate response strategy to be developed ensuring it is proportional to each of the tiered categories identified.

Section 2: Actions and Operations

The actions and operations section contains all emergency procedures and information required to activate a rapid and organised response that is proportional to the size of a spill.

Data includes report forms, notification procedures and communication networks prompted by action sheets designated to key individuals assigned specific roles.

Section 3: Data Directory

The data directory contains additional supplementary information, cross-referenced with Section 2 of the OSRP, required to assist response operations.

Specifically the section includes the notification chart, contact directory, oil spill response resources list, maps & charts, surveillance and quantification techniques, use of dispersant, containment and recovery operations and considerations, health and safety issues and waste disposal issues.

14. REFERENCES

Alastair H.F. Robertson (1998), Formation and destruction of the Eratosthenes seamount. Eastern Mediterranean Sea and implications for collisional processes. Proceedings of the Ocean Drilling Program, Scientific Results, Vol. 160. 681-699.

Alexandria environmental profile report (2007), EEAA

Anon, 1992. The marine ecosystem of Fuka-Matrouh area (Egypt), Status of Species and Habitates. RAC. Coatal area management Program. UNEP/MAP.58pp.

Anton Micallef, University of Malta,2009, Mediterranean coastal hazards in a climate change context, Euro-Mediterranean Centre on Insular Coastal Dynamics

BBC, 2007, Country Profile: Egypt
http://news.bbc.co.uk/2/hi/middle_east/country_profiles/737642.stm

Biodiversity monitoring and assessment project, http://www.biomapegypt.org/

Bouchet, PH. and M. Taviani, 1992. The Mediterranean deepsea fauna: pseudopopulations of Atlantic species. Deep- Sea Res., 39(2): 169-184

Bulletin de l'Institut Oceanographique,1990, Monaco, no special, 7:11–27, On the potential migration of Indo-Pacific plankton through the Suez Canal.

Campbell, A.C., 1982, The Hamlyn Guide to the flora and fauna of the Mediterranean Sea

Cartes, J. E. and J.-C. Sorbe, 1996. Temporal population structure of deep-water cumaceans from the western Mediterranean slope (between 400 to 1300 m). Deep-sea Res., 43: 1423-1438.

Cartes, J. E. and J.-C. Sorbe, 1999. Deep-water amphipods from the Catalan Sea slope (western Mediterranean): Bathymetric distribution, assemblage composition and biological characteristics. J. Nat. Hist.. 33(8): 1133-1158.

Cartes, J. E., D. Jaume and T. Madurell, 2003. Local changes in the composition and community structure of suprabenthic peracarid crustaceans on the bathyal Mediterranean: influence of environmental factors. Mar. Biol., 143: 745- 758.

Central Agency for Public Mobilization and Statistics (CAPMAS), 2008, The Statistical Book; Arab Republic of Egypt

Central Agency for Public Mobilization and Statistics (CAPMAS), 2008, The Statistical Book Alexandria subordinates

Central Agency for Public Mobilization and Statistics (CAPMAS), 2008, The Statistical Book Marsa Matrouh subordinates

Cosson, N., M. Sibuet and J. Galeron, 1997. Community structure and spatial heterogeneity of the deep-sea macrofauna at three contrasting stations in the tropical northeast Atlantic. Deep-sea Res., 44(2): 247-269.

Danovaro, R., N. Della Croce, A. Eleftheriou, M. Fabiano, N. Padopolou. Smith and A. Tselepides, 1995, Meiofauna of the deep Eastern Mediterranean Sea: distribution and abundance in relation to bacterial biomass, organic matter composition and other environmental factors. Prog. Oceanogr., 36: 329-341.

Danovaro, R., A. Dinet, G. Duineveld and A. Tselepides, 1999, Benthic response to particulate fluxes in different trophic environments: a comparison between the Gulf of Lions- Catalan Sea (Western Mediterranean) and the Cretan Sea (Eastern Mediterranean). Prog. Oceanogr., 44: 287-312.

Danovaro, R., A. Tselepides, A. Otegui and N. Della Croce, 2000. Dynamics of meiofaunal assemblages on the continental shelf and deep-sea sediments of the Cretan Sea (NE Mediterranean): relationships with seasonal changes in food supply. Prog. Oceanogr., 46: 367-400.

ECMWF, 2010, European Centre for Medium-Range Weather Forecast, El Dabaa Field-Monthly metocean data

El Raey, Mohamed; Nasr, S., Frihy, O.; Fonda, Y.; El-Hattab, M.; Elbadawy; O.; Shalaby, A. and Mohammed, W., 2005, Sustainable Management of Scarce Resources In the Coastal Zone (SMART); Case Study Report (Egypt) Abu Qir.

Environmental Information and Monitoring Programme (EIMP)/ EEAA, 2005, Annual Coastal Water Quality Report in Egypt

Environmental Information and Monitoring Programme (EIMP)/ EEAA, 2005, Annual Air Quality Report in Egypt

European Environmental Agency, 2006, Priority issues in the Mediterranean environment

Food and Agriculture Organization (FAO), 2004, Fishery Country Profile, http://www.fao.org/fi/fcp/en/EGY/profile.htm

Flach, E. and C. Heip, 1996, Vertical distribution of macrozoobenthos within the sediment on the continental slope of the Goban Spur area (NE Atlantic). Mar. Ecol. Prog. Ser., 141: 55-66.

Frihy, O.E., 1988, Nile delta shoreline changes: Aerial photographic study of a 28-year period. J. Coast. Res., 4:597–606

http://www.unesco.org/csi/pub/source/alex6.htm

http://www.iucn.org/about/union/secretariat/offices/iucnmed/iucn_med_programme/marine_programme/marine_protected_areas/site_based_work/egypt___salum/

http://www.medpan.org/?arbo=accueil

http://www.naturalgas.org/naturalgas/extraction_offshore.asp

http://sea.unep-wcmc.org/sites/pa/0353v.htm

http://nasreya.com/english/Project%20Services4.htm

Hussein, M.M., 1977, A study of the zooplankton in the waters off the Egyptian coast during 1970-1971 with special reference to copepods. M.Sc. thesis, faculty of Science, Alexandria University.

ICUN, 2004, The Mediterranean deep-sea ecosystems, an overview of their diversity, structure, functioning and anthropogenic impacts, with a proposal for their conservation.

J. C. Dolson, P. J. Boucher, J. Siok and P. D. Heppard, 2005, Key challenges to realizing full potential in an emerging giant gas province: Nile Delta/Mediterranean offshore, deep water, Egypt. Geological Society, London, Petroleum Geology Conference series, v. 6, p. 607-624

Jones, F.V., C. Hood, and G. Moiseychenko, 1996, International methods of evaluating the discharge of drilling fluids in marine environments.

Marsa Matrouh environmental profile,2007, EEAA

Mashaly, I.A., 2001, Contribution to the ecology of the deltaic Mediterranean coast, Egypt. J. Biol. Sci., 1: 628-635.

Madurell, T. and J. E. Cartes, 2003, Suprabenthic peracarid fauna collected at bathyal depths of the Ionian Sea (Eastern Mediterranean). Crustaceana, 76(5): 611-624.

Monniot, C. and F. Monniot, 1990, Revision of the class Sorberacea (benthic tunicates) with descriptions of seven new species. Zool. J. Linn. Soc., 99: 239-290.

Morcos, S.A., 1972. Sources of Mediterranean intermediate water in the Levantine Sea. In Studies in Physical Oceanography, a Tribute to Georg Wüst on his 80th Birthday, Edited by Arnold A. Gordon, Gordon and Breach, New-York, 2:185–206

Peres, J. M., 1985. History of the Mediterranean biota and the colonization of the depths. In: Key environments: Western Mediterranean. R. Margalef (ed.). Pergamon Press, New York. pp. 198-232.

PESCO, 2010, Kiwi A-1X Oil Spill Trajectory Modelling.

Previous BP Egypt ESIAs, ESIA for BP NAB-4, April 2010(WPEEL)

Previous BP Egypt ESIAs, ESIA for BP Raven 3 Well, November 2007 (WPEEL)

Previous BP Egypt ESIAs, ESIA for BP Ruby-3, October 2008

Previous BP Egypt ESIAs, ESIA for BP West Akhen-7 Well, July 2009 (WPEEL)

Previous BP Egypt ESIAs, ESIA for Fayoum South-1 Well, June 2007 (WPEEL)

RAMSAR, www.ramsar.org

Ruffo, S., 1998, The Amphipoda of the Mediterranean. Part 4 Mém. Inst. Océanog. Monaco, 13, 1-959.

Scotto Di Carlo, B., A. Ianora, M. G. Mazzocchi and M. Scardi, 1991, Atlantis II cruise: uniformity of deep copepod assemblages in the Mediterranean sea. J. Plankton Res., 13(2),263-277.

Statoil, 2009, Guideline for Impact Assessment in Projects, ver. 1.01

Statoil HMS Poster

Statoil, 2009, HSE Management, ver. 2.01

Statoil, 2009, HSE Risk Management, ver. 1.02

Statoil, 2009, Statoil Egypt Emergency Response Plan, ver. 1.0

Statoil, 2009, Technical Environment for Offshore Plants, ver. 2.0

Tselepides A., Lampadariou N., 2004, Deep-sea meiofaunal community structure in the Eastern Mediterranean: are trenches benthic hotspots,Deep-Sea Research I 51,833–847.

Turley, C. M., M. Bianchi, U. Christaki, P. Conan, J. R. W. Harris, S. Psarra, G. Ruddy, E. D. Stutt, A. Tselepides and F. Van Wambeke, 2000, Relationships between primary producers and bacteria in an oligotrophic sea – the Mediterranean and biogeochemical implications. Mar. Ecol. Prog. Ser., 193,11-18.

Wikipedia,2010, http://en.wikipedia.org/wiki/Mediterranean_Sea

www.lrc.usace.army.mil/GrtLakes/OilGas/Chapter2.pdf

Zakaria, H. Y., 2006, Zooplankton community in the eastern Harbor of Alexandria, Egypt. Inter. Conf. Aqu: Res. Needs and Benefits. 18-21 Sept. 2006, Alex. Egypt.

Appendix 1 - Figures

Appendix 2 - Schedule

Appendix 3 - Statoil HSE Policy and Guidelines

Appendix 4 - Well Design

Appendix 5 - Drill Ship and Vessels Specification

Appendix 6 - Oil Spill and Emergency Response Plan

a. Surface Oil Spill Trajectory Model

b. Subsurface Oil Spill Trajectory Model

c. Emergency Response Plan

Appendix 7 - Waste Management Plan

Appendix 8 - Material Safety Data Sheet

Appendix 9 - Desktop Screening Report