SEA for Petroleum Activities

In Lebanese Waters

2011/2012

Vol. 1 SEA Report

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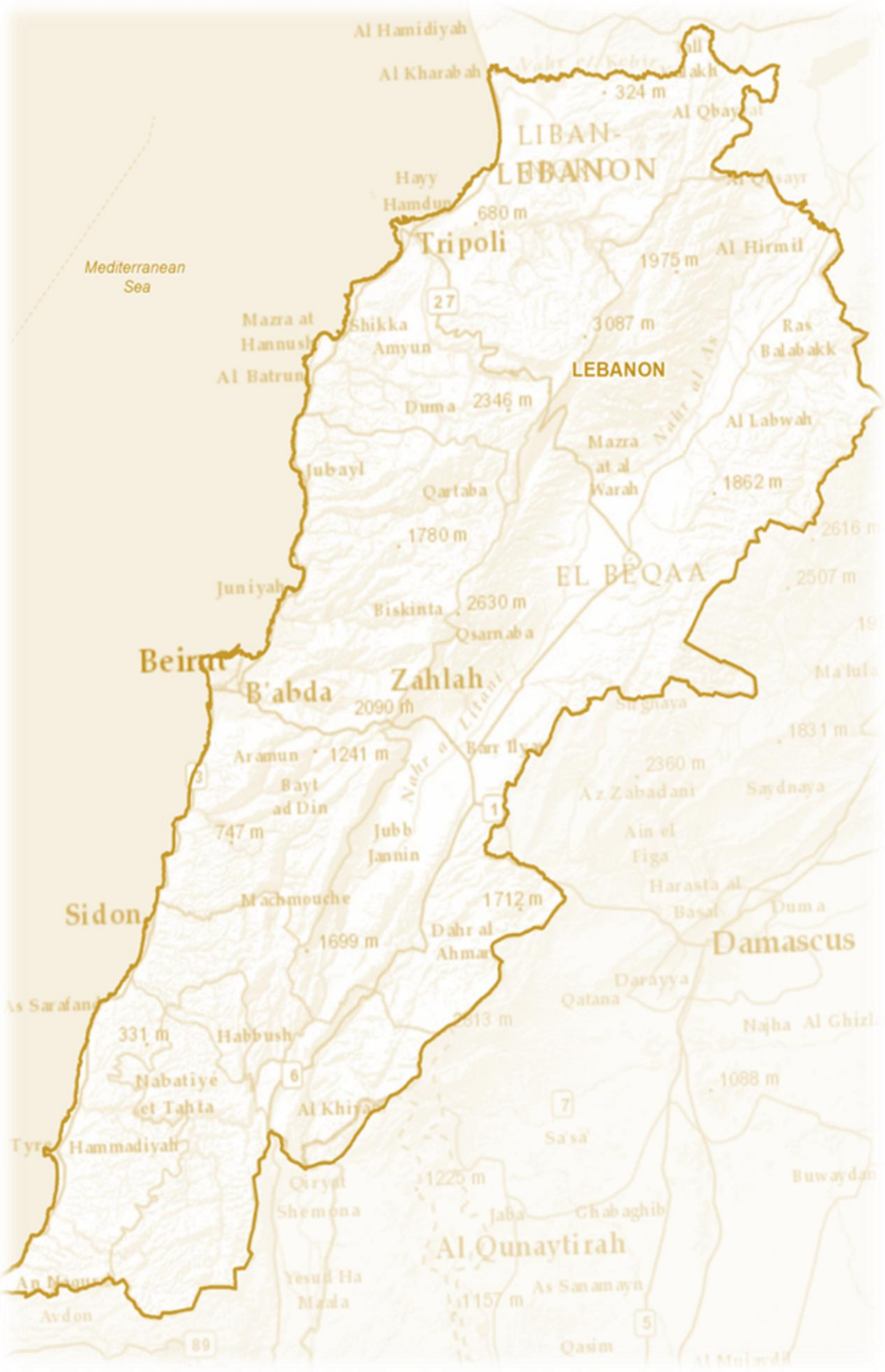
REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

RPS Energy


Al Hamidiyah
Al Kharabah
324 m
Al Qbayat
LIBAN-
LEBANON
Hayy
Hamdun
680 m
Tripoli
Al Hirmil
1975 m
Mediterranean
Sea
27
Mazra at
Hannush
Shikka
Amyun
3087 m
Ras
Balabakk
Al Batrun
LEBANON
Duma
2346 m
Al Labwah
Mazra
at al
Warah
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Jubayl
Qartaba
1862 m
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2616 m
EL BEQAA
2507 m
Juniyah
Biskinta
2630 m
Qsarnaba
Beirut
B'abda
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Sighaya
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Aramun
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Barr Ilyas
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Bayt
ad Din
Az Zabadani
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747 m
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Harasta al
Basal
Duma
Sidon
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1712 m
Damascus
1699 m
Dahr al
Ahmar
Darayya
Qatana
331 m
Habbush
Najha
Al Ghizl
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Al Khiyam
Tyre
Hammadiyah
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Qiryat
Shemona
1225 m
Buwaydan
Jaba
Ghabaghib
Al Qunaytirah
Yesud Ha
Mazala
As Samamayn
1157 m
Avdon
Qasim
89
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CONTENTS

1. PROJECT INTRODUCTION

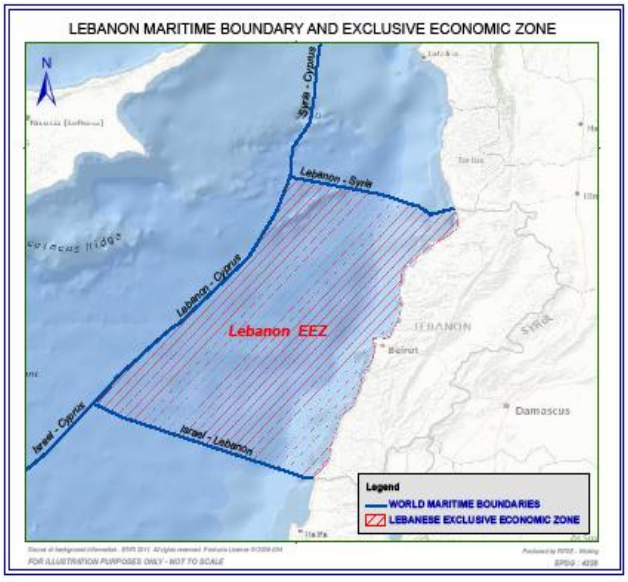
RPS Energy Ltd has been awarded the contract to develop a Strategic Environmental Assessment for the Offshore Petroleum Sector in Lebanon on behalf of the Ministry of Energy and Water. This also includes the provision of consultancy support to the Ministry.

Lebanese territorial waters (Exclusive Economic Zone) are part of the deep Levantine Basin where there are proven hydrocarbon resources. The Lebanese offshore area covers a total of 22,730km^2 in the Eastern Mediterranean and has never been previously licensed for hydrocarbon exploration. The recent deepwater, sub-salt gas discoveries to the south, which encountered high quality Lower Miocene sands, have significantly increased the industry's interest in Lebanon and the eastern Mediterranean. The Levantine Basin within the eastern Mediterranean region is regarded to contain some of the most exciting exploration plays in the region which are being re-evaluated through advances in seismic technology.

The Lebanese Government is in the process of preparing the first offshore exploration and production licensing round. To support these ongoing preparations, and ensure that negative impacts are controlled and minimised and that any benefits are maximised, the Government of Lebanon has commissioned a comprehensive Strategic Environmental Assessment (SEA).

Well drilling will be carried out in areas presenting technical challenges as the Levantine Basin includes deep water and is also an earthquake zone. Oil and Gas developments and support services onshore are constrained by the urban development that occupies so much of the land along Lebanon's littoral.

Strategic Environmental Assessment is the process of appraisal through which environmental protection and sustainable development may be considered, and factored into national and local decisions regarding Government plans and programmes – such as oil and gas licensing rounds and other offshore and onshore energy developments. The process aims to help inform Ministerial decisions through consideration of the environmental and social implications of the proposed action; it is a means of striking a balance between promoting economic development of offshore energy resources and effective environmental and community protection.



2. OVERVIEW

2.1. PURPOSE AND OBJECTIVES OF THE STRATEGIC ENVIRONMENTAL ASSESSMENT

Lebanon has expressed an interest in acceding to the EU Convention's Protocol on Strategic Environmental Assessment (SEA) and has been invited to participate in meetings under the Protocol. In the context of this bid the EU SEA Directive (2001/42/EC) guidance documents will also be employed as they are entirely compatible with the relevant Lebanese Laws. The Directive's stated objective is:

"to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development, by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans and programmes which are likely to have significant effects on the environment"

An SEA is also further defined as *'the formalised, systematic and comprehensive process for evaluating the environmental effects of a public policy, plan or programme and its alternatives, in order to ensure they are fully included and appropriately addressed at the earliest possible stage of decision making on par with economic and social considerations'.*

The purpose of this SEA Report is to specifically evaluate the likely environmental and social effects of introducing and developing oil and gas activities in Lebanon. Lebanon has not hitherto had an oil and gas industry and there is no detailed scenario for development. This SEA report extends its focus to the likely results of the licensing programme, including exploratory and production drilling, processing and transportation. It is expected that detailed, specific Environmental and Social Impact Assessments (ESIAs) will be prepared for individual projects and included as part of the contractual agreement between the Lebanese government and oil and gas operators.

The stated objectives of this report, itemised in the contract, are as follows:

1. To integrate environmental, socio-cultural and socio-economic aspects in the exploration and development of offshore oil and gas resources and related industries in order to ensure a balanced and sustainable development.
2. Establish a basis for the development of institutional strengthening in order to build competence and capacity in dealing with the identified aspects.
3. Ensure that all relevant issues are addressed at the earliest stages of oil and gas exploration and development and that appropriate advice is given to support decision making.
4. Establish a common understanding and joint baseline for project specific environment and socio-economic related assessments.

5. Identify sampling and testing requirements as needed.
6. Establish thresholds for acceptable cumulative effects.
7. Identify potential environmental sensitive areas and provide guidance for the protection of such areas whilst at the same time exploiting oil and gas resources.
8. Identify key issues to be dealt with in order to ensure a focussed discussion amongst decision makers.
9. Identify environmental and socio-economic related opportunities and risks associated with various scenarios of oil and gas exploitation and develop appropriate guidelines for maximising benefits and minimising risks.
10. Ensure that relevant stakeholders are identified and involved and that their concerns and expectations are considered during the decision making process.
11. Outline mitigation and monitoring requirements and objectives to establish best practice and ensure effective impact management for future oil and gas development.

The scope of this SEA Report is summarised in the section below which identifies the contents of each of the eight volumes.

2.2. SEA REPORT STRUCTURE

The SEA Report has been divided into eight Volumes for ease of reference. These are:

Volume	Title	Contents
Volume 1	**SEA REPORT**	Non Technical Summary Introduction to SEA project Overview • Purpose of SEA • SEA Report Structure • SEA Methodology • Description and objectives of plan • Assessment of alternatives of plan • Identification of other PPPs • Legislative background • Environmental responsibilities in Lebanon • Background Reference Documents Oil and Gas Scenarios Impacts Assessment Oil Spill Models Recommendations Conclusion
Volume 2	**NATIONAL CONTINGENCY PLAN**	Draft National Contingency Plan for oil spills
Volume 3	**STAKEHOLDER MANAGEMENT**	Stakeholder Engagement Strategy Stakeholder Engagement Plan Stakeholder Engagement Results Stakeholder Engagement Recommendations
Volume 4	**GAP ANALYSIS & ESIA REQUIREMENTS**	Introduction ESIA Requirements Oil & Gas Summary Environmental Law Onshore Ecology Offshore Ecology Fisheries Water Air Waste Social Health Tourism Cultural Heritage Anthropogenic Effects
Volume 5	**GIS**	Geo Database & MXD Oil Spill Modelling Maps A0 Overview Map Land Use Map Current & Proposed Protected Areas Maps Aerial Photo Maps Other SEA Maps Admiralty Chart Template List of GIS Data Recommendations & Data Management
Volume 6	**REGISTERS**	Introduction Legal Register Data Acquisition Register Stakeholder Register Consultation Register Concerns Register
Volume 7	**ONSHORE PIPELINE ROUTE**	Map series of the entire proposed onshore pipeline route
Volume 8	**FIELD SURVEY INSTRUCTION MANUAL**	Description of survey and sampling techniques for offshore and onshore biological surveys and social surveys

2.3. SEA METHODOLOGY

The contract to produce an initial SEA Report was of five months duration making the programme necessarily intensive and requiring progress on several parallel fronts simultaneously. An integrated and multi-disciplinary approach was taken using expertise developed within the context of the oil and gas industry. The following aspects were developed:

Registers: The registers are designed to be live documents that will be maintained throughout the lifespan of petroleum activities in Lebanon, not just the SEA phase. Effective data management is always a key issue and registers are an aid to data organisation and management, providing easy access and cross referencing. The Registers were initiated within the first few weeks of contract award and form Volume 6; they comprise:

- Legal Register – to record the legal and regulatory context of the Plan
- Stakeholder Register – to record all identified stakeholders with their contact details and interests
- Consultation Register – to record all consultations that were carried out, and their outcome
- Data Acquisition Register – to record the existing information and data collected for the Gap Analysis and baseline assessment
- Concerns Register – to record environmental and social concerns

Stakeholder Management: This component started with designing a suitable strategy and then a plan of action within the first month of contract award. Detailed consultations took place with as many high level stakeholders relevant to the MoEW Plan as possible throughout the duration of the work. The consultation process contributed to data acquisition as well stakeholder engagement.

Gap Analysis: The first two months of the contract were focussed on collecting existing data relevant for each of the main areas of concern within the context of the oil and gas development in Lebanon and assessing the deficiency in information that would be required for a full ESIA. A Field Survey Instruction Manual (Volume 8) was compiled to give guidance and instruction on appropriate survey techniques for the future ESIA baseline surveys.

Identification of Scenarios and Impacts, Risks and Opportunities: Oil and gas development scenarios were developed during the fourth month of the contract using methods based on expert opinion and detailed experience within the industry.

National Contingency Plan and oil spill modelling: A draft plan was compiled during the third month for dealing with an oil spill affecting Lebanese waters and coastal zone. A range of oil spill scenarios was modelled to illustrate the potential situations that could arise.

GIS: A parallel but interrelated scope of work was the collection of geo-spatial data, which started at the beginning of the project and continued until month five. GIS is now considered an

essential tool for data managing and this technology supported the SEA process throughout. A solid basis now exists for future data management and interrogation.

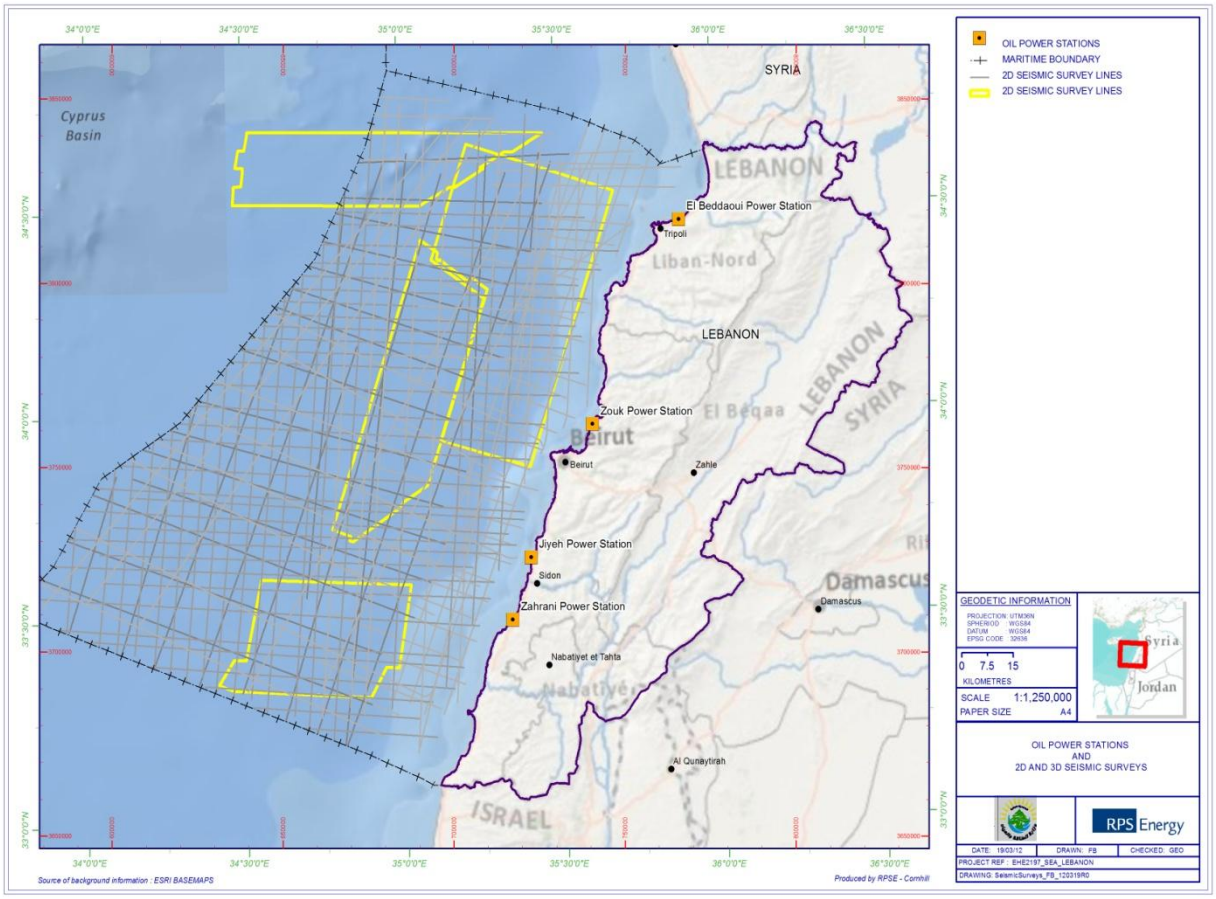
Recommendations: Detailed recommendations for future development and management of the environmental and social assessment process have been considered.

2.4. DESCRIPTION AND OBJECTIVES OF PLAN

In SEA parlance, the Plan or Programme associated with this SEA Report can be described as the development of an oil and gas industry in Lebanon. This Plan includes seismic survey, establishing License blocks and a bidding round, exploratory and production drilling, processing and transportation.

Lebanese territorial waters (Exclusive Economic Zone) are part of the deep Levantine Basin where there are proven hydrocarbon resources. The first 2D and 3D seismic surveys have been shot to obtain an improved understanding of the geological structures and the petroleum potential in these deep water areas. The Lebanese offshore area covers a total of 22,730km^2 in the Eastern Mediterranean and has never been previously licensed for hydrocarbon exploration. The recent deepwater, sub-salt gas discoveries to the south, which encountered high quality Lower Miocene sands, have significantly increased the industry's interest in Lebanon and the eastern Mediterranean. The Levantine Basin within the eastern Mediterranean region is regarded to contain some of the most exciting exploration plays in the region which are being re-evaluated through advances in seismic technology.

The Lebanese Government is in the process of preparing the first offshore exploration and production licensing round. Well drilling will be carried out in areas presenting technical challenges as the Levantine Basin includes deep water and is also an earthquake zone. Oil and Gas developments and support services onshore are constrained by the urban development that occupies so much of the land along Lebanon's littoral.



One of the main drivers for this plan is the energy crisis that exists in Lebanon. The reform of the Lebanese energy sector has featured as a major priority for several consecutive governments but the failure of the state monopoly Electricité du Liban (EDL) to ensure reliable electricity supplies continues to underline the profound energy crisis in Lebanon. The consequences of failing energy sector and unreliable electricity supplies present impediments to Lebanon's economic and social development.

The energy situation in Lebanon is characterized by two major shortcomings. The first one is the shortage of electricity generation capacities resulting in shortage of supplies. Despite the 99 % electrification rate, most of Lebanese energy consumers suffer from daily electricity blackouts. As a result, Lebanese consumers rely on private electricity generators, running on costly and polluting fuel. The second shortcoming is the high dependence on oil, which dominates Lebanon's energy mix in terms of electricity generation and the transport sector. This leaves Lebanon extremely vulnerable to oil price increases.

It is therefore extremely important for Lebanon to be able to exploit any oil and gas resources, primarily for domestic use. The expectation is for gas reserves, based on recent findings in the general area, and the immediate goal would be to bring this onshore. The existing oil fuelled

power stations located along the coast would be converted to gas fuelled power stations; electricity would remain the national power source as it is not practical to supply domestic gas directly.

2.5. ASSESSMENT OF ALTERNATIVES TO PLAN

Lebanon's energy crisis creates an urgency and expediency for the Plan to exploit any oil and gas reserves which possibly detracts from the exploration of alternative solutions. The opinion in Lebanon at present is that thermal, solar, wind, hydroelectric and bio-energy technologies all have long-term potential in Lebanon, but that these remain largely unexplored options. A more realistic first step is for Lebanon to reduce its energy consumption and optimise the efficiency of its industry and institutions. Although a significant reduction in the country's consumption of fossil fuels may not be a feasible option in the short-term, awareness of the need for a transition to sustainable energy is important. An exciting development in Lebanon is the strategy of Waste for Energy which is in the process of being implemented. By 2014 all waste will be incinerated and contributing to the national grid.

The World Bank has carried out a detailed feasibility study in 2009 on behalf of the government for the importing of LNG and conversion of Zahrani power plant from oil to gas powered. The options ranged from having a Floating LNG plant offshore to construction of a full onshore LNG plant, the budget ranging from $70m to $550m accordingly. It is not known if this is still under consideration.

A short term solution to Lebanon's immediate energy crisis is to bring in floating, oil fuelled power plants and anchor these adjacent existing power plants; this is a quick, 'plug and play' option as an immediate solution to a crisis.

2.6. IDENTIFICATION OF OTHER PLANS, PROGRAMMES AND POLICIES

It is a usual component of an SEA to review the primary Plan in relation to plans and programmes from other government departments and ministries and to assess the potential for cumulative effects and incompatibilities. In this instance the exercise was only partially successful.

Although plans and programmes were requested from the ministries consulted these were either not in a document format or unavailable. There was reluctance in many departments to discuss future plans as a culture of secrecy still exists. For example, the Water Strategy has been compiled, but despite formal, written requests it has not yet been released. The Waste strategy, Waste to Energy, is available and supports the plan to develop an oil and gas industry.

The only area of conflict identified was between the MoEW's proposed onshore pipeline using the disused railway as a route and the Ministry of Public Works and Transport, Urban Planning Directorate proposal, still relatively unformulated, to resurrect the railway line for public transport.

It is recommended that this issue remain open and all available plans and programmes from Lebanese ministries are collated as a specific exercise.

2.7. LEGISLATIVE BACKGROUND

The legal framework within which all oil and gas operators will have to work is recorded in a Legal Register (Volume 6). The scope encompasses National Law and relevant international Conventions relating to environmental issues, particularly those that will be affected by an oil and gas industry. The format is an excel spreadsheet as this is a more suitable than a table; it facilitates searches made on a variety of topics, so, for instance all legislation pertaining to Waste can be accessed together.

Lebanese legislation is undergoing significant change in readiness for the regulation of a developing oil and gas industry, so it is recommended that the Legal Register presented in Volume 6 be kept up to date.

The most notable change is the drafting of a completely new Petroleum Activity Law and accompanying Regulations which are the instrument that will control and regulate oil and gas activities.

The most significant Laws and Conventions supporting the Petroleum Activity Law are MARPOL, OSPAR (for comparison) and the Barcelona Convention. These suite of standards have been instrumental in guiding the development of the European oil and gas industry and are being continually improved in the light of new technologies and approaches so Lebanon stands to benefit from a close comparison of these standards and adoption of those that are consistent with Lebanese Law and the developing hydrocarbon industry. Lebanon also stands to benefit from the detailed and intensive enquiry mounted after the Deep Water Horizon disaster in the Gulf of Mexico.

A recent industry report says ‘To reduce the risk of another accident as catastrophic as the Deepwater Horizon explosion and oil spill, a new report from the National Academy of Engineering and National Research Council says, companies involved in offshore drilling should take a "system safety" approach to anticipating and managing possible dangers at every level of operation -- from ensuring the integrity of wells to designing blowout preventers that function "under all foreseeable conditions." In addition, an enhanced regulatory approach should combine strong industry safety goals with mandatory oversight at critical points during drilling operations.

The report says the lack of effective safety management among the companies involved in the Macondo Well-Deepwater Horizon disaster is evident in the multiple flawed decisions that led to the blowout and explosion, which killed 11 workers and produced the biggest accidental oil spill in U.S. history. Regulators also failed to exercise effective oversight.’

It has also been observed that a contributing factor to the accident was the very prescriptive and rigid character of US law, compared to the UK Risk Based approach which allows flexibility and Management of Change.

The UK has found it beneficial to hand over Health and Safety regulation to an independent body rather than the government department responsible for permitting.

Another aspect that is worth considering is the tendency when drafting new laws and regulations to make them very prescriptive. However state of the art they may appear now, in a few years with changing conditions and technology they will fast become outmoded and an obstruction to effective implementation. It is often easier for the Law or Regulation to refer to Standards, which can more easily be aligned with changing conditions.

The crucial Environmental law in Lebanon is the Protection of the Environment Law No. 444 - issued on 29/7/2002. This is an impressive piece of legislation that is comprehensive in its scope, however, it is dependent on the passing of Decrees for it to be implemented. There are still many Decrees waiting to be passed by the Council of Minister, most significantly in the context of this SEA, the EIA Decree.

Environmental Law is discussed in more detail in Volume 4, Gap Analysis.

2.8. BACKGROUND REFERENCE DOCUMENTS

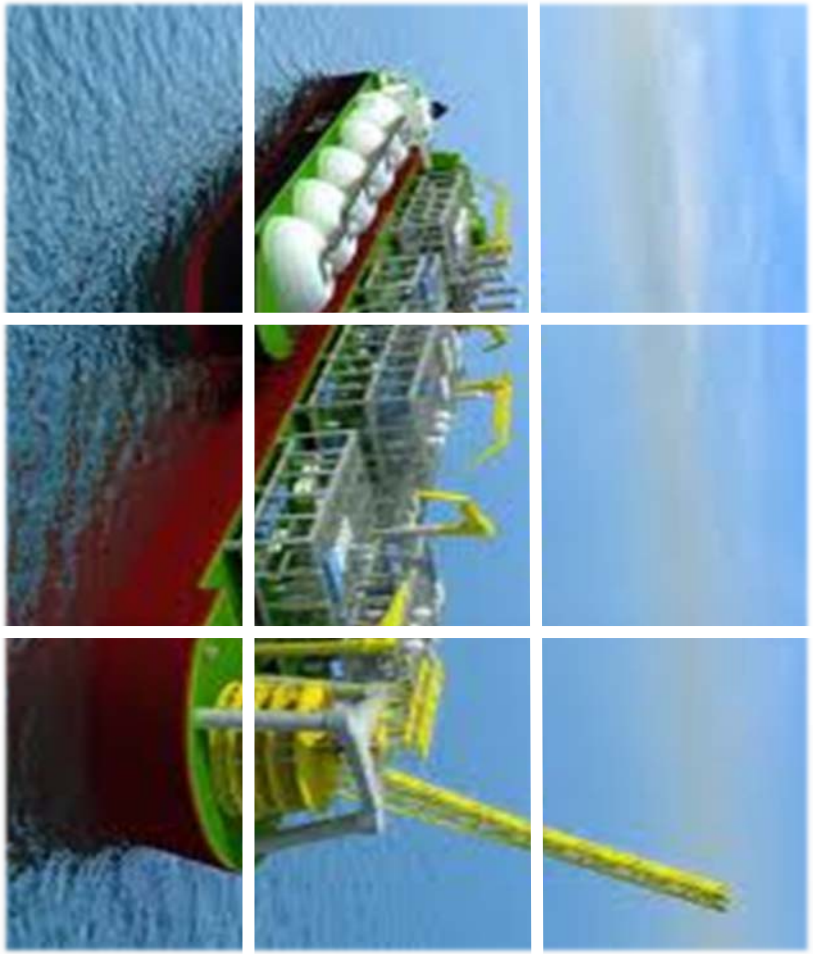
In undertaking and compiling an the SEA for the MoEW, Lebanon, RPS Energy have taken full account of both International Standards and industry best practice. Our SEAs are conducted with reference to:

- Client internal Policies, Standards, Requirements and Commitments
- National legislation
- World Bank Operational Policies - OP/BP 4.01 – Environmental Assessment
- World Bank Technical Paper No. 154, Environmental Assessment Sourcebook Volume III - Guidelines for Environmental Assessment of Energy Projects
- Addressing the Social Dimensions of Private Sector Projects, Good Practice Note (International Financial Corporation (IFC), Environmental & Social Development Department)
- IFC Performance Standards on Social and Environmental Sustainability (Note: the latest set of performance standards, due to be formally issued in January 2012, will be used)
- Equator Principles (Financial Industry standard for Social & Environmental Risk)
- EU SEA Directive (2001/42/EC)
- EU Amended EIA Directive (97/11/EC)
- International Association of Oil and Gas Producers (OGP); Principles for Impact Assessment

- Joint OGP (E&P Forum) / UNEP Publication - Environmental Management in Oil & Gas Exploration & Production
- IAGC (International Association of Geophysical Contractors) - Environmental Manual for Worldwide Geophysical Operations
- IPIECA (International Petroleum Industry Environmental Conservation Association) - The Oil & Gas Industry; Operating in Sensitive Environments
- Joint Nature Conservation Committee (JNCC) guidelines for minimising the risk of disturbance and injury to marine mammals from seismic surveys. June 2009.

- Seismic Surveys and Marine Mammals. Joint OGP/IAGC Position Paper No. 358.
- Institute of Field Archaeology – Codes, Standards and Guidelines
- The Organisation for Economic Co-operation and Development (OECD) Guidelines for Multinational enterprises
- State and Trends of the Lebanese Environment; UNDP 2010
- AccountAbility: AA1000 Assurance Standard : AA1000AS, London (2003)
- AccountAbility: AA1000 Stakeholder Engagement Standard : AA1000SES, London (2005)
- Petroleum Industry Standards and Guidelines, produced by the Exploration and Production (E&P Forum)
    - *Exploration and Production (E&P) Waste Management Guidelines (Report No. 2.58/196, Sept 1993)*Guidance on area-specific waste management planning, and handling and treatment methods of drilling and production waste streams.
    - *Environmental Management in Oil and Gas exploration and Production 1997.*An overview of environmental issues and technical and management approaches to achieve high environmental performance in oil and gas exploration and production.

All reference material and information collected during the SEA data gathering exercise has been recorded in the Data Acquisition Register, Volume 6.



SCENARIOS

3 SCENARIOS

During the SEA phase of a development it is appropriate to identify a variety of foreseeable scenarios that illustrate the range of activities that could take place and the impacts, risks and opportunities that these activities can generate. A scenario is also an aid to visualisation, promotes discussion and provides clarity and focus on development sequences.

An evaluation of the impacts, risks and opportunities highlights those of greatest significance; helps prioritise their relative importance and opens discussion on how best to manage them. Key issues have been identified and are presented at the end of this section. They have been grouped under five headings:

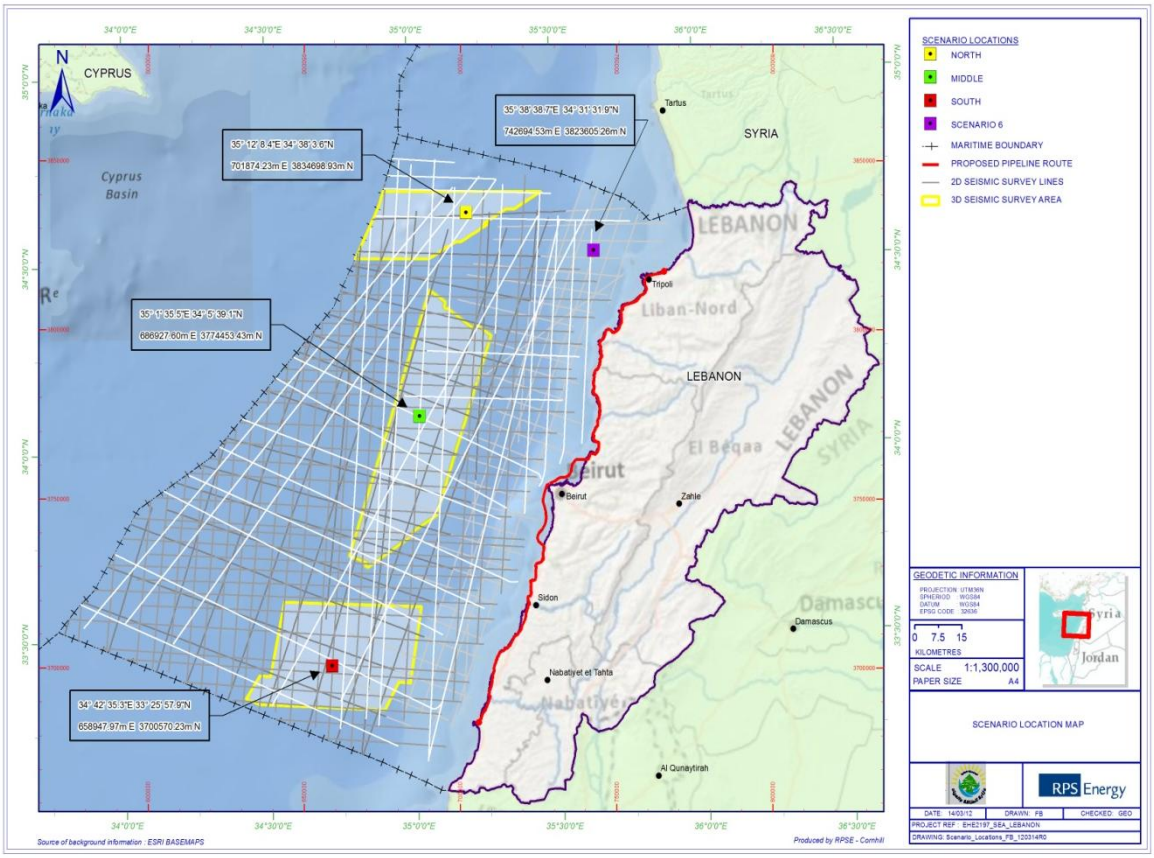
- Environment
- Economy
- Socio-Cultural
- Institutional
- Other

Evaluation is based on expert opinion, using the industry standard Risk Assessment Matrix that is fully described in Section 4 of this document. The risks, impacts and opportunities identified for the SEA report are relatively high level (an ESIA would take the assessment to a more detailed level) but they are nevertheless country specific. For example, Waste Management and Landtake are cited as two main areas for concern in relation to the oil and gas industry in Lebanon, due specifically to Lebanese constraints in these aspects.

The selected Scenarios are as follows:

Scenario 1	No Commercial Findings
Scenario 2	Lean/Rich Gas and Petroleum Liquids – Onshore bias
Scenario 3	Lean/Rich Gas and Petroleum Liquids – Offshore bias
Scenario 4	Crude Oil and Rich Gas
Scenario 5	Multiple and Successive Field Developments
Scenario 6	Onshore Gas Transportation and Use
Scenario 7	Nearshore Oil/Associated Gas

As there are three well identified areas that have undergone 3D seismic survey, as illustrated in the map below, it was assumed that Scenarios 1-5 would take place somewhere within them. Scenario 6 is in the nearshore by Tripoli, and Scenario 7 is located in the coastal zone.



To define the scenarios a number of assumptions have been made. Some of these may ultimately prove unfounded, but they were made with expert judgement using available information at the time and an assessment of comparable findings in the East Mediterranean. The assumptions made are as follows:

- There will only be a single drilling rig operating at any one time, except for scenario 5 which assumes multiple operations. The support vessels and helicopters will therefore be consistent with that needed by a single rig.
- Drilling operations and subsequent production will take place at depths >1000m, except for Scenario 6 which will be in shallower, nearshore waters.
- Exploratory drilling will take 60 – 80 days drilling per well.
- Deep water drilling rigs are few; a constraint to any programme will be rig availability.
- Only large companies will have the resources to operate under these conditions.
- As environmental survey data is deficient and no seasonal windows have been identified, it is assumed there can be year-round drilling. This may change after analysis of survey data.

- Offshore activities during exploration, field development and operations will be supported by an onshore base, including supply of all necessary goods and services and transportation of personnel and materials, handling of waste materials returned from offshore, etc.
- 5Tcf (gas) or 2million barrels (oil) is taken as a cut off for commerciality.
- The lead time from licensing to production for gas fields will be at least 10 years.
- The lead time for oil fields development is at least 6 -8 years.
- The priority for Lebanon is domestic gas consumption, on a gas to power basis.
- An onshore terminal is probably only realistic in the north, close to Tripoli due to land availability. Further south a nearshore barge solution may be preferable

Deepwater Nautilus

Sedco Express drilling rig

Scenario 1 – No Commercial Findings

This scenario describes a situation where exploratory drilling would take place, but there would be no commercially viable findings and therefore no further work required. This scenario would involve as a minimum:

- Exploration drilling carried out from a rig suitable for ultra-deep waters.
- Onshore support comprising two supply vessels, helicopter support.
- Onshore supply base (a dedicated area of at least 1000m^2) with storage areas for pipes, tank facilities, waste handling facilities etc and infrastructure such as harbours.
- Supply of food, potable water etc.
- National contingency plan in place including all necessary equipment.

Large Supply base, Stavanger Norway

Analysis of Scenario 1 – No Commercial Findings

The impacts, risks and opportunities attendant on such a scenario have been evaluated and are as follows:

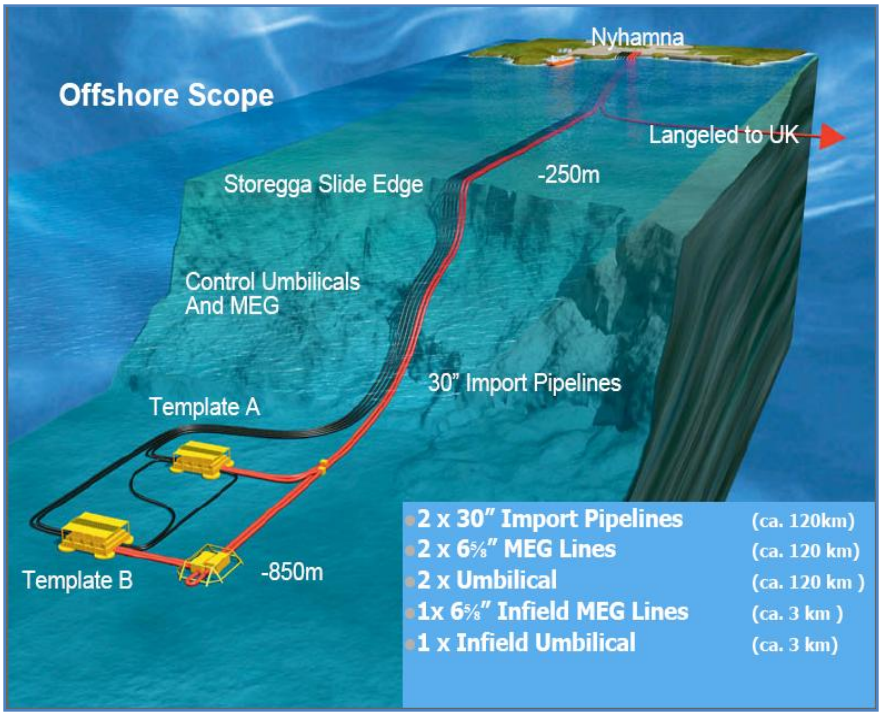
Activity	Aspect	Significance
ENVIRONMENT		
Mobilisation and drilling operations	Noise emissions	Mod/High
	Air emissions	Low
	Light emissions	Low
	Discharges	Low
	Waste disposal	High
	Disposal of cuttings	Low
	Disposal of oil based muds	High
	Blow out	High
	Safety flaring	Moderate
	Physical presence	Low
Support to drilling operations	Supply vessels	Moderate
	Helicopter transportation	Low
	Helicopter base	Low
	Supply base and service provision	Low
	Road transportation	Low
ECONOMY		
Presence of the new industry	Generated revenues	Low
	Investments based on expectations	Moderate
	Purchasing power of employees	Low
	Increased international connections	Moderate
	Catalyst for increase in industrial activities	Low
	Employment	Low
	Procurement of goods and services	Low
	Land acquistion/lease	NA
	Infrastructure	Low
	Resource use	Low
	Co-existence fisheries	Low

	Co-existence commercial shipping	Low
	Co-existence other industry	Low
	Co-existence tourism	Low
SOCIO-CULTURAL ISSUES		
Presence of the new industry	Expectations	Low
	Price increase	Low
	Use of public services	Moderate
	Community relations	Low
	Damage to local land/property	Low
	Safety and nuisance to the community	Low
	Change in livelihoods	Low
	Resettlement	Low
	In-migration	Low
	Social structure	Low
	Security	High
	Public health	Low
INSTITUTIONAL ISSUES		
Presence of the new industry	Relevant HSE legislation in place	High
	Plans for maximizing benefits for relevant services/industries	Moderate
	Capacity deficiency within authorities	High
	Stakeholder management	High
	Community engagement	Low
	Build trust among decision makers	High
	Land use planning and control	Low
	Capacity building on environmental awareness	High
	Official plans for potential CSR programs	High
OTHER		
Technology	Ultra deep water drilling	Moderate
Training	Availability of training facilities	Low
Infrastructure	Waste management	High
	National contingency plan	High
Data deficiency	Environmental baseline data	High
	Social data	High

Scenario 2– Lean/Rich Gas and Petroleum Liquids. Onshore bias

This scenario describes a situation which includes exploratory drilling (and therefore all of the requirements of Scenario 1), and assumes a commercially viable finding of Gas which would entail ongoing production drilling. Scenario2 describes the requirements for processing and managing of gas production with a bias to onshore installations. As a minimum this scenario would include:

- Offshore operations from subsea facilities
- Offshore pipelines, cables etc
- Operational centre
- Multi-phase gas flow pipeline from offshore production facilities to onshore
- Receiving terminal onshore (at least 600m x 600m area, excluding safety zones)
- Deliveries from terminal: sales gas, LPG (in the case of rich gas), condensate and/or LNG
- Onshore support to drilling and subsea installation comprising supply vessels, helicopters etc
- Operational support to onshore/nearshore facilities including support to subsea intervention
- Onshore supply base (a dedicated area of at least 1000m^2) with storage areas for pipes, tank facilities, waste handling facilities etc and infrastructure such as harbours
- Supply of food, potable water etc
- National contingency plan in place including all necessary equipment



Although the illustration is of the Ormen Lange Gas development the sea bed topography is very similar to that which will be experienced in Lebanese waters, that is a narrow nearshore with a steep cliff descending sharply to deep water. In Lebanon the depths will be much greater than those experienced in the North Sea.

Ormen Lange Gas development, Norway

Illustrated (on the right) are three examples of onshore facilities; a gas receiving terminals with processing facilities and an LNG. They are given as examples of the landtake that woould be required should these options become a reality in Lebanon.

Norwegian terminal for receiving/processing of rich gas and high pressure condensate.
Export of dry sales gas by pipeline, liquid ethane, LPG and codensate by ships.(*Source: Statoil)*

Ormen Lange Gas receiving terminal,

LNG Angola

LNG in Angola

Analysis of Scenario 2– Lean/Rich Gas and Petroleum Liquids. Onshore bias

The impacts, risks and opportunities attendant on such a scenario have been evaluated and are as follows:

Activity	Aspect	Significance
ENVIRONMENT		
Mobilisation and drilling operations	Noise emissions	High
	Air emissions	Low
	Light emissions	Low
	Discharges	Low
	Waste disposal	High
	Disposal of cuttings	Low
	Disposal of oil based muds	High
	Blow out	High
	Safety flaring	Moderate
	Physical presence	Low
Support to drilling and field operations	Supply and construction vessels	Moderate
	Helicopter transportation	Low
	Helicopter base	Low
	Harbour facilities	Low
	Supply base and service provision	Low
	Road transportation	Moderate
Field development and production including pipelines to shore	Physical presence of subsea installations, field pipelines/cables, FPSO, pipelines to shore	Moderate
Landfall Site	Temporary landtake and construction	Moderate
Supply Base onshore	Landtake	High
Gas receiving and processing facilities	Landtake	High
	Air emissions from Flaring	High
LNG production, storage and export	Air emissions from Flaring	High
Pipeline gas export, domestic and international	Construction	High
	Permanent landtake	High

ECONOMY		
Presence and operations of the new industry	Generated revenues	High
	Investments based on expectations	High
	Purchasing power of employees	High
	Increased international connections	High
	Catalyst for increase in industrial activities	High
	Employment	Moderate
	Procurement of goods and services	Moderate
	Land acquisition/lease	High
	Infrastructure	Moderate
	Resource use	Mod/High
	Co-existence fisheries	Low
	Co-existence commercial shipping	Low
	Co-existence other industry	Low
	Co-existence tourism	Low
SOCIO-CULTURAL ISSUES		
Presence and operations of the new industry	Expectations	High
	Price increase	Moderate
	Use of public services	Moderate
	Community relations	High
	Damage to local land/property	Low
	Safety and nuisance to the community	Moderate
	Change in livelihoods	Low /Mod
	Resettlement	High
	In-migration	Moderate
	Social structure	Moderate
	Security	High
	Public health	Low
INSTITUTIONAL ISSUES		
Presence of the new industry	Relevant HSE legislation in place	High
	Plans for maximizing benefits for relevant services/industries	Moderate

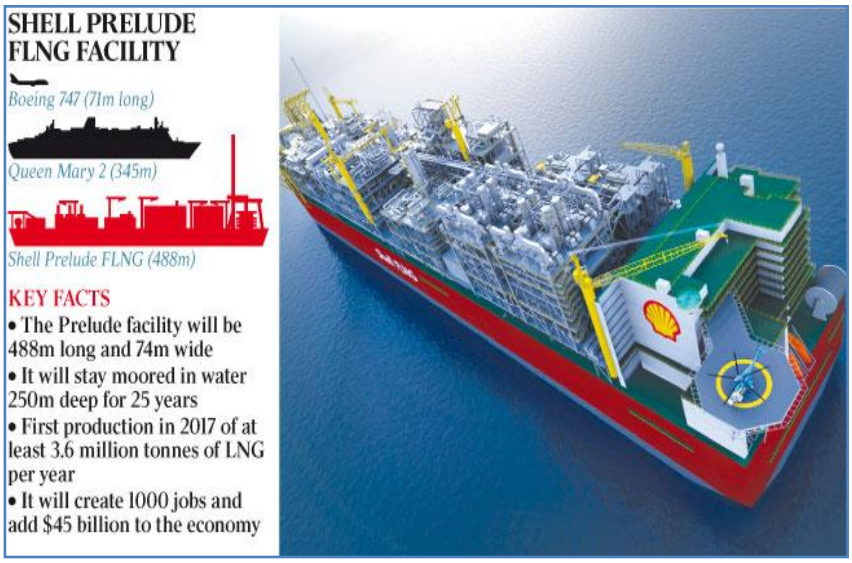
	Capacity deficiency within authorities	High
	Stakeholder management	Moderate
	Community engagement	High
	Build trust among decision makers	High
	Land use planning and control	Low
	Capacity building on environmental awareness	High
	Official plans for potential CSR programs	High
OTHER		
Technology	Ultra deep water drilling	Moderate
	Ultra deep water for subsea and pipeline installations and operations	High
	Possible ultra deep water subsea gas compression	High
Training	Availability of training facilities	High
Infrastructure	Waste management	High
	National contingency plan	High
Data deficiency	Environmental baseline data	High
	Social data	High

Scenario 3– Lean/Rich Gas and Petroleum Liquids. Offshore bias

This scenario describes a situation which includes exploratory drilling (and therefore all of the requirements of Scenario 1), and assumes a commercially viable finding of Gas which would entail ongoing production drilling. Scenario 3 describes the requirements for processing and managing of gas production with a bias to offshore installations. As a minimum this scenario would include:

- Offshore operations from subsea facilities
- Operational centre
- Receiving terminal offshore on barge (80m x 500m)
- Deliveries from barge: gas, LPG (in the case of rich gas), condensate and LNG if decided
- Optional pipeline to shore
- Onshore support to drilling and subsea installation comprising supply vessels, helicopters etc
- Support to subsea intervention and operation of the barge
- Need for continuing support from vessels, helicopters as for drilling

- Onshore supply base (a dedicated area of at least 1000m2) with storage areas for pipes, tank facilities, waste handling facilities etc and infrastructure such as harbours
- Supply of food, potable water etc
- National contingency plan in place including all necessary equipment



Technology developments in offshore liquefied natural gas (LNG) storage and transfer have made offshore LNG production commercially viable. Floating LNG production, storage and offloading concepts (LNG FPSOs) have a number of advantages over conventional liquefaction plants for offshore resources, not least the ability to station the vessel directly over distant fields thus avoiding expensive offshore pipelines and the ability to move the production facility to a new location once the existing field is depleted. The difficulties with onshore LNG projects have

renewed interest in offshore LNG production and LNG FPSOs are now on the cusp of commercialisation.

Analysis of Scenario 3– Lean/Rich Gas and Petroleum Liquids. Offshore bias

The impacts, risks and opportunities attendant on such a scenario have been evaluated and are as follows:

Activity	Aspect	Significance
ENVIRONMENT		
Mobilisation and drilling operations	Noise emissions	High
	Air emissions	Low
	Light emissions	Low
	Discharges	Low
	Waste disposal	High
	Disposal of cuttings	Low
	Disposal of oil based muds	High
	Blow out	High
	Safety flaring	Moderate
	Physical presence	Low
Support to drilling and field operations	Supply and construction vessels	Moderate
	Helicopter transportation	Low
	Helicopter base	Low
	Harbour facilities	Low
	Road transportation	Moderate
Field development and production including possible small pipeline to shore	Physical presence of subsea installations, field pipelines/cables, FPSO, pipelines to shore	Moderate
Landfall Site	Temporary landtake and construction	Moderate
Supply Base onshore	Landtake	High
Gas receiving and processing facilities	Landtake	High
	Air emissions from Flaring	High
LNG production, storage and export	Air emissions from Flaring	High
ECONOMY		
Presence and operations of the new	Generated revenues	High

industry		
	Investments based on expectations	High
	Purchasing power of employees	Moderate
	Increased international connections	High
	Catalyst for increase in industrial activities	Moderate
	Employment	Mod/Low
	Procurement of goods and services	Mod/Low
	Land acquisition/lease	High
	Infrastructure	Mod/Low
	Resource use	Mod/Low
	Co-existence fisheries	Low
	Co-existence commercial shipping	Low
	Co-existence other industry	Low
	Co-existence tourism	Low
SOCIO-CULTURAL ISSUES		
Presence and operations of the new industry	Expectations	High
	Price increase	Moderate
	Use of public services	Mod/Low
	Community relations	Moderate
	Damage to local land/property	Low
	Safety and nuisance to the community	Mod/Low
	Change in livelihoods	Low
	Resettlement	High/Mod
	In-migration	Mod/Low
	Social structure	Mod/Low
	Security	High
	Public health	Low
INSTITUTIONAL ISSUES		
Presence of the new industry	Relevant HSE legislation in place	High
	Plans for maximizing benefits for relevant services/industries	Moderate
	Capacity deficiency within authorities	High

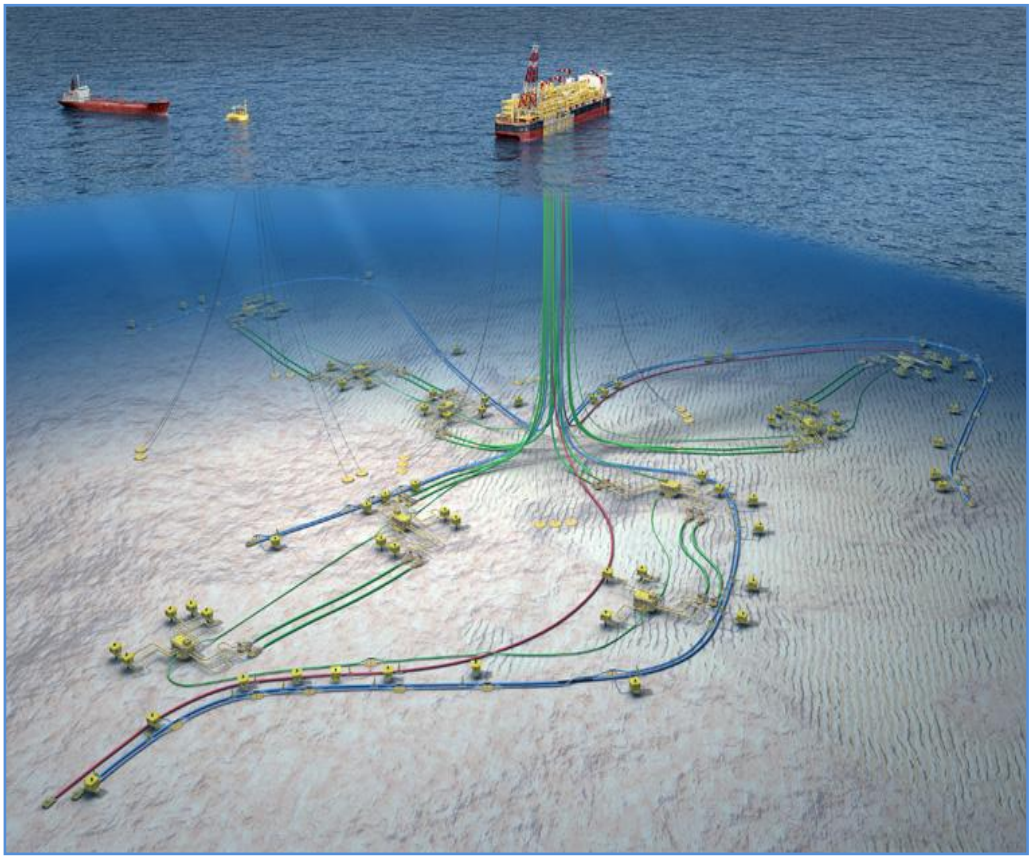
	Stakeholder management	Moderate
	Community engagement	Mod/Low
	Build trust among decision makers	High
	Land use planning and control	Low
	Capacity building on environmental awareness	High
	Official plans for potential CSR programs	High
OTHER		
Technology	Ultra deep water drilling	Moderate
	Ultra deep water for subsea and pipeline installations and operations	High
Training	Availability of training facilities	High
Infrastructure	Waste management	High
	National contingency plan	High
Data deficiency	Environmental baseline data	High
	Social data	High

Scenario 4– Crude Oil and Rich Gas

This scenario describes a situation which includes exploratory drilling (and therefore all of the requirements of Scenario 1), and assumes a commercially viable finding of Oil which would entail ongoing production drilling. Based on findings from exploratory drilling that has already taken place in the East Mediterranean, crude oil is less likely than gas; however it is an enviseageable scenario, with sufficiently different aspects, so has been included in this exercise. Scenario 4 describes the requirements for processing and managing oil production. As a minimum this scenario would include:

- Offshore operations from subsea facilities
- Offshore pipelines, cables etc
- Operational centre
- FPSO (120 people) at the field also covering oil storage and gas compression (60m x 300m)
- Offshore loading facilities
- Deliveries from barge: crude oil, gas to shore, possibly LPG
- Gas pipeline to shore
- Receiving terminal onshore or on a nearshore barge if feasible

- Onshore support to drilling and subsea installation comprising supply vessels, helicopters etc
- Support to subsea intervention and operation of the barge
- Need for continuing support from vessels, helicopters as for drilling
- Onshore supply base (a dedicated area of at least 1000m2) with storage areas for pipes, tank facilities, waste handling facilities etc and infrastructure such as harbours
- Supply of food, potable water etc
- National contingency plan in place including all necessary equipment



Configuration of subsea installations

Dalia FPSO

A floating production, storage and offloading (FPSO) vessel is designed to receive hydrocarbons produced from nearby platforms or subsea template, process them, and store oil until it can be offloaded onto a tanker or transported through a pipeline. FPSOs are preferred in frontier offshore regions as they are easy to install, and do not require a local pipeline infrastructure to export oil. FPSOs can be a conversion of an oil tanker or can be a vessel built specially for the application. The Dalia FPSO, illustrated, can operate at 1200m depth and has a crude oil capacity of 240 000 bbls/day

Analysis of Scenario 4– Crude Oil and Rich Gas

The impacts, risks and opportunities attendant on such a scenario have been evaluated and are as follows:

Activity	Aspect	Significance
ENVIRONMENT		
Mobilisation and drilling operations	Noise emissions	High
	Air emissions	Low
	Light emissions	Low
	Discharges	Low
	Waste disposal	High
	Disposal of cuttings	Low
	Disposal of oil based muds	High
	Blow out	High

	Safety flaring	Moderate
	Physical presence	Low
Support to drilling and field operations	Supply and construction vessels	Moderate
	Helicopter transportation	Low
	Helicopter base	Low
	Harbour facilities	Low
	Road transportation	Moderate
Field development and production including possible small pipeline to shore	Physical presence of subsea installations, field pipelines/cables, FPSO, pipelines to shore	Moderate
Landfall Site	Temporary landtake and construction	Moderate
Supply Base onshore	Landtake	High
Gas receiving and processing facilities	Landtake	High
	Air emissions from Flaring	High
Oil processing, storage and offshore loading	Air emissions from Flaring	Moderate
ECONOMY		
Presence and operations of the new industry	Generated revenues	High
	Investments based on expectations	High
	Purchasing power of employees	Moderate
	Increased international connections	High
	Catalyst for increase in industrial activities	Moderate
	Employment	Mod/Low
	Procurement of goods and services	Mod/Low
	Land acquisition/lease	High
	Infrastructure	Mod/Low
	Resource use	Mod/Low
	Co-existence fisheries	Low
	Co-existence commercial shipping	Low
	Co-existence other industry	Low
	Co-existence tourism	Low
SOCIO-CULTURAL ISSUES		

Presence and operations of the new industry	Expectations	High
	Price increase	Moderate
	Use of public services	Mod/Low
	Community relations	Moderate
	Damage to local land/property	Low
	Safety and nuisance to the community	Mod/Low
	Change in livelihoods	Low
	Resettlement	High/Mod
	In-migration	Mod/Low
	Social structure	Mod/Low
	Security	High
	Public health	Low
INSTITUTIONAL ISSUES		
Presence of the new industry	Relevant HSE legislation in place	High
	Plans for maximizing benefits for relevant services/industries	Moderate
	Capacity deficiency within authorities	High
	Stakeholder management	Moderate
	Community engagement	Mod/Low
	Build trust among decision makers	High
	Land use planning and control	High
	Capacity building on environmental awareness	High
	Official plans for potential CSR programs	High
OTHER		
Technology	Ultra deep water drilling	Moderate
	Ultra deep water for subsea and pipeline installations and operations	High
Training	Availability of training facilities	High
Infrastructure	Waste management	High
	National contingency plan	High
Data deficiency	Environmental baseline data	High
	Social data	High

Scenario 5– Multiple and Successive Field Developments

This scenario describes a situation which includes exploratory drilling (and therefore all of the requirements of Scenario 1), and assumes a commercially viable finding of oil or gas which would entail ongoing production drilling. The previous scenarios have been evaluated on the basis having a single rig drilling and only a single scenario. Scenario 5 describes the requirements for processing and managing oil and gas production if Scenarios 1-4 happened simutaneously. While there would be no new aspects as such, the cumulative effects would alter the ranking of impacts and opportunities. As a minimum this scenario would include:

- Offshore operations from subsea facilities
- Offshore pipelines, cables etc
- FPSO and offshore loading facilities
- Operational centres
- Deliveries from barge: crude oil, gas to shore, possibly LPG
- Gas pipelines to shore
- Receiving terminals onshore (or nearshore barge if feasible)
- Onshore support to drilling and subsea installation comprising supply vessels, helicopters etc
- Support to subsea intervention and operation of the barges
- Need for continuing support from vessels, helicopters to FPSO
- Onshore supply base (a dedicated area of at least 1000m^2) with storage areas for pipes, tank facilities, waste handling facilities etc and infrastructure such as harbours
- Supply of food, potable water etc
- National contingency plan in place including all necessary equipment

Analysis of Scenario 5– Multiple and Successive Field Developments

The impacts, risks and opportunities attendant on such a scenario have been evaluated and are as follows:

Activity	Aspect	Significance
ENVIRONMENT		
Mobilisation and drilling operations	Noise emissions	High
	Air emissions	Moderate
	Light emissions	Low

	Discharges	Low
	Waste disposal	High
	Disposal of cuttings	Low
	Disposal of oil based muds	High
	Blow out	High
	Safety flaring	Moderate
	Physical presence	Low
Support to drilling and field operations	Supply and construction vessels	High
	Helicopter transportation	Low/Mod
	Helicopter base	Low
	Harbour facilities	High
	Road transportation	Moderate
Field development and production including gas pipelines to shore	Physical presence of subsea installations, field pipelines/cables, FPSO, pipelines to shore	Mod/High
Landfall Sites	Temporary landtake and construction	Moderate
Supply Base onshore	Landtake	High
Gas receiving and processing facilities	Landtake	High
	Air emissions from Flaring	High
Oil and LNG processing, storage and offshore loading	Air emissions from Flaring	High
ECONOMY		
Presence and operations of the new industry	Generated revenues	High
	Investments based on expectations	High
	Purchasing power of employees	High
	Increased international connections	High
	Catalyst for increase in industrial activities	High
	Employment	High
	Procurement of goods and services	High
	Land acquisition/lease	High
	Infrastructure	Moderate
	Resource use	Moderate

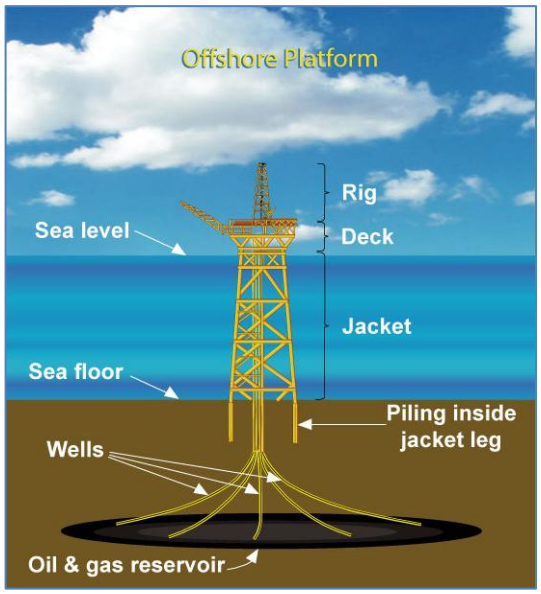
	Co-existence fisheries	Moderate
	Co-existence commercial shipping	Moderate
	Co-existence other industry	Low
	Co-existence tourism	Low
SOCIO-CULTURAL ISSUES		
Presence and operations of the new industry	Expectations	High
	Price increase	High
	Use of public services	Moderate
	Community relations	High
	Damage to local land/property	Low
	Safety and nuisance to the community	Moderate
	Change in livelihoods	Moderate
	Resettlement	High
	In-migration	Moderate
	Social structure	Mod/High
	Security	High
	Public health	Moderate
INSTITUTIONAL ISSUES		
Presence of the new industry	Relevant HSE legislation in place	High
	Plans for maximizing benefits for relevant services/industries	High
	Capacity deficiency within authorities	High
	Stakeholder management	High
	Community engagement	High
	Build trust among decision makers	High
	Land use planning and control	High
	Capacity building on environmental awareness	High
	Official plans for potential CSR programs	High
OTHER		
Technology	Ultra deep water drilling	Moderate
	Ultra deep water for subsea and pipeline installations and operations	High

Training	Availability of training facilities	High
Infrastructure	Waste management	High
	National contingency plan	High
Data deficiency	Environmental baseline data	High
	Social data	High

Scenario 6– Nearshore Oil and associated Gas

This scenario differs from scenarios 1-5 in that the activity would take place in the nearshore shallow water. Scenario 6 nevertheless assumes exploratory drilling, a commercially viable finding of oil (the more likely result given the onshore oil situation in the general region) and ongoing production drilling. As a minimum this scenario would include:

- Offshore operations from fixed platform or anchored production vessel
- Offshore loading of crude oil and initial reinjection of associated gas, pending reservoir conditions (fast track development in order to generate early cash flow)
- Pipeline to shore carrying associated (rich) gas when reinjection of gas is terminated



Fixed offshore platform for oil and gas

- Construction/operation of onshore gas receiving terminal for processing of rich gas into LPG and dry sales gas
- Commercial operations related to sales and dispatching of crude oil, LPG and sales gas
- Crude oil to be offloaded offshore onto shuttle tankers, LPG (approx. 10% of the associated gas) to be extracted at the onshore gas terminal (sold in bulk and/or bottled)

and dry gas to be used as fuel in new high efficiency gas fired power plant (3 Bcm/year will satisfy the fuel needs for a 2000 MW power plant

- Possible construction of new large scale combined cycle gas power station adjacent to the gas receiving terminal, rated at 2000 MW
- Peak production of crude oil of 50.000 bbls/d, while the associated gas is re-injected into the reservoir for pressure support during the first 8 years of production (pending reservoir conditions)
- Gas production to extend over 25 years with plateau production over 20 years at 3 Bcm/year
- Need for continuing support from vessels, helicopters as for drilling
- Onshore supply base (a dedicated area of at least 1000m2) with storage areas for pipes, tank facilities, waste handling facilities etc and infrastructure such as harbours
- Supply of food, potable water etc
- National contingency plan in place including all necessary equipment

Production vessel, crude oil shuttletank and drilling rig on site

Analysis of Scenario 6– Nearshore Oil and associated Gas

The impacts, risks and opportunities attendant on such a scenario have been evaluated and are as follows:

Activity	Aspect	Significance
ENVIRONMENT		
Mobilisation and drilling operations	Noise emissions	High
	Air emissions	Low
	Light emissions	Low
	Discharges	Low
	Waste disposal	High
	Disposal of cuttings	Low
	Disposal of oil based muds	High
	Blow out	High
	Safety flaring	Moderate
	Physical presence	Low
Support to drilling and field operations	Supply and construction vessels	Moderate
	Helicopter transportation	Low
	Helicopter base	Low
	Harbour facilities	Low
	Road transportation	Moderate
Field development and production including possible small pipeline to shore	Physical presence of subsea installations, field pipelines/cables, FPSO, pipelines to shore	Moderate
Landfall Site	Temporary landtake and construction	Moderate
Supply Base onshore	Landtake	High
Gas receiving and processing facilities	Landtake	High
	Air emissions from Flaring	High
Oil processing, storage and offshore loading	Air emissions from Flaring	High/Mod
ECONOMY		
Presence and operations of the new industry	Generated revenues	High

	Investments based on expectations	High
	Purchasing power of employees	Moderate
	Increased international connections	High
	Catalyst for increase in industrial activities	Moderate
	Employment	Mod/Low
	Procurement of goods and services	Mod/Low
	Land acquisition/lease	High
	Infrastructure	Mod/Low
	Resource use	Mod/Low
	Co-existence fisheries	Low
	Co-existence commercial shipping	Low
	Co-existence other industry	Low
	Co-existence tourism	Low
SOCIO-CULTURAL ISSUES		
Presence and operations of the new industry	Expectations	High
	Price increase	Moderate
	Use of public services	Mod/Low
	Community relations	Moderate
	Damage to local land/property	Low
	Safety and nuisance to the community	Mod/Low
	Change in livelihoods	Low
	Resettlement	High/Mod
	In-migration	Mod/Low
	Social structure	Mod/Low
	Security	High
	Public health	Low
INSTITUTIONAL ISSUES		
Presence of the new industry	Relevant HSE legislation in place	High
	Plans for maximizing benefits for relevant services/industries	Moderate
	Capacity deficiency within authorities	High
	Stakeholder management	Moderate

	Community engagement	Mod/Low
	Build trust among decision makers	High
	Land use planning and control	High
	Capacity building on environmental awareness	High
	Official plans for potential CSR programs	High
OTHER		
Technology	Drilling in 100-200m water depth	Low
	Pipeline design, installations and operations	Moderate
Training	Availability of training facilities	High
Infrastructure	Waste management	High
	National contingency plan	High
Data deficiency	Environmental baseline data	High
	Social data	High

Scenario 7– Onshore Gas Transportation and Use

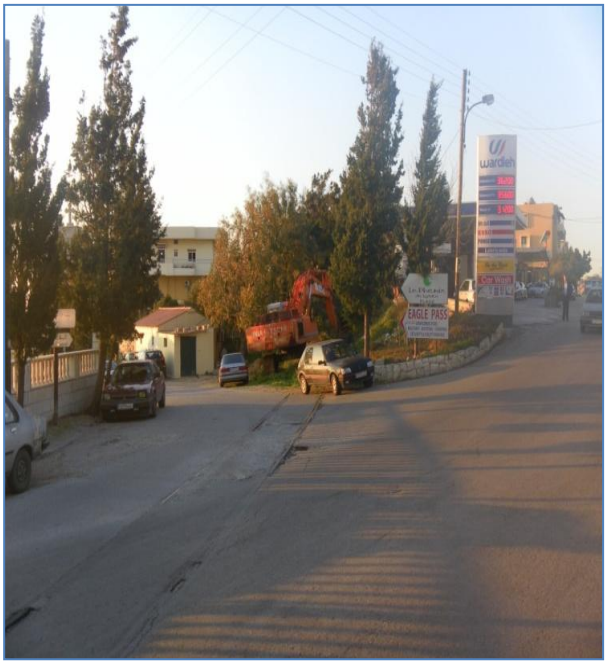
This scenario differs from the others in that it describes the downstream development, once the gas has been shipped to shore. This scenario describes the options for transporting gas from the receiving terminals/ LNG plants to the power plants. There are three options envisaged: an onshore pipeline, an off/nearshore pipeline and truck transportation of LNG along the existing road network. Route selection and pipeline design will be subject to a full ESIA and design risk assessment prior to construction. In this scenario the construction phase gives rise to the greatest level of significant impacts, and while this is a temporary event the consequences can be far reaching. (Volume 7 portrays the onshore pipeline route graphically).

As a minimum this scenario would include:

- Pipelines – onshore and off/nearshore. The onshore pipeline proposed is 36” at 75 barg
- Road transportation
- Compressor station (approx 600mx600m excluding safety zone)
- Gas quality conditioning
- Gas metering
- Conversion of power stations
- Gas for power stations
- Gas dispatch (delivery) centre.

In some areas the pipeline has been subject to coastal erosion and has been built on by coastal hotels

It is proposed that the onshore pipeline will use the dis-used railway. Construction through urban areas will present challenges.



Road transport of LNG will have a significant impact on road use

Analysis of Scenario 7– Onshore Gas Transportation and Use

The impacts, risks and opportunities attendant on such a scenario have been evaluated and are as follows:

Activity	Aspect	Significance
ENVIRONMENT		
Pipeline for dry gas onshore	Construction activities	High
	Effects on habitats during operation	Low
	Landtake and presence of AGIs	Low
Pipeline for dry gas off/nearshore	Construction activities	High
Truck transport of LNG from terminal to power plants	Emissions	High
	Increased traffic	High
Support to drilling and field operations	Supply and construction vessels	Moderate
Power plant conversion from oil to gas	Construction activities	Moderate
	Emissions	High (beneficial)
ECONOMY		
Presence and operations of the new industry	Generated revenues	High
SOCIO-CULTURAL ISSUES		
Pipeline Onshore	Community relations	High
	Damage to local land/property	High
	Safety and nuisance to the community	High
	Change in livelihoods	High
	Resettlement	High
	In-migration	Low
	Security	High
	Maintaining servitude requirements	High
Pipeline Offshore	Community relations	Low
	Safety and nuisance to the community	Low
	Security	Moderate
Transportation of LNG with trucks	Community relations	High
	Damage to local land/property	High

	Safety and nuisance to the community	High
	Security	High
INSTITUTIONAL ISSUES		
Installation of new technology and gas/LNG transportation	Relevant HSE legislation in place	High
	Capacity deficiency within authorities	High
	Stakeholder management	High
	Community engagement	High
	Build trust among decision makers	High
	Land use planning and control	High
	Capacity building on environmental awareness	High
OTHER		
Infrastructure	Waste management	High
	National contingency plan	High
Data deficiency	Environmental baseline data	High
	Social data	High

Summary of Significant Impacts, Risks and Opportunities

All of the scenarios described have a great deal of overlap in the risks, impacts and opportunities that have been identified. It is therefore reasonable to extract all High level ratings for further consideration at this SEA phace of the work.

The following table provides a summary of issues that rank High in a significance evaluation, and the specific scenario number in which they feature.

Category	Activity/Aspect	Significant Issue	Scenario
Environment	Mobilization and exploration drilling	Noise emissions Waste disposal Disposal of oil based muds Blow out	2 3 4 5 6 1 2 3 4 5 6 1 2 3 4 5 6 1 2 3 4 5 6
Environment	Suport to drilling and field operations	Disturbance	5
Environment	Onshore supply base	Landtake	2 3 4 5 6
Environment	Gas receiving and processing facilities	Landtake Flaring	2 3 4 5 6 2 3 4 5 6
Environment	Pipeline for gas transport	Construction activities Permanent landtake	3 5 3 5
Environment	LNG processing, storage and export	Air emissions from Flaring	3 5
Environment	Onshore Pipeline	Construction activities	7 7
Environment	Truck LNG from facility to power plant	Air Emissions Increased road traffic	7 7
Environment	Power plant conversion oil to gas	Air emissions – long term beneficial impact	7
Economy	Operations of a new industry	Generated revenues Investments based on expectations Purchasing power of employees Increased international connections Catalyst for increase in industrial activities Landtake/Lease Employment Procurement of goods and services	2 3 4 5 6 7 2 3 4 5 6 2 5 2 3 4 5 6 2 5 2 3 4 5 6 5 5

Socio-cultural	Operations of a new industry	Expectations Community relations Resettlement Security Price increase	2 3 4 5 6 2 5 2 5 1 2 3 4 5 6 5
Socio-cultural	Pipeline Onshore	Community relations Resettlement Security Damage to local land/property Safety and nuisance to the community Maintaining servitude requirements	7 7 7 7 7 7
Socio- cultural	Trucking LNG from facility to Power Plant	Community relations Security Damage to local land/property Safety and nuisance to the community	7 7 7 7
Institutional	Presence and Operations of a new industry	Relevant HSE legislation in place Capacity deficiency within authorities Stakeholder Management Community Engagement Build trust among decision makers Land use planning and control Capacity building on environmental awareness Offical plans for potential CSR programs Plans for maximising benefits for relevant services/industries	1 2 3 4 5 6 7 1 2 3 4 5 6 7 1 5 7 2 5 7 1 2 3 4 5 6 7 2 3 4 5 6 7 1 2 3 4 5 6 7 1 2 3 4 5 6 5
Other	Technology	Ultra deep water for subsea and pipeline installations and operations Possible ultra deep water subsea gas compression	2 3 4 5 2
Other	Training	Availability of training facilities	2 3 4 5 6
Other	Infrastucture	Waste Management National Contingency Plan Harbour Facilities	1 2 3 4 5 6 7 1 2 3 4 5 6 7 5
Other	Data deficiency	Environmental baseline data Social data	1 2 3 4 5 6 7 1 2 3 4 5 6 7

This list can be further refined by prioritising the issues in relation to the timelines of the various activities. The timeline from License award to production is approximately 10 years for

gas and 7 years for oil, so the issues relevant to production do not have the same level of urgency as those for institutional and infrastructure strengthening.

It is suggested that the following 13 items represent the Key Issues that should be addressed and developed as part of the general preparation for an oil and gas industry. These Key Issues will be fully described in Section 4 of this document.

1. Relevant HSE legislation in place.
2. National Contingency Plan
3. Capacity deficiency within authorities
4. Landtake
5. Data Deficiency
6. Waste Management
7. Infrastructure
8. Environmental Awareness
9. Building Trust among decision makers
10. Security
11. Air Emissions
12. Resettlement
13. Expectations

IMPACTS

4. RISK AND IMPACT ASSESSMENT AND EVALUATION

The ISO's standard for Environmental Management Systems (EMS), ISO 14001 defines environmental impact as:

'Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services.'

This definition has been extended to include Social, Economic and Institutional spheres as well as Environmental; the evaluation process is the same.

A risk, impact or opportunity may result from any of the project activities, the project in this instance being oil and gas development in Lebanese waters. Section 3 has described seven different scenarios, and identified the potential High Level effects from these. At this SEA phase it is only appropriate to highlight those impacts that have a High Level ranking.

Evaluation is a systematic process by which the nature of impacts and the levels of risk are assessed and understood.

4.1. Significance Assessment

Significance assessment in the oil and gas industry uses a Risk Assessment Matrix that is derived from the Health and Safety approach to assessing Hazards and has subsequently been adopted to accommodate Environmental issues. Essentially it is a subjective assessment which considers the Probability or Likelihood of an aspect resulting in an impact against the Severity or Consequence if it does, on a 5x5 matrix. It is illustrated by a simple matrix format coloured Red, Yellow, Green indicating High, Medium and Low Risk.

	Consequence				
Probability	**Minor**	**Moderate**	**Serious**	**Major**	**Critical**
Remote	*Low*	*Low*	*Low*	*Medium*	*Medium*
Unlikely	*Low*	*Low*	*Medium*	*Medium*	*High*
Possible	*Low*	*Low*	*Medium*	*High*	*High*
Likely	*Low*	*Medium*	*High*	*High*	*High*
Certain	*Medium*	*Medium*	*High*	*High*	*High*

However, the Risk Matrix is simplistic and the more complex interactions of impacts cannot be so easily assessed. This is especially true with Social Impact Assessment, which is becoming increasingly part of the oil and gas industry pre-project evaluations.

The process is only as good as the competency and experience of the assessor, it is a subjective assessment. But it is also a multivariate one and should be carried out in a multidisciplinary context to ensure a robust assessment. It is also not so much a methodology as a way of

illustrating the findings in a simple broad-brush manner which clearly emphasises the issues that require addressing and their priority.

Risk Criteria	Tolerability
High	Intolerable – If the risk level is high, the risk is considered to be unacceptable. If a high risk remains, after all available controls are implemented, the activity should not be undertaken. High risks require further review, risk assessment and additional controls.
Medium	Tolerable – If the risk level is medium, the risk is considered tolerable. Despite being in the tolerable range, mitigation must be taken to reduce the risk to As Low as Reasonably Practicable (ALARP).
Low	Acceptable – If the risk is low, the risk is broadly considered acceptable. This does not necessarily mean that the risk requires no mitigation. All mitigation that is economic, readily identified, and practicable should be applied.

The issues that were identified as High ranking for the immediate and pre-drilling timespan are as follows:

1. Relevant HSE legislation in place.
2. National Contingency Plan
3. Capacity deficiency within authorities
4. Landtake
5. Data Deficiency
6. Waste Management
7. Infrastructure
8. Environmental Awareness
9. Building Trust among decision makers
10. Security
11. Air Emissions
12. Resettlement
13. Expectations

These issues will contribute to a project specific Design Risk Register when individual projects are identified.

4.2. Detailed Impact Assessment

Impact assessment is a process which becomes increasingly detailed as the overall plan, in this case developing an oil and gas industry in Lebanon, develops into a multitude of individual projects. An ESIA Impact assessment and evaluation follow the same conceptual process as the high level Risk Assessment described above in that it uses the same Risk Based Matrix, plotting severity against likelihood. However, the scope is at a more grass roots level and the **Source-Pathway-Receptor** model is used where individual receptors are identified.

In preparation for the next project based phase it has been deemed appropriate to provide an example of the more detailed impact assessment typical of an ESIA.

4.3. Example of an Impact Assessment for a Drilling Project

This sub-section identifies and qualitatively assesses aspects of the drilling programme that may have an environmental or socio-economic impact. The potential for positive impacts from drilling (primarily socio-economic) are recognised along with negative impacts. The impacts are restricted to this proposed drilling campaign and do not include future petroleum development.

The following aspects have been identified:

- Emissions to air
- Emissions to water
- Waste materials
- Physical presence
- Use of resources
- Socio-economic impacts

The impact assessment process first identifies potential impacts that may result from the proposed project activities. They may either directly, indirectly or cumulatively affect the environment. The impacts are then assessed based on these criteria:

- Nature — effect on potential receptors
- Scope — geographical area affected (Local, Regional, Continental – L, R, C))
- Persistence — duration of the impact: Short (minutes–hours), medium (days–weeks), long (months–years), permanent or unknown (S, M, L, P)
- Consequence — overall severity of the impact (Minor, Moderate, Serious, Major, Critical)
- Probability — likelihood of the impact occurring (Remote, Unlikely, Possible, Likely, Certain)
- Importance — overall significance of the impact in relative terms (Low, Medium, High)
- Type of effect — direct, indirect or cumulative effects.

The risk assessment matrix categorises the consequence of potential impacts arising from various activities and aids in the development of mitigation measures. The table below summarises potential impacts:

Activity	Aspect	Impacts					Impact Description		
		Scope L R C	Persistence S M L P	Probability R U P L C	Consequence Mi Mo S Ma C	Importance L M H	Direct Effects	Indirect Effects	Cumulative Effects
Emissions to Air									
Rig mobilisation	Rig engine emissions	L	S	L	Mi	L	Local reduction in air quality. Contribution of GHGs.	Impacts to human health.	Contribution to regional air pollution.
Drilling	Generator emissions	L	S	L	Mi	L			
Vessel use	Engine emissions	L	S	L	Mi	L			
Helicopter operations	Engine emissions	L	S	L	Mi	L			
Well testing	Flare emissions	L	S	L	Mi	L			
Drilling	Fugitive emissions	L	S	L	Mi	L			
Fire control	Fugitive testing emissions	L	S	L	Mi	L			
Drilling / vessels	Noise	L	S	L	Mi	L	Disturbance to wildlife.		Injury to or loss of individual marine species.
Helicopter operations	Noise	L	S	L	Mi	L			
Emissions to Water									
Drilling	Sewage discharge	L	S	L	Mi	L	Local reduction in water quality from nutrient enrichment and/or toxicity effects of low levels of oil / chemical spills. Limited localised temperature increase.	Pollution of ecosystems. Localised behavioural changes in marine life.	Local organic enrichment. Loss of biodiversity.
Drilling	Rig drainage discharge	L	S	L	Mi	L			
Drilling	Cooling water discharge	L	S	L	Mi	L			
Drilling	Run-off / wash water discharge	L	S	L	Mi	L			
Top hole drilling	Cuttings discharge	L	M	L	Mi	M	Localised smothering of the seabed around the well site. Localised turbidity.	Pollution of ecosystems. Loss of seafloor habitat.	Loss of biodiversity.
Drilling lower hole sections	Cuttings discharge	L	M	L	Mi	M			
Top hole drilling	Cement release	L	M	L	Mi	M			

Activity	Aspect	Impacts					Impact Description		
		Scope L R C	Persistence S M L P	Probability R U P L C	Consequence Mi Mo S Ma C	Importance L M H	Direct Effects	Indirect Effects	Cumulative Effects
Well completion	Chemical discharge	L	S	L	Mi	M	Depletion of oxygen in surface sediments. Low level toxicity impacts to marine biota.		
Well testing	Hydrocarbon drop-out	L	M	P	Mi	L	Low level toxicity impacts to marine biota.	Pollution of ecosystems.	Loss of biodiversity.
Supply / re-supply of rig.	Loss of materials to sea	L	M-L	U	Mo	L	Localised pollution Physical harm / snaring from lost materials	Pollution of ecosystems.	Loss of biodiversity.
Rig / vessel ballast water	Ballast water discharge	L	S-M	U	Mo	L	Localised pollution. Introduction of exotic species.	Displacement of native species.	Loss of biodiversity.
Drilling / offshore bunkering	Large (>10,000 litre) fuel / oil spill	L-R	L	R	C	M	Physical oiling and toxicity impacts to wildlife. Localised mortality to krill, eggs and larvae. Contamination of coastal habitats. Physical oiling and toxicity impacts to wildlife, contamination of coastal habitats.	Decreased food resource from krill mortality, impacts to fishing and tourism. Political problems from transboundary issues (large spill only). Issue of waste disposal. Habitat loss, impacts to tourism and nearshore fisheries. Human health and disposal issues from cleanup.	Accumulation of oil in the food chain and in sediments. Loss of biodiversity and revenue.
Drilling / offshore bunkering	Small-med (<10,000 litre) fuel / oil spill	L-R	M-L	R	Ma	M			
Near-shore loading / unloading	Small-med (<10,000 litre) fuel / oil spill	L	M	U	Mo	L			
Drilling	Chemical spill	L	S-M	U	Mi	L	Toxicity effects on marine biota.	Pollution of ecosystems. Human health and safety.	Bioaccumulation of toxic substances.

Activity	Aspect	Impacts					Impact Description		
		Scope L R C	Persistence S M L P	Probability R U P L C	Consequence Mi Mo S Ma C	Importance L M H	Direct Effects	Indirect Effects	Cumulative Effects
Drilling	Underwater noise	L-R	M	P	Mi	L	Disturbance of animals in close proximity to the rig and vessels.	Potential behavioural effects in marine mammals.	Increase in background marine noise levels.
Waste Materials - Offshore Aspects									
Drilling	Food waste discharge	L	M	L	Mi	L	Organic enrichment, food source for marine fauna.	Changes to localised ecosystem.	Organic enrichment.
Waste transfer	Escape of waste material	L	M-L	U	Mo	L	Localised pollution. Physical harm / snaring from waste items.	Pollution of ecosystems.	Loss of biodiversity.
Waste Management	Segregation & compaction	L	S-M	C	S	H	Positive effect: improved waste management option. Reduced volume of waste material.	See onshore waste management below.	Reduced landfill take-up.
Onshore waste management									
Incineration	Air emissions	L	S	L	Mi	L	Air pollution.	Pollution of ecosystems.	Contribution to regional and continental air pollution.
Incineration	Landfill of ash	L	L-P	L	Mo	M	Visual impact. Possible soil and groundwater pollution.	Human health and safety effects. Amenity impacts. Damage to flora and fauna.	Reduced landfill availability. Increasing footprint of operations.
Disposal on shore	Landfill	L	L-P	U	Ma	H	Possible contamination of soil and groundwater. Amenity impacts. Polluting emissions to air.	Human health and safety effects. Land take-up. Damage to flora and fauna.	Increasing footprint of operations.

Activity	Aspect	Impacts					Impact Description		
		Scope L R C	Persistence S M L P	Probability R U P L C	Consequence Mi Mo S Ma C	Importance L M H	Direct Effects	Indirect Effects	Cumulative Effects
Transfer to UK	Trans-frontier shipment	C	M	L	Mo	M	Impacts from long distance shipping of waste material (air emissions, fuel use, risk of spills etc).	Impacts from treatment / disposal of waste in the UK.	Increasing footprint of operations.
Waste Management	Storage & reuse	L	M-L	C	S	H	Positive effect - reduced incineration / landfill take up.	Potential for releases from waste storage.	Reduce waste disposal. Reduce raw material consumption.
Re-use of oily wastes	Re-use for heating	L	M-L	L	So	H	Positive impacts: reduction in waste, local heating.	No trans-frontier shipment of oily waste required.	Boost to local business.
Physical Presence									
Rig mobilisation	Interference with other sea users	L	M	P	Mi	L	Hazard to fisheries and shipping on route.	Economic costs to shipping and fisheries.	Negligible.
Rig presence	Interference with other sea users	L	M	U	Mo	L	Exclusion of fisheries and shipping from drilling areas.	Economic costs to shipping and fisheries. Collision risk.	Impacts to local economy.
Anchoring	Seabed disturbance	L	M	U	Mo	L	Harm to marine biota. Damage to seafloor habitats.	Increased turbidity in the water column.	Loss of biodiversity.
Anchoring	Damage to seabed artefacts	L	L-P	R	S	L	Damage to any unlisted artefacts or archaeological remains in the area.	Potential emergency situation should explosives be impacted.	Loss of items of historic value.
Support vessels	Interference with other sea users	L-R	M	U	Mo	L	Disruption to fisheries, shipping, harbour operations..	Potential emergency situation from vessel collision.	Impacts to local economy.

Activity	Aspect	Impacts					Impact Description		
		Scope L R C	Persistence S M L P	Probability R U P L C	Consequence Mi Mo S Ma C	Importance L M H	Direct Effects	Indirect Effects	Cumulative Effects
Well suspension / abandonment	Residual seabed hazards	L	L-P	P	Mi	L	Any items or extruding equipment will be a potential trawl fishing hazard.	Impacts to local fisheries. Some positive environmental effect from seabed exclusion.	Impacts to local economy.
Use of Resources									
Pre-mobilisation	Purchase of drilling consumables	L-C	M-L	P	Mi	L	Consumption of resources - steel, mud, cement, chemicals etc.	Effects of mining, processing and manufacturing.	Loss of natural resources. Pollution of the environment.
Mobilisation & transfers	Fuel use	L-C	M-L	P	Mo	M	Consumption of helifuel, aviation fuel, diesel etc.	Effects of extraction and processing, price of fuel.	Loss of natural resources. Pollution of the environment.
Drilling	Fuel use	L	M-L	P	Mo	M	Consumption diesel.	Effects of extraction and processing, price of fuel.	Loss of natural resources. Pollution of the environment.
Drilling	Use of seawater	L	M-L	C	Mi	L	Extraction and use of seawater.	None.	Negligible.
Drilling	Use of potable water	L	M-L	L	Mo	M	Consumption of water from the town supply.	Drop in towns' pressure while loading into vessels.	Reduced resource availability.
Socio-Economic Impacts									
Mobilisation / demobilisation	Accommodation & offices	L	L-P	U	S	L	Positive effect - Financial income for local people / businesses.	Increased competition for available accommodation.	Pressure on local resources. Localised economic growth.
Mobilisation / demobilisation	Flights	L-C	M-L	P	S	M	Potential increased pressure on available airline seats.	Development of new travel options / routes in the long term.	Negligible.
Drilling	Direct / indirect economic	L-R	M-L	L	S	H	Positive effect - Increase in jobs and income.	Change in focus of local economy towards servicing	Adaptation of local service providers to

Activity	Aspect	Impacts					Impact Description		
		Scope L R C	Persistence S M L P	Probability R U P L C	Consequence Mi Mo S Ma C	Importance L M H	Direct Effects	Indirect Effects	Cumulative Effects
	flow-on							the drilling operations.	exploration industry.

4.4. Mitigation

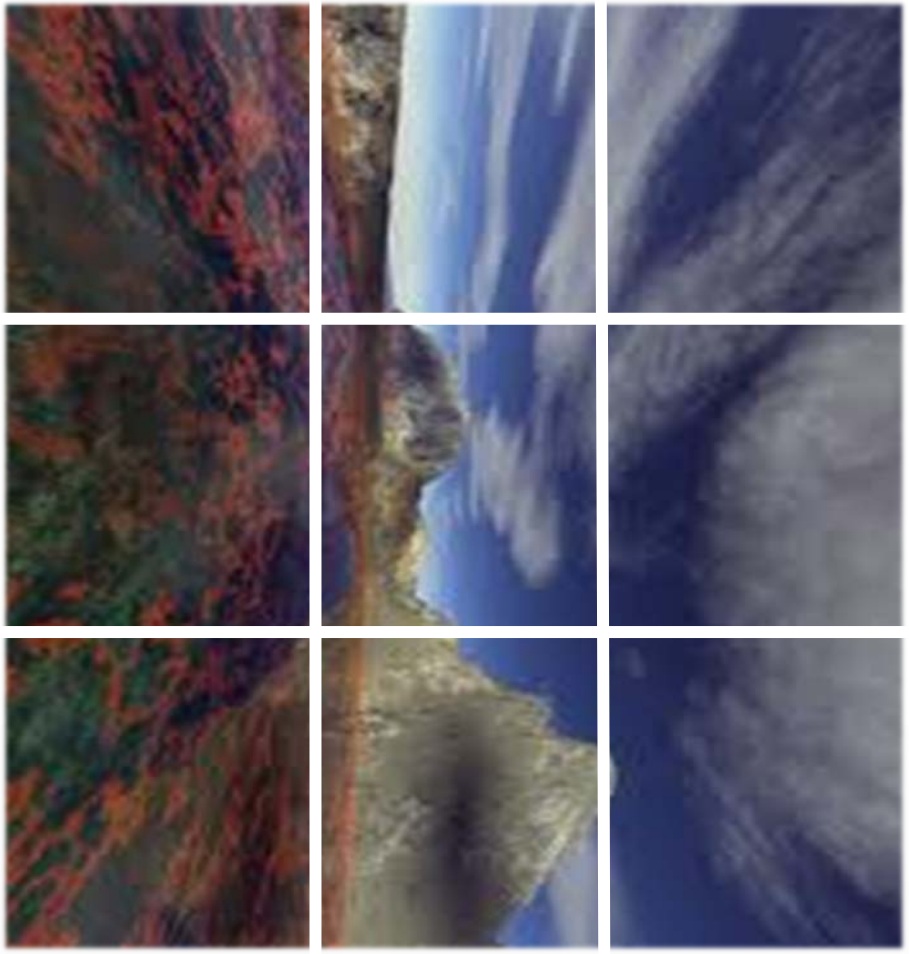
Mitigation involves identification and definition of management measures which lessen the risks to tolerable or acceptable levels. Risks can be mitigated by altering the consequences or likelihood, or both. At optimum, a change in design would negate the risk. Mitigation will follow the Mitigation Hierarchy - **Avoid - Reduce - Remedy – Compensate**; this gives priority to avoidance where possible. Residual Risks will be reassessed after proposed mitigation measures.

The final stage of characterising residual risks uses the same methodology of risks evaluation but gives due consideration to the proposed risk mitigation measures. Activities which are deemed to still have a high level of residual risk to the environment are highlighted through this process.

During the ESIA process a detailed Impact Register, including assessment, mitigation, and re-assessment of residual risk is compiled.

4.5. Constraints To Approach

This is only one way of evaluating impacts from oil and gas activities, although it is now the established industry approach that has been refined over many years use. However, stakeholder and community engagement processes are evolving other ways, such as number of times an issue is raised. The Stakeholder Management Plan, Volume 3, expands and describes issues and concerns from these perspectives.



OIL SPILL MODELS

5. OIL SPILL SCENARIOS

Spillage of oil from drilling and production operations can result from many events, typically those tabulated below (Table5.1)

Table 5.1: Typical Oil Spill Scenarios during Drilling and Production Phases

Initiating Event Drilling Production	Exploration	Production
Reservoir blowout after installation of BOP	X	
Reservoir blowout during well completion	X	
Reservoir blowout during production		X
Loss of drilling mud containment due to leakage or during transfer	X	
Loss of reservoir fluid containment from surface infrastructure due to defects, corrosion, impact, fire/explosion	X	X
Loss of aviation fuel containment (e.g. container dropped)	X	X
Loss of diesel or fuel oil containment during transfer or due to leakage	X	X
Loss of lubricating oil containment during transfer or due to leakage	X	X
Loss of hydraulic oil containment during transfer or due to leakage	X	X
Loss of crude oil containment from subsea infrastructure due to from defects, corrosion, impact		X
Loss of crude oil containment from risers to environment due to defects, corrosion, impact, fire, explosion		X
Loss of crude oil containment from process equipment due to defects, corrosion, impact, fire, explosion		X
Loss of crude oil containment from oil storage tank due to defects, corrosion, impact		X
Loss of crude oil containment during offloading		X

5.1. Spills during Offshore Construction and Installation

The main risk of hydrocarbon releases during construction and installation would be a result of accidental fuel spills from vessels during bunkering or as a result of vessel impacts. It is recommended that controls and procedures be put in place to minimise the risk of accidental spills during this stage. Such measures should include the auditing of all vessels, implementation of bunkering and fuel transfer procedures, an Oil Spill Contingency Plan (OSCP), vessel management and co-ordination plans.

In the event of such a spill, it is anticipated impacts will be localised to the immediate vicinity of the spill and will occur over a short time period.

5.2. Spills during Drilling Operations

The main environmental risk associated with drilling operations is a risk of accidental hydrocarbon releases during drilling operations, mainly from the fuel bunkering of diesel or a loss of well control. The three main sources of potential spills, from historical oil spill records are listed in Table 5.2 together with the measures typically taken to minimise or eliminate the risks.

Table 5.2: Sources of Oil Spills and Control Measures Planned

Potential Source of Spill	Risk and Control Measures Taken
Fuel or other utility fluids (e.g. diesel, lubricants)	No transfer of lubricants and other utility fluids. Where practical before drilling any wells a rig should be fully bunkered before moving onto location to try and minimise the requirement for re-fuelling on site. Re-fuelling should only be undertaken during daylight and in good weather conditions. Non-return valves should be installed on fuel transfer hoses, and operations supervised at all times.
Loss of Rig (ship collision)	Standby vessel can monitor exclusion zone. Notification of planned drilling programme with all relevant maritime and fishing authorities. Ship collision risk assessment to be undertaken.
Loss of well control	Precautions to prevent loss of well control include shallow gas survey, appropriate well design and engineering, well monitoring programme, blow-out preventer, well control training and emergency drills.

It is expected that accidental diesel spills during bunkering will lead to small volumes of hydrocarbons being released (generally less than a tonne). Typically, such small hydrocarbon volumes disperse rapidly and therefore do not usually represent a significant threat to local marine or coastal environmental sensitivities. A number of measures can be taken to manage fuel transfer operations to reduce spill risks to a minimum. Non-return valves can be installed on transfer hoses, and operations should be supervised at all times.

5.3. Worst Case Scenario Definition

Worst case spill scenarios are determined by the inventory of a drilling rig and the reservoir characteristics (assuming an oil or condensate reservoir). The total hydrocarbon inventory during a drilling campaign is considered in a worst case scenario. Where available, the characteristics of the well will also be considered as will any anticipated flow rate. As an example, a worst case diesel spill of 500 tonnes has been assumed.

5.4. Predicted Potential Impact on the Marine / Coastal Environment

5.4.1 Oil Spill Modelling Software

OilMap, developed by Applied Science Associates Inc., is an oil spill model that predicts the movement of oil on the water surface and the distribution of oil in the environment. It produces a fully validated and calibrated oil spill model based upon extensive research. The weathering model and associated algorithms within OilMap have been validated against controlled actual spills at sea and real spill events supported with laboratory calibration.

5.4.2 Stochastic and Trajectory Models

Stochastic modelling simulations predict probable behaviour of potential oil spills under typical historic meteorological and oceanographic conditions. The outputs indicate the probability of where the spill may impact; they do not indicate volumes of oil.

Trajectory modelling is a deterministic approach used to predict the movement of an oil spill on the sea surface, based on a single set of meteorological and oceanographic conditions. It predicts the fate and behaviour of oil spilled on the water and the time it takes for oil to intersect maritime boundaries and beach.

5.4.3 Modelling Limitations

There are a number of limitations to consider when interpreting the outputs, in particular:

- Modelling results are to be used for guidance purposes only and response strategies should not be based solely on modelling results alone;
- The resolution / quality of tidal and oceanic current data vary between regions and models. As with any other model, results are dependent on the quality of the environmental parameters and scenario inputs used;
- The properties of the oil in the model's database may not precisely match those of the product spilled;
- The properties and behaviour of the oils spilt in a dynamic marine environment may vary slightly to those outputs produced using data held within OilMap. This is likely with all oils in the database and is intrinsic to all modeling;
- If the same scenario was conducted in another oil spill modelling programme, with identical parameters and inputs, the results may show a degree of variance. This is expected as the different fate and weathering models have been developed and programmed independently;
- Each oil in the OilMap database is characterised by a series of numerical constants. The software uses these in various algorithms to simulate the behaviour of the oil when spilled. Therefore in consideration of the above, all advice, modelling, and other information provided is generic and illustrative only and not intended to be relied upon in any specific instance.

5.4.4 Model Inputs

As no exploration wells have been drilled within Lebanese waters the possible crude oil characteristics are currently unknown and therefore to cover a broad range of possibilities four oils were used as follows:-

- Diesel
- Condensate (from gas wells)
- Light crude oil
- Heavy crude oil

5.4.5 Trajectory Model Scenarios

For the purposes of this illustration three release points were chosen in the Northern, Southern and centre sections of the Lebanese EEZ to enable indicative model scenarios to be run. Trajectory models were run until all oil had either evaporated, been naturally dispersed or had beached. The scenario parameters are given in Table 5.3 to 5.5. The modelling results can be seen in Table 5.6.

Table 5.3: Model scenarios at the Northern EEZ Position

Northern EEZ Position 34° 38' 3.6" N / 35° 12' 8.4" E						
Ref.	**Oil**	**Release**		**MetOcean Data**		**Sea Temp**
		Quantity	**Duration**	**Wind**	**Current**	
T1	Diesel	500m^3	Instantaneous	1999 – 2009 Data set	OilMap Database	17°C
T2	Light crude	1000m^3	Instantaneous			
T3	Heavy Crude	1000m^3	Instantaneous			
T4	Light Crude	5000m^3	40 day blowout			
T5	Heavy Crude	5000m^3	40 day blowout			
T6	Condensate	1100bbls/day	40 day blowout			

Table 5.4: Model scenarios at the Centre EEZ Position

Centre EEZ Position 34o 5' 39.1" N / 35o 1' 34.5" E						
Ref.	**Oil**	**Release**		**MetOcean Data**		**Sea Temp**
		Quantity	**Duration**	**Wind**	**Current**	
T7	Diesel	500m^3	Instantaneous	1999 – 2009 Data set	OilMap Database	17°C
T8	Light crude	1000m^3	Instantaneous			
T9	Heavy Crude	1000m^3	Instantaneous			
T10	Light Crude	5000m^3	40 day blowout			

T11	Heavy Crude	5000m^3	40 day blowout			
T12	Condensate	1100bbls/day	40 day blowout			

Table 5.5: Model scenarios at the Southern EEZ Position

Southern EEZ Position 33o 25' 57.9" N / 34o 42' 35.3" E						
Ref.	**Oil**	**Release**		**MetOcean Data**		**Sea Temp**
		Quantity	**Duration**	**Wind**	**Current**	
T13	Diesel	500m^3	Instantaneous	1999 – 2009 Data set	OilMap Database	17^{o}C
T14	Light crude	1000m^3	Instantaneous			
T15	Heavy Crude	1000m^3	Instantaneous			
T16	Light Crude	5000m^3	40 day blowout			
T17	Heavy Crude	5000m^3	40 day blowout			
T18	Condensate	1100bbls/day	40 day blowout			

Table 56: Trajectory model scenario results

Ref.	**Oil**	**Release**		**Possible shoreline impact after**	**Possible Trans Border crossing after**	**Section figure reference**
		Quantity	**Duration**			
T1	Diesel	500m^3	Instantaneous	163 hrs	84 hrs	5.1
T2	Light crude	1000m^3	Instantaneous	162 hrs	72 hrs	5.2
T3	Heavy Crude	1000m^3	Instantaneous	143 hrs	72 hrs	5.3
T4	Light Crude	5000m^3	40 day blowout	206 hrs	48 hrs	5.4
T5	Heavy Crude	5000m^3	40 day blowout	144 hrs	48 hrs	5.5
T6	Condensate	1100bbls/day	40 day blowout	Unlikely	Unlikely	5.6
T7	Diesel	500m^3	Instantaneous	275 hrs	72 hrs	5.7
T8	Light crude	1000m^3	Instantaneous	No impact modelled	60 hrs	5.8
T9	Heavy Crude	1000m^3	Instantaneous	290 hrs	60 hrs	5.9
T10	Light Crude	5000m^3	40 day blowout	140 hrs	64 hrs	5.10
T11	Heavy Crude	5000m^3	40 day blowout	140 hrs	64 hrs	5.11
T12	Condensate	1100bbls/day	40 day blowout	No impact modelled	Unlikely	5.12
T13	Diesel	500m^3	Instantaneous	78 hrs	No trans border crossing modelled	5.13

T14	Light crude	1000m^3	Instantaneous	78 hrs	No trans border crossing modelled	5.14
T15	Heavy Crude	1000m^3	Instantaneous	78 hrs	No trans border crossing modelled	5.15
T16	Light Crude	5000m^3	40 day blowout	83 hrs	37 days	5.16
T17	Heavy Crude	5000m^3	40 day blowout	79 hrs	18 days	5.17
T18	Condensate	1100bbls/day	40 day blowout	No impact modelled	Unlikely	5.18

Figure 5.1 500m3 instantaneous diesel spill from the Northern EEZ Position (Trajectory)

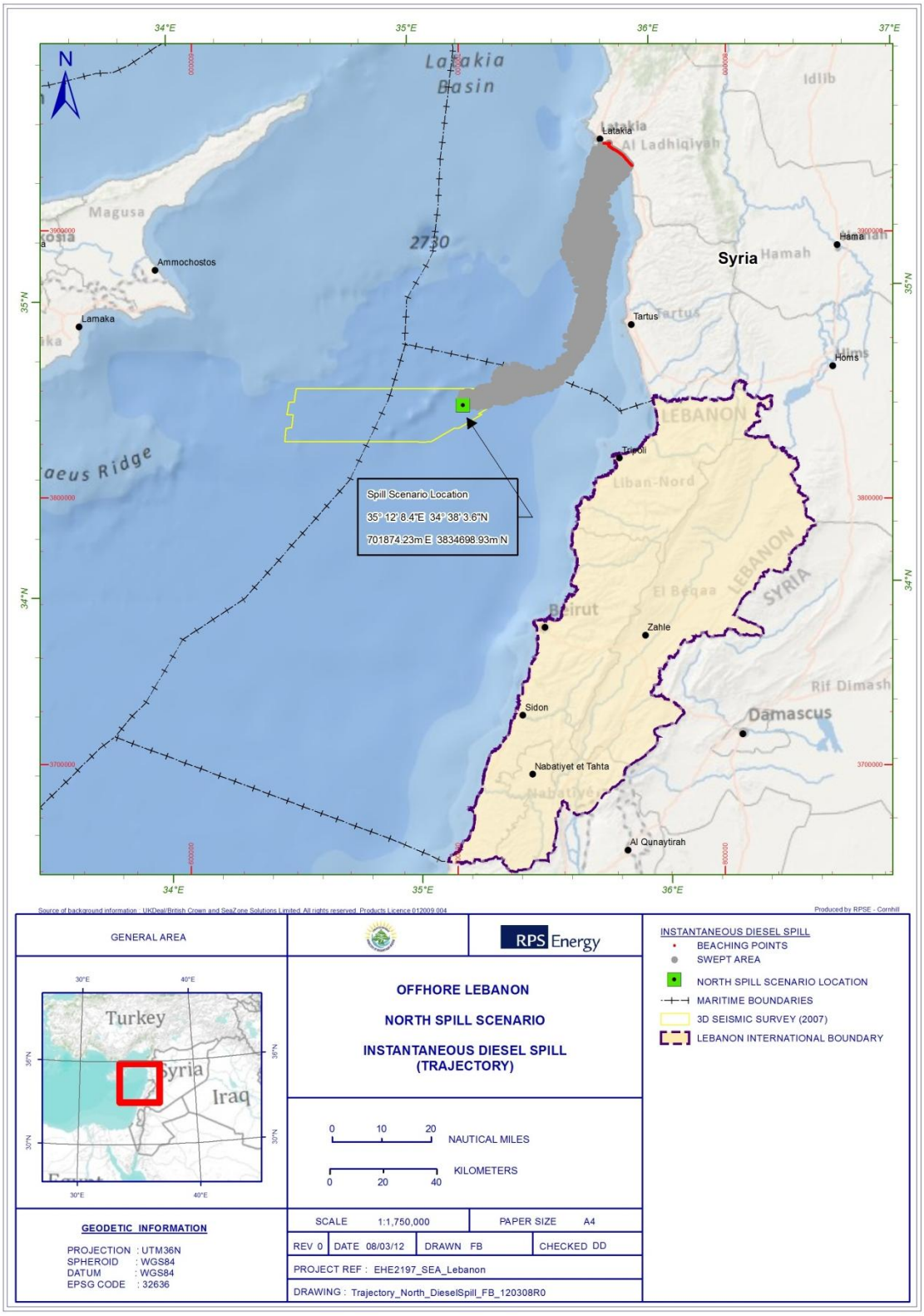


Figure 5.2 1000m^3 instantaneous light crude spill from the Northern EEZ Position (Trajectory)

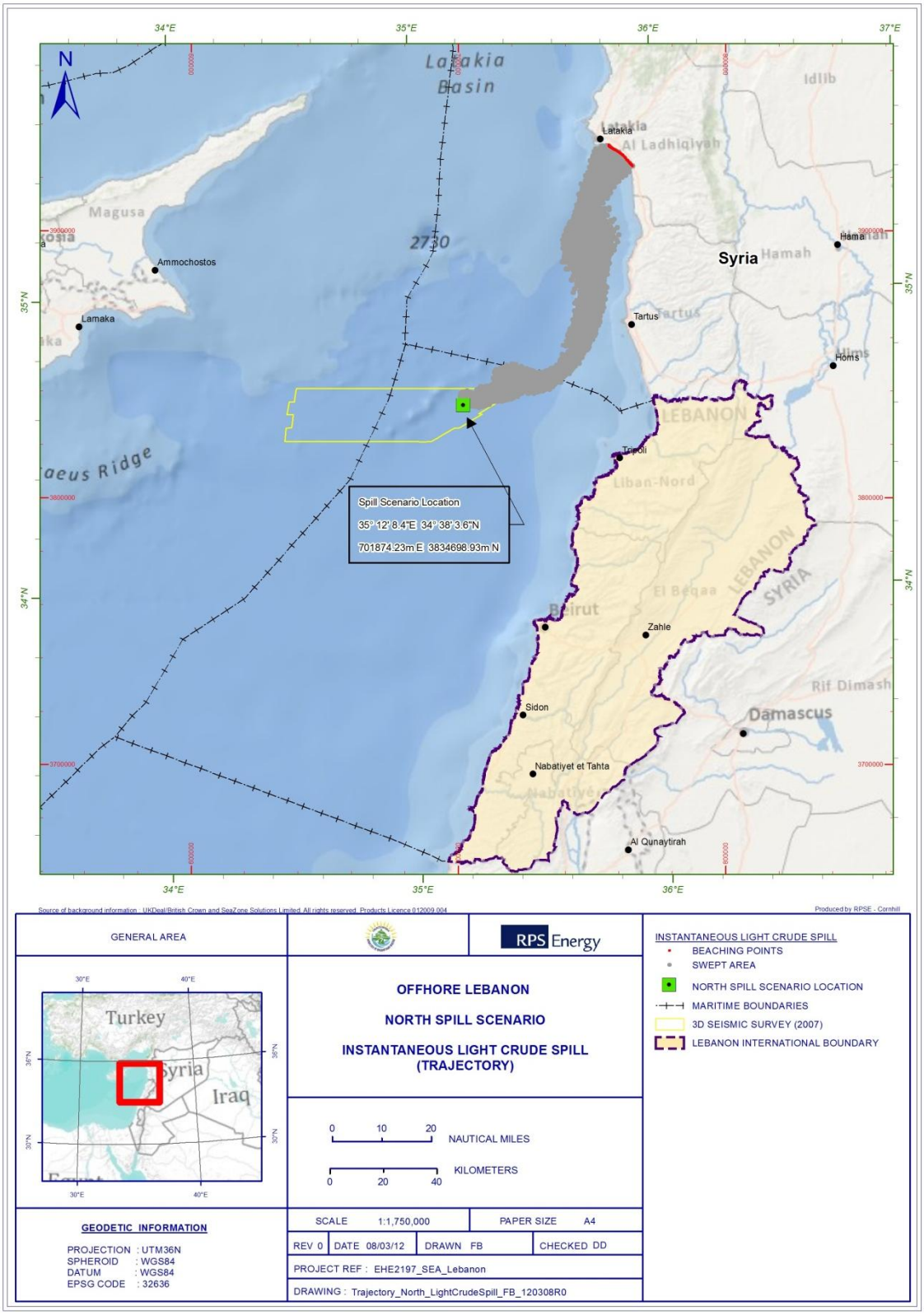


Figure 5.3 1000m^3 instantaneous heavy crude spill from the Northern EEZ Position (Trajectory)

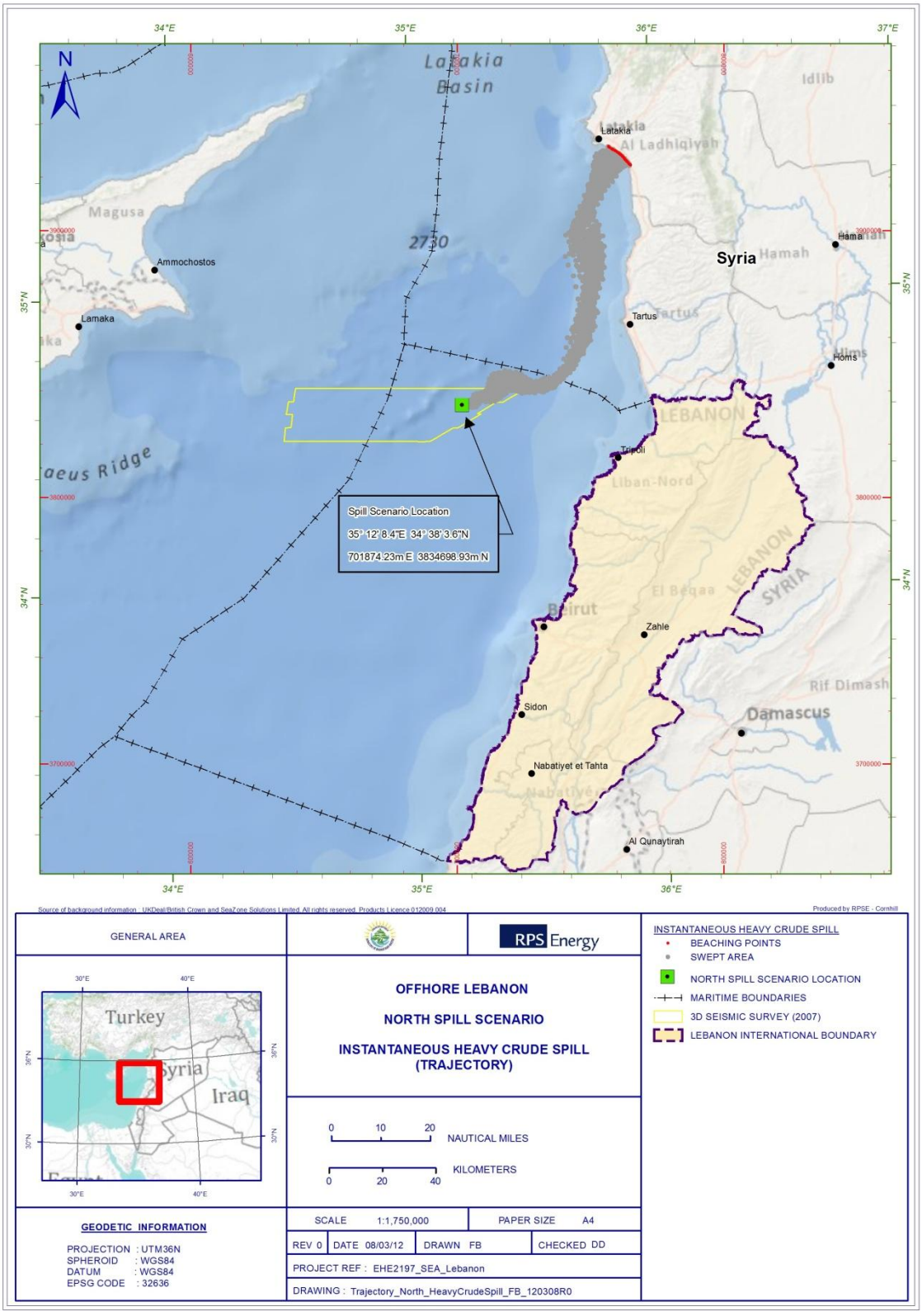


Figure 5.4 5000m^3 40 day blowout of light crude spill from the Northern EEZ Position (Trajectory)

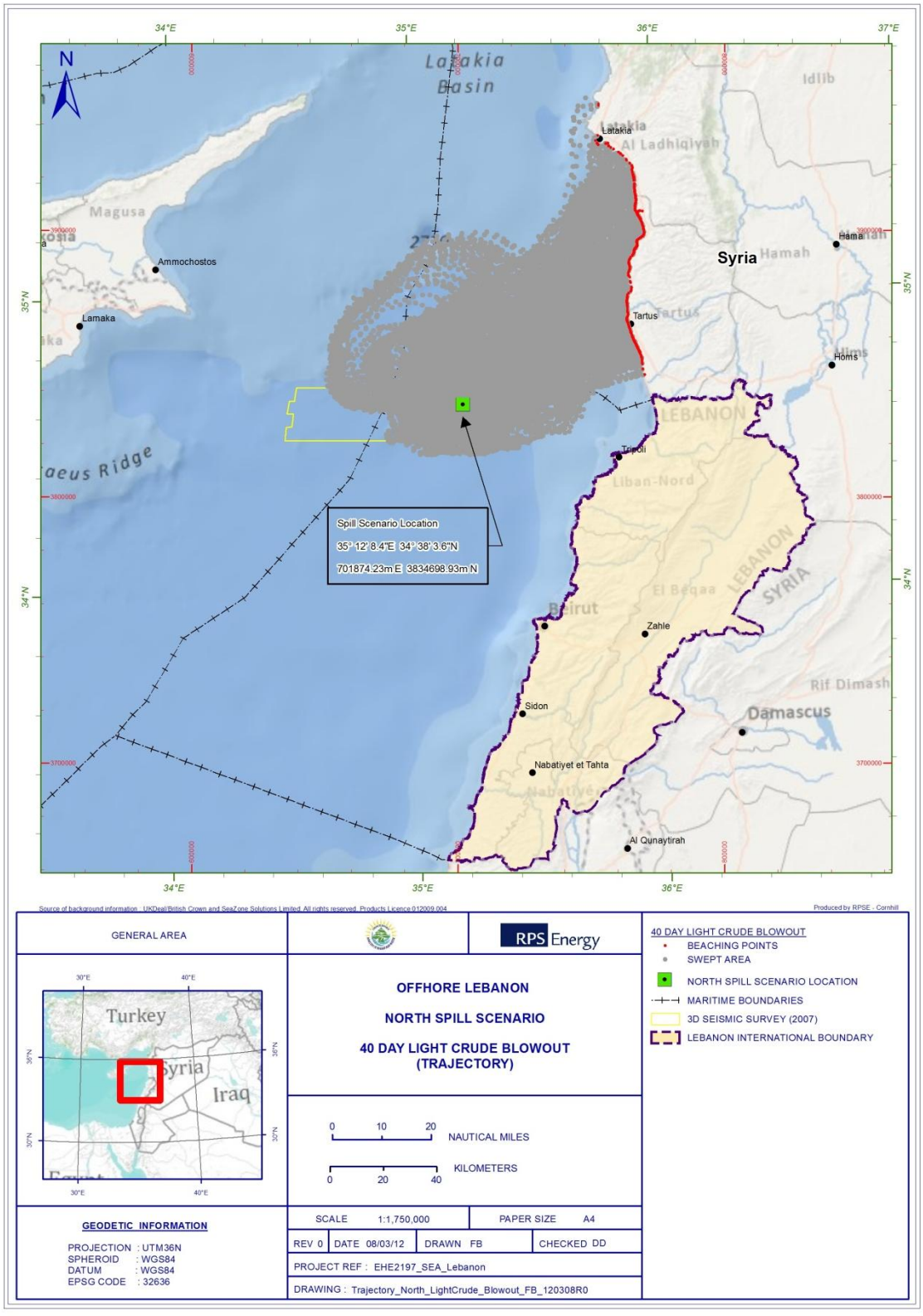


Figure 5.5 5000m^3 40 day blowout of heavy crude spill from the Northern EEZ Position (Trajectory)

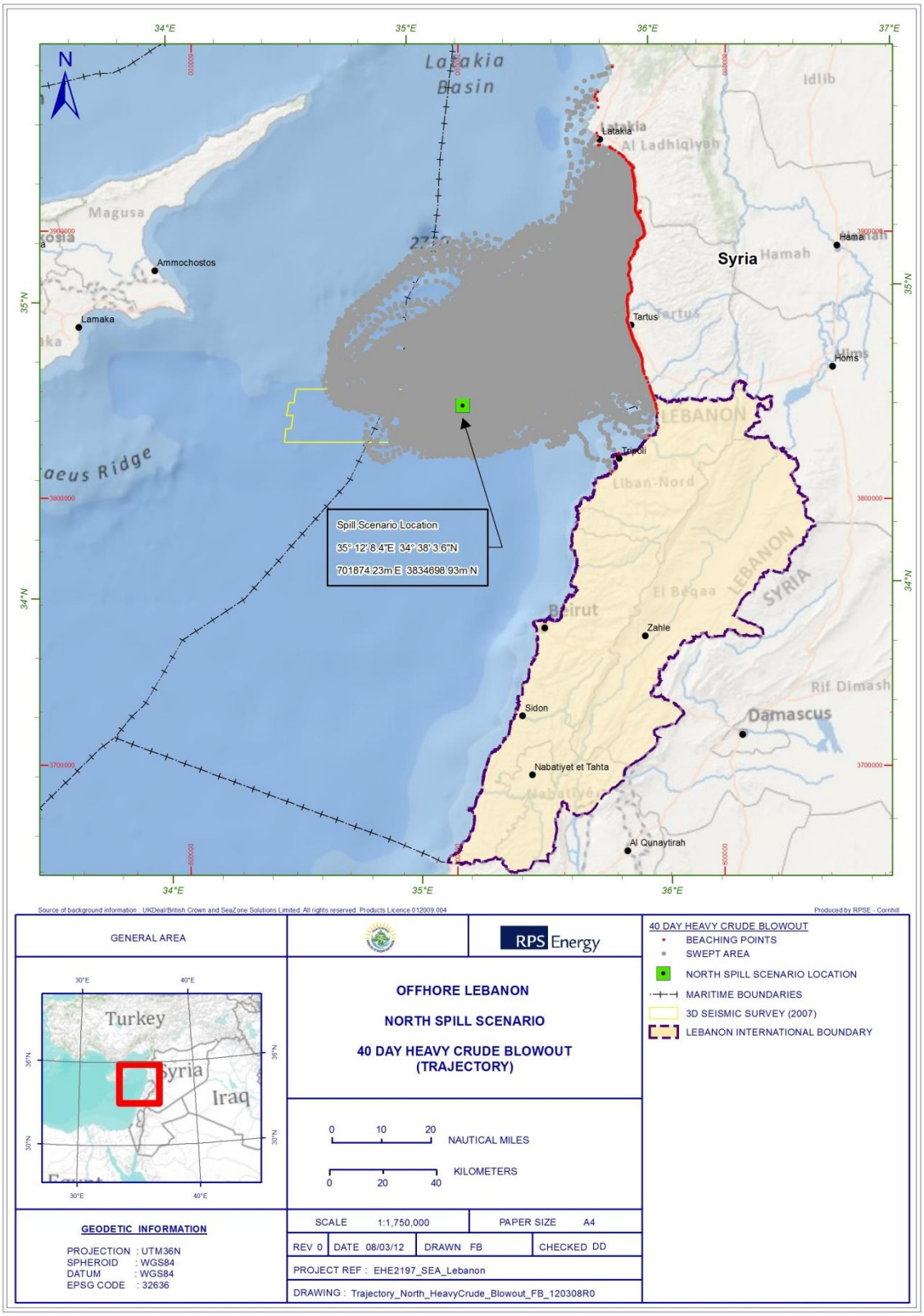


Figure 5.6 1100bbls/day 40 day blowout of condensate spill from the Northern EEZ Position (Trajectory)

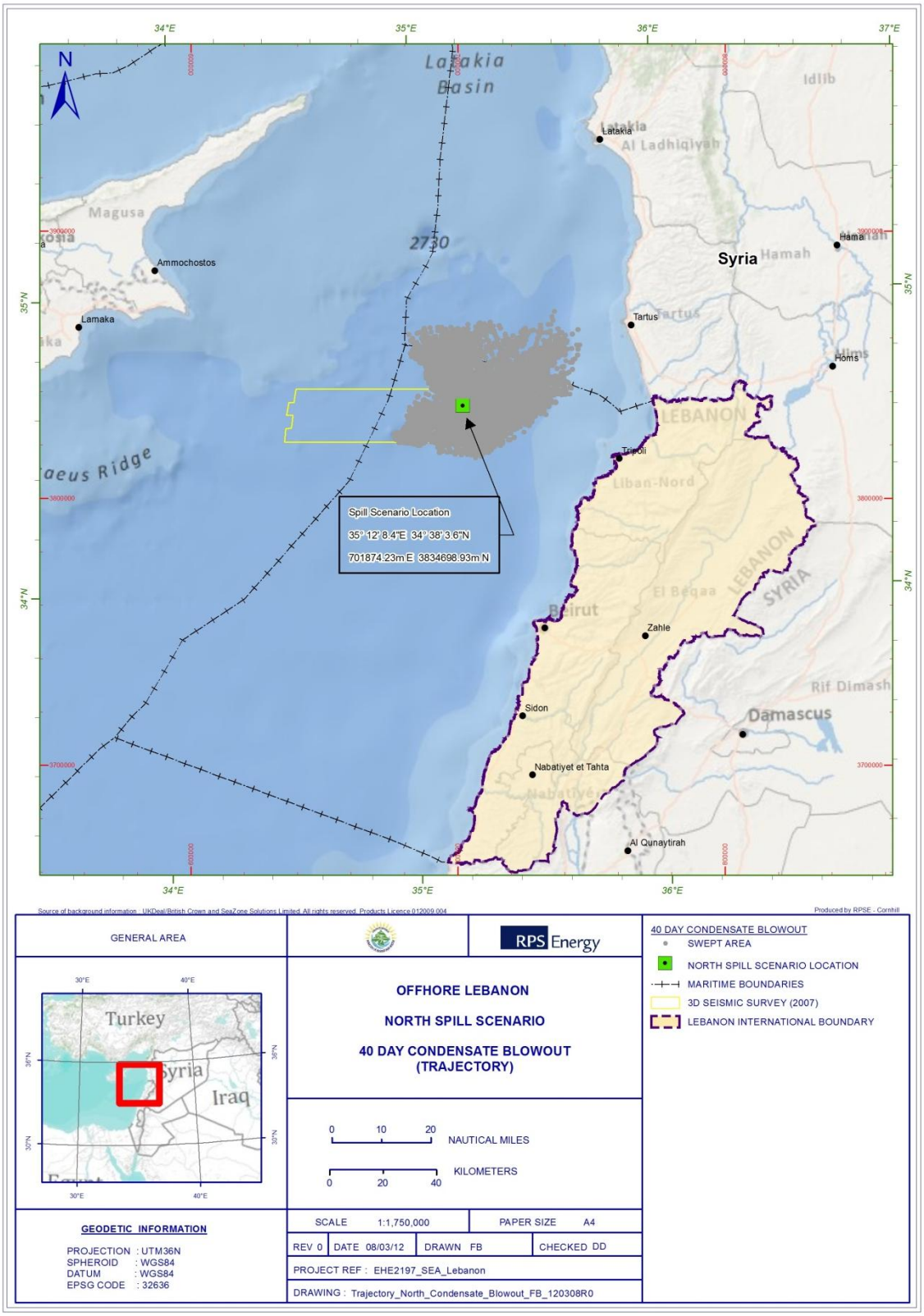


Figure 5.7 500m^3 instantaneous diesel spill from the Centre EEZ Position (Trajectory)

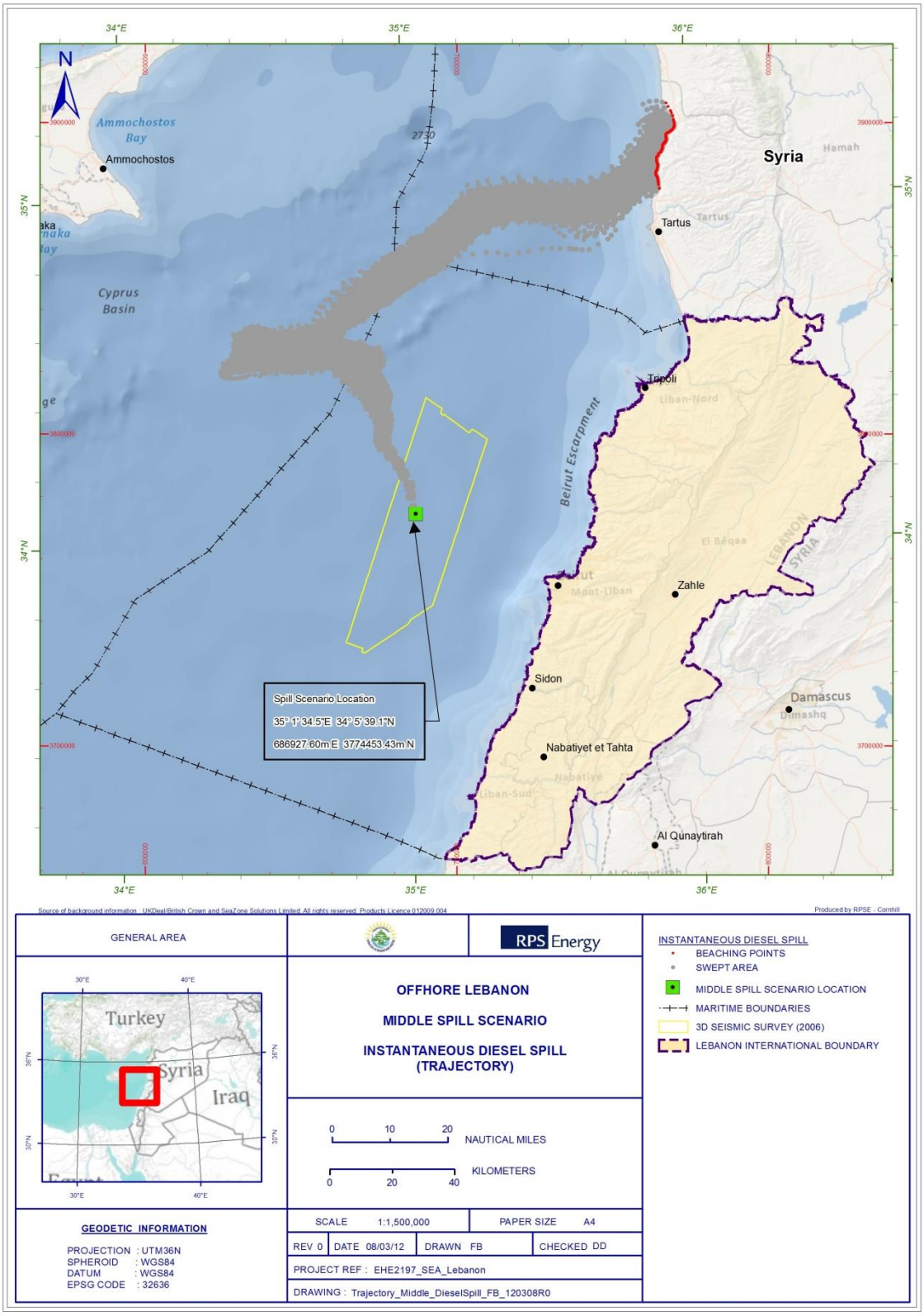


Figure 5.8 1000m^3 instantaneous light crude spill from the Centre EEZ Position (Trajectory)

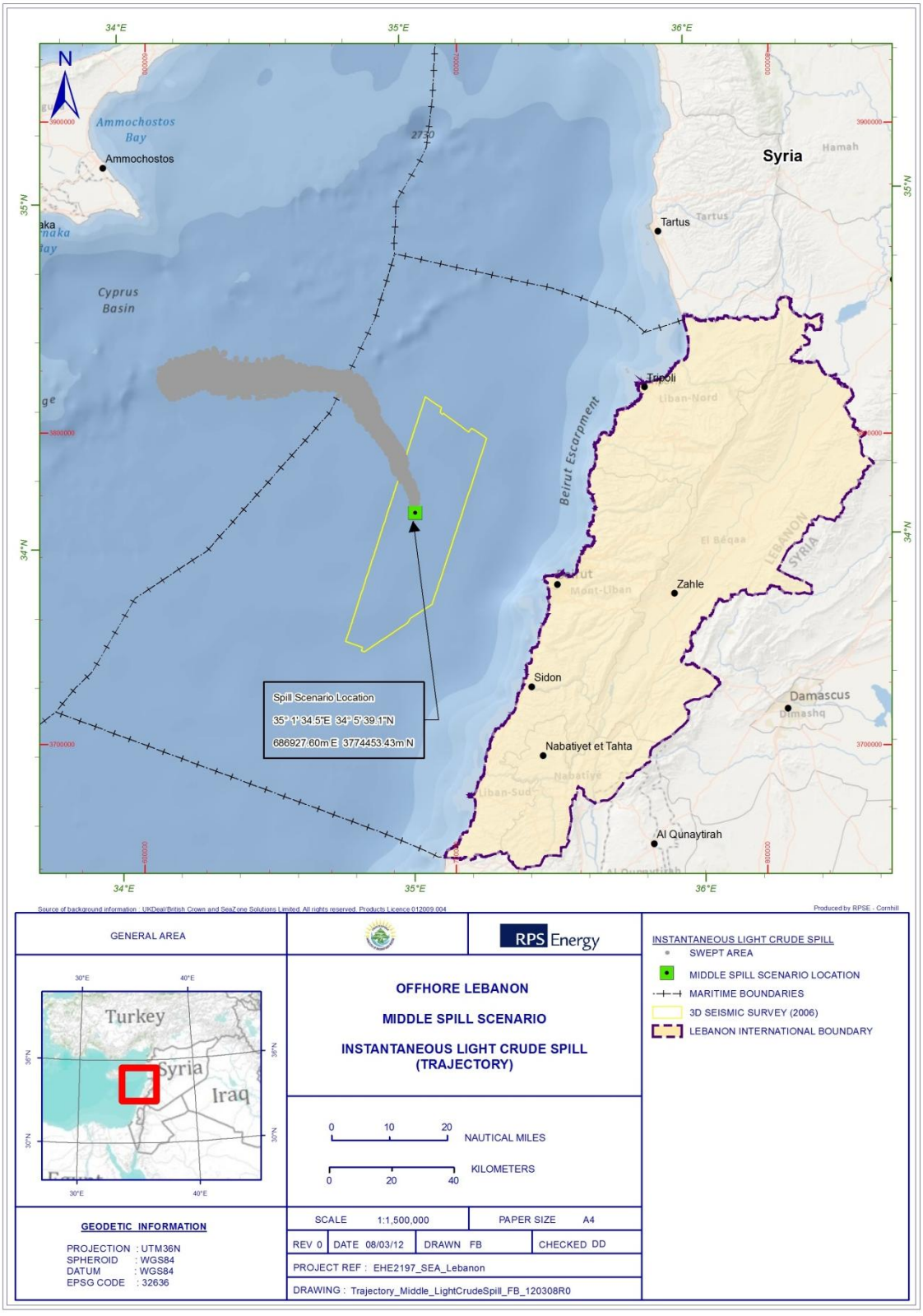


Figure 5.9 1000m^3 instantaneous heavy crude spill from the Centre EEZ Position (Trajectory)

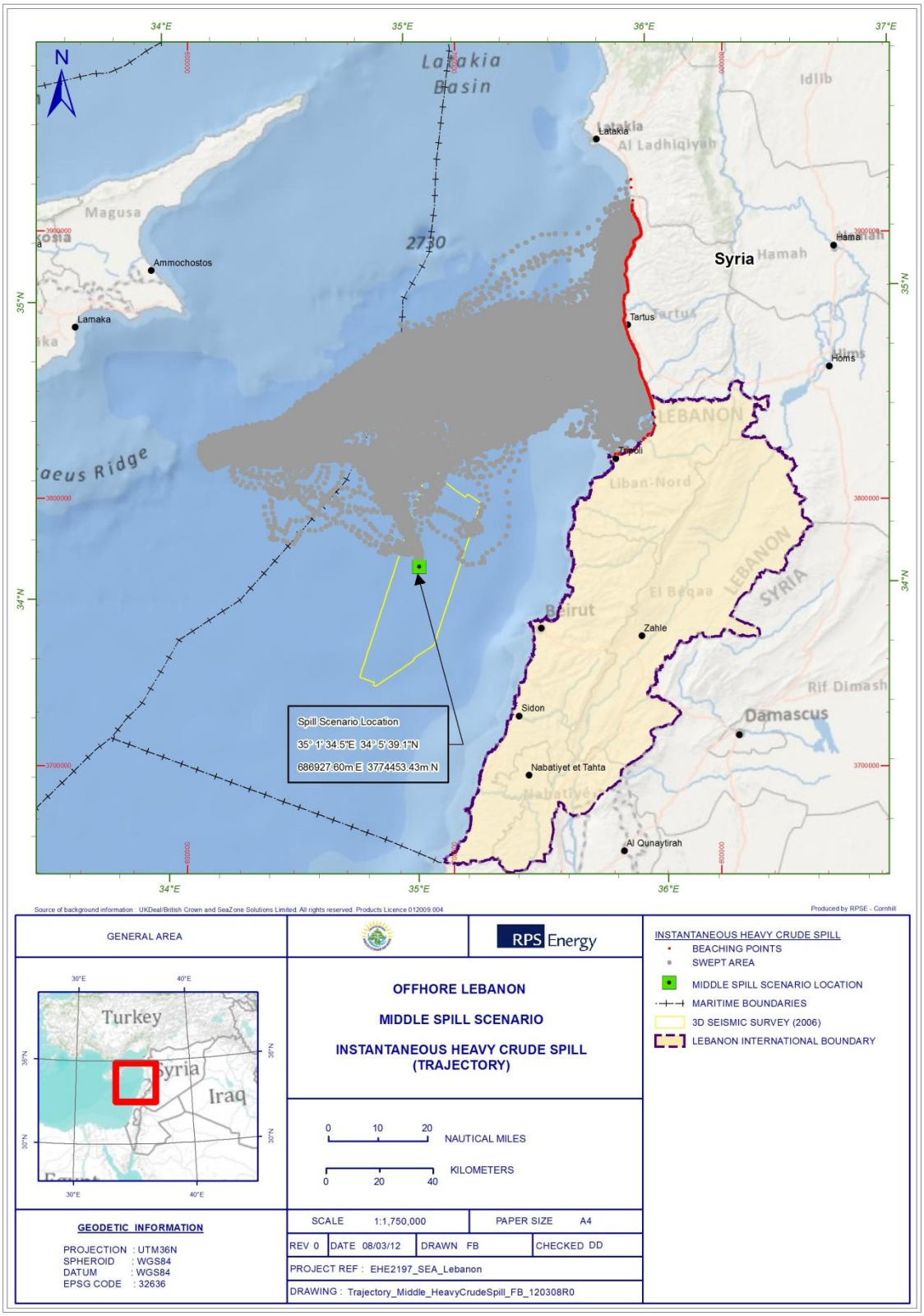


Figure 5.10 5000m^3 40 day blowout of light crude spill from the Centre EEZ Position (Trajectory)

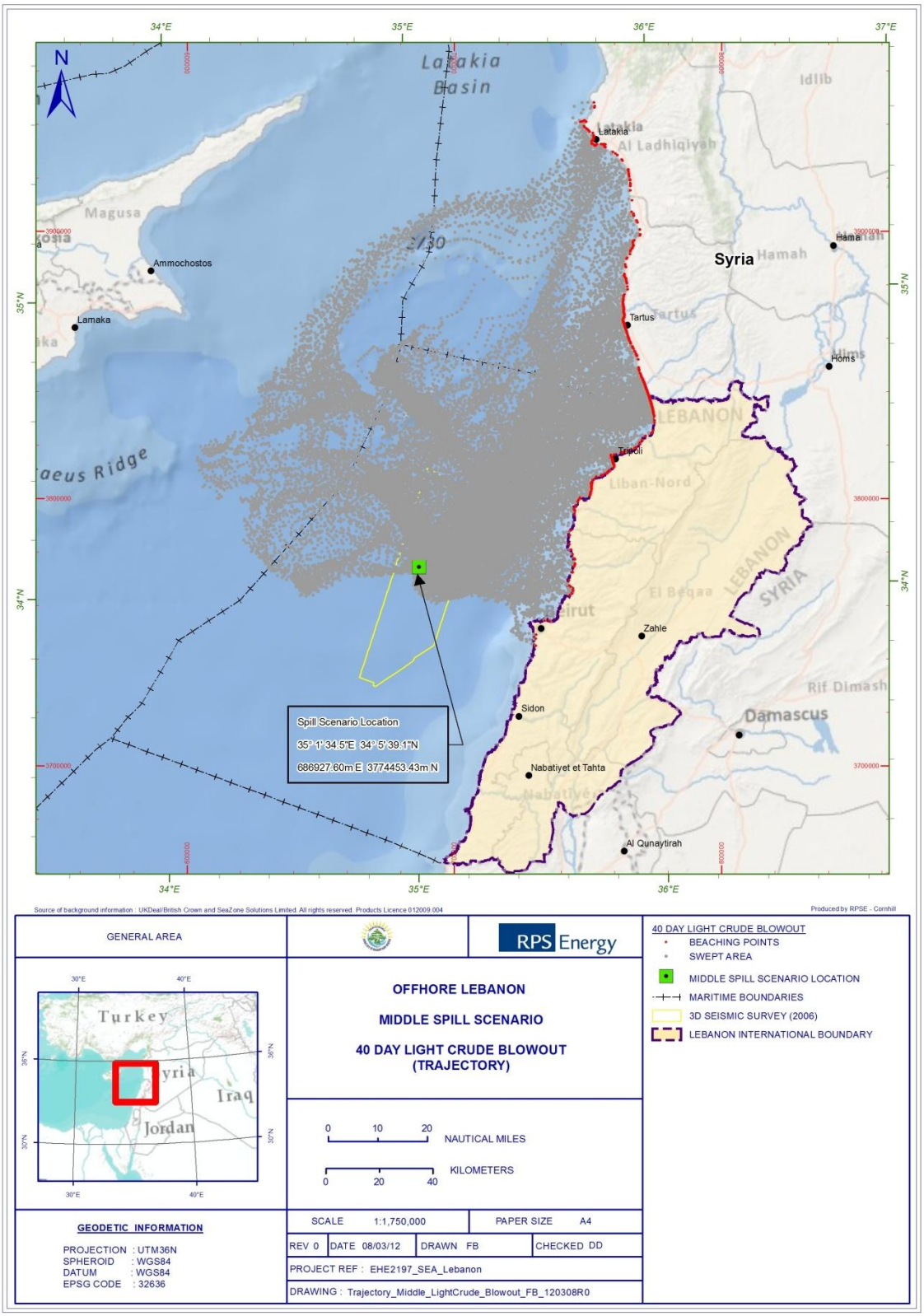


Figure 5.11 5000m^3 40 day blowout of heavy crude spill from the Centre EEZ Position (Trajectory)

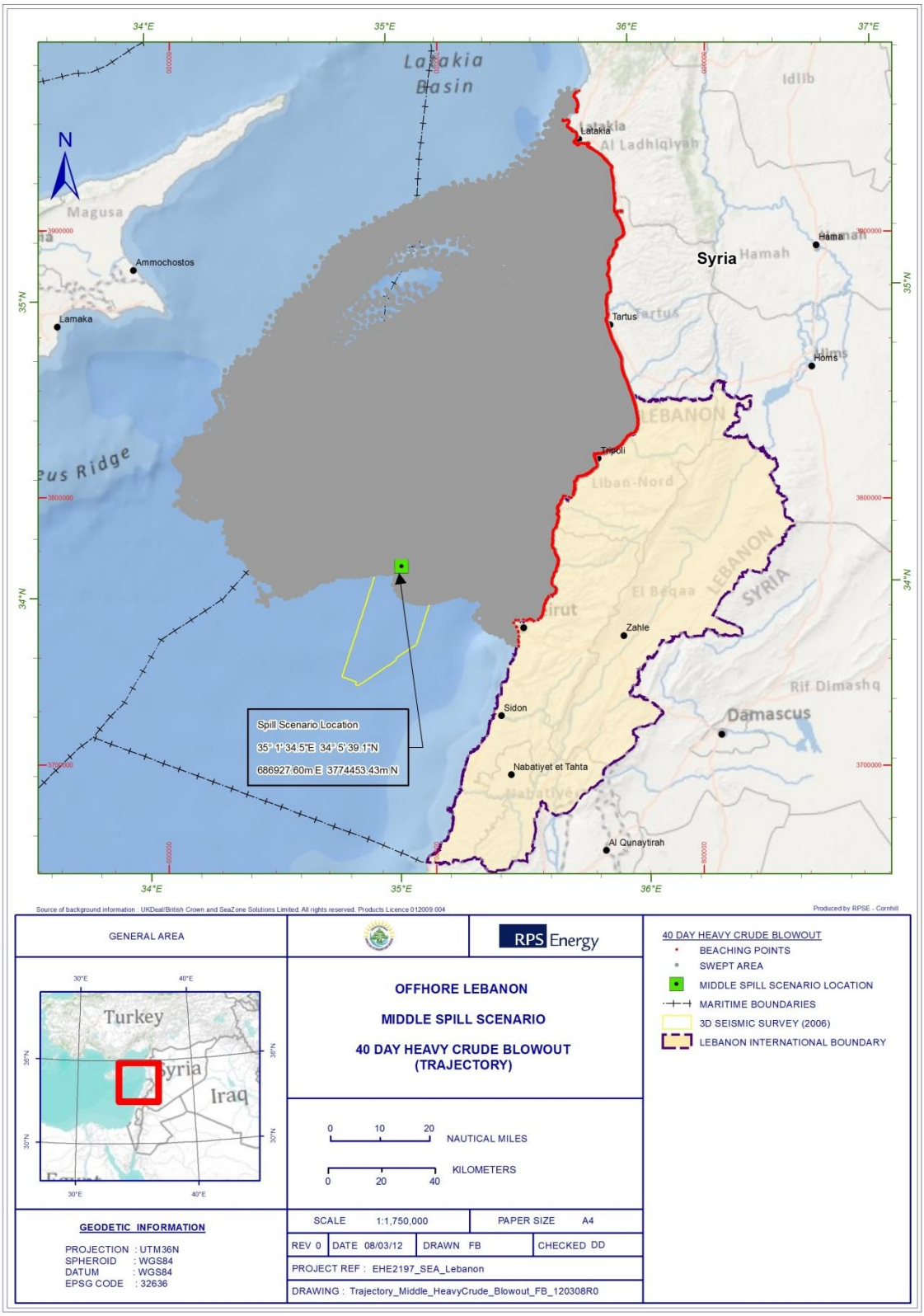


Figure 5.12 1100bbls/day 40 day blowout of condensate spill from the Centre EEZ Position (Trajectory)

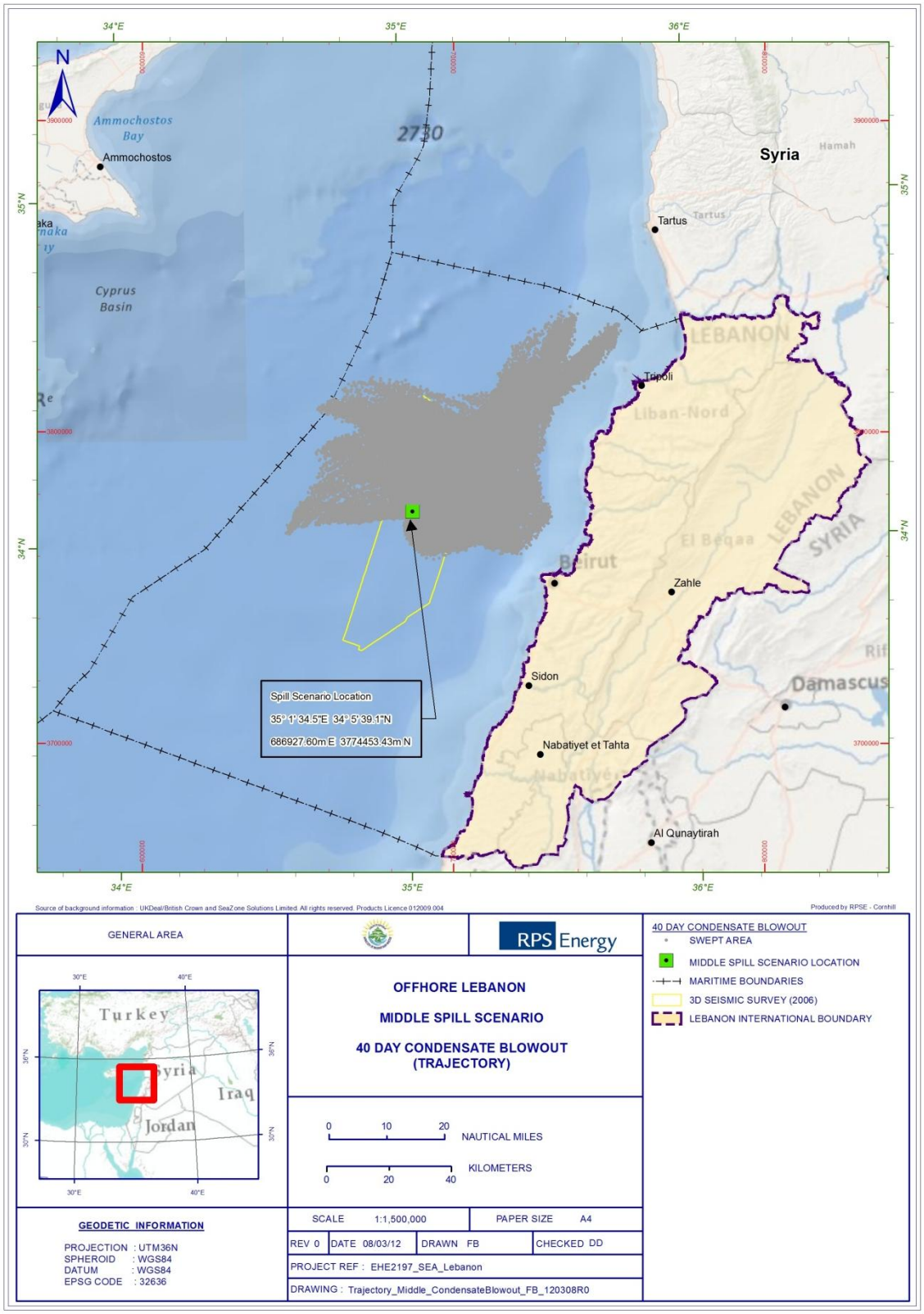


Figure 5.13 500m^3 instantaneous diesel spill from the Southern EEZ Position (Trajectory)

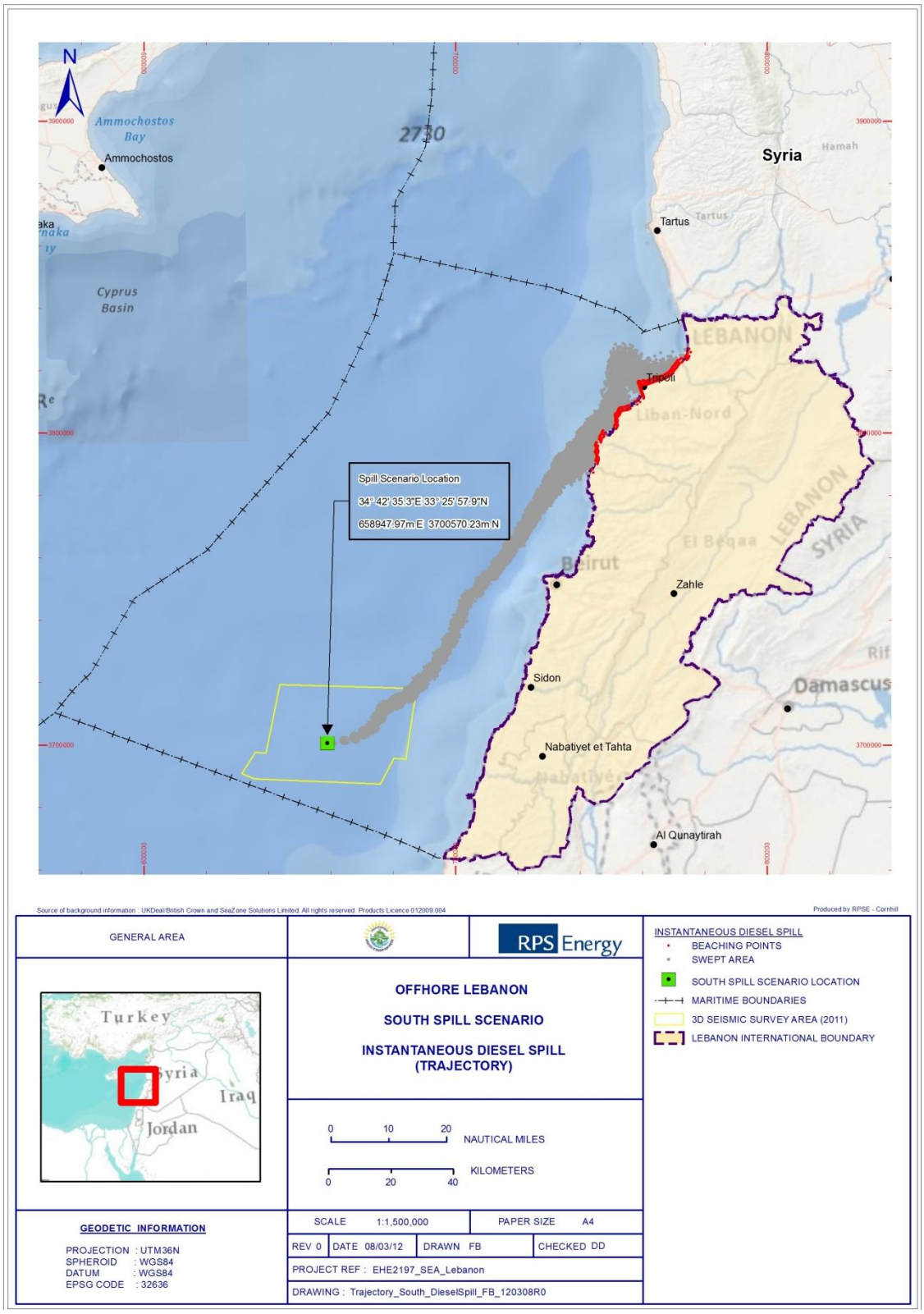


Figure 5.14 1000m^3 instantaneous light crude spill from the Southern EEZ Position (Trajectory)

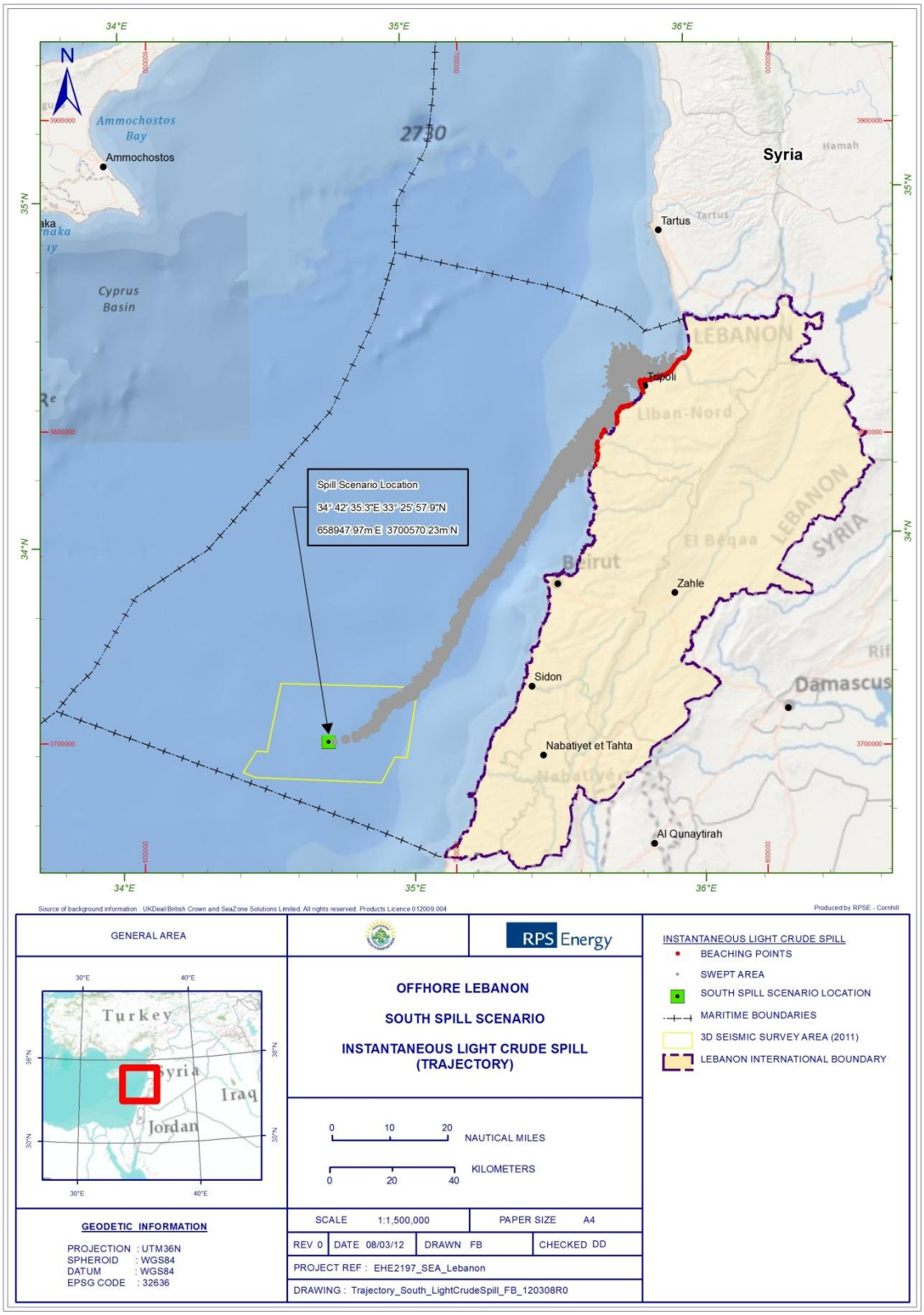


Figure 5.15 1000m^3 instantaneous heavy crude spill from the Southern EEZ Position (Trajectory)

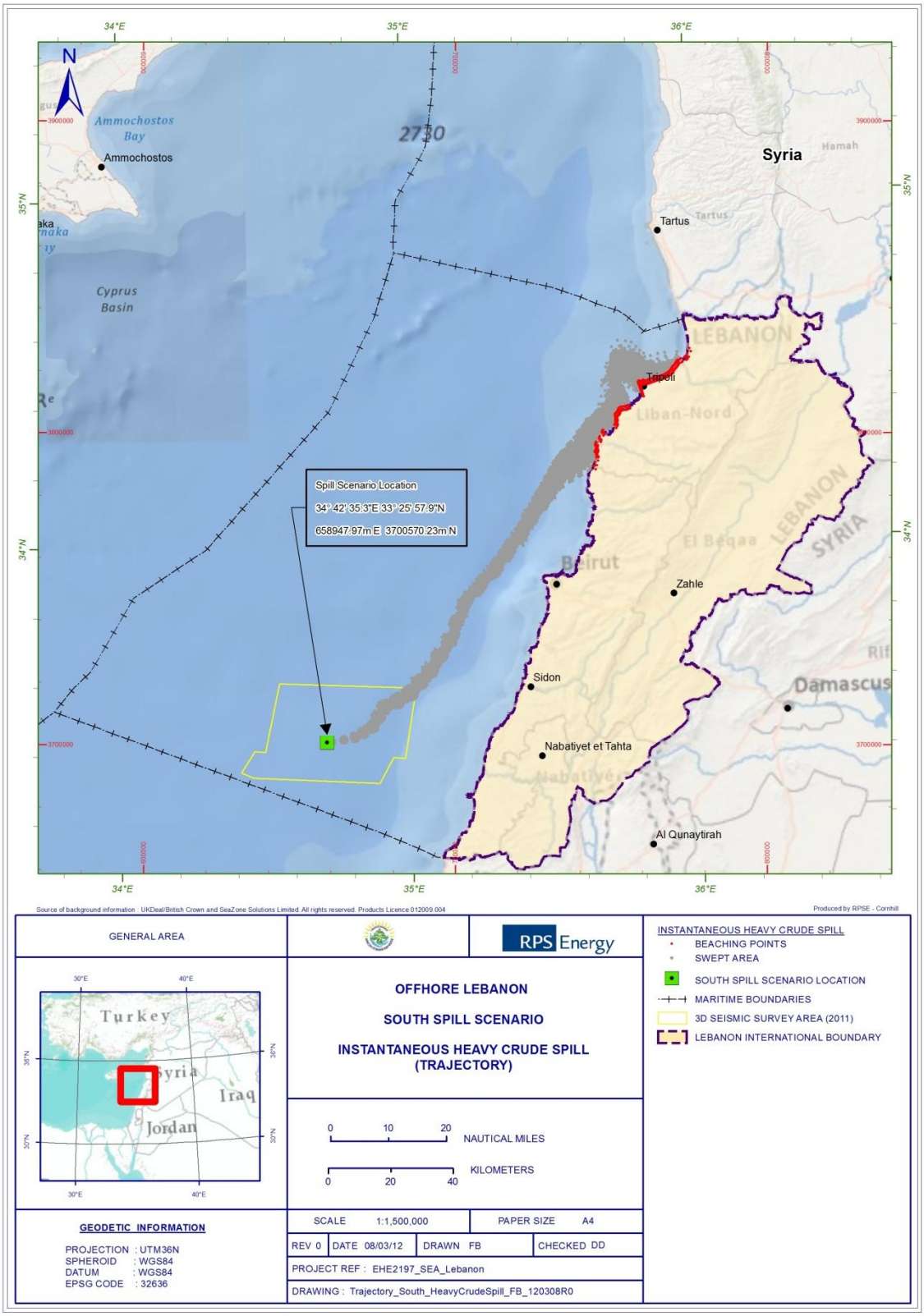


Figure 5.16 5000m^3 40 day blow out of light crude oil from the Southern EEZ Position (Trajectory)

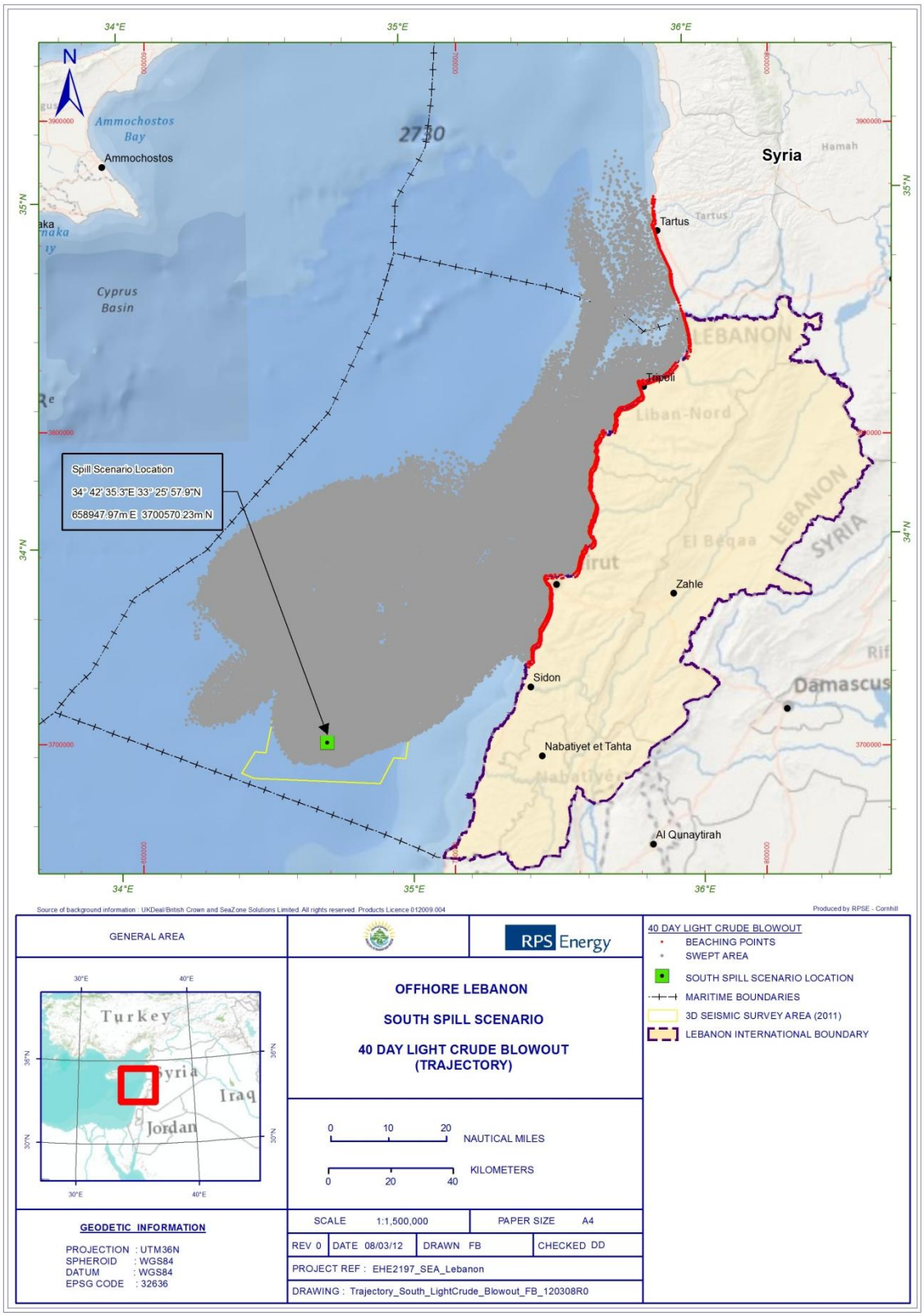


Figure 5.17 5000m^3 40 day blow out of heavy crude oil from the Southern EEZ Position (Trajectory)

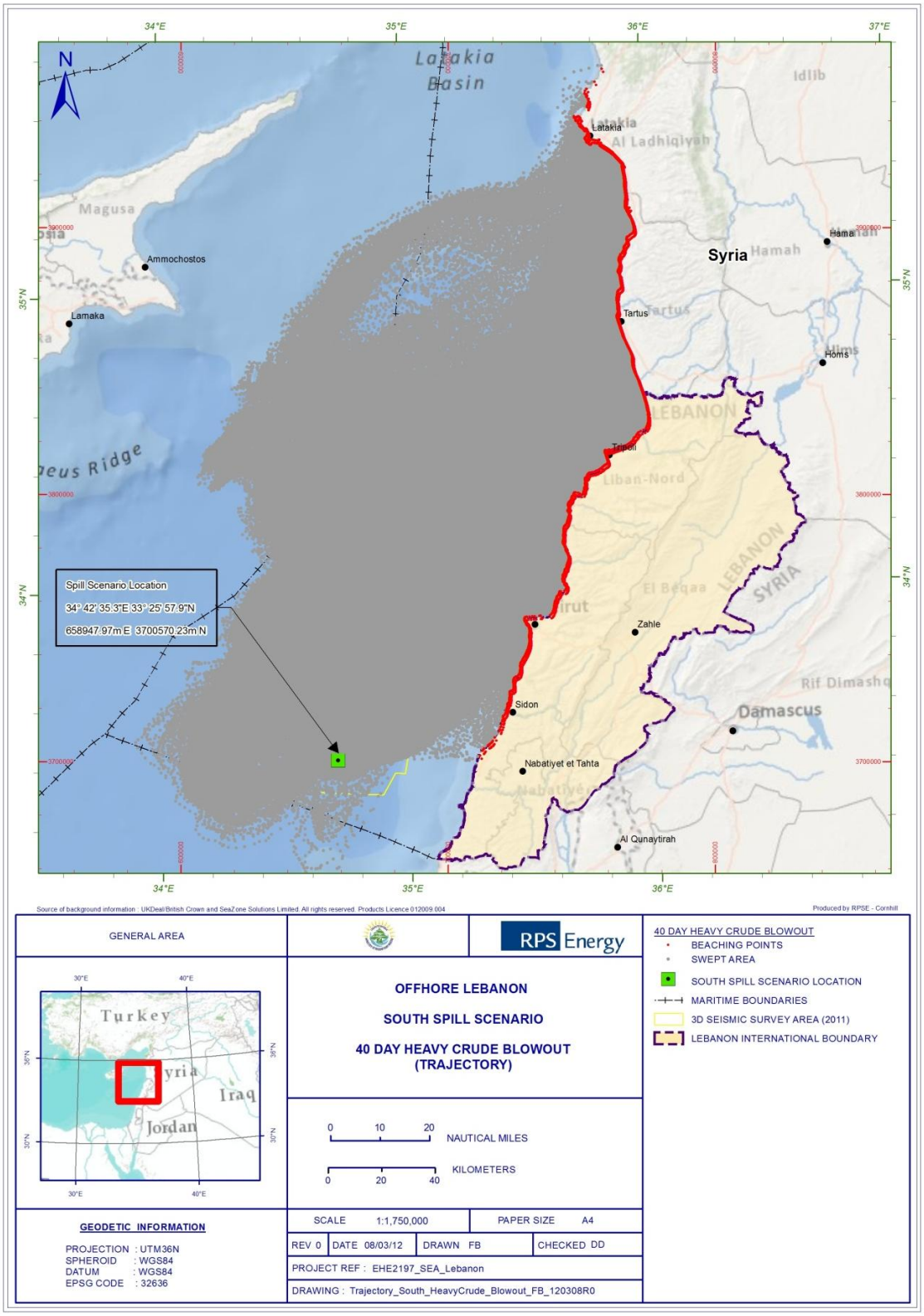
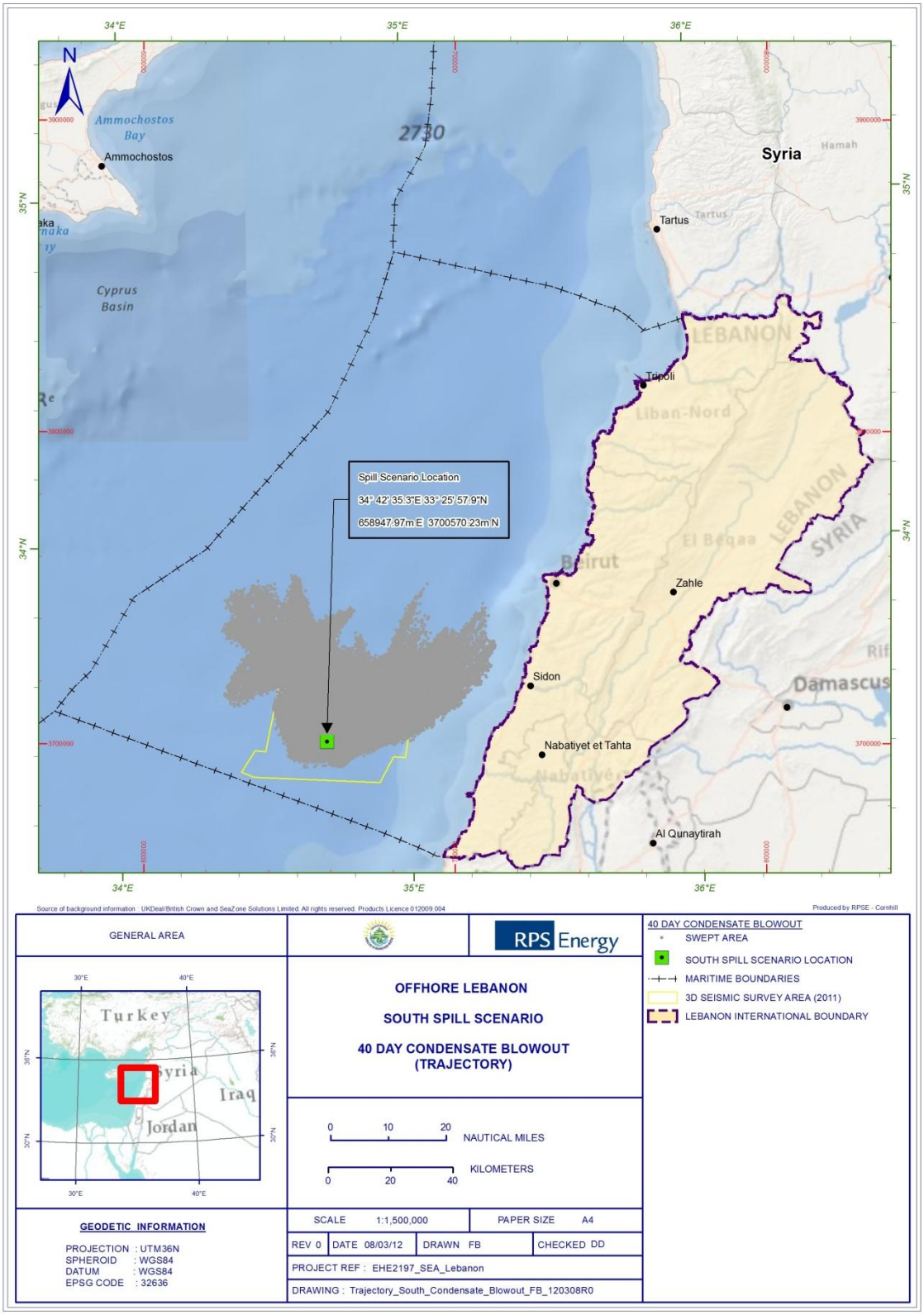


Figure 5.18 5000m^3 40 day blow out of condensate from the Southern EEZ Position (Trajectory)



5.4.6 Stochastic Model Scenarios

For the purposes of this illustration three release points were chosen in the Northern, Southern and centre sections of the Lebanese EEZ to enable indicative model scenarios to be run. The scenario parameters are given in Table 5.7 to 5.9.

Model Scenarios

Table 5.7: Model scenarios at the Northern EEZ Position

Northern EEZ Position 34o 38' 3.6" N / 35o 12' 8.4" E							
Ref.	**Oil**	**Release**		**MetOcean Data**		**Sea Temp**	**Section figure reference**
		Quantity	**Duration**	**Wind**	**Current**		
ST1	Diesel	500m^3	Instantaneous	1999 – 2009 Data set	OilMap Database	17^{o}C	5.19
ST2	Medium crude	1000m^3	Instantaneous				5.20
ST3	Medium crude	5000m^3	15 day				5.21
ST4	Condensate	1100bbl/ day	15 day				5.22

Table 5.8: Model scenarios at the Centre EEZ Position

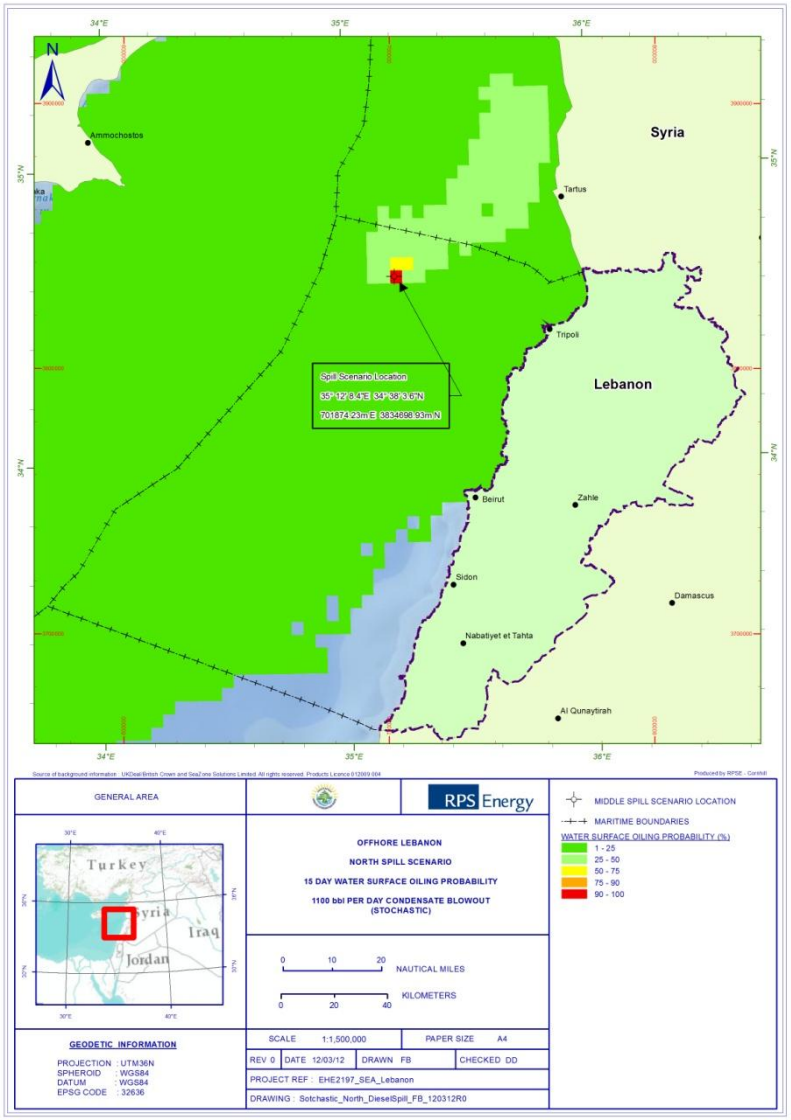
Centre EEZ Position 34o 5' 39.1" N / 35o 1' 34.5" E							
Ref.	**Oil**	**Release**		**MetOcean Data**		**Sea Temp**	**Section figure reference**
		Quantity	**Duration**	**Wind**	**Current**		
ST5	Diesel	500m^3	Instantaneous	1999 – 2009 Data set	OilMap Database	17^{o}C	5.23
ST6	Medium crude	1000m^3	Instantaneous				5.24
ST7	Medium crude	5000m^3	15 day				5.25
ST8	Condensate	1100bbl/ day	15 day				5.26

Table 5.9: Model scenarios at the Southern EEZ Position

Southern EEZ Position 34o 5' 39.1" N / 35o 1' 34.5" E							
Ref.	**Oil**	**Release**		**MetOcean Data**		**Sea Temp**	**Section figure reference**
		Quantity	**Duration**	**Wind**	**Current**		
ST9	Diesel	500m^3	Instantaneous	1999 – 2009 Data set	OilMap Database	17^{o}C	5.27
ST10	Medium crude	1000m^3	Instantaneous				5.28
ST11	Medium crude	5000m^3	15 day				5.29
ST12	Condensate	1100bbl/ day	15 day				5.30

Figure 5.19 500m^3 instantaneous diesel spill from the Northern EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling

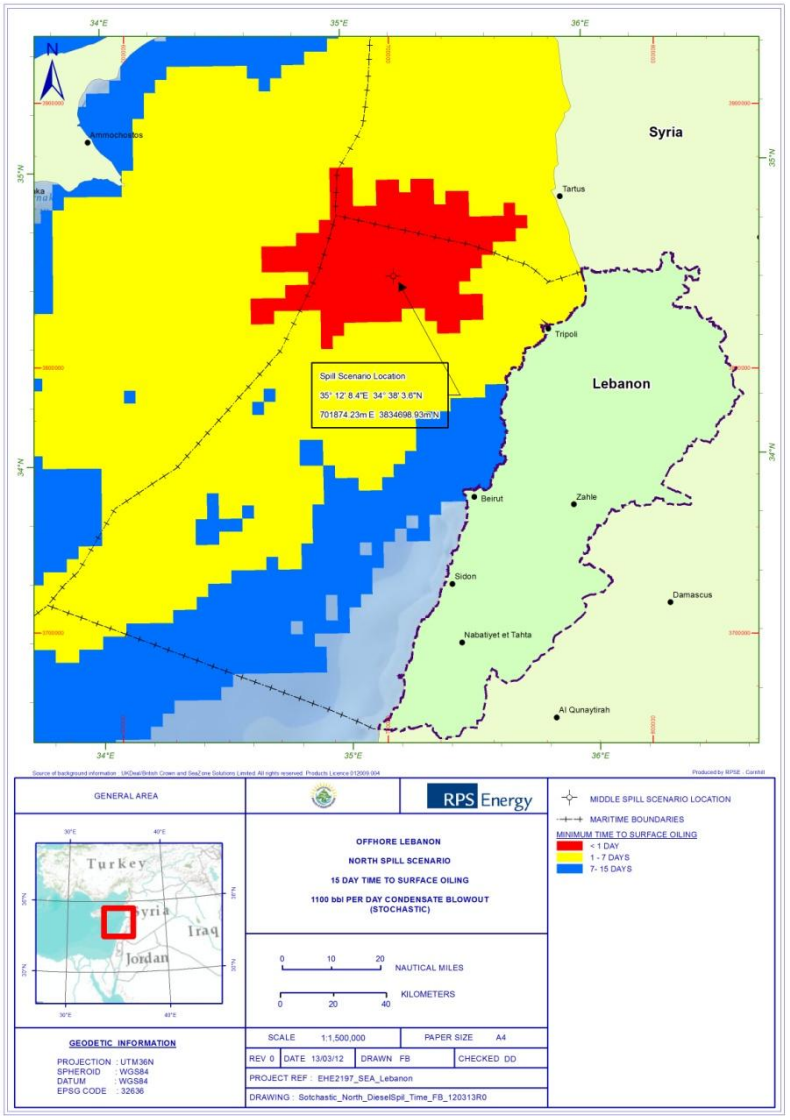
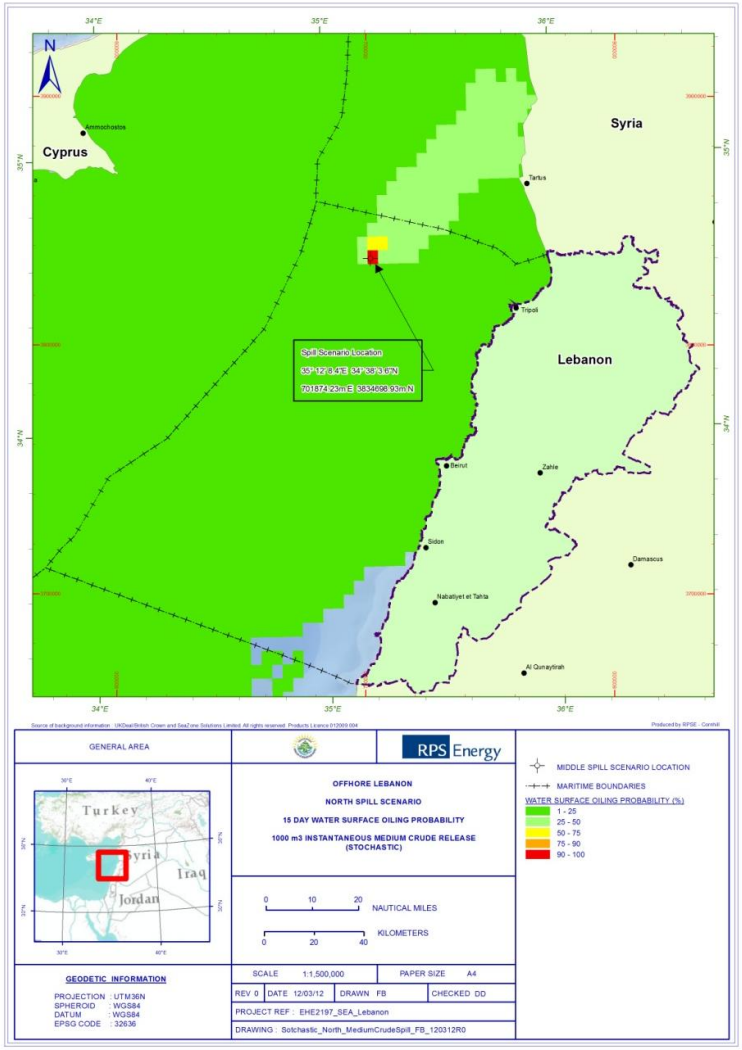


Figure 5.20 1000m^3 instantaneous medium crude spill from the Northern EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling

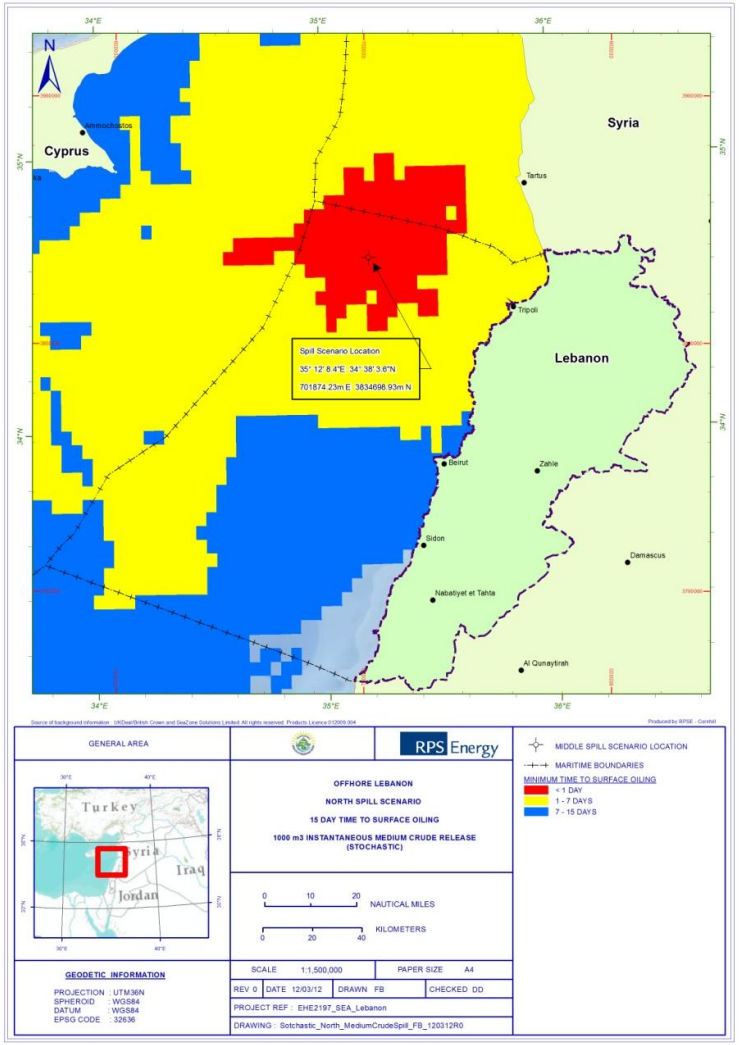
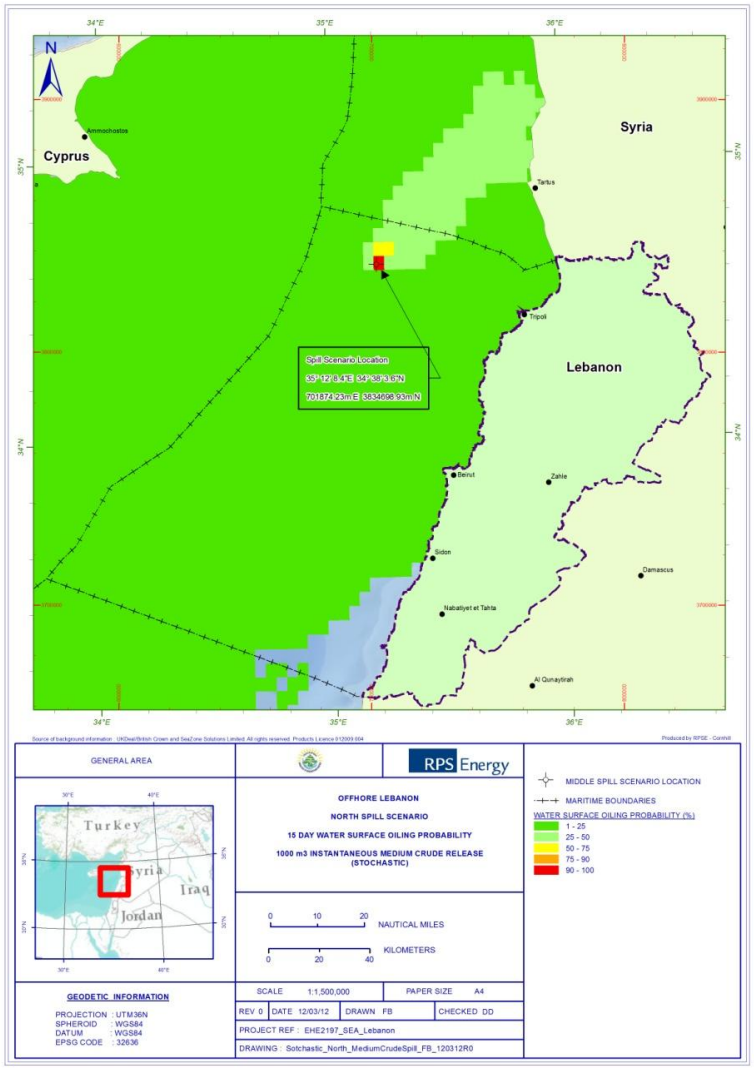


Figure 5.20 1000m^3 instantaneous medium crude spill from the Northern EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling

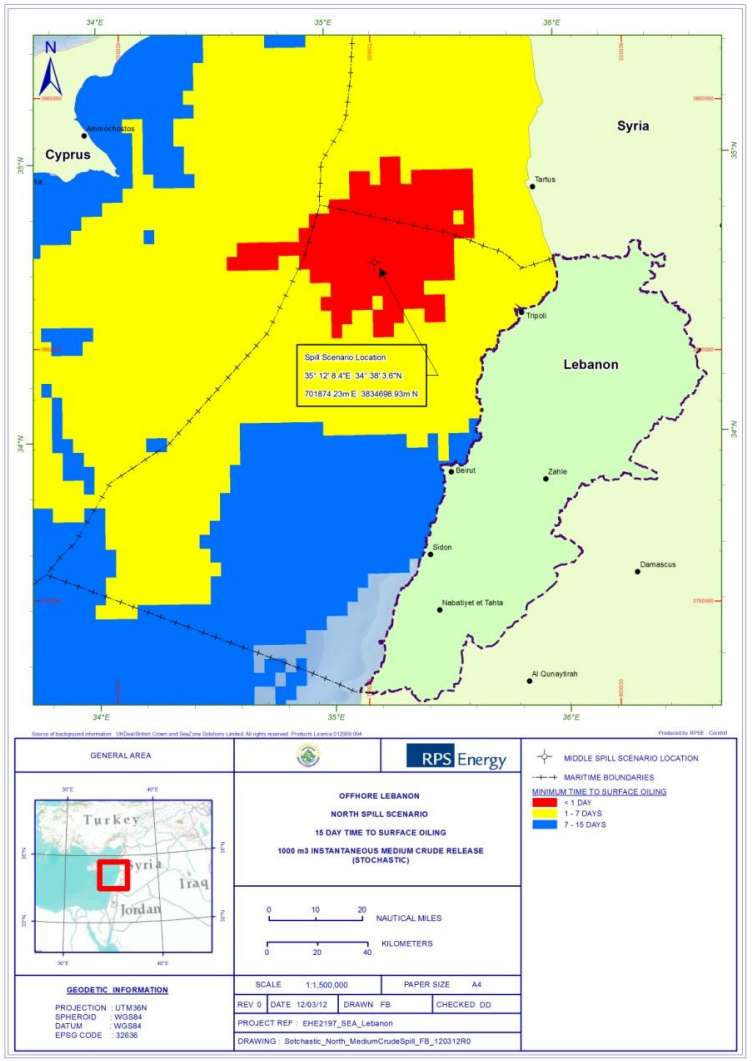
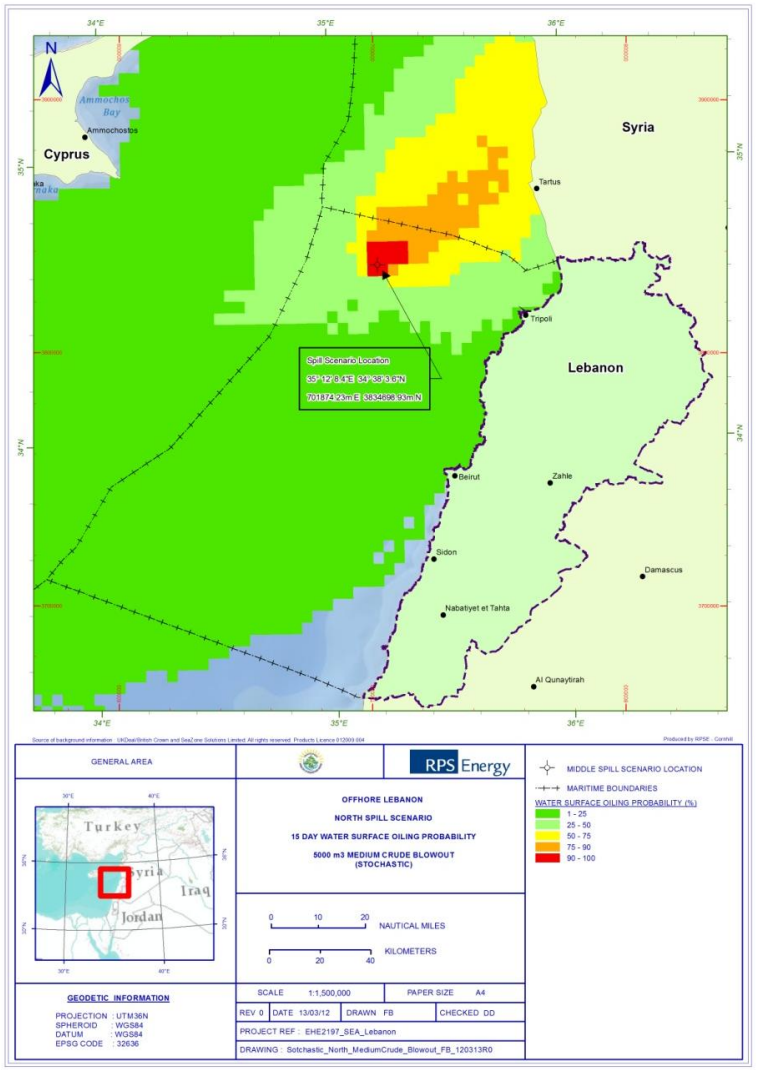


Figure 5.21 5000m^3 15 day blowout of medium crude oil from the Northern EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling

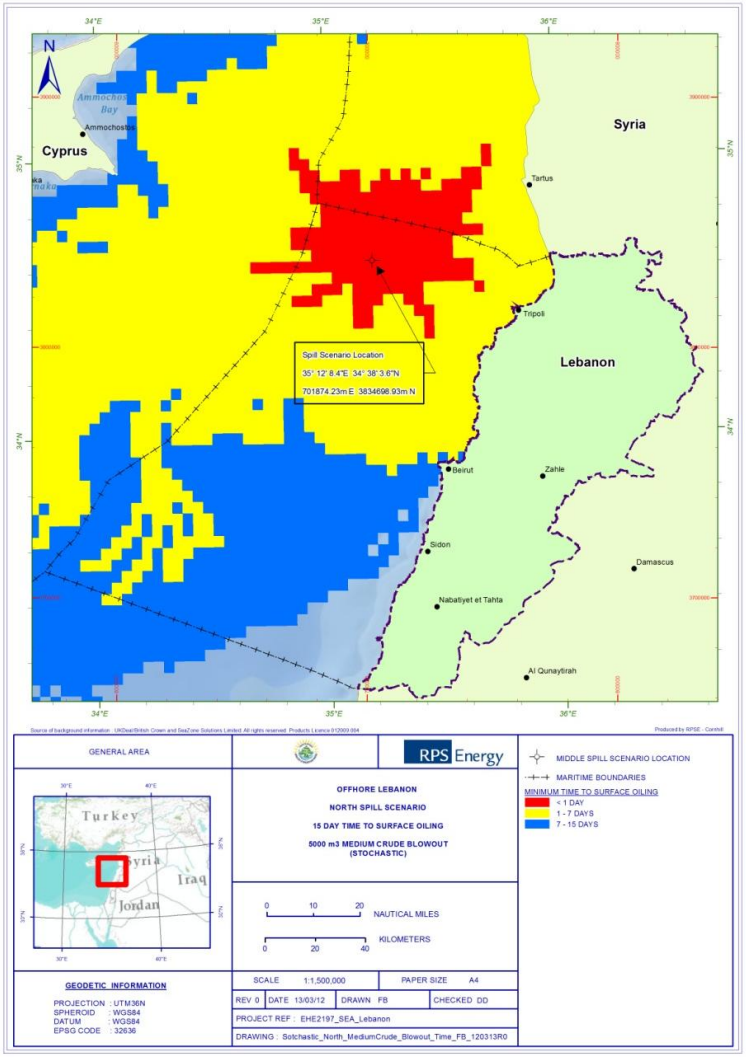
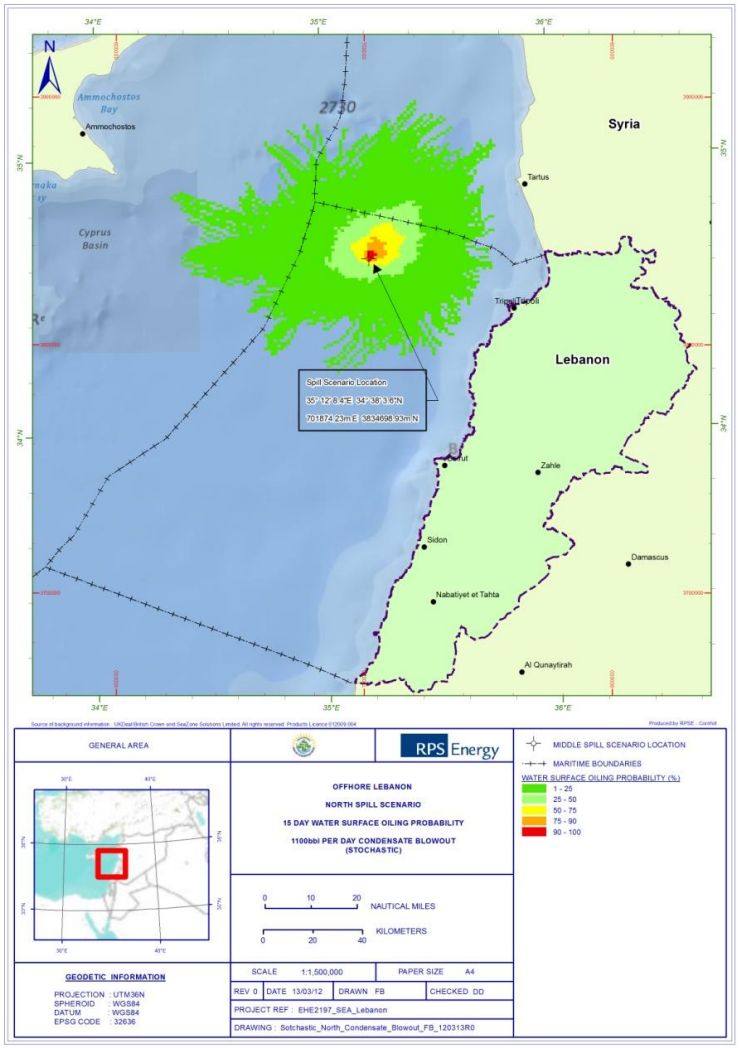


Figure 5.22 1100 bbl/day 15 day blowout of condensate from the Northern EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling

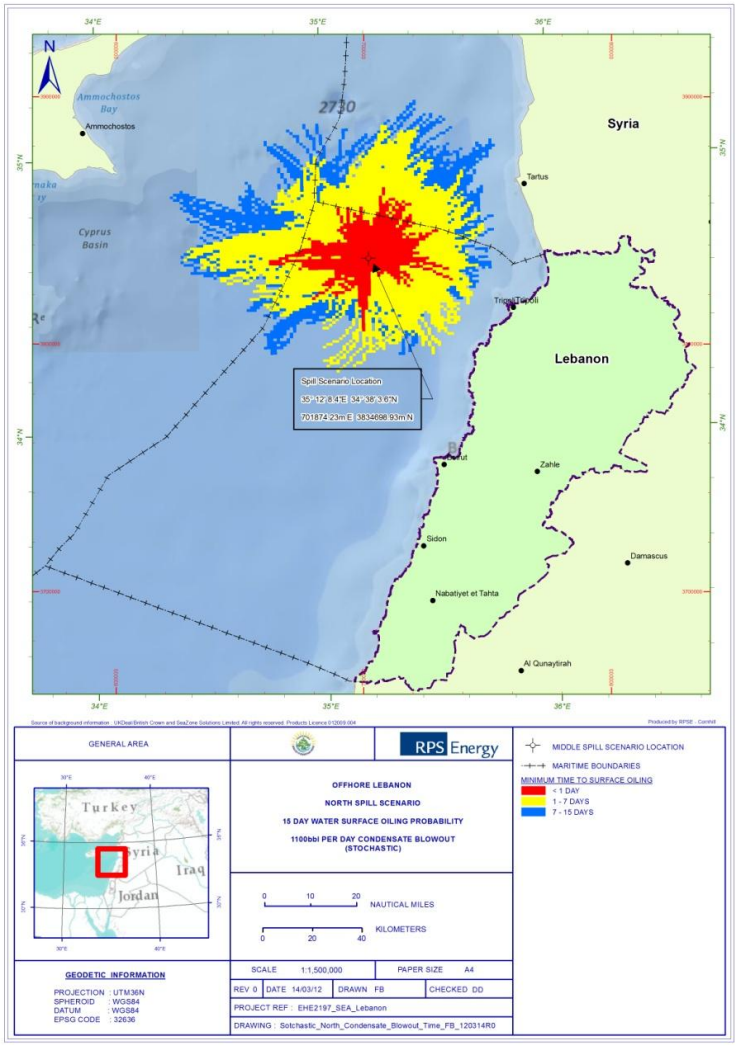
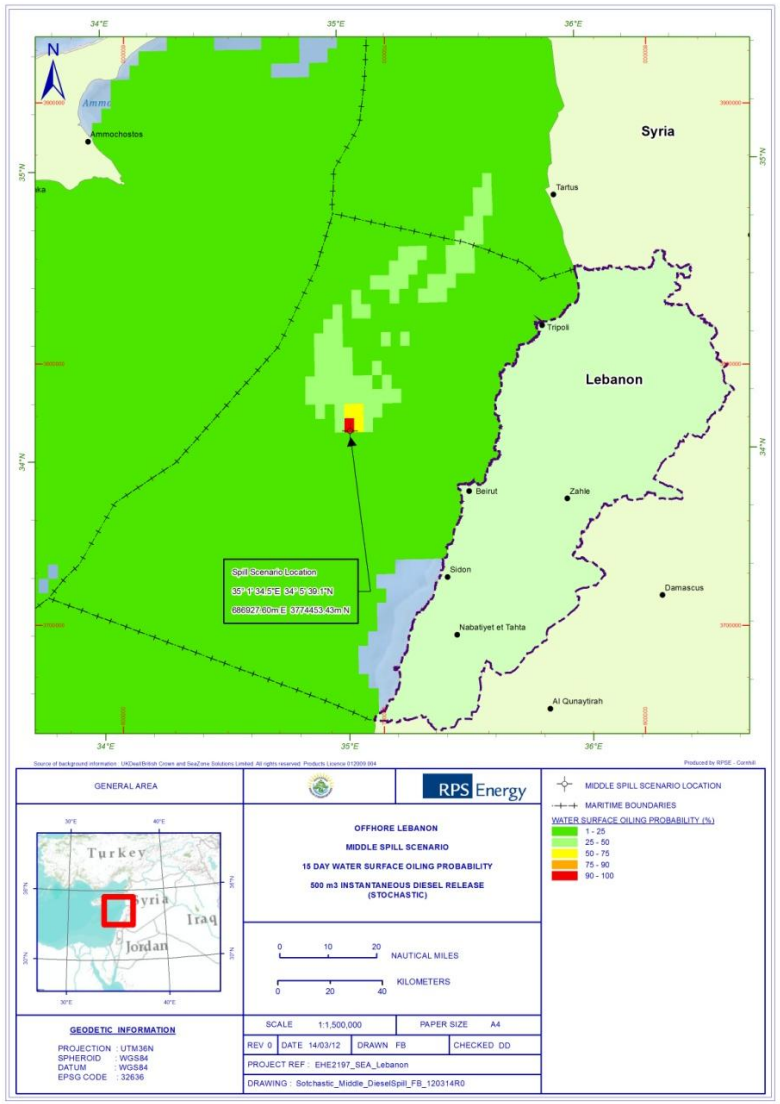


Figure 5.23 500m^3 instantaneous diesel spill from the Center EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling

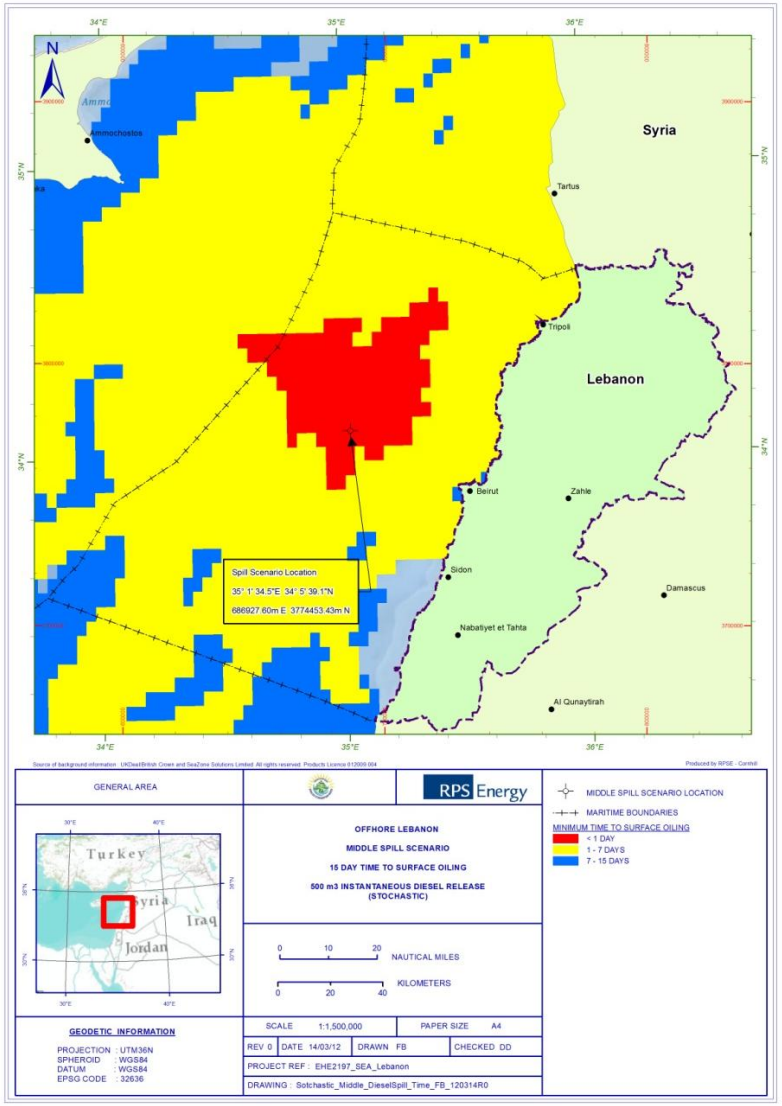
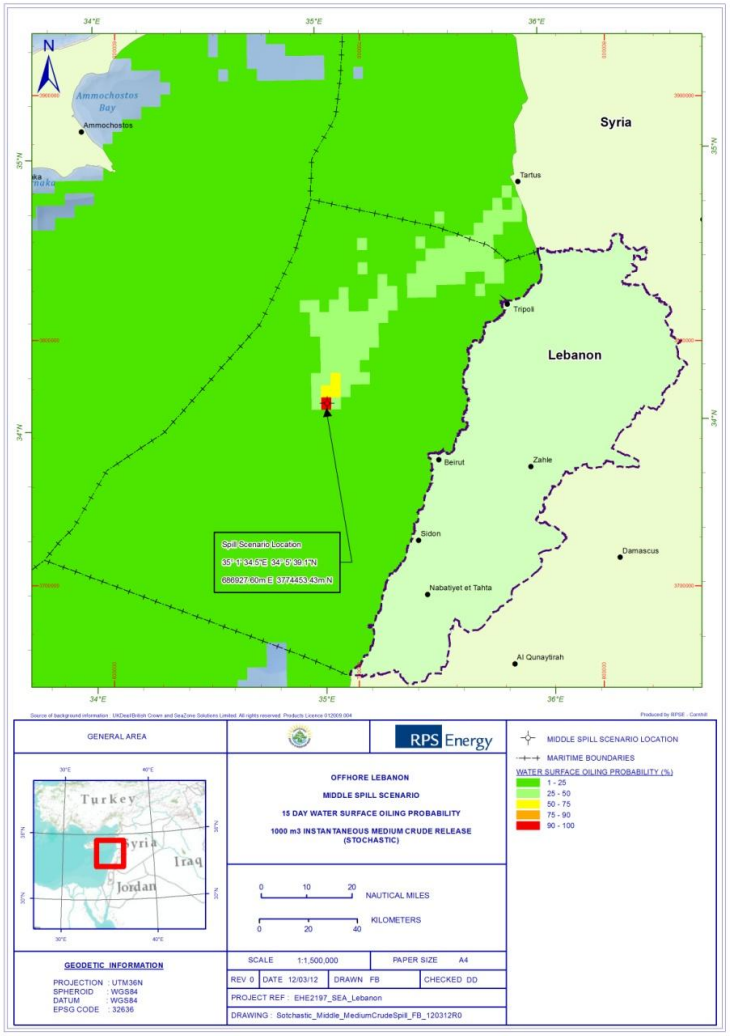


Figure 5.24 1000m^3 instantaneous medium crude spill from the Centre EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling

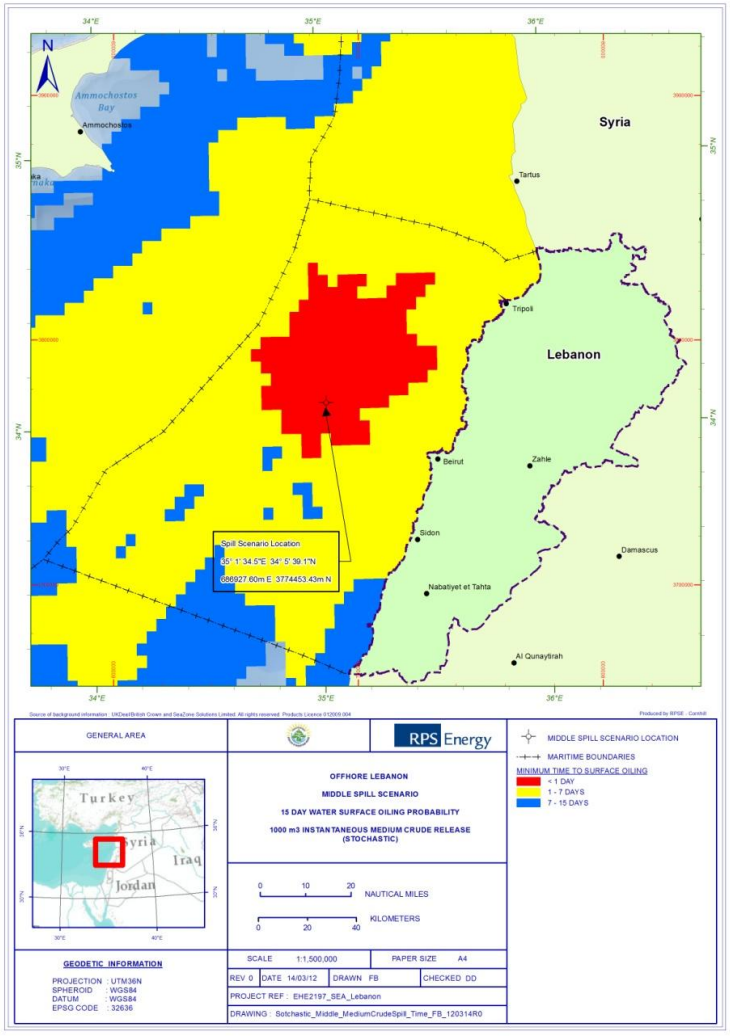
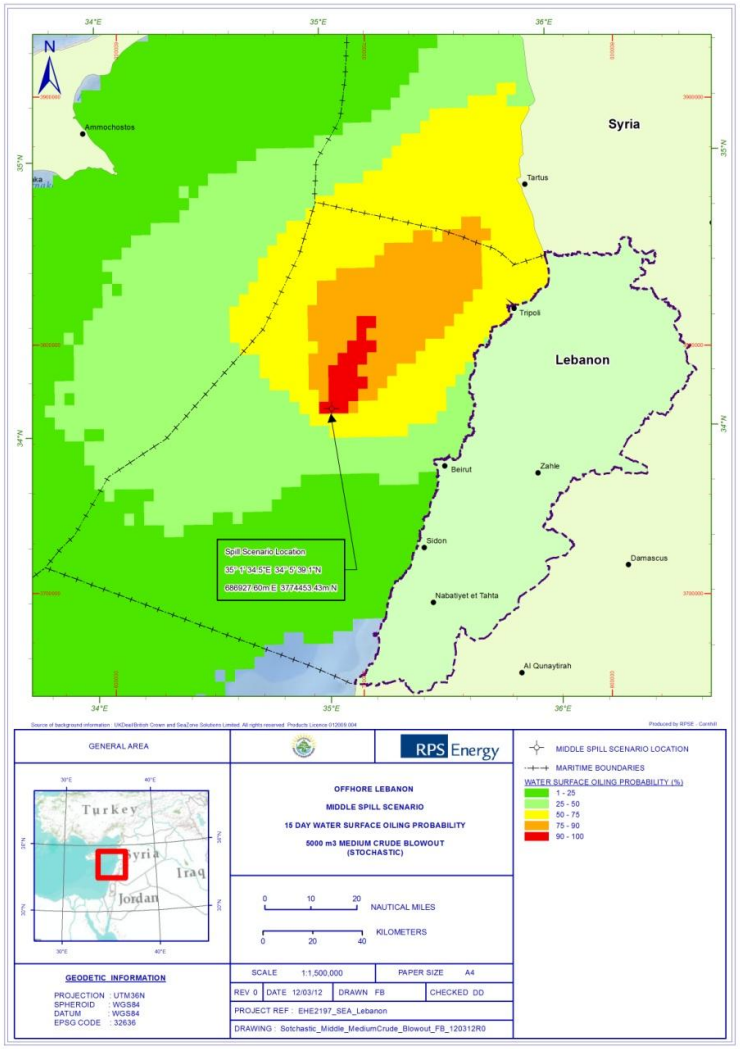


Figure 5.25 5000m^3 15 day blowout of medium crude oil from the Centre EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling

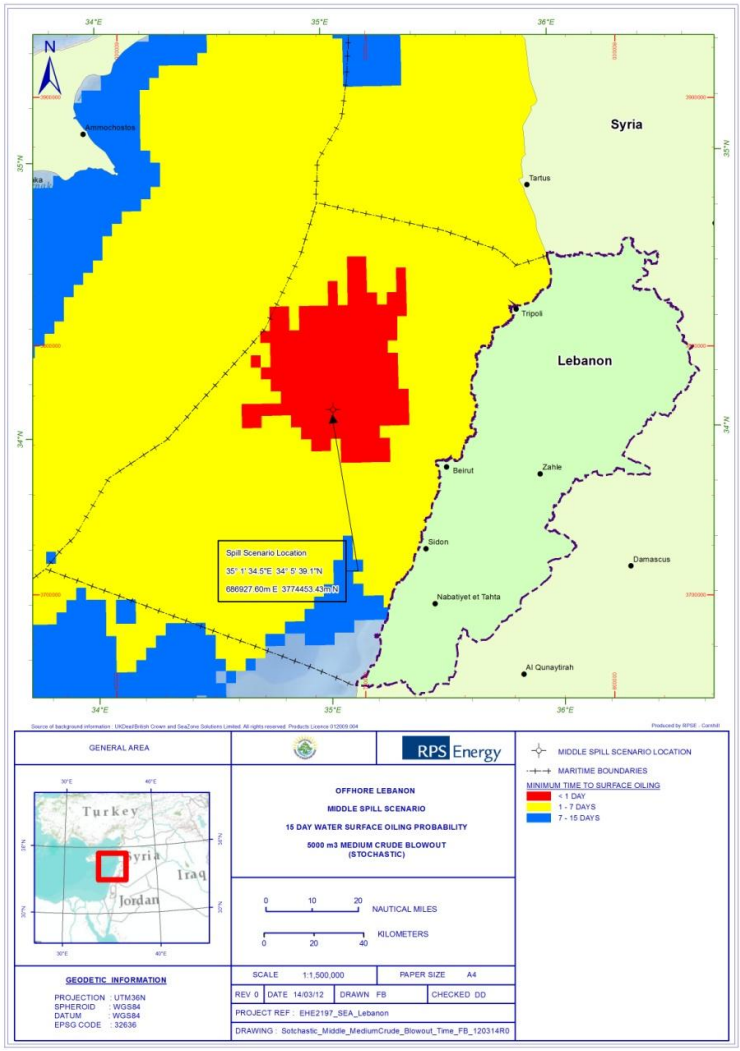
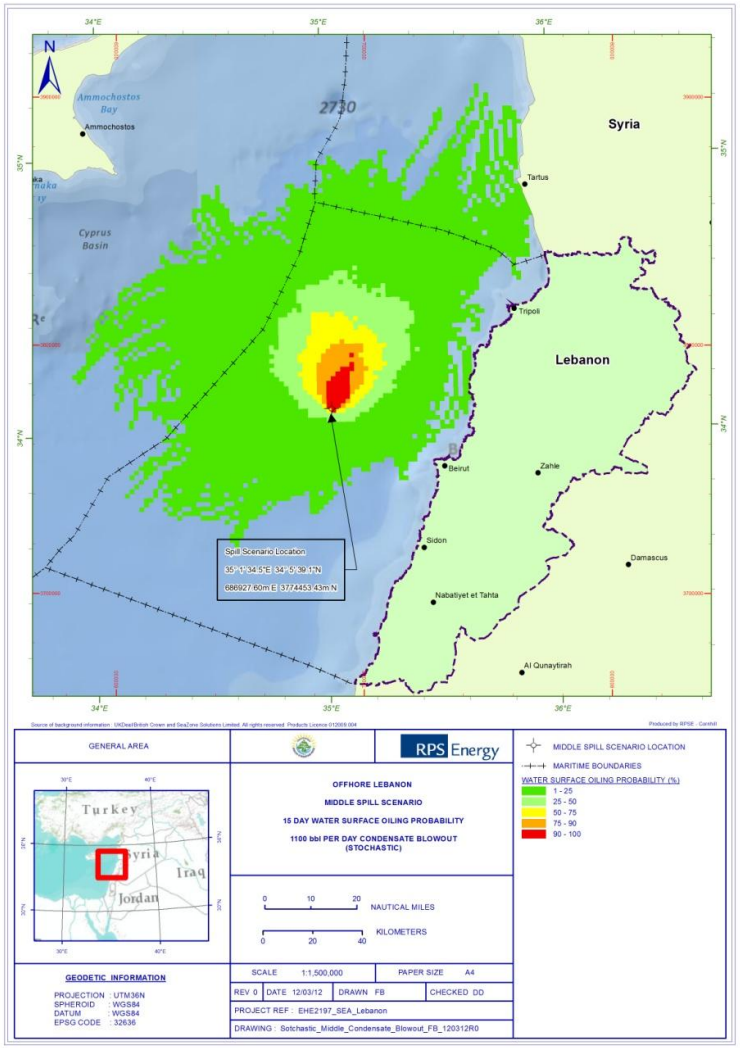


Figure 5.26 1100 bbl/day 15 day blowout of condensate from the Centre EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling

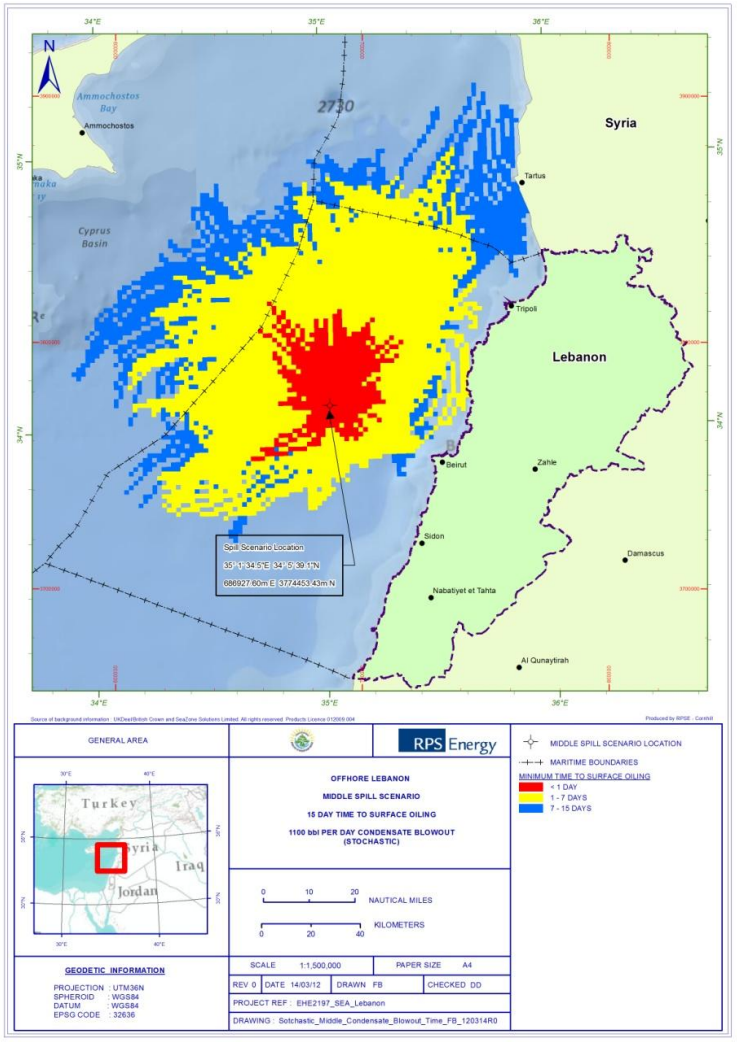
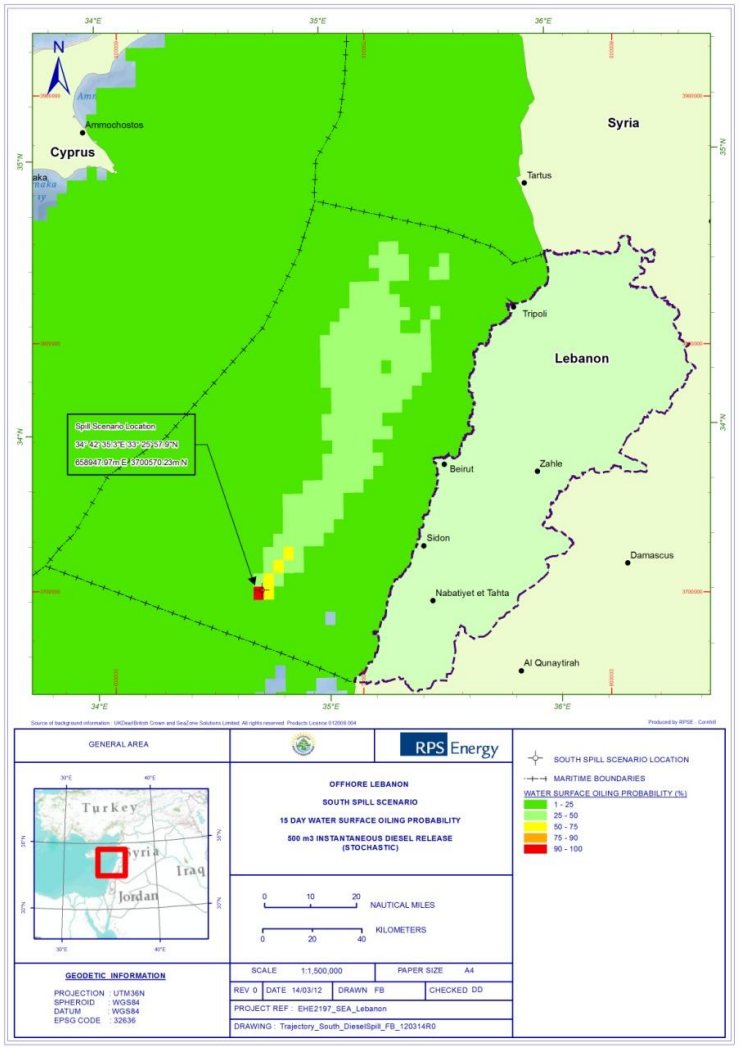


Figure 5.27 500m^3 instantaneous diesel spill from the Southern EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling

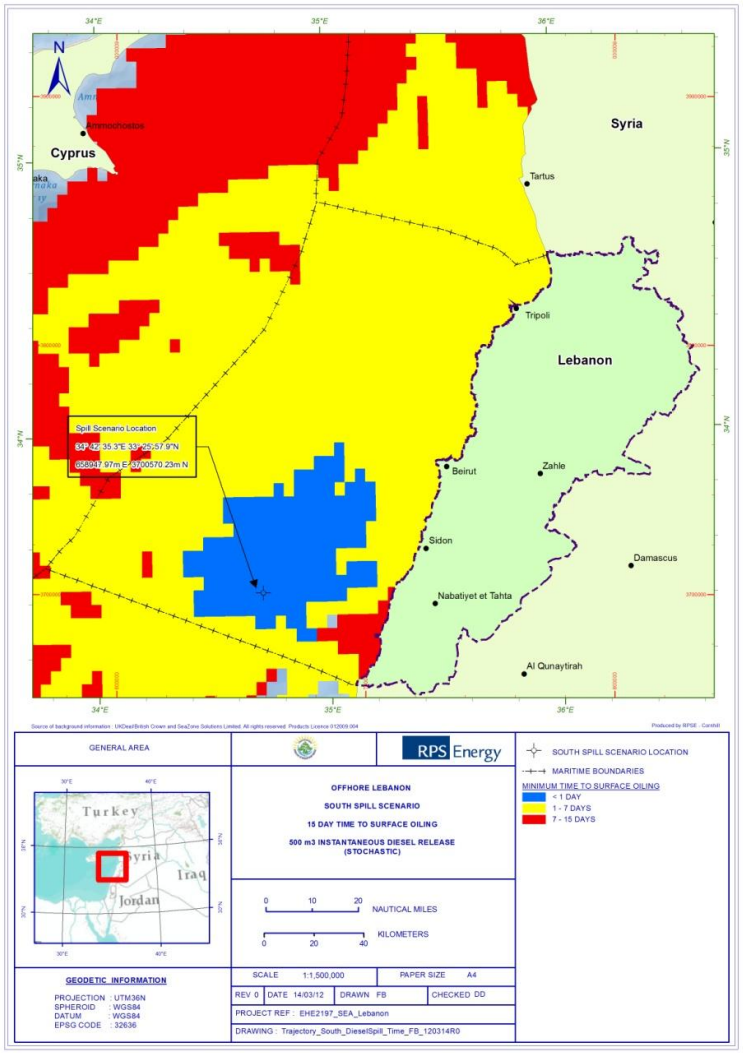
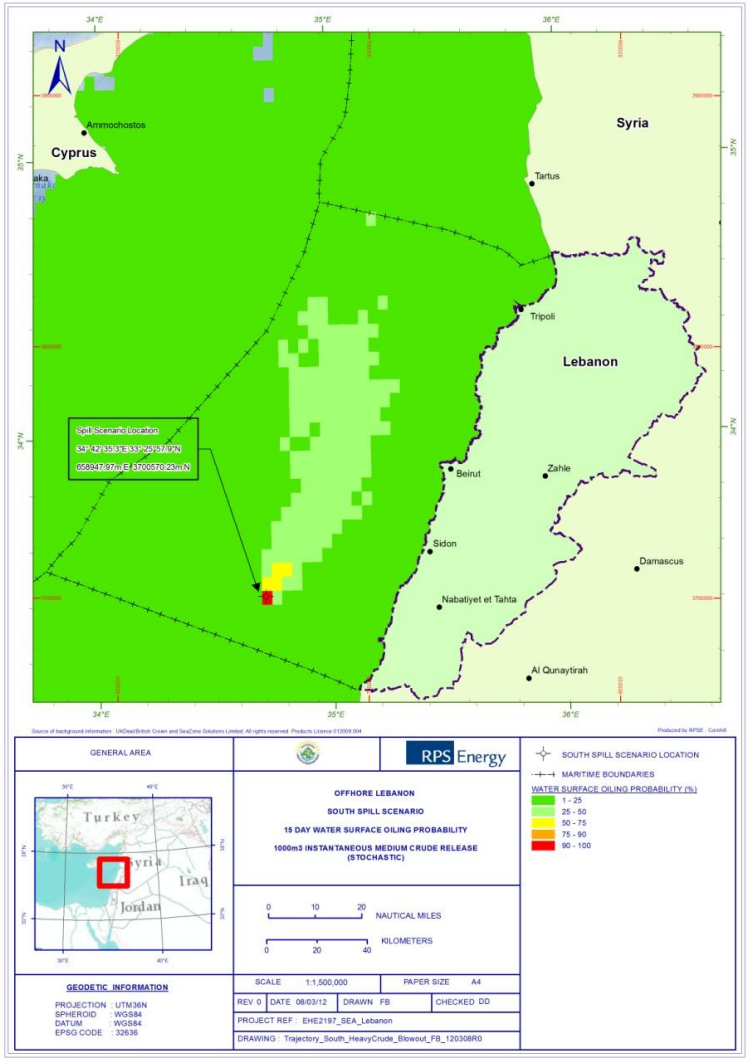


Figure 5.28 1000m^3 instantaneous medium crude spill from the Southern EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling

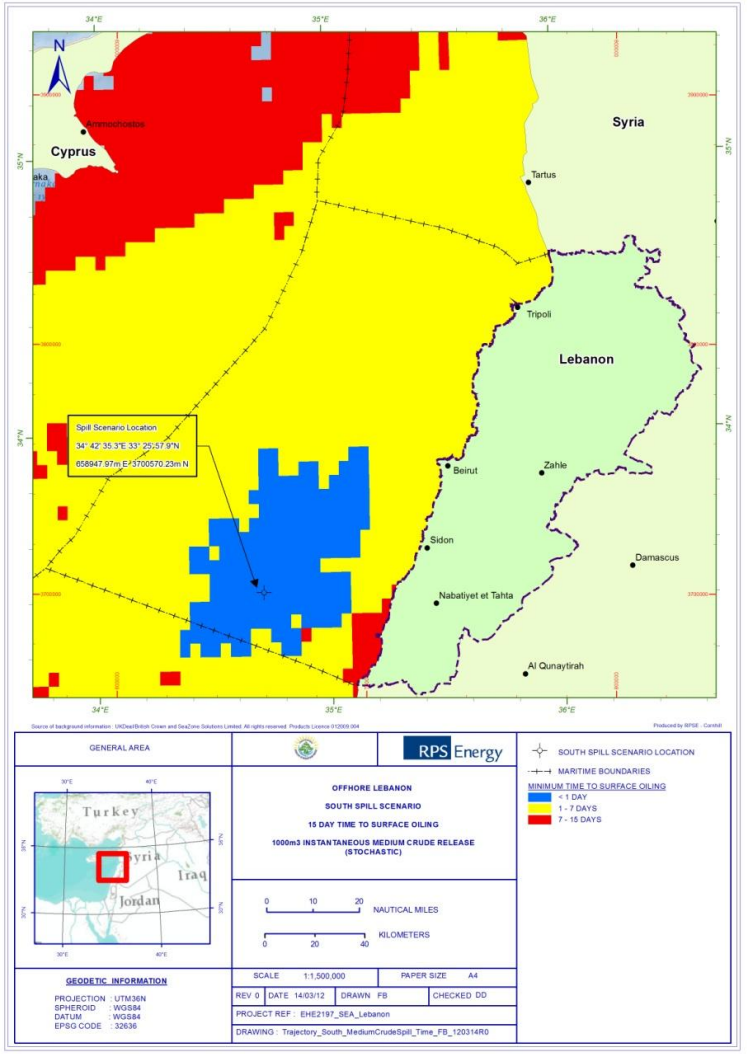
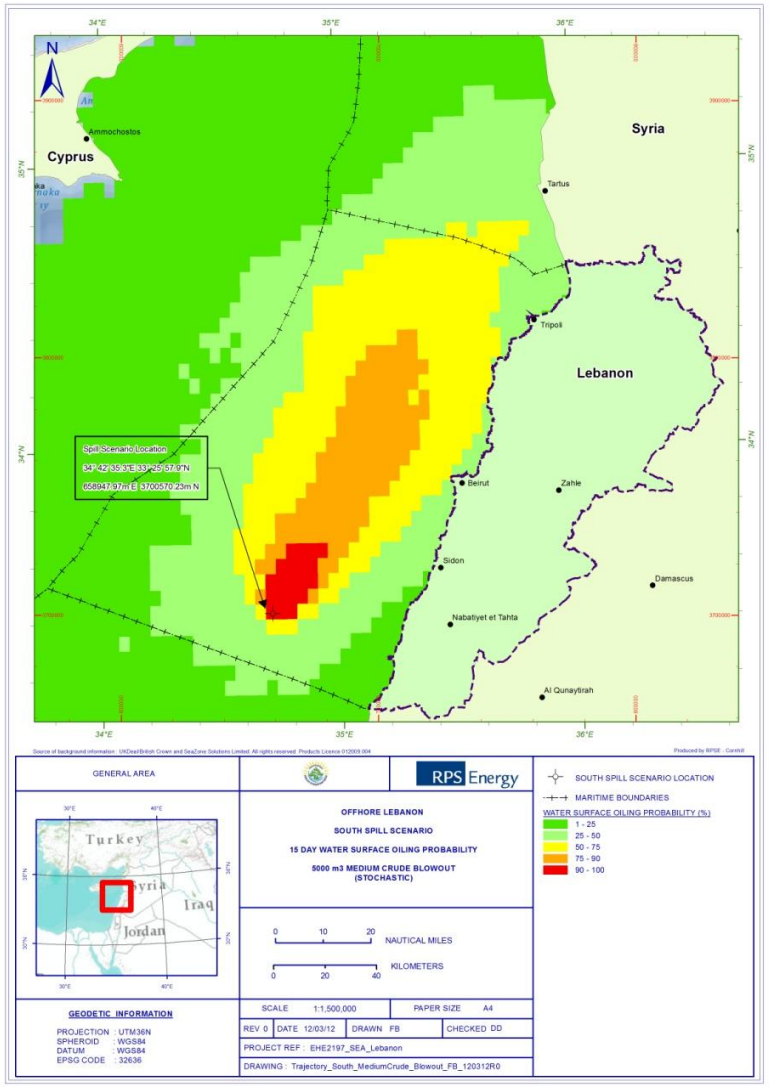


Figure 5.29 5000m^3 15 day blowout of medium crude oil from the Southern EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling

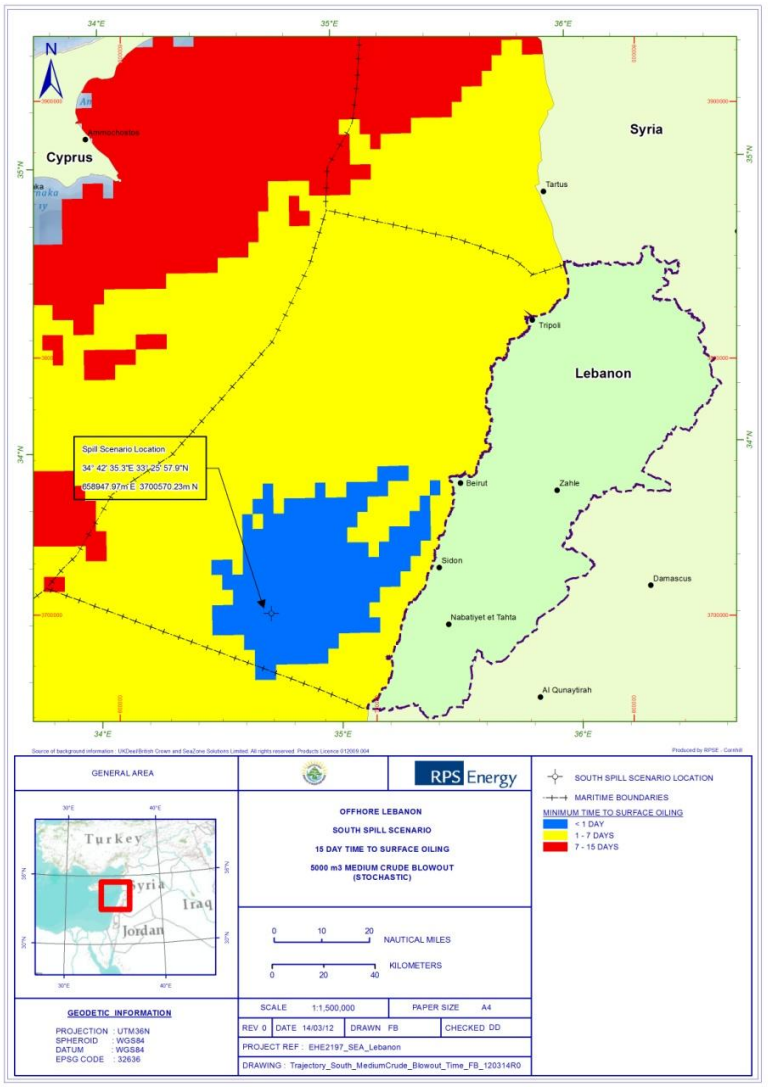
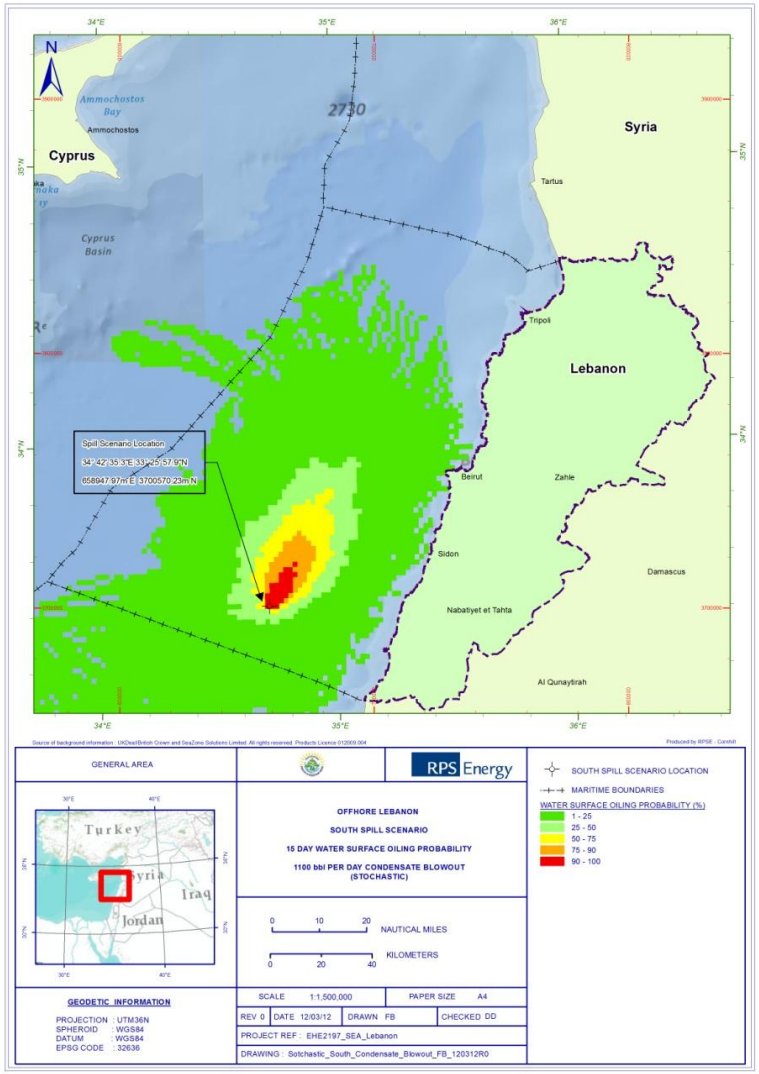
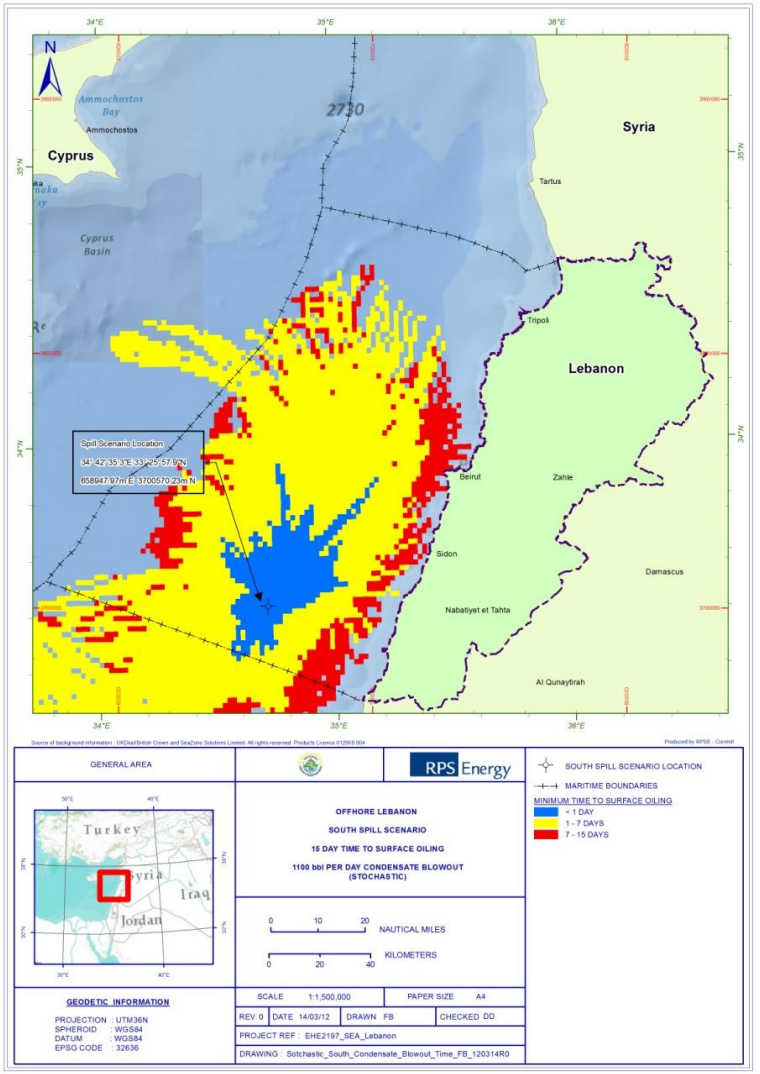


Figure 5.30 1100 bbl/day 15 day blowout of condensate from the Southern EEZ Position (Stochastic)

Water surface oiling probability



Time to surface oiling



RECOMMENDATIONS

6. ASSESSMENT AND RECOMMENDATIONS

The following section evaluates the major, high level concerns that have become apparent through the initial SEA process. Other volumes describe issues in greater detail; the Gap Analysis, Volume 4, focuses on environmental and socio-economic aspects that have the potential to be affected by oil and gas activities and assesses the available information held; the Stakeholder Management, Volume 3, discusses the range of concerns voiced by many individuals and organizations who have been consulted as part of the SEA process. The approach is integrated and documents should be read in conjunction with each other.

The aim of this particular section is to focus on a small number of identified issues that:

- Are of immediate relevance, as opposed to aspects that relate to activities some years hence;
- Are relevant to Lebanon's preparation for successfully managing an exploration and production oil and gas industry;
- Should be addressed in order to maximize the benefits that international oil and gas operating companies can bring to Lebanon;
- Should be the subject of an Action Plan for the next phase of work.

The issues selected focus on the following list which has been derived from both the Scenario outcome (see section 3) and the results of the SEA consultation process. Although they are listed as discrete issues there is a broad degree of overlap and they should be considered as component parts of a single issue.

Issues
National Contingency Plan
Relevant HSE legislation and Regulatory Framework
Data Deficiency and Data Management
Increase Environmental Awareness and Protection
Onshore Pipeline Construction
Transboundary Issues and Cumulative Impacts

6.1. National Contingency Plan.

Issue:

At present Lebanon has a National Emergency Plan with a scope covering natural disasters and foreign invasion. A risk assessment associated with oil and gas development scenarios has been undertaken and the results highlighted the need for a National Contingency Plan covering oil spills in Lebanese waters. International oil and gas operating companies would expect such a Plan to be in place at a national level prior to commencing offshore exploration operations (in particularly offshore drilling operations). As a matter of due process, offshore operators will have their Company and location specific Oil Spill Response and Emergency Plans, but for them to be fully effective they will need to identify, and be coordinated with, the National Plan.

Recommendation:

RPS has presented a draft National Contingency Plan (Volume 2) to facilitate the establishment of a National Plan. It awaits the assignment of roles and responsibilities and a commitment for it to be implemented.

6.2. Relevant HSE Legislation and Regulatory Framework

Issue:

At present Lebanon appears to lack a coherent and integrated regulatory framework to deal with environmental issues. There are many obsolete regulations contradicting International Conventions that Lebanon is signatory to and there are several pieces of legislation that have been drafted but not yet officially sanctioned by government for implementation (for example the EIA Decree). In addition, there are several International Conventions that have been signed but not ratified. This has created a confused situation leading to an overall lack of internal government consistency towards the regulatory process; a potentially dangerous position to be in at the start of introducing an international, fast moving and assertive industry into the country.

One particular issue is that, at times, it can be unclear which ministerial body is responsible and accountable for which regulatory sector, this is especially so in land related issues. Although such a system of several ministries having 'prerogatives' on specific issues can be strong positive, allowing a democratic approach that can result in positive 'buy-in' from different sectors, it can also often lead to infighting and stalemate resulting in a lack of positive direction and progress.

Past experience from other parts of the world would indicate that development of an oil and gas industry can have a significant impact on a country's political and economic stability and on its environment. It can bring both risks and threats, and potentially large benefits, but it undoubtedly brings change. In preparation for this, Lebanon should have in place a regulatory framework and clear institutions that allow for transparency, good governance and efficient

development of the industry for Lebanon's benefit. A regulatory framework must include a well thought out enforcement scheme in which legislation is enforced in a clear and consistent manner, and according to open and established criteria. All regulatory frameworks for oil and gas industries must encompass a large variety of issues, such as licensing regimes, profit sharing, royalties, taxation, drilling, reporting, information confidentiality, intellectual property, permitting, environment, safety, health and security. It must also interact with international law and international Conventions.

The international oil and gas industry has its own well developed principles and standards and expects to comply with a national regulatory framework and international Conventions. However, the operators will require confidence in the national regulatory framework and assurance that they can operate effectively.

The challenge for Lebanon is in developing a governance system for sustainable development that is highly integrated, multi-sectorial, process oriented and participatory, while also being culturally and politically sensitive.

Recommendation:

The EIA Decree and other Decrees supporting the Environmental Law should be finalised and implemented within Lebanon as soon as possible. The EIA Decree is a critical piece of legislation, which should go hand in hand with planning and permitting regulations in preparation for the increased pressure on infrastructure that the oil and gas industry will undoubtedly generate. As the Ministry of Environment will have the main responsibility for designing the scope of ESIAs and their quality assurance, its capacity should be strengthened accordingly.

Within the current Lebanese regulatory framework, Environmental Standards are present but these not comprehensive and rarely implemented or enforced. Effective implementation of Standards is best undertaken by a politically independent regulatory body; for example an Environment Agency with sufficient in-house expertise to understand the issues. In the absence of such a body capacity building within the existing framework should be strengthened in order to meet the challenges of a developing in-country oil and gas industry.

Many of the internationally adopted health, safety, environment, and quality management systems have been pioneered by the global oil and gas industry, and certified in line with international standards such as those of the International Organisation for Standardisation (ISO). The industry itself has developed a series of HSE guidelines on Environment Management Systems, Environmental and Social Impact Assessments, Environmental Risk Assessments etc., and routinely use the Equator Principles and IFC Performance Standards as a way of doing business. RPS would suggest that the Ministry of Environment staff become familiar with these internationally recognized and integrated suites of standards with a view to adopting them into a regulatory framework for the oil and gas development.

RPS recommends that the Lebanese government is selective in choosing oil and gas operating companies to operate within Lebanon. Pre-qualification criteria should include having well

developed management systems and a respectable international reputation as regards Safety, Social and Environmental issues.

RPS would welcome the opportunity to support the Ministry of Environment in capacity building to meet the challenges of the increased responsibilities and work load associated with the contents of the EIA Decree and implementation of a regulatory framework. This would include comprehensive training and guidance with a pre-defined timetable of knowledge transfer.

6.3. Data Deficiency and Data Management

Issue:

There have been a number of recent, good quality environmental and socio-economic surveys, mainly undertaken in Lebanon by the World Bank, FAO East Med and UNDP, partnered with Lebanese institution. In the context of this SEA, however, the existing relevant survey data has only served to highlight the paucity of available and scientifically robust offshore and coastal data set and the lack of any co-ordination between the various survey programmes.

The Gap Analysis Volume 4 of this SEA describes in detail the available and existing information compared to that which is needed for an internationally acceptable ESIA.

Recommendations:

Lebanon's extensive offshore territory and the deficiency of environmental data sets, especially for the deeper offshore areas, is reminiscent of the situation in the North Sea in the 1960's at the start of oil and gas exploration in those waters. A lesson learnt from this situation is that it takes time to acquire and collate data, and that this data gathering phase happens in a piecemeal manner over time rather than as a product of a single, huge exercise.

In recognition of this experience it is suggested that Lebanon could envisage a series of location specific Baseline surveys being carried out as part the Licence specific Environmental and Social Impact Assessments (ESIAs) performed by the operators who acquire the License Block rights. Operators will expect to carry out comprehensive ESIAs as a condition of any Block Licenses they acquire and also to meet Lebanese legal requirements. In these circumstances Baseline Surveys are also seen as an insurance requirement to guard against future liabilities; but from the perspective of enhancing a Lebanese national environmental database such surveys are invaluable.

To maximise the value of the surveys the Ministry of Environment (MoE) would need to closely manage the ESIA process carried out by the operators. To maximise the benefits and compensation that might accrue due to operator proposed mitigation measures, MoE needs to be fully cognisant of the best interests and development requirements in the varying sectors. This may include research funding for further survey and monitoring, equipment or a variety of investment programmes.

Data acquisition is only part of the story. Data management is the process that ensures that information is stored in a secure environment, is easily discovered and delivered in a way that enhances the value of data and information assets. Given the expected quantity and complexity of information arising from the operators ESIA reports, a good spatial data infrastructure (SDI) needs to be put in place using GIS and data management software. Our GIS capabilities and recommendations are described in detail in Volume 5 of this SEA.

RPS recommends that the MoE set up a strong, well coordinated, technical steering group to provide expertise and ensure the various surveys carried out are consistent, compatible and are systematically providing the requisite data in the appropriate format. The role of such a group would not only provide quality control, but also help to co-ordinate different surveys that have a synergy and could share costs and facilities, especially in the offshore context where survey costs can be high.

RPS would welcome the opportunity to serve on such a technical steering group.

6.4. Environmental Awareness and Protection

Issue:

At present there is poor provision for the protection of habitats and species in Lebanon; habitats and species are not afforded adequate protection from the pressures of urbanization and development. The oil and gas industry will potentially increase that pressure offshore and along the coastal littoral to the detriment of ecological and landscape considerations.

The Biodiversity goals of the 1998 Biodiversity agreement are not being implemented. This is partly due to lack of a suitable regulatory framework and partly to the dearth of systematically and scientifically collected information on key habitats and species in Lebanon. It is essential that, in Lebanon, the oil and gas industry develops under an effective legal framework which, amongst other things, protects the environment. The industry is well acquainted with such provisions and many companies support significant Biodiversity initiatives in the countries where they operate.

Consistent with a lack of regulatory framework is a lack of land use planning with consideration for environmental issues. This is understandable in the context of post-war recovery, but with the development of an oil and gas industry there is now the opportunity to construct coherent, long term plans for environmental protection and rehabilitation. It is disappointing to find that there is a proposal to build a Naval Base north of Tripoli proximal to one of the few stretches of coastline with significant ecological value.

Recommendations:

The coastal littoral is compromised, probably beyond repair, by urban sprawl, habitat fragmentation and chronic industrial pollution. However, a strong policy of environmental protection for what remains, coupled with a clear programme of habitat creation, such as the

provision of wildlife refugia and sand replenishment of beaches eroding due to wartime sand extraction is strongly recommended.

Although data deficient at present, the indications are that the offshore ecology is extremely rich in Lebanese waters. There are only two officially protected areas: the Palm Islands off Tripoli and Tyre coast; and both of these are coastal rather than marine. RPS strongly advises the creation of adequately protected Marine Protected Areas (MPAs) prior to the development of hydrocarbon production. Proposed areas have already been identified and well researched b Lebanese academics.

At present there is no habitat classification system used in Lebanon, or criteria with which to assess habitats. It is suggested that the EU Habitats Directive could be used effectively while a system more specifically focused on Lebanon's actual habitats is developed.

RPS have experience in developing plans for maximizing Biodiversity investment programmes funded by international oil and gas operating companies and would welcome the opportunity to support and advise the Ministry of Environment on the issues discussed above.

Enhancing environmental awareness generally should be a significant component of the ongoing Stakeholder and Community Engagement programme.

6.5. Proposed Onshore Pipeline Construction

In section 3 of this document Scenario 7 described the options for gas transportation to the existing oil fired power stations located on Lebanon's coast, and one of these options was the construction of an onshore pipeline. The onshore gas pipeline is a component of the overall oil and gas development plan; the whole package could include offshore wells, offshore pipelines, landfall sites, port facilities, OPF and LNG plants, onshore pipeline with associated AGIs, compressor stations, off-takes, metering stations and a central operations centre. As part of the consultation process RPS was appraised of the plan to construct the onshore gas pipeline in the near future as all associated developments, from production, transportation, processing to use, fall under the remit of an SEA.

In anticipation of gas production the Ministry of Energy and Water has commissioned a 36 inch diameter bi-directional flow gas pipeline to be constructed from the north of Lebanon, to Tyre in the south. The pipeline will link the presently oil powered power stations with a view to converting them to gas at some point in the future. The pipeline will be wholly onshore, using a disused railway corridor for the majority of the route, except for the Beirut area where the pipeline will be offshore around the Beirut headland, making landfalls at the Zouk power plant and south of the International airport.

It is of extreme concern that no EIA has been carried out on the proposed pipeline; apparently it was considered superfluous as the route proposed lay on an existing railway corridor, which is government owned land. The concept of mitigation measures other than moving a route, have not been considered and it is not envisaged that the pipeline route will deviate from

government land. Ministry engineers are believed to be under the impression that the new Petroleum Law only refers to the offshore petroleum developments, and therefore there is no legal requirement for an EIA from this perspective (together with the fact that the EIA Decree has yet to be formally passed). The new Lebanese Petroleum Law has an article relating to an EIA for transportation works; although the new Law is only a framework document at present it is disappointing that the spirit of the law has not been adopted in this case.

Pipeline construction will be funded by the Lebanese government with no need of funding from the Lending Banks, so there is no requirement for any assessment. Past industry experience shows that timely environmental and social assessment can ameliorate risk and save costs.

Laying an offshore pipeline was apparently discounted due to excessive cost, however, past industry experience suggests that the cost differential is not so great in the light of a detailed Design Risk Assessment which would consider pipeline integrity, financial, security, contractual, safety, socio-economic as well as environmental issues. Feasibility studies have apparently been carried out, but these have not been passed to the SEA team.

As RPS understand it:

- The pipeline is 36 inch diameter gas pipeline which will operate at 75 barg pressure.
- The new line will join with an existing 24 inch gas line coming in from Syria, which has lain idle for the last 7 months.
- The route will use the disused railway, except for the Beirut area where the route will be offshore.
- The route is on level terrain for the whole length, so a Compressor Station is not envisaged, although there will be many Block Valves.
- The landfall from offshore wells will be near Tripoli at Bedaawi and the line will run to Zahrani power plant, then on to Tyre. A proposed LNG plant will be located in the Zahrani area.
- The composition of the gas is as yet unknown, if sour additional processing facilities will be required to extract H2S.
- Pre-qualification has taken place for construction contractors and the ITT will be released in the near future. Contractors are from China, Iran, Turkey and Russia.
- The origin of the pipe sections is unknown, as is whether the long lead items have yet been ordered. It is not thought that hot bends will be necessary as the line will run level.
- All water course crossings will be open cut.
- Hydrotest sections have not been defined, or any assessment of water source and abstraction rates.

- There are many steep, tight ravines lying perpendicular to the coast which were crossed by the railway bridges. The pipeline will use an aerial crossing (it was not known whether the design of the aerial crossing incorporates the extra weight of water during hydrotesting.
- It is not known how far from buildings a high pressure gas line should be.
- Residential Buildings have come right up to and onto the disused railway, but they will be removed.
- It is proposed that construction will take place within a 14 metre Right of Way; 30 metres is normal for a 36 inch sized pipeline, 14 metres is not possible if top soil is to be segregated for reinstatement purposes.
- The offshore section, going around the Beirut headland has not been finalised – offshore shelves steeply to deep water.
- Near Salata the railway runs through a tunnel for 1.5 km under a rock headland. It is not known yet how a pipeline will be taken through the tunnel. The line bends at both ends, leaving no lay down areas for stringing out.
- There will almost certainly be bats in the tunnel (all bats are protected species).
- Railway lines typically provide suitable habitat for reptiles.
- There have been no ground investigation works to date.
- Access has not been assessed. While there will be no need for extra access roads – rail and road run closely together – there has been no consideration that large trucks carrying 18 metres lengths of 36 inch pipe will be using the road.
- It is not known where construction camps and laydown areas will be located.
- For the most part the railway land runs on the sea side of the coastal road. There are places where the railway has been undermined by coastal erosion (especially south of Rmaileh), so the twisted track is on the beach, the road is 2metres away inland and the inland side of the road is residential.
- Many parts of the railway track have already been built upon, including, it appears, a new sports stadium on the north side of Sidon.
- There are many low slung cables across the road that may inhibit the haulage lorries carrying pipe. In many places the public coast road will form the running track, creating many safety and liability issues.

This pipeline proposal has been discussed at length as it highlights several aspects that have been identified as concerns during the impact evaluation during the Scenario exercise and during stakeholder consultations. The proposal demonstrates why detailed and transparent Environmental and Social Impact Assessments are considered mandatory for sensible planning,

development and project management, and why ESIAs are now routine procedures for responsible and competent oil and gas companies.

RPS have a great deal of experience in onshore pipeline routing and construction and would be available to advise on this issue. Volume 7 of this SEA Report includes illustration of the onshore pipeline route.

6.6. Transboundary Issues and Cumulative Impacts

Transboundary issues and cumulative impacts have not been addressed during this SEA phase. Both will be critical in the context of oil and gas development in Lebanon and the potential for cumulative impacts will need careful analysis for many environmental and social aspects.

Transboundary issues identified to date include the following:

- The overriding consideration is the geo-political instability of the region in relation to national (especially offshore) boundaries. This will have consequences for a National Contingency Plan relating to oil spills; spills in Israeli waters wash up in Lebanon, and those in Lebanon reach the Syrian shore.
- There is insufficient data at present, but it appears that the Lebanese nearshore waters host the sole nursery grounds of a species of pelagic fish which support the fishing industry in other countries, notably Egypt. Further research is necessary prior to any oil and gas activity to establish the situation.
- At present, hazardous waste produced by oil and gas activities in Lebanese waters would require transportation to another country for disposal, increasing vessel movements and putting pressure on another country's facilities. Lebanon's Waste to Energy strategy would resolve this issue, and the intention is to have this in place prior to any oil and gas development on the ground. RPS would welcome the opportunity to support this initiative by offering advice on its extensive experience in waste management issues.

7. CONCLUSION

In order to conclude this SEA Report the original objectives identified in the contract have been re-visited and an assessment made as to how thoroughly they have been addressed.

A Strategic Environmental Assessment is the start of a process that continues with ever greater levels of refinement and detail. Subsequent stages are the subject of location and/or project specific Environmental and Social Impact Assessment reports, and these in turn determine the suite of management plans which describe the exact measures to be employed in mitigating and controlling identified impacts and risks.

The SEA Report objectives cited in the contract have been comprehensively met and they initiate a process that will be developed in subsequent phases. The SEA Report includes recommendations for future development of the process.

It is proposed that this SEA Report also meets the requirements of the new Petroleum Activity Law and therefore there is no material reason to delay the licensing round and allocation of rights to the blocks from the environmental and socio-economic perspective. However, it is understood that the SEA has initiated a process that is ongoing, and the individual operators acquiring the rights will be contractually committed to providing an ESIA in sufficient detail to identify their location and project specific impact assessments and full baseline studies. In view of the data deficiency, especially offshore, these baseline studies assume critical importance.

The stated objectives of this SEA Report are as follows:

Objective	Contract Objective	Status at end of initial SEA phase
1	To integrate environmental, socio-cultural and socio-economic aspects in the exploration and development of offshore oil and gas resources and related industries in order to ensure a balanced and sustainable development.	The SEA Report has been written with an integrated multi-disciplinary approach. Volume1, section 3, describes a range of potential scenarios that could occur during exploratory and production drilling, processing and transportation. Environmental, social and economic risks, impacts, opportunities relating to each scenario have been identified.
2	Establish a basis for the development of institutional strengthening in order to build competence and capacity in dealing with the identified aspects.	Volume 1, section 6, describes the high level issues where institutional strengthening and capacity building would be appropriate. Recommendations are made that would support and promote this in the next phase.
3	Ensure that all relevant issues are addressed at the earliest stages of oil and gas exploration and development and that appropriate advice is given to support decision making.	Volume1, section 3, 4, 5 and 6 identify, analyse and describe all relevant issues that are foreseeable during oil and gas development.
4	Establish a common understanding and joint baseline for project specific environment and	An integrated and multi-disciplinary approach has ensured a common understanding at this initial SEA

	socio-economic related assessments.	phase. Volume 4 is a gap analysis identifying those areas that are data deficient. A scope of work for a typical ESIA that would be part of an operator's contractual obligation is also provided.
5	Identify sampling and testing requirements as needed.	At the end of month two in this SEA contract a Survey Manual, Volume 8, was submitted which described in detail appropriate survey techniques for the bio-physical environment offshore and onshore and the socio-cultural environment.
6	Establish thresholds for acceptable cumulative effects.	The outline for assessment of cumulative effects has been laid down in Volume 1, section 3; however, this aspect is very much part of ongoing assessment when suitable data becomes available.
7	Identify potential environmental sensitive areas and provide guidance for the protection of such areas whilst at the same time exploiting oil and gas resources.	Environmentally sensitive areas in the SEA's Zone of Influence (offshore, nearshore and the coastal zone up to the 200m contour) have been identified. This includes the two legally protected Nature Reserves at Tyre and near Tripoli, and the eighteen proposed Marine Protected Areas. It is strongly recommended that legal protection is afforded these eighteen MPAs prior to oil and gas activity.
8	Identify key issues to be dealt with in order to ensure a focussed discussion amongst decision makers.	Volume 1, sections 3, 4, 5 and 6 and Volume 3 identify all foreseeable key issues and discuss their significance in relation to decision making.
9	Identify environmental and socio-economic related opportunities and risks associated with various scenarios of oil and gas exploitation and develop appropriate guidelines for maximising benefits and minimising risks.	Volume1, section 3, describes a range of potential scenarios that could occur during exploratory and production drilling, processing and transportation. Environmental, social and economic risks, impacts, opportunities relating to each scenario have been identified. Appropriate guidelines have been initiated but they are essentially on-going and should be further developed in the next phase.
10	Ensure that relevant stakeholders are identified and involved and that their concerns and expectations are considered during the decision making process.	Volume 3, the Stakeholder Register and Consultation Register identifies stakeholders and records the consultations that have taken place to date. For the SEA phase only high level stakeholders have been interviewed; future phases of stakeholder management will include a greater range of stakeholders, including the public.
11	Outline mitigation and monitoring requirements	Volume 1, section 4, identifies impacts arising from

	and objectives to establish best practice and ensure effective impact management for future oil and gas development.	foreseeable oil and gas activities and Volume 4 identifies potential receptors. However, this area of work is ongoing and awaits greater definition of proposed oil and gas activities and further data on the potential receptors. Precise locations will be a component of this ongoing work.