PUBLIC

EXECUTIVE COUNCIL

CONFIDENTIAL

Title: Noble Energy – Oil Spill Contingency Plan

Paper No: 48/15

Date: 08 April 2015

Report of: Director of Mineral Resources

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1 Purpose

1.1 To seek approval from Executive Council for the Oil Spill Contingency Plan submitted by Noble Energy

2 Recommendation

2.1 Honourable Members are advised to approve Noble Energy's Oil Spill Contingency Plan, Rev 05, together with its accompanying Appendix A covering the Humpback-1 well, Rev 02.

Responsible Officer: ***Director of Mineral Resources***
Due date: ***Immediate upon approval***

3 Additional Budgetary Implications

None.

4 Background

4.1 Prior to drilling wells in the Falkland Islands, an oil spill contingency plan (OSCP) is required under additional conditions to licences contained in Schedule 7 of Production Licences awarded under the Offshore Petroleum (Licensing) Regulations 2000. An OSCP must be approved by the Governor in Executive Council prior to commencement of any drilling activities by an operator.

4.2 UK legislation requires operators to submit an equivalent document called an Oil Pollution Emergency Plan (OPEP). FIG does not directly apply the UK legislation that requires an OPEP (the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998), but instead introduces a requirement for oil spill planning as an additional condition in Production Licences. This provision is contained in Schedules 6 and 7 of Production Licences awarded under the Offshore Petroleum (Licensing) Regulations 1995 and 2000 respectively. Each Production

Licence requires "approval of the Governor in writing to an oil spill contingency plan which covers the licensed activity in question". This is a wide ranging requirement and as such, changes in the methodology of assessing oil spill response planning do not require legislative change, and best practice can easily be revised.

4.3 For the avoidance of doubt, the terms Oil Pollution Emergency Plan (OPEP), Oil Spill Contingency Plan (OSCP) and Oil Spill Response Plan (OSRP) are terms used for essentially the same document in different jurisdictions. Current FI requirements refer to an Oil Spill Contingency Plan but it is likely that future legislation will align with the UK OPEP terminology.

4.4 Following the 2010 Gulf of Mexico disaster, a new assessment process has been developed by the UK Department of Energy and Climate Change (DECC) for Oil Pollution Emergency Plans (OPEPs) covering operations in the UK Continental Shelf. The new requirements are outlined in guidelines published by DECC that came into effect on 1 January 2013, entitled "GUIDANCE NOTE TO UK OFFSHORE OIL AND GAS OPERATORS ON THE DEMONSTRATION OF FINANCIAL RESPONSIBILITY BEFORE CONSENT MAY BE GRANTED FOR EXPLORATION & APPRAISAL WELLS ON THE UKCS".

4.5 The new DECC guidelines state that "*For an OPEP to be credible and for DECC to have sufficient assurance that the OPEP will be implemented when required, DECC requires operators to provide sufficient evidence that the risks of the operation have been appropriately estimated and that the financial mechanisms are in place to meet those risks, should they materialise.*" Effectively, this is stating a relatively common sense requirement, namely that a licensee must be resourced to deliver an effective oil spill response either through corporate financial strength, or adequate insurance cover. Without this assurance, there is potentially no means of resourcing the OPEP in which case it is a worthless document. To assist with the preparation of Financial Responsibility statements, the UK oil industry body UK Oil & Gas (formerly the UK Offshore Operators Association or UKOOA) produce a guidance note for their members. Noble have used this set of guidelines to prepare their submissions.

4.6 As a best practice measure, DMR intends to apply the new DECC financial responsibility guidance to the assessment of the oil spill contingency plan that is required from all operators prior to drilling operations commencing. Operators have therefore been instructed to submit oil spill contingency plans and associated documentation in compliance with the DECC guidance and the associated UK Oil & Gas guidelines published in November 2012.

4.7 An OSCP was submitted to the Department of Mineral Resources by Noble Energy on the 13th February 2015. The plan was circulated for comment to the Marine Officer, the Environmental Planning Department, the local representative of the Joint Nature Conservation Committee (JNCC) and Falklands Conservation. The OSCP broadly conforms to UK North Sea guidelines and outlines both applicable procedures and responsibilities and the

supporting data used to formulate the plan, such as oil spill modelling and sensitive area maps.

4.8 In the event of an oil spill, preliminary daylight slick surveillance will be carried out from platform supply vessels, crew change helicopters, and chartered FIGAS aircraft. However, only one FIGAS airframe is suitable for this work, and it is scheduled to undergo 6-week "deep maintenance" in late September/ early October, rendering it unusable for surveillance purposes during that time. In addition, the aircraft will be required to undergo a 2-week corrosion audit in July. In the event that either of these periods coincide with Noble operations, Noble will put in place plans which will involve the mobilisation of oil spill response contractor aircraft and the use of in-country crew change helicopters.

4.9 Under call-out arrangements with Oil Spill Response Limited (OSRL), a specialist oil spill management contractor, dedicated surveillance aircraft with imaging equipment and trained surveillance crew will be on-site in around 72-96 hours. Basic spill surveillance training has already been provided to FIGAS and Bristows pilots.

4.10 Initial chemical dispersant application will be available within 30 minutes from one of the platform supply vessels, while wider area aircraft dispersant spray would be available within 28-96 hours as OSRL resources reach the Falklands. Dispersant use has to be approved by the Marine Officer or Director of Natural Resources and is not necessarily the preferred response option due to the possible environmental impacts of the dispersant itself. Depending on the nature of the oil spilled, natural weathering may be the preferred option for dispersal.

4.11 Initial mechanical containment will be available through booms and "skimmers" deployed from platform support vessels within 12 hours, with further equipment available through OSRL as per the above. Such mechanical recovery equipment requires relatively calm sea states and may prove ineffective in open seas.

4.12 Mobilisation and successful deployment of a well capping device from Brazil could take between 23 and 73 days. Aerial mobilisation is not an option due to lack of suitable dockside facilities and craneage in the Islands.

4.13 In the event of an uncontrolled blowout, and the loss or incapacitation of the primary drilling unit, another rig may have to be mobilised to the Islands to drill a relief well. The drilling of a relief well could take between 123 – 263 days. This is considerably longer than the equivalent time-period for the North Falklands Basin due to the depth of the water; which limits the number of suitable rigs that can be utilised and necessarily extends the time required to drill such a well. Noble have made a detailed assessment of the available relief rigs, their current contractual commitments, expected location, and their estimated mobilisation time. The preference in such a case would be for a semi-submersible rig similar to the Eirik Raude, though a suitable deep water

harsh environment drillship would be an option. Details on both types have been provided.

4.14 The plan contains oil spill modelling in accordance with DECC North Sea guidelines and models spills of diesel and light crude (40° API). The modelling shows the following:

- a total loss of rig diesel inventory (4631m^3) has a 0% chance of beaching from the Humpback-1 well due to natural weathering.

- A surface blowout of 40° API lasting 10 days at 50,071 bbls per day would have a 2% chance of beaching in the March – September period, and a 0% chance in October to February (30-day simulation)

- If that 2% chance were to materialise, it would take a minimum of 12 days for the oil to beach.

- A seabed blowout of 40° API lasting 10 days at 50,071 bbls per day would have a 0% chance of beaching in the March – September period (30-day simulation).

- A surface blowout of 40° API lasting 10 days at 50,071 bbls per day under theoretical worst case meteorological conditions (prolonged 30kt onshore wind from ESE) would beach after 3.2 days.

4.15 The OSCP has been reviewed by the Marine Officer, who did not express any objection to the plan. Comments were also received from the UK Joint Nature Conservation Committee and the Department of Mineral Resources, and subsequently addressed satisfactorily by Noble.

4.16 The OSCP was forwarded to the UK Department of Energy and Climate Change (DECC) for comment at the time of submission to FIG. While no significant objection was posed to the plan, questions were raised regarding its usability as a procedural manual in the event of a spill. In responding to this comment, Noble have provided assurance that the document is indeed structured in a logical order and drawn up in close cooperation with its internal emergency response teams that would allow the document to serve as an appropriate response plan.

4.17 In contrast to their recent review of Premier Oil's submission, DECC declined to comment on Financial Responsibility documents submitted by Noble (documents which are considered a key aspect of oil spill contingency in the North Sea) on the basis that they do not have sufficient knowledge of the area to accurately gauge the potential financial ramifications of a spill. DMR has therefore reviewed the submission internally along with FIG's internal auditor and input from Anne Drinkwater, FIG's specialist oil and gas advisor. The information supplied by Noble in its FR statement was assessed against the UK Oil & Gas Guidelines, and due diligence was carried out on the insurers identified. Noble responded with further information to address questions from

DMR and the Treasury and it is considered that the provision in place is satisfactory and appropriate.

4.18 In contrast with Premier's approach (which was to choose to demonstrate financial responsibility for the entire joint venture (JV), and recover the cost of doing so commercially from its partners) Noble chose to require each member of their JV to demonstrate FR for its percentage working interest (WI) in the licence. Production Licence PL012, in which the Humpback-1 well will be drilled, is held by three JV partners: Noble Energy Falklands Ltd (operator) with 35% WI, Edison International sPa with 12.5% WI, and Falkland Oil & Gas Ltd with 52.5% WI.

4.19 Noble have applied the UK Oil & Gas guidelines to assess the likely cost of both drilling a relief well to control a blowout, and the cost of remediation and cleanup. A summary is attached to this paper as Appendix 1. It should be noted for the avoidance of doubt that the large number of uncertainties around a potential pollution incident (type of oil, dispersion, rate of discharge, volume of oil spilled etc) it is difficult to place any exact value upon remediation costs, and the UKO&G assessment guidelines are therefore designed to result in a generic risk assessment that reflects this.

4.20 Noble's assessment is that direct well intervention and control of a blowout event could cost $310m, and that remediation costs are assessed as falling into UK Oil & Gas Band 2 which requires coverage of OPOL + $125m. OPOL cover is set at $250m, which therefore means that the level of cover for remediation is set at $375m. The total financial responsibility assessment made is therefore that FR needs to be demonstrated for $685m. Co-venturers must therefore demonstrate that, as a minimum, they have in place sufficient resource to meet their licence % share of this amount. Financial responsibility can be demonstrated by corporate financial strength of the operator, by insurance cover, or by a parent company undertaking.

4.21 All three co-venturers have chosen in this case to demonstrate financial responsibility through insurance cover and have submitted the appropriate certificates and documentation to evidence this which has been reviewed by DMR and Treasury internal audit. Noble have done so through cover from Oil Insurance Ltd, a Bermuda based industry mutual insurance company that insures over US$2 trillion worth of global assets for a number of the oil industry's leading oil and gas companies, while Edison have a similar arrangement via their captive insurance company Wagram, which is owned by Edison's parent company EDF but also derives coverage from OIL. Falkland Oil & Gas Ltd have provided insurance certification from Lockton, the world's largest privately owned insurance brokerage firm. The total insurance cover in place very substantially exceeds the total of the FR calculation, and further details are provided in Appendix 1. DMR is therefore satisfied that an appropriately robust arrangement exists to support liabilities that could be generated in any pollution incident that would fall within the remit of the Noble Oil Spill Contingency Plan.

4.22 It is worthy of note that the new assessment process now being used has resulted in significantly greater financial resource being put in place to support drilling in the 2015 campaign than existed in the 2012 campaign.

4.23 As per the attached letter, serious concerns were expressed by Falklands Conservation regarding the OSRP. While there was no objection to the wider approach, which will mirror that implemented by Premier, Falklands Conservation felt there was a lack of detail regarding any locally-led oiled wildlife response, particularly the roles and responsibilities involved in co-ordinating such an operation and the interface with any international spill organisation prior to and following their mobilisation.

4.24 In conjunction with Premier Oil, Noble Energy arranged for an oiled wildlife specialist organisation to deliver training sessions for local responders and Falklands Conservation in February - March, as per the agreed joint oiled wildlife response approach. As part of that response strategy, both operators are currently working jointly with a local response provider and have committed to submitting a document outlining the detail required by Falklands Conservation once negotiations and relevant plans are complete. At the time of writing, both Premier Oil and Noble Energy were awaiting input from the organisation that delivered the training before finalising a document outlining the detail of the local response, but it is expected that verbal confirmation will be given at the meeting that this detail has indeed been provided. Falklands Conservation have further expressed concern that this detail was not provided in the original plan, but drawn-out negotiations and the late adoption of the current wildlife response approach have made this an unavoidable situation.

4.25 Given the commitments made by both Premier Oil and Noble Energy to fund the FIG's oiled wildlife facility on a retainer basis, and the efforts to build local response capacity, the Department considers that sufficient overarching oiled wildlife contingency has been taken to recommend approval of the plan. Oiled wildlife response will, however, form a subject for discussion post-drilling and operators will be invited to review the issue in depth prior to future drilling activity. The final version of the Oil Spill Contingency Plan was Rev 05, submitted on 20 March 2015, and this is the version attached to this paper for approval.

4.26 It is considered that the issues raised by consultees through this process have been satisfactorily addressed, and that Noble have submitted a satisfactory Oil Spill Contingency Plan and demonstrated that all partners have the ability to deliver it with appropriate financial backing. Furthermore, it is considered that the standard achieved for the final commitment, based as it is on the new guidelines, offers substantially improved environmental protection in comparison to previous submissions.

4.27 It is therefore recommended that Honourable Members approve the Oil Spill Contingency Plan submitted by Premier Oil.

4.28 This matter was considered at the Mineral Resources Committee on 17 March 2015 and approved by that committee for submission to Executive Council.

5 Financial Implications

5.1 None for the purposes of this paper.

6 Legal Implications

6.1 <REDACTED>

6.2 <REDACTED>

6.3 <REDACTED>

6.4 <REDACTED>

6.5 <REDACTED>

6.6 <REDACTED>

6.7 <REDACTED>

7 Human Resources Implications

7.1 None.

Appendices:

Appendix 1:

Summary review of Noble Energy FR submission
(COMMERCIALLY CONFIDENTIAL – NOT FOR PUBLICATION)

Appendix 2:

Noble Energy Oil Spill Contingency Plan Rev 05 **(redacted for publication – sensitive contact details removed)**

Appendix 3:

Noble Energy Oil Spill Contingency Plan Appendix A – Humpback-1 Well Rev 02

Appendix 4:

Letter from Falklands Conservation dated 05 March 2015

Noble Energy Falklands Limited

Oil Spill Response Plan (OSRP) for Exploration Drilling Offshore the Falkland Islands

Date: *March 2015*

Revision: *05*

Noble Energy Falklands Limited

Oil Spill Response Plan (OSRP) for Exploration Drilling Offshore the Falkland Islands

IN THE EVENT OF A SPILL
GO STRAIGHT TO PART I - SECTIONS 3.0 and 4.0:
RESPONSE PROCEDURES

DATE	VERSION	DESCRIPTION	PREPARED	CHECKED	APPROVED
02.10.14	Rev 00	Initial draft for review	SJS	TJE	JP
22.10.14	Rev 01	Draft 1	SJS	TJE	
15.12.14	Rev 02	Draft 2	SJS	TJE	
13.02.15	Rev 03	Final	SJS	TJE	
10.03.15	Rev 04	Final – FIG comments addressed	SJS	AP / SS	
16.03.15	Rev 05	Final – Further comments addressed	SJS	AP / SS	
File Reference: P:\RPS (RBA) USA\EHE4212 - RPS Noble Oil Spill Response Plan\03_Deliverables					

noble energy NOBLE ENERGY DOCUMENT CONTROL			
DATE	**VERSION**	**DOCUMENT OWNER**	**DOCUMENT APPROVER**
Document Number: 009-15-EHSR-OSR-PA-T3			

Prepared by: Steve Saunders

March 2015

RPS Energy
HSE and Risk Management
1st Floor
14 Cornhill
London
EC3V 3ND

Tel +44 (0)207 280 3200
Fax +44 (0)207 283 9248
Email saunderss@rpsgroup.com

RPS Energy

Controlled Copy Holders

Copy Number	Company	Position	Location
1	Falkland Islands Government - Department of Mineral Resources	Director of Mineral Resources	Stanley, Falkland Islands
2	Falkland Islands Department of Natural Resources – Fisheries Department	Duty Marine Officer	Stanley, Falkland Islands
3	Noble Energy Falklands Limited	Incident Management Team Incident Commander	Stanley, Falkland Islands
4	Noble Energy Falklands Limited	Incident Management Team EHS Advisor	Stanley, Falkland Islands
5	Noble Energy Falklands Limited	Drilling Superintendent	Stanley, Falkland Islands
6	Noble Energy Inc.	Corporate Support Team Director	Houston, Texas
7	Noble Energy Inc.	Crisis Management Team	Houston, Texas
8	Ocean Rig	Rig Manager	Stanley, Falkland Islands
9	Ocean Rig	Rig Manager	Stanley, Falkland Islands
10	Ocean Rig	Duty Manager – Incident Support Team	Athens, Greece
11	Ocean Rig	Offshore Installation Manager	Offshore, Falkland Islands
12	Noble Energy Falklands Limited	Senior Drilling Supervisor	Offshore, Falkland Islands
13	SSV / OSV 1	Vessel Master	Offshore, Falkland Islands
14	SSV / OSV 2	Vessel Master	Offshore, Falkland Islands
15	SSV / OSV 3	Vessel Master	Offshore, Falkland Islands
16	Oil Spill Response Limited (OSRL)	Operations Room	Southampton, UK
17	National Response Corporation (NRC)	Operations Room	New York, USA

Abbreviations

API	American Petroleum Institute
BAOAC	Bonn Agreement Oil Appearance Code
BOP	Blow Out Preventer
CMT	Crisis Management Team
CST	Corporate Support Team
DECC	Department of Energy and Climate Change (UK Agency)
EHS	Environment, Health and Safety
EMP	Emergency Management Plan
FIG	Falkland Islands Government
FIGAS	Falkland Islands Government Air Service
GOR	Gas:Oil Ratio
HSE	Health and Safety Executive
ICT	Incident Command Team (FIG)
IMT	Incident Management Team (NEFL)
IST	Incident Support Team (Drilling Contractor)
ITOPF	International Tanker Owners Pollution Federation
MCA	Maritime & Coastguard Agency (UK Agency)
MMO	Marine Management Organisation (UK Agency)
MODU	Mobile Offshore Drilling Unit
mPa	Millipascals (viscosity)
MS-ML	Marine Scotland – Marine Laboratory (UK Agency)
NEFL	Noble Energy Falklands Limited
NOSCP	National Oil Spill Contingency Plan
NRC	National Response Corporation
OGUK	Oil and Gas UK (formally UKOOA)
OIM	Offshore Installation Manager
OSRP	Oil Spill Response Plan
OSRL	Oil Spill Response Limited
PWD	Public Works Department (of FIG)
SOPEP	Ship Board Oil Pollution Emergency Plan
SLAR	Side Looking Airborne Radar
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
VHF	Very High Frequency
WBM	Water Based Mud

Table of Contents

1 Introduction

1.1 Purpose & Scope

This Oil Spill Response Plan (OSRP) provides guidance on the actions and reporting requirements in the event of an unintentional release of hydrocarbons originating from Noble Energy Falklands Limited (hereafter referred to as 'NEFL') drilling activities offshore the Falkland Islands in the NEFL license areas (Figure 1.1).

The plan will guide the various onshore and offshore personnel through the actions and decisions which will be required in the event of an oil spill.

It is stressed that despite the guidance given, the priority in the event of a spill is to take measures to ensure the safety of personnel and the installation, and to prevent escalation of the incident.

Where an oil spillage is part of an emergency situation, such as a well control incident, fire or explosion, the emergency aspects of the incident must be addressed as a priority and reference shall be made to the NEFL Emergency Management Plan (EMP) and relevant contractor bridging/interface documents, which include a detailed description of the emergency response arrangements between NEFL and its contractors.

This OSRP is presented in three Parts:

- Part I – Response Procedures;
- Part II – Supporting Information;
- Part III – Project Specific Appendices.

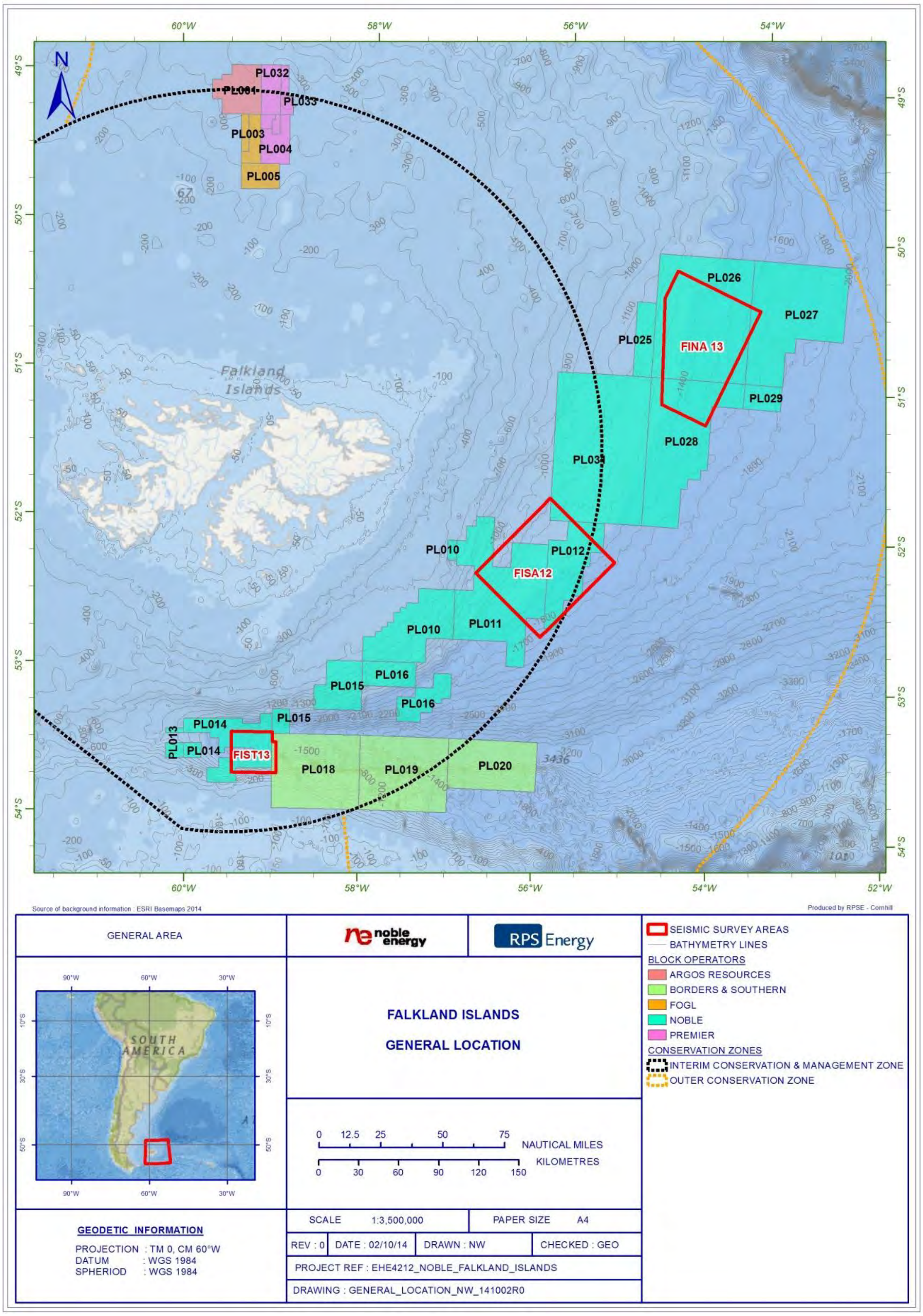
The project specific Appendices contain information for active project locations, including:

- Details of the proposed drilling programmes;
- Oil Spill Modelling;
- Basic relief well planning details; and
- Environmental sensitivities.

Future exploration and appraisal wells/campaigns will be appended to this OSRP as and when appropriate.

This OSRP provides guidance on oil spill response. However, as every incident will be unique, flexibility and an understanding of the available resources and their limitations is required. The response required for each event will be determined by the exact nature of the spill, as well as the circumstances and environmental conditions prevailing at that time.

Figure 1.1: NEFL licenses and previously surveyed areas

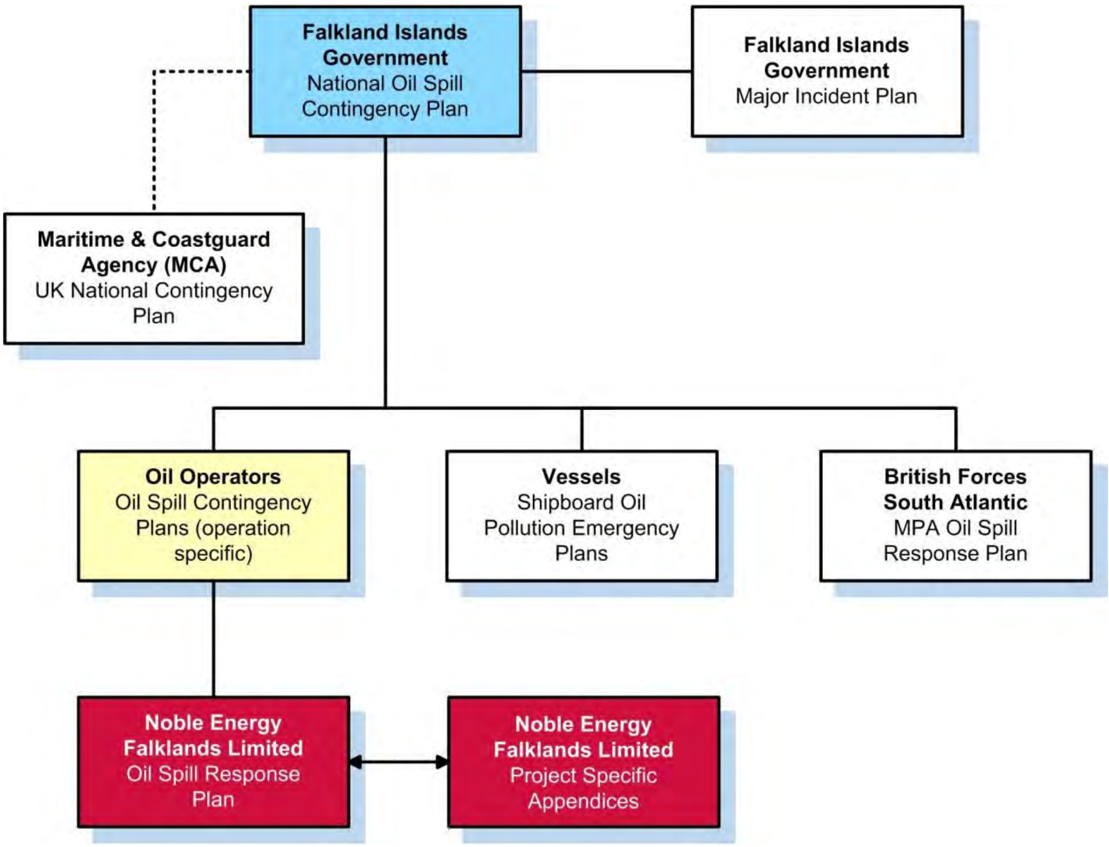


1.2 Interface with Falklands NOSCP

This OSRP interfaces with the Falkland Islands Government (FIG) National Oil Spill Contingency Plan (NOSCP). The way in which the OSRP interfaces with the NOSCP is shown in Figure 1.2 below.

Further information on the NOSCP is provided in **Part II, Section 4.1.6**.

Figure 1.2: Interface with Falkland Islands NOSCP and NEFL OSRP (adapted from Falkland Islands NOSCP)



1.3 Noble Energy Inc. Global Environmental, Health & Safety Management System

Noble Energy Inc. (NEI) operates under a Global Environmental, Health and Safety (EHS) Management System (GMS). NEI is committed to conducting its business in a manner that protects the environment, health and safety of employees and communities. To achieve this, NEI strives to comply with EHS laws and minimise injuries and incidents whilst protecting the environment. An outline of the NEI GMS elements can be found below in Figure 1.3.

Figure 1.3: Noble Energy Inc. Global Environmental, Health & Safety Management System Elements

PART I

RESPONSE PROCEDURES

Recommended response procedures and actions in the event of an unintentional release of hydrocarbons originating from the NEFL exploration drilling operations.

2. ROLES AND RESPONSIBILITIES OF INTERESTED PARTIES
3. OFFSHORE RESPONSE PROCEDURES
4. ONSHORE RESPONSE PROCEDURES
5. COMMUNICATIONS INTERFACE SUMMARY
6. SELECTING A RESPONSE STRATEGY
7. RESPONSE FORMS
8. CONTACTS DIRECTORY

2 Roles & Responsibilities of Interested Parties

2.1 Noble Energy Falklands Limited

NEFL recognises that as the operator and Licence/concession owner, it has primary operational and financial responsibility for any oil spill during the course of its operations.

NEFL is responsible for:

- Developing and maintaining this OSRP;
- Maintaining membership with Tier 2 or 3 contractors;
- Establishing a contractual relationship with NRC to support Tier 2 or 3 spill response;
- Managing the spill response in the event of a spill;
- Liaising with statutory bodies in the event of a spill;
- Training in response procedures.

In-country, NEFL will control the **Incident Management Team (IMT)** based at the NEFL offices in Stanley (refer to **Part I, Section 4.1.1**).

The IMT will provide primary onshore support and the first point of onshore contact, for any offshore oil spill incident. **The IMT has primacy in overall spill response**.

The IMT may be supported by the NEI **Corporate Support Team (CST)** based at the NEI corporate HQ in Houston, Texas (refer to **Part I, Section 4.1.3**). The CST will be mobilised where a pollution incident is of significant severity to warrant corporate and media support.

The IMT may also be supported by the NEI **Crisis Management Team (CMT)** based at corporate HQ in Houston, Texas (refer to **Part I, Section 4.1.4**). The role of the CMT is to provide the wider corporate business overview of the incident.

2.2 The Drilling Contractor

NEFL's drilling contractor in the Falkland Islands is Ocean Rig, based in Athens, Greece. The drilling contractor will be responsible for initial notifications and coordinating the onsite response to an oil spill from the MODU.

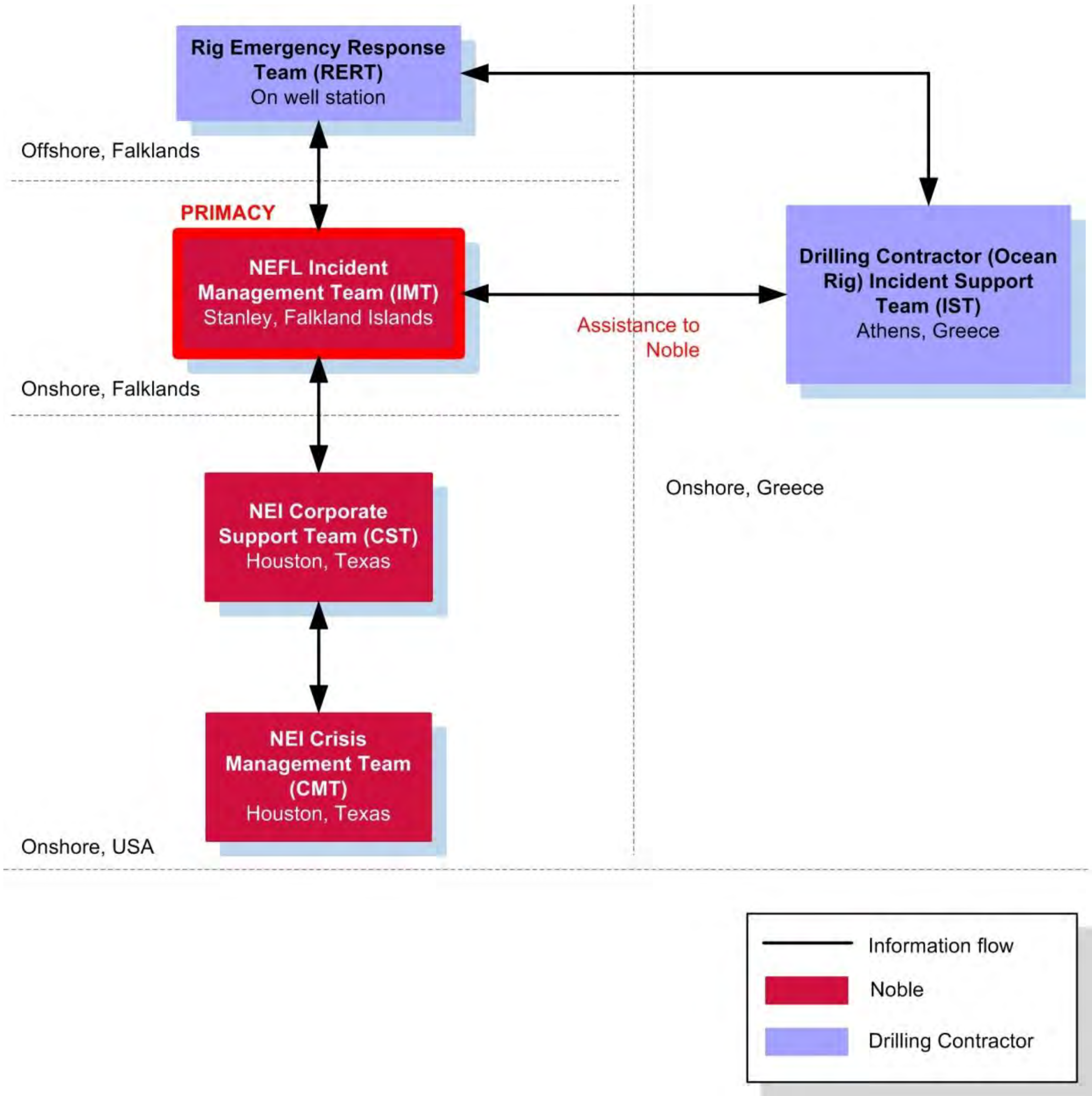
The drilling contractor will support the IMT in oil spill response. The drilling contractor will also co-ordinate the offshore emergency and spill response operations. The Offshore Installation Manager (OIM) will respond, dependent on the nature of the emergency, by following the procedures described in **Part I, Section 3.0**. The OIM and the offshore personnel on site make up the **Rig Emergency Response Team (RERT)**.

The drilling contractor may also mobilise the drilling contractor's **Incident Support Team (IST)** based at the Ocean Rig offices in Athens, Greece (refer to **Part I, Section 4.1.2**).

As the installation owner and duty holder, Ocean Rig is ultimately responsible for the safe conduct of all operations on board the *Eirik Raude* and inside the 500 metre safety zone.

Figure 2.1 shows a summary of the response teams.

Figure 2.1: Response teams summary diagram



3 Offshore Response Procedures

This Section is a guide to specific offshore reporting and response actions.

Roles are colour-coded throughout to enable speed of response. The colour codes are defined as follows:

First Person Sighting Oil Spill (Offshore Falklands, either from the rig or on board a vessel)	
Offshore Installation Manager (OIM) (Offshore Falklands)	
NEFL Senior Drilling Supervisor (Offshore Falklands)	

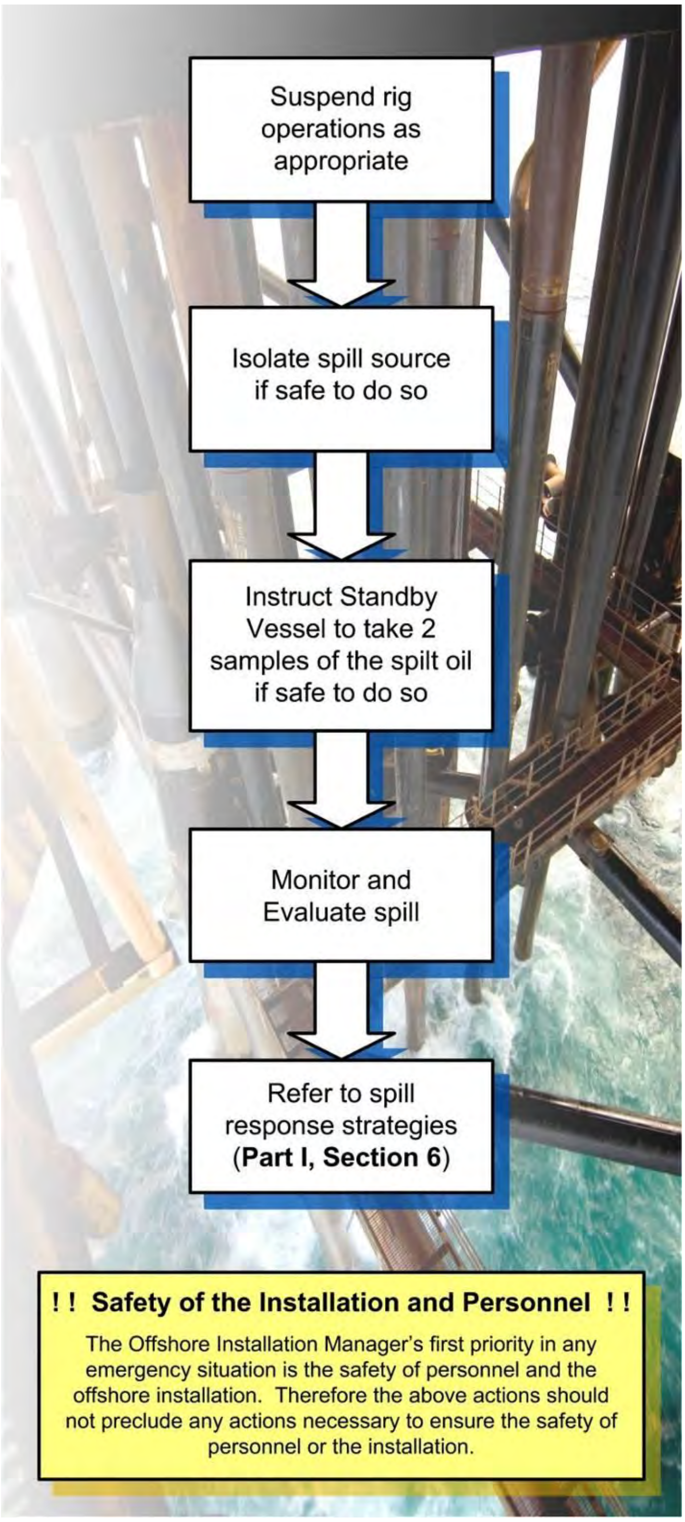
3.1 Rig Emergency Response Team (RERT)

On board the *Eirik Raude*, the OIM, NEFL Senior Drilling Supervisor, and rig emergency response personnel, together make up the Rig Emergency Response Team (RERT). The role of the RERT is to manage the immediate response to an incident on the drilling rig, at the site of the incident.

The RERT will liaise with the IMT (Stanley) and provide information on the nature, status and response to an incident. The IMT (Stanley) will provide any required advice, support and coordination on behalf of the RERT.

The initial offshore response on board the *Eirik Raude* is managed by the OIM. The chain of initial offshore spill response actions and notifications is illustrated in Figure 3.1.

Figure 3.1: Initial offshore response actions and notifications on board the drilling rig



3.2 Reporting Requirements

3.2.1 Spill Reporting from the Rig

NEFL shall remain accountable for Tier 1 spills, however, the OIM will retain immediate command control within the 500 metre zone. The OIM shall take immediate actions to prevent further spillage (if possible) and to ensure the safety of the rig and personnel.

NEFL will have primacy for Tier 2 or 3 response. However, for incidents within the 500 metre zone, in the short term the OIM shall take immediate actions to prevent further spillage (if possible) and to ensure the safety of the rig and personnel.

The first person sighting the spill will report the spill incident to the Offshore Installation Manager (OIM). The OIM will then notify the drilling contractor's onshore Rig Manager that there has been an oil spill incident. At the same time the NEFL Senior Drilling Supervisor will notify the NEFL Drilling Superintendent (who is located onshore, Stanley).

These are the initial notifications that will be made from the installation in the event of an oil spill emergency within the 500 metre safety zone.

3.2.2 Spill Reporting from an Offshore Vessel

Vessel spills beyond the 500 metre zone from NEFL contracted vessels still need to be reported to FIG as soon as practicable, using form PON8 (refer to **PART I, Section 7.1**), and may also need an appropriate response from NEFL. Vessel spills will also be managed by the vessel owner, according to their Shipboard Oil Pollution Emergency Plan (SOPEP).

If a spill is from a vessel offshore, the vessel master should report the spill to the onshore Drilling Superintendent as soon as possible, to ensure the appropriate reporting procedures can be followed.

3.3 Actions and Notifications

Key actions and notifications for offshore personnel, namely, the oil spill observer (the first person to see the spill), the Offshore Installation Manager (OIM), the NEFL Senior Drilling Supervisor and the NEFL Drilling Superintendent (onshore, although included here for completeness), are summarised in Checklists 3.1 to 3.4, respectively.

All spills must be reported to the relevant authorities. Formal notification requirements are also listed in the below checklists as relevant to each role.

Checklist 3.1: Oil spill observer offshore (first person to see the spill) – Actions & Notifications

	Oil Spill Observer Actions below should be completed by the first person to see the spill
	INITIAL ACTIONS
❐	In the event of a spill being observed, the relevant Competent Person for the site should be notified: • On board the drilling rig, this will be the OIM. • On board a vessel offshore, this will be the ships master. Ensure that the ships master reports the incident to the Drilling Superintendent.
❐	Notify the Competent Person and provide details of: • Time; • Possible source of spill; • Current spill location; • Oil type; • Estimation of quantity of oil spilled; and • Any other relevant actions.
❐	Contact all personnel in the vicinity of the leak or spill and warn of the potential hazard.
❐	Act as instructed by the Competent Person.
	ONGOING ACTIONS
❐	**If safe to do so**, stay in vicinity of the leak or spill and continue observation.
❐	**If safe to do so,** take any reasonable action to contain or reduce the leak or spill.

Checklist 3.2: OIM – Actions & Notifications

Offshore Installation Manager Completion of the actions below are the responsibility of the OIM, either for completion by the OIM or delegation	
INITIAL ACTIONS	
❐	Receive report on spill from Oil Spill Observer and take charge of the situation.
❐	If safe to do so, immediately initiate actions to identify source and stop leakage at source.
❐	Maintain the safety of: • Personnel; • The installation and; • Any vessel within 500 metres of the installation.
❐	Initiate a chronological log of events and actions taken - maintain this log until stand down.
❐	Inform the NEFL Senior Drilling Supervisor and jointly assess the situation and the required resources and onshore support to tackle the spill.
❐	Inform the drilling contractor's Onshore Rig Manager.
❐	Inform the Safety Stand-by Vessel (SSV) that there has been an oil spill incident.
❐	Make contact with the Incident Management Team (IMT) once mobilised.
ONGOING ACTIONS	
❐	Confirm source and estimate the quantity of oil spilled if possible (refer to Oil Spill Assessment Checklist in **Part I, Section 7.5**).
❐	Instruct the SSV to monitor the slick: determine the oil slick size and its movement (refer to **Part II, Section 13.2.3**).
❐	Instruct the SSV to track the spill and take two samples of the spilled oil if safe to do so.
❐	In the event that the spill poses a threat to the safety of the personnel or installation, utilize vessel based dispersants (as needed) to reduce hazard. If dispersant has been used in this way, both the Department of Natural Resources (Fisheries) and the Department of Mineral Resources must be notified afterwards, via the IMT.
❐	Assess the ongoing nature of the spill and the need to mobilise Tier 2 or 3 resources. Maintain close contact with the NEFL Senior Drilling Supervisor and the Rig Manager in making this assessment.
❐	Refer to the incident briefing checklist in **Part I, Section 7.6**, which will assist with briefing meetings.
❐	In the event of a Tier 1 spill, unless there are compelling reasons to do otherwise, the spill will be monitored by the SSV and allowed to disperse naturally. In the event of a Tier 2 or 3 spill, consult with the IMT to determine a response strategy (refer to **Part I, Section 6.0**).
❐	Ensure other vessels in the vicinity have been informed of the oil spill.
CLOSE-OUT ACTIONS	
❐	At the end of the incident, stand down response and prepare a report of the incident for the drilling contractor.
SUMMARY OF NOTIFICATION RESPONSIBILITES	
❐	NEFL Senior Drilling Supervisor (for Regulatory Reporting)
❐	Onshore Rig Manager
❐	Safety Stand-by Vessel
❐	Incident Management Team (IMT) (if activated)

Checklist 3.3: NEFL Senior Drilling Supervisor – Actions & Notifications

	NEFL Senior Drilling Supervisor Completion of the actions below are the responsibility of the NEFL Senior Drilling Supervisor
	INITIAL ACTIONS
❒	On being notified of an incident by the OIM, contact the NEFL Drilling Superintendent and provide initial details of the spill and actions taken.
❒	If spill is controlled (minor), complete the regulatory notification process and stand-by. If spill source is not controlled (moderate / major) activate the NEFL Incident Management Team (IMT).
❒	Assist the OIM in all tasks related to offshore response to the spill as required.
	ONGOING ACTIONS
❒	Maintain contact with the NEFL Drilling Superintendent and IMT Incident Commander once the IMT has been mobilised.
❒	Keep a chronological log of events.
❒	Provide regular written (hourly) updates to the IMT on extent of spill, actions taken and any additional equipment/resource requirements.
❒	In the event of a Tier 1 spill, unless there are compelling reasons to do otherwise, the spill will be monitored and allowed to disperse naturally. In the event of a Tier 2 or 3 spill, consult with the IMT to determine a response strategy (refer to **Part I, Section 6.0**).
❒	In the event that on site resources are not able to adequately respond to the existing spill, or if the existing spill is likely to escalate, request Tier 2 or 3 assistance from the IMT as appropriate.
❒	Monitor the spilled oil and response operations and advise the IMT when the spill emergency is over.
	CLOSE-OUT ACTIONS
❒	Collect copies of Incident Logs.
❒	Ensure an incident report is prepared for NEFL.
	SUMMARY OF NOTIFICATION RESPONSIBILITIES
❒	NEFL Drilling Superintendent

Checklist 3.4: NEFL Drilling Superintendent

NEFL Drilling Superintendent (Stanley, Falkland Islands) Completion of the actions below are the responsibility of the NEFL Drilling Superintendent	
INITIAL ACTIONS	
❒	On being notified of an incident, contact the NEFL Incident Management Team (IMT) Incident Commander and discuss initial details of spill and action taken. Assess if the IMT should be mobilised.
❒	If the IMT is activated, complete the regulatory notification process to include submission of the PON8, through the IMT (refer to **Part I, Section 7.1**).
❒	Report the spill to the drilling contractor's Onshore Rig Manager, providing details of spill and actions taken. Advise if the drilling contractor's Incident Support Team (IST) should be mobilised.
ONGOING ACTIONS	
❒	Maintain contact with IMT until mobilised. Attend the IMT once mobilised.
❒	Provide regular written (hourly) updates to the Onshore Rig Manager (copied to CST if mobilised) on extent of spill and actions taken.
❒	In the event of a Tier 1 spill, unless there are compelling reasons to do otherwise, the spill will be monitored and allowed to disperse naturally. In the event of a Tier 2 or 3 spill, consult with the IMT to determine a response strategy (refer to **Part I, Section 6.0**).
❒	In the event that on site resources are not able to adequately respond to the existing spill or if the existing spill is likely to escalate, request Tier 2 or 3 assistance from NRC and/or OSRL as appropriate.
❒	Ensure a log keeper is assigned to monitor response operations and keep a chronological log of events and conversations.
CLOSE-OUT ACTIONS	
❒	Advise the Onshore Rig Manager (copy to CST) when spill emergency is over.
❒	Collect copies of Incident Logs and forward to the IMT Incident Commander (copy to CST).
SUMMARY OF NOTIFICATION RESPONSIBILITIES	
❒	Incident Management Team (IMT) Incident Commander
❒	Drilling contractor's onshore Rig Manager
❒	Ensure regulator notifications are completed and PON8 is submitted on all spills (refer to **Part I, Section 7.1**). .

4 Onshore Response Procedures

This Section is a guide to specific onshore reporting and response actions.

4.1 Onshore Response Teams

The response to a major oil spill is managed by designated onshore teams.

Primary responsibility for leading the onshore response to an emergency rests with the NEFL Incident Management Team (IMT).

4.1.1 NEFL Incident Management Team (IMT) (Stanley)

The principal aim of the NEFL Incident Management Team (IMT), located in Stanley, is to manage the oil spill incident and response. The IMT will provide primary onshore support and the first point of onshore contact, for any pollution incident.

NEFL shall remain accountable for Tier 1 spills, however, the OIM will retain immediate command control within the 500 metre zone. The OIM shall take immediate actions to prevent further spillage (if possible) and to ensure the safety of the rig and personnel.

NEFL will have primacy for Tier 2 or 3 response. However as noted above, for incidents within the 500 metre zone, in the short term the OIM shall take immediate actions to prevent further spillage (if possible) and to ensure the safety of the rig and personnel.

The principal members of the IMT are:

- IMT Incident Commander;
- Drilling Superintendent (Source Control Section Chief);
- Drilling contractor's Onshore Rig Manager;
- EHS Advisor (Safety Officer);
- Operations Personnel;
- Oil Spill Technical Advisor (provided by Oil Spill Response Limited (OSRL));
- Log Keeper.

The IMT members will comprise of personnel trained in the principles of oil spill response in order to provide effective management of the pollution incident, and to be competent to mobilise additional resources as required. The principal roles of the IMT are outlined below:

- The IMT will provide any coordination of local assets (internal or external assets as required).
- The IMT will call and liaise with any emergency service or external agencies as required. They will also liaise with industry regulators as required.
- The IMT will liaise with in-country Authorities and Government Departments and contractors and advise them as necessary.
- The IMT will advise the RERT as required, including on any operational, technical, EHS, media or HR matters.
- The IMT will liaise with the Corporate Support in Houston as required and provide information on the nature, status and response to an incident.
- The IMT will manage the local (Falkland Islands) media response in conjunction with the media strategy issued by the CST and CMT (Houston).

4.1.2 Drilling Contractor's Incident Support Team (IST) (Athens, Greece)

The drilling contractor's Incident Support Team (IST), located in Athens, Greece, will provide support to the RERT, IMT and assist the Rig Manager with the co-ordination of the offshore emergency and spill response operations. The principal members of the IST are as follows:

- Duty Manager;
- Chief Operating Officer;
- VP Operations;
- VP HSE;
- Ocean Rig Drilling Manager;
- Human Resources Manager.

The IST is trained to be conversant in the general principles of oil spill response and management in order to provide effective support to the IMT in Stanley.

4.1.3 Noble Energy Inc. Corporate Support Team (CST), Houston, Texas

In the event of a significant oil spill incident, the NEI Corporate Support Team (CST), located in Houston, Texas, may be mobilised after notification from the IMT. This team would be led by the CST Director.

In the event of a Tier 1 spill from NEFL operations, the CST will be notified after the event by the IMT Qualified Individual.

In the event of a Tier 2 or 3 spill from NEFL operations, the CST will be notified as soon as possible by the IMT Qualified Individual. The CST Director will respond to the incident by mobilising the NEI CST based in Houston, Texas, if required.

The role of the CST in oil spill response is to:

- Deal with immediate relative response from families and coordinate family liaison as necessary through the establishment of Relative Response and Family Liaison Teams.
- Provide any coordination of International or Regional assets (internal or external asset) and will also liaise with any international agencies or organizations as required.
- Advise the IMT as required, including on any technical, legal, contractual, insurance and financial matters.
- Manage the international media response under the supervision of the CMT.
- Provide stakeholder liaison at the strategic (corporate) level and provide advice on stakeholder liaison at the local level to the IMT.

The CST will function from the NEI. Corporate HQ in Houston, Texas and will maintain contact with the IMT. The CST can deploy personnel from Houston to augment the IMT in Stanley if required.

4.1.4 Noble Energy Inc. Crisis Management Team (CMT), Houston, Texas

The role of the NEI Crisis Management Team (CMT) is to manage NEI's corporate response to the incident. The CMT is led by the CMT Director. The CMT is mobilised by the CST if they feel that the significance of the pollution incident warrants mobilisation.

The primary focus of the CMT is to maintain the integrity of the company as a whole and to preserve the company's reputation. The CMT will monitor the situation and provide support to the incident response, as needed. The CMT will:

It is **NOT** the role of the CMT to provide assistance at the scene of the incident or duplicate the work of either the CST or the IMT. The CMT will function from the NEI. Corporate HQ in Houston, Texas.

4.1.5 Tier 2 or 3 Oil Spill Response Contractors

It is the responsibility of the IMT Qualified Individual to initiate the call to the Tier 2 or 3 Oil Spill Response contractors (NRC and/or OSRL), if deemed necessary. This would most likely happen in the event of a Tier 2 or 3 incident.

If mobilised, the Tier 2 or 3 spill response contractor teams will be primarily operating in the field, and will establish a command centre appropriate to the needs of the response operations. A Technical Advisor from OSRL will also be available to assist the IMT with ongoing operations.

4.1.6 FIG Incident Command & the National Oil Spill Contingency Plan

In accordance with the Falkland Islands National Oil Spill Contingency Plan (NOSCP), the Fisheries Department Marine Officer (taking the role of Incident Commander) may monitor the operator's management of oil spill incidents. Upon notification from the Department of Natural Resources (Fisheries), the Fisheries Department Marine Officer will decide whether to activate all or part of the Incident Command structure and Incident Command Team (ICT) (Figure 4.1). Representatives from NEFL may need to be part of this team. It should be noted that mobilisation of the ICT is at the discretion and judgement of the duty Marine Officer. The ICT is most likely to be activated for pollution incidents of national significance.

In the event of a Tier 2 or 3 spill, the full FIG Incident Command structure and ICT may be activated. For the Marine Officer, this would be based at Fishops. However, the ICT may also be mobilised to the Silver Command centre at the Falkland Islands Defence Force Head Quarters (FIDF HQ), as appropriate to the incident.

Once the ICT is activated, its function is to manage the spill response process with the Responsible Party (operator), monitor the operator's plans for control and prevention of pollution and to provide a forum for discussion of response planning, environmental impacts and the interests of other key parties, States and organisations, which may be affected by the incident. Both the operator and drilling contractor should provide full cooperation and compliance with the ICT directions and to assign full time representatives to attend the Incident Command Centre.

The full incident command structure is detailed in Figure 4.1. The principal roles and responsibilities within the ICT are summarised in Table 4.1. It is the responsibility of the Incident Commander to ensure all positions are suitably filled commensurate to the scale of the incident.

Figure 4.1: FIG Incident Command Team (ICT) (Falkland Islands NOSCP)

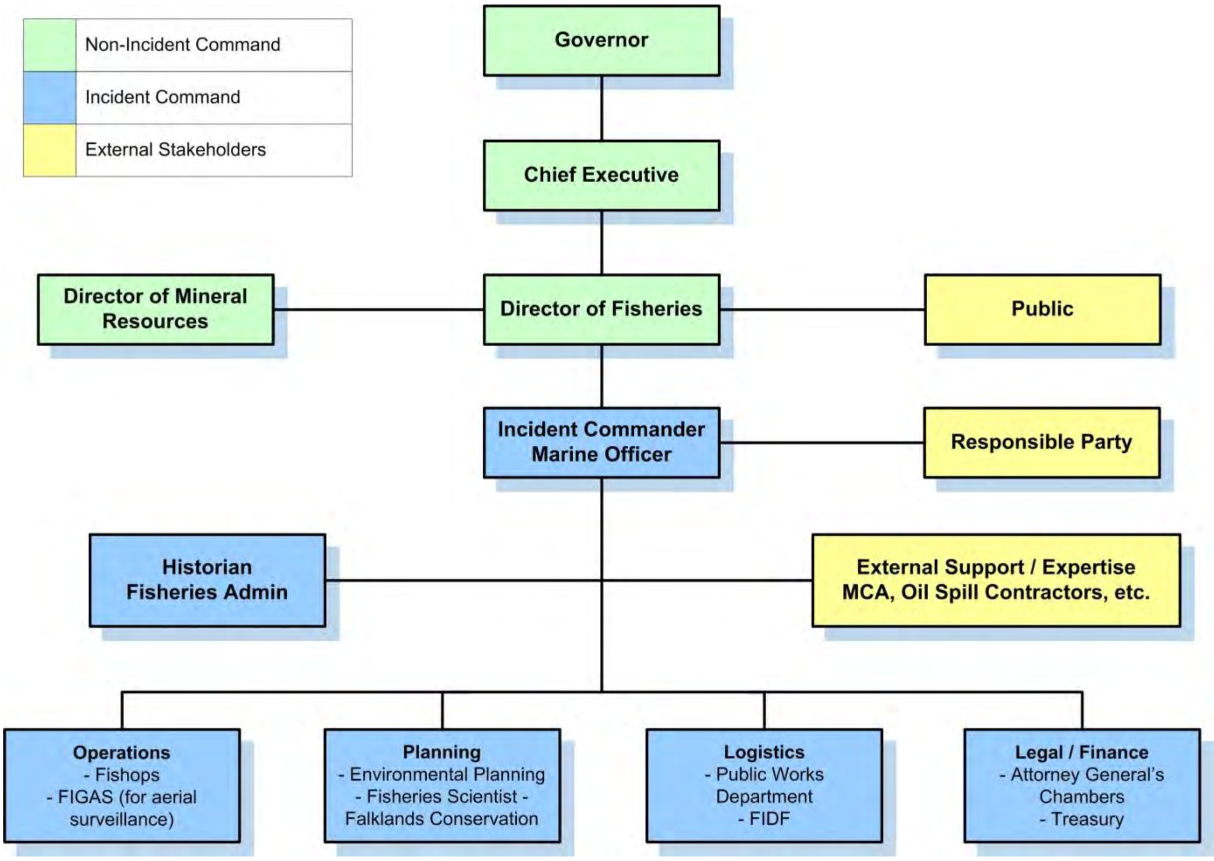


Table 4.1: Summaries of ICT roles and responsibilities (Falkland Islands NOSCP)

Roles	Responsibilities
Incident Commander	Assume overall responsibility for the spill response management. Report to the director of Natural Resources.
Legal / Finance	Ensure all legal issues are addressed. Record all costs incurred and ensure compensation/ cost recovery issues are addressed.
Operations	Implement/manage response operations. Ensure safe and effective mobilisation and deployment of field equipment and manpower.
Logistics	Provide logistical support to operations. Assess required logistical support for external agencies that may be mobilised and ensure support is provided.
Planning	Formulate response strategies. Advise on environmental/socio-economic sensitivities.
Historian	Coordinate the flow of information between functions within the incident command. Log all action points and information discussed in briefings. Ensure status boards are kept up to date.

4.2 Statutory Reporting Requirements

According to FIG PON 8 requirements, all spills must be reported to the Falkland Islands Government (FIG) Department of Natural Resources (Fisheries) and Department of Mineral Resources immediately. The first notification should be made by the Country Manager / IMT to both Departments by telephone, giving brief details of the incident.

Note that outside of office hours, the Fishops and Royal Falkland Islands Police contact numbers will double up as emergency out of hours contacts. Therefore, out of hours, these organisations should be contacted.

The Petroleum Operations Notice (PON) 8 Form (refer to **Part I, Section 7.1**) should then be filled in and sent to both the Department of Natural Resources (Fisheries) and the Department of Mineral Resources for all spills, regardless of volume. Submission of the PON 8 Form should not delayed; If certain information is lacking, this can be provided in an updated submission at a later time. Instructions for sending the PON8 form are included in **Section 7.1**.

Following the initial notification to these authorities, all subsequent Government notification will be the responsibility of the Department of Fisheries. Further liaison with these departments will be the responsibility of the NEFL Incident Management Team (IMT).

If chemical dispersant use is considered, permission must be sought from both the **Department of Mineral Resources and Department of Natural Resources (Fisheries)** prior to application. Dispersant may be used immediately, if, in the opinion of the OIM, a spill poses an immediate threat to human health or the safety of an installation. However, if dispersant has been used in this way, both the Department of Mineral Resources and Department of Natural Resources (Fisheries) must be notified afterwards.

In normal circumstances, the IMT must obtain the relevant permission from the authorities to use dispersants. The IMT must report back to the authorities on the use of dispersant after its application. Refer to **Part I, Section 6.3.4** for further information on dispersant use and approval.

4.3 Spill Reporting from Harbour Operations

Spills in inshore waters from NEFL operations or contracted vessels still need to be reported to FIG as soon as practicable, using form PON8 (refer to **Part I, Section 7.1**), and may also need an appropriate response from NEFL.

If a spill is from harbor operations, or from a vessel in inshore waters, the spill should be reported directly to the Drilling Superintendent, who can initiate the appropriate onshore response.

4.4 Roles & Responsibilities

Key actions and notifications for onshore personnel are summarised in Checklists 4.1 to 4.7. Roles are colour-coded to enable speed of response. The colour codes and key personnel are defined as follows:

If applicable: First Person Sighting Oil Spill onshore Falklands, either from a harbour or on board an inshore vessel	(yellow)
NEFL Drilling Superintendent (Stanley)	(blue)
NEFL Incident Management Team (IMT) Incident Commander (Stanley)	(red)
Drilling contractor's Onshore Rig Manager (Stanley)	(green)
NEI Corporate Support Team (CST) Director (Houston)	(cyan)
NEI Crisis Management Team (CMT) Director (Houston)	(magenta)
NEFL EHS Advisor (Stanley)	(orange)

Checklist 3.1: Oil spill observer onshore (first person to see the spill) – Actions & Notifications

	Oil Spill Observer Actions below should be completed by the first person to see the spill
	INITIAL ACTIONS
❒	In the event of a spill being observed, the relevant Competent Person for the site should be notified: • At a harbour location, this will be the Marine Superintendent. Ensure the Marine Superintendent reports the incident to the NEFL Drilling Superintendent, who can then initiate an appropriate response from NEFL if required. • On board a vessel in inshore waters, this will be the ships master. Ensure that the ships master reports the incident to the NEFL Drilling Superintendent, who can then initiate an appropriate response from NEFL if required.
❒	Notify the Competent Person and provide details of: • Time; • Possible source of spill; • Current spill location; • Oil type; • Estimation of quantity of oil spilled; and • Any other relevant actions.
❒	Contact all personnel in the vicinity of the leak or spill and warn of the potential hazard.
❒	Act as instructed by the Competent Person.
	ONGOING ACTIONS
❒	**If safe to do so**, stay in vicinity of the leak or spill and continue observation.
❒	**If safe to do so**, take any reasonable action to contain or reduce the leak or spill.

Checklist 4.2: NEFL Drilling Superintendent

NEFL Drilling Superintendent (Stanley, Falkland Islands) Completion of the actions below are the responsibility of the NEFL Drilling Superintendent	
INITIAL ACTIONS	
❐	On being notified of an incident, contact the NEFL Incident Management Team (IMT) Incident Commander and discuss initial details of spill and action taken. Assess if the IMT should be mobilised.
❐	If the IMT is activated, complete the regulatory notification process to include submission of the PON8, through the IMT (refer to **Part I, Section 7.1**). .
❐	Report the spill to the drilling contractor's Onshore Rig Manager, providing details of spill and actions taken. Advise if the drilling contractor's Incident Support Team (IST) should be mobilised.
ONGOING ACTIONS	
❐	Maintain contact with IMT once mobilised. Attend the IMT once mobilised.
❐	Provide regular written (hourly) updates to the Onshore Rig Manager (copied to CST if mobilised) on extent of spill and actions taken.
❐	In the event of a Tier 1 spill, unless there are compelling reasons to do otherwise, the spill will be monitored and allowed to disperse naturally. In the event of a Tier 2 or 3 spill, consult with the IMT to determine a response strategy (refer to **Part I, Section 6.0**).
❐	In the event that on site resources are not able to adequately respond to the existing spill or if the existing spill is likely to escalate, request Tier 2 or 3 assistance from NRC and/or OSRL as appropriate.
❐	Ensure a log keeper is assigned to monitor response operations and keep a chronological log of events and conversations.
CLOSE-OUT ACTIONS	
❐	Advise the Onshore Rig Manager (copy to CST) when spill emergency is over.
❐	Collect copies of Incident Logs and forward to the IMT Incident Commander (copy to CST).
SUMMARY OF NOTIFICATION RESPONSIBILITIES	
❐	Incident Management Team (IMT) Incident Commander
❐	Drilling contractor's onshore Rig Manager
❐	Ensure regulator notifications are completed and PON8 is submitted on all spills (refer to **Part I, Section 7.1**).

Checklist 4.3: Incident Management Team (IMT) Incident Commander

NEFL Incident Management Team (IMT) Incident Commander (Stanley, Falkland Islands) Completion of the actions below is the responsibility of the Incident Management Team (IMT) Incident Commander. Assistance will be provided by the IMT members.	
INITIAL ACTIONS	
❒	On being notified by the Drilling Superintendent, mobilise the IMT members as appropriate.
❒	Make contact with the drilling contractor's onshore Rig Manager.
❒	Monitor Statutory Reporting requirements (refer to **Part I, Section 4.2**). Ensure the EHS Advisor Informs both the Department of Mineral Resources and Department of Natural Resources (Fisheries) via telephone that there has been an oil spill. Follow up using the PON8 oil spill reporting form in **Part I, Section 7.1**.
❒	Notify the Corporate Support Team (CST) Director in Houston. Advise and update them on the situation.
ONGOING ACTIONS	
❒	Take charge of the situation. Manage and coordinate the efforts of the IMT to manage the incident.
❒	Work closely with the EHS Advisor to determine and execute a response strategy (refer to **Part I, Section 6.0**).
❒	Record all details of the incident and all incoming information, maintaining a chronological log of events and conversations.
❒	Assess the scope and potential of incident to escalate and the probable effects on the project.
❒	Liaise with and update the drilling contractors Incident Support Team (IST) throughout the response. Request assistance from the IST if required.
❒	Ensure that a daily report for the duration of the incident is being sent to both the Department of Mineral Resources and Department of Natural Resources (Fisheries).
❒	Liaise with and update the CST as appropriate throughout the response.
❒	Request mobilisation of additional Tier 2 or 3 resources from NRC and/or OSRL, if required.
❒	Refer to the incident briefing checklist in **Part I, Section 7.6**, which will assist with briefing meetings.
CLOSE-OUT ACTIONS	
❒	Initiate "stand down" only when satisfied that all matters relating to the incident have been dealt with as far as is practicable and that the offshore team no longer require management support.
❒	Request return of all personnel logs, incident reports, communications copies, etc. This may be in the form of a collated report. All original documentation from all working locations must be preserved.
❒	Inform both the Department of Mineral Resources and Department of Natural Resources (Fisheries) of final state of the incident.
❒	Ensure that a comprehensive report of the incident with a chronological log of events, persons notified and all supporting documentation is prepared for subsequent incident investigation and any legal action. Provide a copy of this report to the IST and the CST.
❒	Ensure that a "lessons identified" profile is available quickly so that remedial action and the possible upgrading of procedures can take place.
SUMMARY OF NOTIFICATION RESPONSIBILITES	
❒	Incident Management Team (IMT) members
❒	Drilling contractor's onshore Rig Manager
❒	Drilling contractor's Incident Support Team (IST)
❒	Department of Mineral Resources and Department of Natural Resources (Fisheries).
❒	Corporate Support Team (CST) Director

Checklist 4.4: Drilling contractor's Onshore Rig Manager

	Drilling contractor's Onshore Rig Manager (Stanley, Falkland Islands) Completion of the actions below is the responsibility of the drilling contractor's Onshore Rig Manager
	INITIAL ACTIONS
❒	On being notified by the Offshore Installation Manager (OIM), notify the drilling contractor's Incident Support Team (IST).
❒	Make Contact with the NEFL Drilling Superintendent.
❒	Make contact with the Incident Management Team (IMT) Incident Commander. Attend the IMT once mobilised.
	ONGOING ACTIONS
❒	Provide support to the NEFL IMT as appropriate throughout the response. Manage and coordinate the efforts of the IST to support the IMT throughout the incident.
❒	Maintain contact with the OIM. Liaise with the OIM and provide management and technical support to the offshore response operations as appropriate throughout the incident.
❒	Provide logistical support and communications to the rig and standby vessel.
❒	Record all details of incident and all incoming information and conversations, maintaining a chronological log of events.
❒	Manage family liaison for the drilling contractor and Third Party personnel, via the drilling contractor HR Manager.
	CLOSE-OUT ACTIONS
❒	Request return of all drilling contractor personnel logs, incident reports, communications copies, etc. This may be in the form of a collated report. All original documentation from all working locations must be preserved.
❒	Ensure that a comprehensive report of the incident with a chronological log of events, persons notified and all supporting documentation is prepared for subsequent incident investigation. Provide a copy of the report to the IMT Incident Commander and the CST as appropriate.
❒	Ensure that a "lessons identified" profile is available quickly so that remedial action and the possible upgrading of procedures can take place.
	SUMMARY OF NOTIFICATION RESPONSIBILITIES
❒	Drilling contractor's Incident Support Team (IST).
❒	NEFL Drilling Superintendent.
❒	Incident Management Team (IMT) Incident Commander.

Checklist 4.5: NEI Corporate Support Team (CST) Director

NEI Corporate Support Team (CST) Director (Houston, Texas) Completion of the actions below is the responsibility of the NEI Corporate Support Team (CST) Director. Assistance will be provided by the CST members.	
INITIAL ACTIONS	
❒	On notification from the Incident Management Team (IMT) Incident Commander, mobilise CST members as appropriate.
❒	Appoint a log keeper to record all details of the incident and all incoming information, maintaining a chronological log of events and conversations.
ONGOING ACTIONS	
❒	Manage and coordinate efforts of the CST in supporting the in-country IMT.
❒	Assist the IMT with liaison with statutory bodies as necessary throughout the process of spill response. Provide advice and guidance on stakeholder liaison as necessary.
❒	Coordinate family liaison as necessary: Establish the Relative Response and Family Liaison Teams.
❒	Make contact with the NEI Crisis Management Team and inform them of the incident. Keep them updated throughout the incident as necessary.
❒	Provide coordination of international or regional assets (internal or external assets) and liaise with any international agencies or organizations as required.
❒	Manage any necessary international media response (under supervision of the CMT) and ensure full briefing of the Media Response Team is being achieved.
❒	If necessary provide stakeholder liaison at the strategic (corporate) level.
❒	Refer to the incident briefing checklist in **Part I, Section 7.6**, which will assist with briefing meetings.
CLOSE-OUT ACTIONS	
❒	Initiate "stand down" only when satisfied that all matters relating to the incident have been dealt with as far as is practicable and that the IMT no longer require support.
❒	Request the return of all personnel logs, incident reports, communications copies etc. This may be in the form of a collated report. All original documentation from all working locations must be preserved.
❒	Ensure that a comprehensive report of the incident with chronological log of events, persons notified and all supporting documentation is prepared by the IMT for subsequent incident investigation. Ensure the report is submitted to the CST.
❒	Ensure that a “lessons identified” profile is available quickly so that remedial action and the possible upgrading of procedures can take place.
SUMMARY OF NOTIFICATION RESPONSIBILITES	
❒	Incident Management Team (IMT) Incident Commander.
❒	Crisis Management Team (CMT) Director.

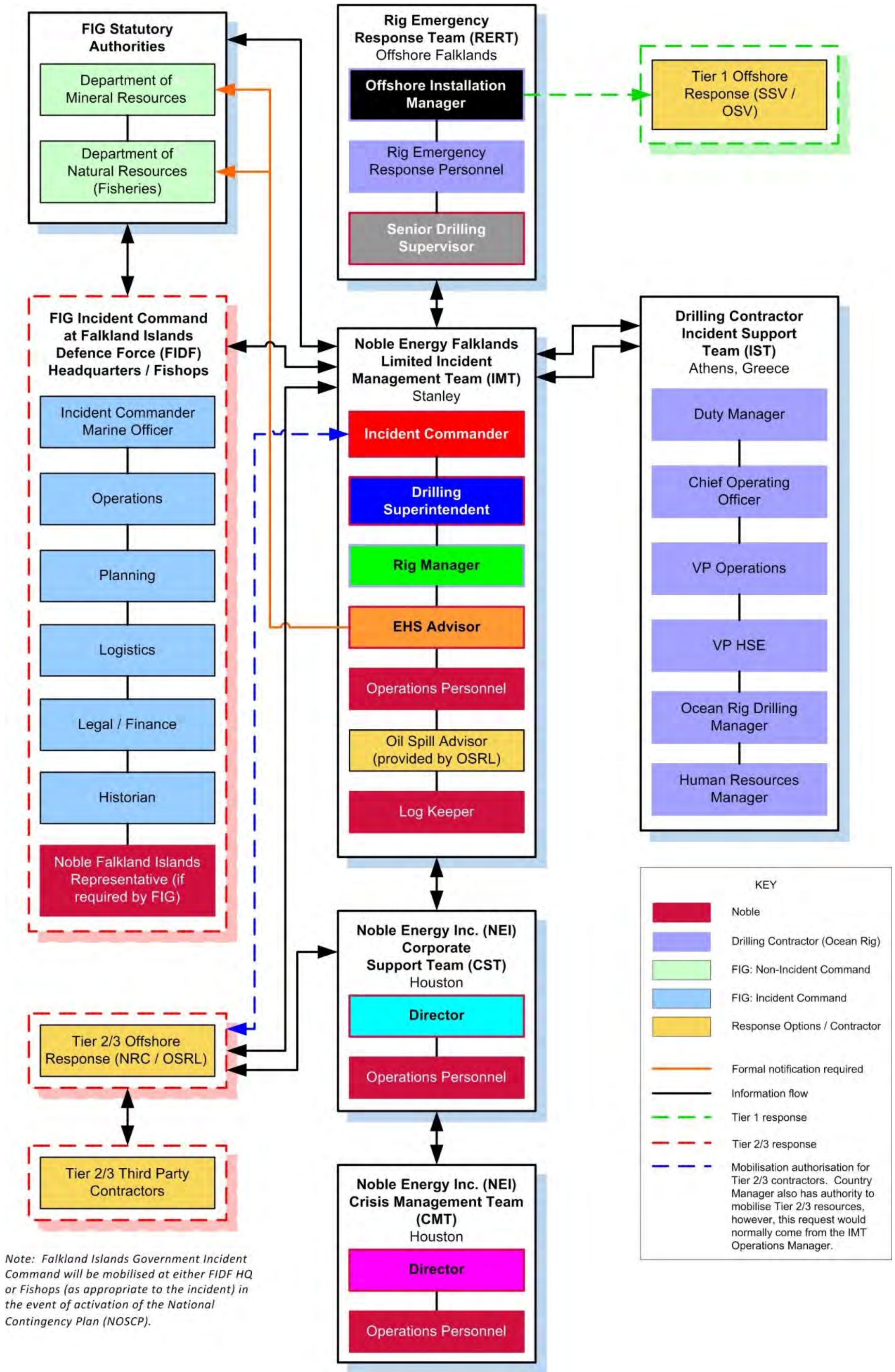
Checklist 4.6: NEI Crisis Management Team (CMT) Director

NEI Crisis Management Team (CMT) Director (Houston, Texas) Completion of the actions below is the responsibility of the NEI Crisis Management Team (CMT) Director. Assistance will be provided by the CMT members.	
INITIAL ACTIONS	
❐	On notification from the Corporate Support Team (CST) Director, mobilise CMT members as appropriate.
❐	Appoint a log keeper to record all details of the incident and all incoming information, maintaining a chronological log of events and conversations.
ONGOING ACTIONS	
❐	Manage and coordinate efforts of the CMT in supporting the NEI CST and in-country IMT.
❐	Assess scope and potential of incident to escalate and the probable effects on the project and company.
❐	Make contact with NEI corporate management and inform them of the incident. Keep them updated throughout the incident as necessary.
❐	Liaise with corporate stakeholders (JV partners, investors and senior agency / government officials) and reduce impact on the business.
❐	Manage any reputational or financial issues that may arise as a result of the incident and mitigate against any reputational or financial risks.
❐	Supervise the communications plan and media response. Provide guidance to the CST on crisis communications and media strategy.
❐	Refer to the incident briefing checklist in **Part I, Section 7.6**, which will assist with briefing meetings.
CLOSE-OUT ACTIONS	
❐	Initiate "stand down" only when satisfied that all matters relating to the incident have been dealt with as far as is practicable and that the IMT and CST no longer require support.
❐	Request the return of all personnel logs, incident reports, communications copies etc. This may be in the form of a collated report. All original documentation from all working locations must be preserved.
❐	Ensure that a comprehensive report of the incident with chronological log of events, persons notified and all supporting documentation is prepared by both the IMT and CMT for subsequent incident investigation.
SUMMARY OF NOTIFICATION RESPONSIBILITES	
❐	Incident Management Team (IMT) Incident Commander.
❐	Corporate Support Team (CST) Director.
❐	NEI corporate management.

Checklist 4.7: NEFL EHS Advisor

	NEFL EHS Advisor (Stanley, Falkland Islands) Completion of the actions below is the responsibility of the NEFL EHS Advisor.
	INITIAL ACTIONS
❐	Record all details of the incident and all incoming information and conversations, maintaining a chronological log of events.
❐	Ensure primary notifications and submission of formal reports, giving full information on location of incident, time, quantity spilled, movement and current status. Record times of notifications. • Inform both the Department of Mineral Resources and Department of Natural Resources (Fisheries) via telephone that there has been an oil spill. Ensure the PON8 oil spill reporting form (**Part I, Section 7.1**) is submitted by the NEFL Drilling Superintendent. • Ensure that a daily report for the duration of the incident is being submitted to both the Department of Mineral Resources and Department of Natural Resources (Fisheries) by the IMT.
❐	Instruct the Safety Stand-by Vessel (SSV) to track the slick. Predict likely movement of the slick (towards environmentally sensitive areas / coastal regions) using OSRL live oil spill modelling services as necessary.
❐	Arrange for photographs and samples to be taken of the slick by the SSV.
❐	In the event of a Tier 1 spill, unless there are compelling reasons to do otherwise, the spill will be monitored by the SSV and allowed to disperse naturally. In the event of a Tier 2 or 3 spill, consult with the IMT Incident Commander and drilling contractor's Incident Support Team (IST) to determine and agree upon a response strategy (refer to **Part I, Section 6.0**).
❐	In the event of a Tier 2 or 3 spill, assist IMT Incident Commander and IST to determine whether aerial surveillance should be mobilised to monitor the spill. In the event of a Tier 2 or 3 spill, aerial surveillance should be carried out immediately and at least twice daily until the oil has completely dispersed.
	ONGOING ACTIONS
❐	Provide assistance to the IMT and IST in determining the long term response strategy (refer to **Part I, Section 6.0**). .
❐	Ensure aerial surveillance has been mobilised if required. In the event of sustained aerial surveillance, the slick must be observed at least twice daily (refer to Aerial Observation Log, **Part I, Section 7.7**). A bird observer may join the surveillance flight if required. In consultation with trained observers, seek advice on the following: • Overall extent of oil slick; • Direction of movement, especially noting other installations and vessels in the vicinity; • Proximity to environmentally sensitive areas; • Areas in need of urgent protection and/or clean-up measures; • Need for additional assistance and back-up services; • Progress and dispersion of slick during operations.
❐	Ensure adequate supervision of all in-field operations is by trained personnel.
	CLOSE-OUT ACTIONS
❐	When instructed by the IMT Incident Commander, commence "stand-down" procedures as follows: • Ensure both the Department of Mineral Resources and Department of Natural Resources (Fisheries) have been informed of final state of clean-up operations; • Ensure all local authorities, contractors, vessels, aircraft, external resource suppliers, etc. are contacted, notified of the end of the incident and stood down; • Remain accessible to support personnel in compiling their reports.
❐	Ensure that a "lessons identified" profile is available quickly so that remedial action and the possible upgrading of procedures can take place.
	SUMMARY OF NOTIFICATION RESPONSIBILITIES
❐	Safety Stand-by Vessel (SSV).
❐	Incident Management Team (IMT) Incident Commander.
❐	Drilling contractor's Incident Support Team (IST).

5 Communications Interface Summary



6 Selecting a Response Strategy

6.1 Tiered Response

The strategy that will be adopted in the event of an oil spill will depend upon several factors:

- The size and characteristics of the spilled oil;
- It's probable and predicted behaviour in the sea;
- Consideration of the environmental sensitivities in the path of the oil; and
- Consideration of the consequences of the different response options on the environment as a whole if they were to be adopted.

The severity of the spill depends on its size, the complexity of the response and the potential consequences for people, environment, assets, reputation, and for the economy. By identifying the tier level, the appropriate resources can be mobilised to combat the spill.

For general oil spill response, it is common to split up levels of response into three tiers, according to the severity of the spill and the resources required to combat it. The three tiers are commonly defined as follows (Figure 6.1):

- **Tier 1 - Local (within the capability of the operator on site):** A Tier 1 response is the lowest response level and requires resources to be available locally. By definition these resources must be at or near the incident site;
- **Tier 2 - Regional (beyond the in-house capability of the operator):** For larger pollution incidents, local resources may be insufficient to deliver a proper response. In these cases it may be that resources from other companies, industries and possibly government agencies can be called in on a mutual aid basis;
- **Tier 3 - National (requiring national and/or international resources):** For very large pollution incidents, resources supplied from national and international sources may be required.

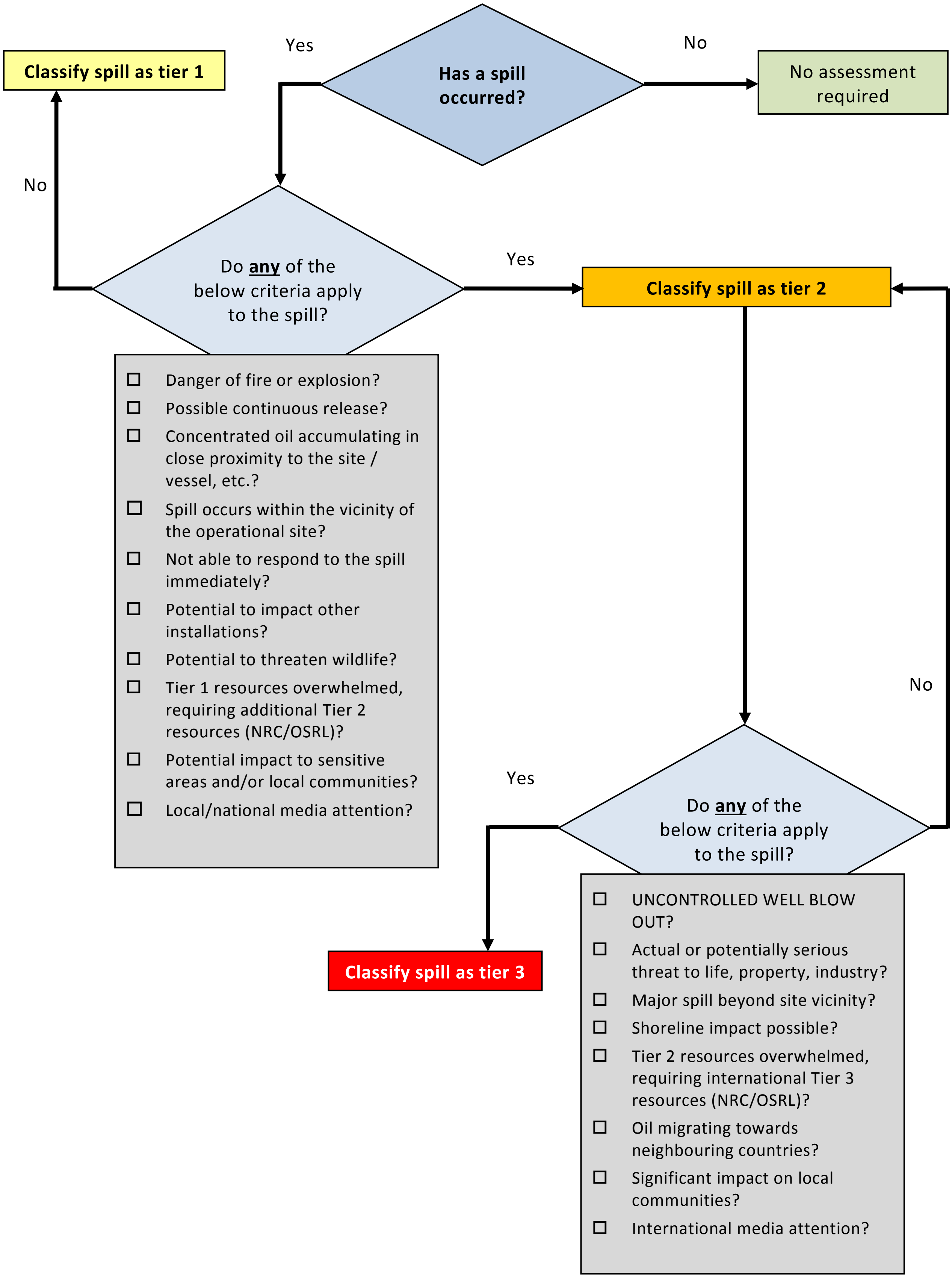
Figure 6.1: The Tiered response concept

The Tier assessment in Figure 6.2 below is provided as an aid for personnel to help assign an appropriate Tier Level to the incident. Figure 6.3 shows the decision tree for establishing the appropriate tier to be assigned.

Figure 6.2: Oil spill Tier assessment table

TICK ALL BOXES THAT APPLY: ☑ IF YOU ARE UNSURE, ASSUME WORST CASE	
TIER 1	
Small oil spills, or those which can be quickly and easily cleaned up using on-site resources or local contractors	
☐ Oil is contained within the incident site ☐ Spill occurs within immediate site proximity ☐ Day time release ☐ Able to respond to the spill immediately	☐ Source of spill has been contained ☐ Oil is evaporating quickly and no danger of explosive vapours (e.g. diesel) ☐ Spill likely to naturally disperse ☐ No media interest
TIER 2	
Oil spills which pose a threat of significant pollution resulting in the mobilisation of external oil spill response resources on a regional level	
☐ Danger of fire or explosion ☐ Possible continuous release ☐ Concentrated oil accumulating in close proximity to the site / vessel, etc. ☐ Spill occurs within the vicinity of the operational site ☐ Potential to threaten wildlife	☐ Not able to respond to the spill immediately ☐ Potential to impact other installations ☐ Tier 1 resources overwhelmed, requiring additional Tier 2 resources (OSRL, with initial response from FIGAS surveillance aircraft if available) ☐ Potential impact to sensitive areas and/or local communities ☐ Local/ national media attention
TIER 3	
Catastrophic oil spills which pose a threat of significant pollution resulting in the mobilisation of external oil spill response resources on a national/ international level	
☐ UNCONTROLLED WELL BLOW OUT ☐ Actual or potentially serious threat to life, property, industry ☐ Major spill beyond site vicinity ☐ Shoreline impact possible	☐ Tier 2 resources overwhelmed, requiring international Tier 3 resources (Oil Spill Response Limited) ☐ Oil migrating towards neighbouring countries ☐ Significant impact on local communities ☐ International media attention

Figure 6.3: Oil spill Tier assessment decision tree



6.2 NEFL Response Resources

6.2.1 Tier 1 Response Resources

NEFL has contracted from NRC, a Tier 1 spill response package and vessel based dispersant delivery systems for potential response to incidents in the Falklands. NRC will travel to the shore base for ongoing maintenance to the equipment. The Tier 1 resources consist of both onshore and offshore elements as described below. NRC also provides Tier 2 and 3 resources that will cascade in to the area upon activation (refer to **Section 6.2.2** below).

Onshore Tier 1 Resources

Onshore response equipment will be kept at both the NEFL shore base and at the Temporary Dock Facility (TDF). The spill response package will include an oil and chemical spill response capability.

For the onshore response equipment, a foam-fill / contractor type boom, a small portable (hand carry) skimmer, a collapsible storage tank, basic PPE suitable for first responders and sorbents, plastic totes for various small items and spares, have been chosen.

In summary, the onshore equipment package will consist of the following:

- 1 x harbour oil skimmer: c/w diesel driven power pack, pump & hoses;
- 500ft x 20in contractor type boom: c/w tow systems & anchor sets (6);
- 1 x 10m^3 temporary oil/ water storage tank: c/w groundsheet & cover;
- 7 x Fish Totes containing 2,000 pads, 200m boom & HD waste bags;
- 2 x Chemical Sorbent Spill kits (wheeled tote);
- 1 x Sealed plastic fish tote, c/w spares, hand tools & basic PPE.

Offshore Tier 1 Resources

The offshore equipment package will consist of the following:

- 200 metres x 1.5 metre offshore oil boom: c/w diesel hydraulic driven boom reel, tow ropes, all fixtures, fittings, power pack, plus air inflator;
- Trawl net and Boom Vane system;
- 1 x offshore oil skimmer: c/w diesel driven power pack & hoses;
- 2 x 25m^3 temporary floating storage bladders: c/w hoses, etc.;
- 1 x diesel driven transfer pump: c/w all hoses & fittings;
- 5 x bales of sorbent pads, boom & rolls;
- 1 x sealed plastic fish tote with spares and basic PPE;
- 3 x diesel driven dispersant spray systems;
- 20 x 1m^3 Intermediate Bulk Containers (IBCs) of Type 2/3 oil spill dispersant. 4 x IBCs to be stored on each OSV, remaining 8 x IBCs to be stored at shore base.

The above equipment will be split between the three OSVs as follows:

- **OSV 1:**
    - Dispersant spray system and dispersant (4 x IBCs);
    - Sorbent pads, boom and rolls;
    - Spares and basic PPE.

- **OSV 2:**
    - Trawl net and Boom Vane system and ancillaries;
    - Dispersant spray system and dispersant (4 x IBCs);
    - Sorbent pads, boom and rolls;
    - Spares and basic PPE.
- **OSV 3:**
    - 200 metres x 1.5 metre offshore oil boom and ancillaries;
    - Offshore oil skimmer;
    - Diesel driven transfer pump;
    - 2 x 25m^3 temporary floating storage bladders;
    - Dispersant spray system and dispersant (4 x IBCs);
    - Sorbent pads, boom and rolls;
    - Spares and basic PPE.

6.2.2 Tier 2 or 3 Response Resources

Equipment

NRC and OSRL are the Tier 2 or 3 oil spill response contractors for NEFL. In the event that Tier 2 or 3 resources are required, both NRC and OSRL will be mobilised. Both personnel and equipment will be mobilized from NRC and OSRL staging bases to support spill response efforts.

Table 6.1 below provides a summary list of the main types of spill response equipment that is typically available from Tier 2 and 3 contractors, together with the effectiveness of the equipment.

Further detailed information on the equipment available from NRC and OSRL, including storage locations, is provided on their websites – please refer to the links below.

http://nrcc.com/our-services/response-services/response-equipment-rental-packages/

http://www.oilspillresponse.com/activate-us/response-equipment

Storage Locations

NRC

Due to the way in which NRC operate, equipment is stored at a number of locations around the world. Equipment would be primarily mobilised from operating office locations, mainly within North America. Further information on the NRC locations can be found on the NRC website at the below link:

http://nrcc.com/global-operations/

OSRL

The main stockpile of spill response equipment is located in Southampton in the UK. Equipment stockpiles are also located in Bahrain and Singapore. However, the primary equipment mobilisation location will be the Southampton base.

Table 6.1: Summary of main types of tier 2 and 3 spill response equipment available through NRC and OSRL

Equipment	Description	Accessories	Manufacturer	Effectiveness
Dispersant Systems				
ADDS Pack Airborne Dispersant Delivery System (*exclusively available through OSRL*)	The ADDS Pack is used for airborne offshore dispersant spraying where a high treatment rate is required. Operations are deployed from a suitable aircraft, such as a Hercules.	Lashings, buffer barriers, spares box, tool box, loading system (e.g. trash pump), road tanker for dispersant stock (if required).	Biegert Aviation, AZ, USA	ADDS Pack can carry up to 5,000 US gallons (19 m^3) of dispersant. The system is calibrated to 238 US gallons per minute, through 34 spray nozzles (7 gallons per minute per nozzle) resulting in a dispersant dosage of 4.88 gallons per acre. A typical rate for application should be 5-20 US gallons per acre (5-20 m^3/km^2).
NIMBUS™ Airborne Dispersant Delivery System (*exclusively available through OSRL*)	NIMBUS is a modular aerial dispersant spray system capable of carrying 12 tonnes of dispersant. The system is designed to be used in a Hercules aircraft but can be mobilised to site by any jet aircraft, increasing deployment speed to remote locations.	Lashings, buffer barriers, spares box, tool box, loading system (e.g. trash pump), road tanker for dispersant stock (if required).	Ayles Fernie, Kent, UK	NIMBUS can carry up to 3,170 US gallons (12 m^3) of dispersant. The system can deliver between 9-10 US gallons per acre.
Boatspray system	The Boatspray systems are designed for deployment from tugs, OSVs and workboats using a variety of spray application equipment.	Diesel pump unit, hoses, spray arms/nozzles, vessel mounting brackets. AFEDO™ nozzles allow the system to be mounted on a wider variety of vessels by clamping onto available deck fittings rather than retrofitting using spray arms.	Ayles Fernie, Kent, UK	Systems are designed for the application of either concentrated (neat) or diluted dispersant in order to achieve a wide range of dosages that can be finely tuned depending on vessel speed.
Chemspray system	For application of dilute dispersant via hand-held nozzle. Uses vessel fire main water supply to drive an educator which draws the dispersant from drums.	Eductor unit, barrel suction pipe with dispersant control valve, 10 metre dispersant suction hose, nozzle assembly, 5 metre x 65mm high pressure hand held lance.	Ayles Fernie, Kent, UK	System can be varied from 0-90 litres per minute.
TC3 Helibucket system	The TC3 helibucket system is an underslung helicopter	Integrated support frame with dispersant tank, diesel engine and pump unit; spray arms,	Vikoma, Isle of Wight, UK	200 gallons (910 litres) dispersant capacity. System can be varied from 0-100 gallons per

	dispersant spray set for the more precise application of dispersant to smaller areas.	hoses, remote control module.		minute (0-455 litres per minute). Application speed is typically 85 knots.
Shoreline Response				
Inshore Booms				
Sea Sentinel boom	High performance range of inshore curtain booms for use along shorelines and in harbours.	Air blowers for inflation, thumb screws for attachment plate unions, end towing/anchoring attachments, anchors, towing/anchoring lines, tripping buoys, small vessel for deployment.	Vikoma, Isle of Wight, UK	Supplied in 10 or 20 metre lengths. Effectiveness depends on deployment angle and incident current angle/speed.
Shore Guardian boom	Water ballasted beach sealing boom for protection of beaches, marshes and intertidal zones. Used in conjunction with sea sentinel boom.	Air blowers for inflation, thumb screws for attachment plate unions, end towing/anchoring attachments, anchors, towing/anchoring lines, tripping buoys, small vessel for deployment.	Vikoma, Isle of Wight, UK	Supplied in 10 or 20 metre lengths. Effective at sealing shorelines with the changing tide.
Troil boom	Lightweight rapid response fence booms for deployment in ports, inland and coastal waters.	Hydraulic or diesel operated boom reel, towing ends, anchors, towing/anchoring lines, tripping buoys, small vessel for deployment.	Desmi, Nørresundby, Denmark	Commonly supplied in 200 or 400 metre lengths. Suitable for use in calm sheltered waters only – booms can fall over and fail in rough seas.
SuperMax boom	Curtain boom with foam-filled buoyancy pockets. Can be rapidly deployed, for inshore use in ports, inland and coastal waters.	Commonly supplied folded inside containers, towing ends, anchors, towing/anchoring lines, tripping buoys, tidal slide(s) (for deployment against sea walls), small vessel for deployment.	Elastec American Marine, IL, USA	Effectiveness depends on deployment angle and incident current angle/speed.
Shoreline Recovery Devices				
Ro-Mop skimmer	Absorbent polypropylene rope mop type skimmer, ideal for use on light, medium and emulsified oils.	Ro-mop drive and wringer unit, rope mop loop, floating pulley, anchor for pulley. Temporary storage solution and transfer pump required.	Desmi, Nørresundby, Denmark	Supplied in a range of unit sizes with varying oil pick-up ratings: Ro-mop OM 140: 13-22 US gallons per minute (3-5 m^3 per hour). Ro-mop OM 240: 26 US gallons per minute (6 m^3 per hour). Ro-mop OM 260: 53 US gallons per minute (12 m^3 per hour).
Komara Disc skimmer	Oleophilic disc skimmer designed	Disc skimmer unit, diesel-hydraulic power	Vikoma, Isle of Wight, UK	Supplied in a range of unit sizes with varying

	for use on light-medium oils. Can be used for shoreline operations, coastal waters and offshore.	pack, transfer pump, hoses and connectors. Temporary storage solution required.		oil pick-up ratings: Komara 7: 7 m^3 per hour. Komara 20: 20 m^3 per hour. Komara 30: 30 m^3 per hour. Komara 50: 50 m^3 per hour.
Drum skimmer	Floating drum oil skimmer, lightweight unit with shallow draft, for use in sheltered inshore environments and inland applications.	Drum skimmer unit with integrated transfer pump, hydraulic power pack, hydraulic lines, transfer hoses and fittings. Temporary storage solution required.	Elastec American Marine, IL, USA	Recovery rate of between 5 and 50 litres per minute.
Mini-vac skimmer	Lightweight vacuum recovery system for collection of oil and floating contaminants.	Minivac vacuum chamber and receptor, diesel drive unit, hoses, suction lance. Temporary storage solution required.	Vikoma, Isle of Wight, UK	Recovery rate of 24 m^3 per hour.
Komara star skimmer	For recovery of very heavy oils. Suitable for use in ports, shoreline operations, inland waterways and coastal waters.	Skimmer unit, hydraulic power pack, hoses and connectors. Temporary storage solution required.	Vikoma, Isle of Wight, UK	Supplied in a range of unit sizes with varying oil pick-up ratings: Komara Star: 22 m^3 per hour. Komara Star 2: 25 m^3 per hour. Komara Star 3: 25 m^3 per hour.
Other Equipment				
Spate pumps	Positive displacement diesel driven pump for transfer of fluids. Simple design, field serviceable.	Spares box (spare oil tolerant seals), hoses and connectors, exhaust spark arrestor.	Selwood, Hampshire, UK	Two main models: PD75: 30 m^3 per hour. PD100: 77 m^3 per hour.
DOP screw pumps	Heavy duty vertical screw pump for high volume oil transfer.	Hydraulic power pack, hydraulic lines, debris guard, transfer hoses and connections, deployment solution (e.g. crane).	Desmi, Nørresundby, Denmark	Two main models: DOP 160: 132 US gallons per minute (30 m^3 per hour). DOP 250: 440-550 US gallons per minute (100-125 m^3 per hour).
Offshore Response				
Offshore Booms				
Ro-boom	Offshore oil containment boom manufactured from heavy duty	Ro-boom and reel, hydraulic power pack, air pump unit for inflation and deflation,	Desmi, Nørresundby, Denmark	Freeboard: 0.59-1.2 metres, Draft: 0.95-1.4 metres (depending on model).

	neoprene rubber, high abrasion resistance and tensile strength, suited to the offshore environment.	cap keys, towing bridle, heavy duty towing line, marker buoys. Two suitably sized offshore vessels needed for deployment.		Effectiveness depends on deployment angle and incident current angle/speed. Stable in currents up to 3 knots.
Hi-Sprint boom	Hi-Sprint boom is a high integrity, single point inflation, rapid deployment boom. Manufactured from reinforced, double faced neoprene fabric.	Hi-Sprint boom and reel, hydraulic power pack, air pump unit for inflation and deflation, towing bridle, heavy duty towing line, marker buoys. Two suitably sized vessels needed for deployment.	Vikoma, Isle of Wight, UK	Freeboard: 0.35-0.60 metres, Draft: 0.40-0.90 metres (depending on model). Boom effectiveness depends on deployment angle and incident current angle/speed. Stable in currents up to 3 knots.
Weir boom	Offshore boom with integrated oil collection and pumping section. Offers a complete oil containment and recovery system.	Wier boom reel, 300 metre boom section, 70 metre weir section and pump cassette, hydraulic power pack, air pump unit for inflation and deflation, towing bridle, heavy duty towing line, marker buoys. Two suitably sized vessels needed for deployment. Temporary storage solution required.	Vikoma, Isle of Wight, UK	Recovery rate 180-210 m^3 per hour. Boom effectiveness depends on deployment angle and incident current angle/speed. Stable in currents up to 3 knots.
Offshore Recovery Devices				
Termite weir skimmer	Floating weir type skimmer incorporating the DOP 160 screw pump. A lightweight package that can skim and transfer a variety of oils.	Termite skimmer unit and integrated pump, aluminium frame, floats, hydraulic lines, hydraulic power pack, transfer hose, deployment solution (e.g. deck crane). Temporary storage solution required.	Desmi, Nørresundby, Denmark	Recovery rate 132 US gallons per minute (30 m^3 per hour). Requires calm water to work properly.
Komara disc skimmer	Oleophilic disc skimmer designed for use on light-medium oils. Can be used for shoreline operations, coastal waters and offshore.	Disc skimmer unit, diesel-hydraulic power pack, transfer pump, hoses and connectors, deployment solution (e.g. deck crane). Temporary storage solution required.	Vikoma, Isle of Wight, UK	Supplied in a range of unit sizes with varying oil pick-up ratings: Komara 7: 7 m^3 per hour. Komara 20: 20 m^3 per hour. Komara 30: 30 m^3 per hour. Komara 50: 50 m^3 per hour.

Helix Brush Skimmer	Weir type skimmer with circular nylon brush oil pick-up and combing system.	Skimmer unit, aluminium frame, floats, diesel-hydraulic power pack, hoses and connectors, deployment solution (e.g. deck crane). Temporary storage solution required.	Desmi, Nørresundby, Denmark	Recovery rate 550 US gallons per minute (125 m^3 per hour).
Sea Devil Skimmer	Mechanical claw type oil recovery system, designed for heavy, viscous oils.	Skimmer unit, diesel-hydraulic power pack, hoses and connectors, deployment solution (e.g. deck crane). Temporary storage solution required.	Vikoma, Isle of Wight, UK	Recovery rate 90 m^3 per hour with more than 98% oil pick-up.
Temporary Storage Systems				
Inflatable oil storage barge	If recovery storage vessels are not available for offshore response, inflatable barges can be used.	Anchors, towing attachments, towing lines, fenders.	Vikoma, Isle of Wight, UK	Various sizes available: Barge 10: 10,000 litres Barge 25: 25,000 litres Barge 50: 50,000 litres Barge 100: 100,000 litres
Oil storage bag	Inflatable oil storage bags for towing alongside recovery vessels.	Anchors, towing attachments, towing lines, fenders.	Vikoma, Isle of Wight, UK	Various sizes available: 100 m^3, 200 m^3 and 500 m^3.
Fastank	Aluminium frame and polyester fabric portable liquid storage tanks. Highly portable and versatile.	Ground sheet, tank cover, pipe saddle, decanting valve.	Fast Engineering, Antrim, UK	Fastank 1500: 7,500 litres. Fastank 2000: 10,000 litres.

The exact response from one contractor or the other will very much be dependent on the circumstances of the spill. However, appropriate agreements are in place with both NRC and OSRL for spill response in the Falkland Islands.

During the early stages of a spill, the Tier 2 or 3 oil spill response contractors may provide a number of services, including:

- Oil spill computer modelling;
- Guidance on oil weathering and movement;
- Advice on appropriate response strategies;
- Aerial surveillance services;
- Planning for deployment of equipment for shoreline protection and clean-up operations.

If required, OSRL can mobilise a Technical Advisor to the operator's in-country emergency response facilities to support the response.

6.2.3 Mobilisation of NRC

NRC are mobilized by a single telephone call to the Duty Officer at the NRC International Operations Centre (IOC)at **+1 (631) 224 9141**. Note that only the nominated call-out personnel from NEFL are able to mobilise NRC. For NEFL, NRC call-out is authorised by the NEFL Country Manager and Incident Commander (IMT).

NRC will also require receipt of the completed Notification and Mobilisation Forms (refer to **Part I, Section 7.3**) signed by a NEFL nominated callout authority. Instructions of to whom and where these forms are to be sent will be provided by the IOC Duty Officer, as appropriate to the incident.

The mobilisation time of NRC between initial call out and resources arriving in country is 35 hours.

6.2.4 Mobilisation of OSRL

The method for mobilising OSRL is by a single telephone call to **+44 2380 331551** on a 24 hour basis. Note that only the nominated call-out personnel from NEFL are able to mobilise OSRL. For NEFL, OSRL call-out is authorised by the NEFL Country Manager and Incident Commander (IMT).

The initial call will be answered by the OSRL security front desk. The caller should request to speak to the Duty Manager and detail the nature of the incident.

The security officer will record some initial details and a contact telephone number. The caller will then be contacted by the OSRL Duty Manager within 10 minutes. The OSRL Duty Manager will also require receipt of completed Notification and Mobilisation Forms (refer to **Part I, Section 7.4**) signed by a NEFL nominated callout authority.

It is best practice to advise the OSRL Duty Manager of an incident (or potential incident) at the earliest opportunity. On receipt of a notification call, the OSRL Duty Manager will request as much information as possible as per the OSRL notification form (refer to **Part I, Section 7.4.1**).

During the mobilisation phase, the OSRL Duty Manager will remain fully available to NEFL, until the arrival on site of the Technical Advisor, when the OSRL Duty Manager will assume a supporting role to the response operations.

The mobilisation time of OSRL between initial call out and resources arriving in country is 28 hours.

6.3 Strategy Selection

The appropriate response strategy will depend not only on the potential limitations of each of the possible response options, but also on the type of oil spilled and the environmental sensitivities that are potentially threatened by the spill.

Table 6.2 presents the preferred response strategies that are available to NEFL, according to spill Tier and oil type. Table 6.3 summarises the approximate mobilisation times according to either mobilisation of an oil spill response to Tier 1, 2 or 3 spills or mobilisation of oiled wildlife response to Tier 1, 2 or 3 spills. Table 6.4 also summarises Falkland Islands Government Policy on oil spill response strategies.

The response options selection decision chart shown in Figure 6.4 will help to assist in selecting an appropriate response strategy. It is recommended that the Oil Spill Response contractor (NRC and/or OSRL) be contacted for advice on response strategies in all situations.

Table 6.2: Response strategies available to NEFL according to spill Tier

Tier & Resources	Preferred Response Strategy		Resources and approximate mobilisation time
	Diesel / Aviation Fuel / Condensate	Persistent Oil (e.g. Crude)	
Tier 1 (small spill) On site	Natural dispersion and monitoring (using SSV / OSVs). If safe to do so, agitate using SSV / OSV propeller ('prop-wash'), by steaming through the slick at speed.	Monitoring of the slick using SSV / OSV. Natural dispersion is preferred. However, if the oil is not dispersing naturally, Tier 1 resources should be used. If environmental conditions are suitable (Beaufort force 0-3), offshore containment and recovery should be considered. If conditions are too rough for containment and recovery, the oil should be tested for dispersability (refer to dispersant test in **Part II, Section 13.5.3**). If the oil is amenable to dispersant, application via the vessel mounted spray systems should be considered**.	SSV / OSV to monitor the spilled oil. Offshore resources (stored on OSVs / SSVs): • Offshore oil containment boom, skimmer and temporary floating storage bladders. • Vessel mounted dispersant spray systems. • Dispersant stocks (4 IBCs per vessel). Rapid response – equipment stored offshore on SSV / OSVs.
Tier 2 or 3 (medium/ large spill) Spill Response contractors (NRC and/or OSRL)	Natural dispersion and monitoring, which will require mobilisation of aerial surveillance (OSRL, with initial response from FIGAS surveillance aircraft if available). Natural dispersion is preferred. However, the additional use of aerial chemical dispersant treatment may be required (NRC and/or OSRL), if the oil is not dispersing naturally, and safety or sensitive areas are threatened**.	Monitoring of the slick, which will require mobilisation of aerial surveillance (OSRL, with initial response from FIGAS surveillance aircraft if available). Natural dispersion is preferred. However, if the oil is not dispersing naturally, Tier 2 or 3 resources should be used. The additional use of aerial chemical dispersant treatment may be required (NRC and/or OSRL), if the oil is not dispersing naturally and safety or sensitive areas are threatened**. Containment and recovery systems available if required (NRC and/or OSRL) and if weather conditions are favourable. Shoreline protection resources and equipment available if required (NRC and/or OSRL).	Initial aerial surveillance provided by: • NEFL crew change helicopter (if available); • Use of FIGAS surveillance aircraft if available; Primary aerial surveillance support provided by OSRL; suitable aircraft chartered and trained observer flown in from UK. Aerial dispersant** application capability provided through OSRL (ADDS or NIMBUS system). Aircraft mobilised from UK (L382-G 'Hercules'). Dispersant stocks located at OSRL Southampton base. Mobilisation time 28 hours. If shoreline is threatened, specialised shoreline protection equipment, mechanical containment and recovery equipment and skilled technicians to lead clean-up operations are held by NRC and/or OSRL. 'Unskilled' labour can mobilised to the Falklands and/or locally, together with general purpose equipment and transport. NRC mobilisation time 35 hours. OSRL mobilisation time 28 hours.
Note: The National Oil Spill Contingency Plan (NOSCP) may be activated by FIG if the spill is likely to require national resources. Activation of the NOSCP is the responsibility of the Department of Fisheries.			

** FIG Department of Natural Resources (Fisheries) approval required prior to chemical dispersant use.

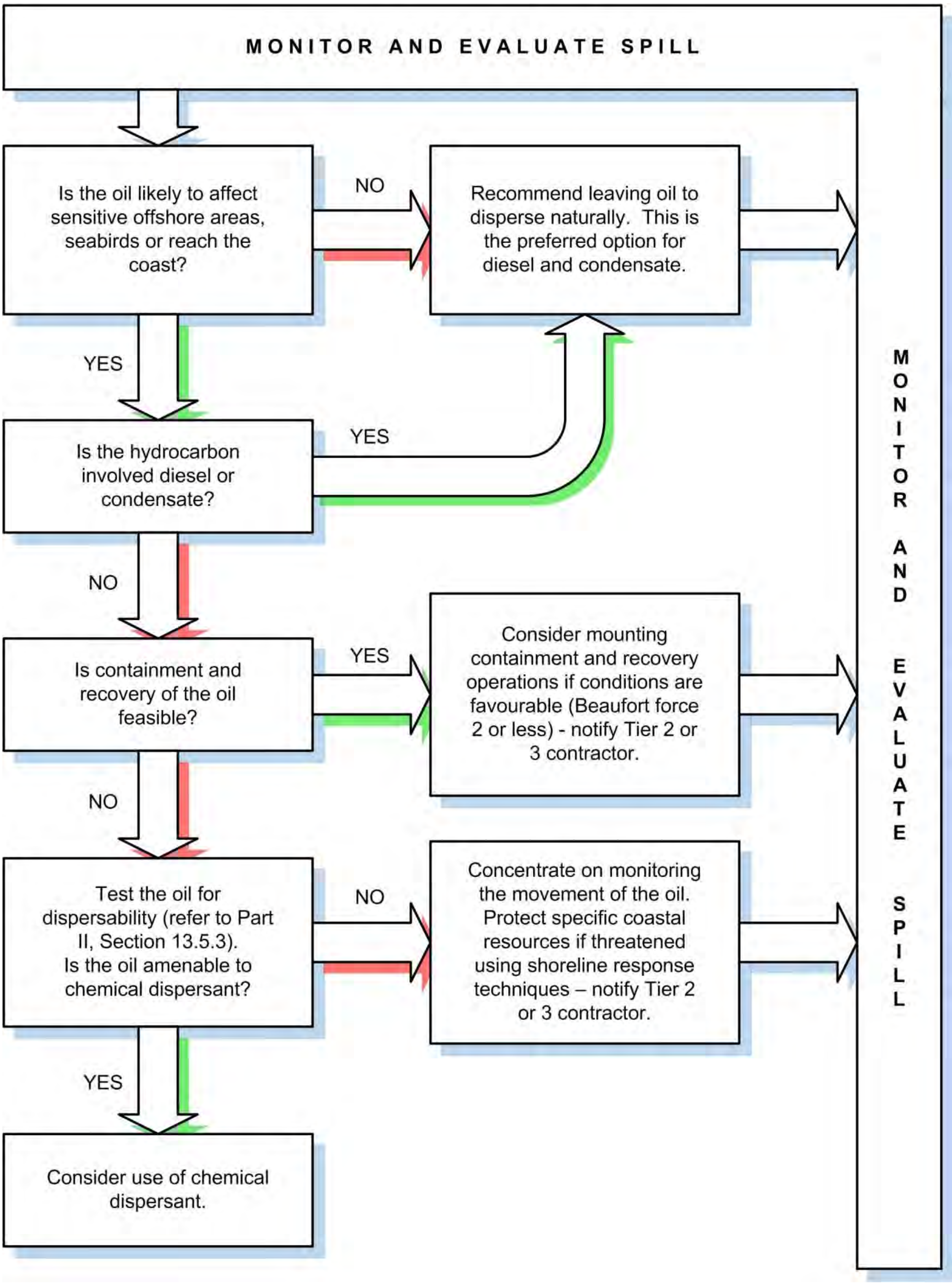
Table 6.3: Mobilisation times for oil spill and oiled wildlife responses

Tier	Resource	Approximate Mobilization Time
Tier 1 (small spill) **Spill Response**	On site	Rapid response – equipment stored offshore on SSV / OSVs (refer to **Section 6.2.1**).
Tier 2 or 3 (medium/ large spill) **Spill Response**	Spill Response contractors (NRC and/or OSRL)	OSRL mobilisation time 28 hours. NRC mobilisation time 35 hours.
Tier 2 or Tier 3 (medium/ large spill) **Oiled Wildlife Response**	OSRL/Sea Alarm	The mobilisation times for OSRL and Sea Alarm to arrive in the Falkland Islands with oiled wildlife response equipment is 96 hours, with a worst case of 148 hours (if an aircraft is not available in Europe). This would provide a small Sea Alarm team and the equipment detailed in the Sea Alarm/OSRL capability statement and summarised in **Part II, Section 13.6.3**.

Table 6.4: FIG policy on oil spill response strategies as per the NOSCP

<table>
<tr><th>Response Strategy</th><th>Aim</th><th>FIG Policy</th></tr>
<tr><td>Monitor & Evaluate</td><td>To locate and track the slick, estimate the amount spilled and the oil type, and predict where impact may occur.</td><td>Monitor and evaluate is the primary strategy for oil spills that pose no significant threat to the coastline or sensitive resources, as the normally high energy conditions will naturally break up the spill. It is recognised that it is essential to monitor the spill.
Where surveillance from a vessel is insufficient, FIG will request that aerial surveillance is undertaken.</td></tr>
<tr><td>Containment & Recovery</td><td>To contain oil so that it can then be recovered from the sea surface.</td><td>Where feasible, containment and recovery is a primary response strategy for inshore waters.</td></tr>
<tr><td>Dispersant Application</td><td>To remove the spill from the sea surface and disperse the oil into the water column.</td><td>Where the application criteria are met and approval from the Department of Natural Resources (Fisheries) is given, dispersant application is a primary response strategy. The application criteria is described below:
<table>
<tr><th>Amount of pollution to be dispersed</th><th>Minimum water depth (metres)</th><th>Minimum distance from shore (nautical miles)</th></tr>
<tr><td>Up to 10 tonnes of oil</td><td>5</td><td>0.5</td></tr>
<tr><td>Up to 100 tonnes of oil</td><td>10</td><td>1.0</td></tr>
<tr><td>Up to 1,000 tonnes of oil</td><td>15</td><td>2.5</td></tr>
<tr><td>Over 1,000 tonnes of oil</td><td colspan="2">FIG would consult with technical experts</td></tr>
</table></td></tr>
<tr><td>Shoreline Protection & Cleanup</td><td>To protect shorelines from impact and to recover any stranded oil.</td><td>To prioritise the most sensitive areas (highest Environmental Sensitivity Index [ESI]) that have suitable access and where there is presence of wildlife that may be at risk of oiling. Also, areas where there is heavy contamination and floating oil will be prioritised to limit further oil mobilisation and contamination.</td></tr>
<tr><td>Oiled Wildlife Response</td><td>To limit the impact of the oil spill on wildlife of the Falkland Islands and assist with the recovery of affected animals and improve survival rates.</td><td>Where animals are at risk, response measures will be employed to limit the impact. In the event of oiled wildlife, the policy will be to capture and rehabilitate the animals wherever possible.</td></tr>
</table>

Figure 6.4: Response options selection decision chart



6.3.1 Monitor & Evaluate

For all spills, the oil slick should be monitored from the outset. In the first instance, and for Tier 1 spills, this will be done primarily using either the Safety Stand-by Vessel (SSV) or Offshore Supply Vessel (OSV). However, aerial surveillance will be required for larger Tier 2 or 3 spills.

During the initial early stages of a spill, an estimation of the movement of the oil slick can be made using marine charts. **Part II, Section 13.2.3** provides the methodology for prediction of oil spill trajectory.

According to FIG PON 8 guidelines, for Tier 2 or 3 spills, the location of oil remaining on the sea surface should be surveyed from the air as soon as possible after the incident and at least twice per day, until the clean-up operation is completed. The survey results of each aerial surveillance flight should be reported to the Department of Mineral Resources and the Department of Natural Resources (Fisheries).

Initial aerial surveillance response may be available through the NEFL crew change helicopter, if available. However, it should be noted that the primary objective of the crew change helicopter is for personnel tender services to the drilling rig. This role should not be compromised; however, if the helicopter is in the vicinity of the rig, it may be able to report on sightings of the oil spill during flight.

Initial aerial surveillance may also be available through the use of the Falkland Islands Government Air Service (FIGAS) surveillance aircraft, if this is available. However, the primary aerial surveillance response will be provided by mobilising a trained aerial surveillance observer from OSRL to the Falklands and chartering a suitable aircraft. OSRL are experts in the field of dispersant response and are able to use their connections within the aviation industry to charter and mobilise suitable aircraft around the world. The trained aerial surveillance observer will make observations of the spill in accordance with the Bonn Agreement Oil Appearance Code (refer to **Part II, Section 13.2.2**) and use the aerial surveillance observers log (refer to **Part I, Section 7.7**).

The physical appearance of the slick should be monitored closely and if there are changes in the oil or conditions, which may influence the perceived impact, an additional response should be considered, and response resources prepared for mobilisation. Further information on monitoring and evaluating oil spills from the air is given in **Part II, Section 13.2.1**.

During the initial stages of a spill, where aerial surveillance may not have arrived yet, initial estimates of the spilt volume may be possible by monitoring the slick with the OSVs. The Bonn Agreement Oil Appearance Code can be used for an initial estimation of spill volume, if the full extent of the slick is visible. **Part II, Section 13.2.2** provides information on the use of the Bonn Agreement Oil Appearance Code.

6.3.2 Natural Dispersion

If light non-persistent oil, or a very small quantity of light crude oil has been spilled, the best strategy may be to allow physical processes to disperse the oil naturally. However, this strategy should always be backed up by thorough monitoring.

If natural dispersion is selected as the key response strategy, it must be shown through close monitoring of the oil slick that natural dispersion is in fact taking place. For Tier 2 or 3 spills, this will require aerial surveillance.

If the oil persists, then an alternative strategy must be selected.

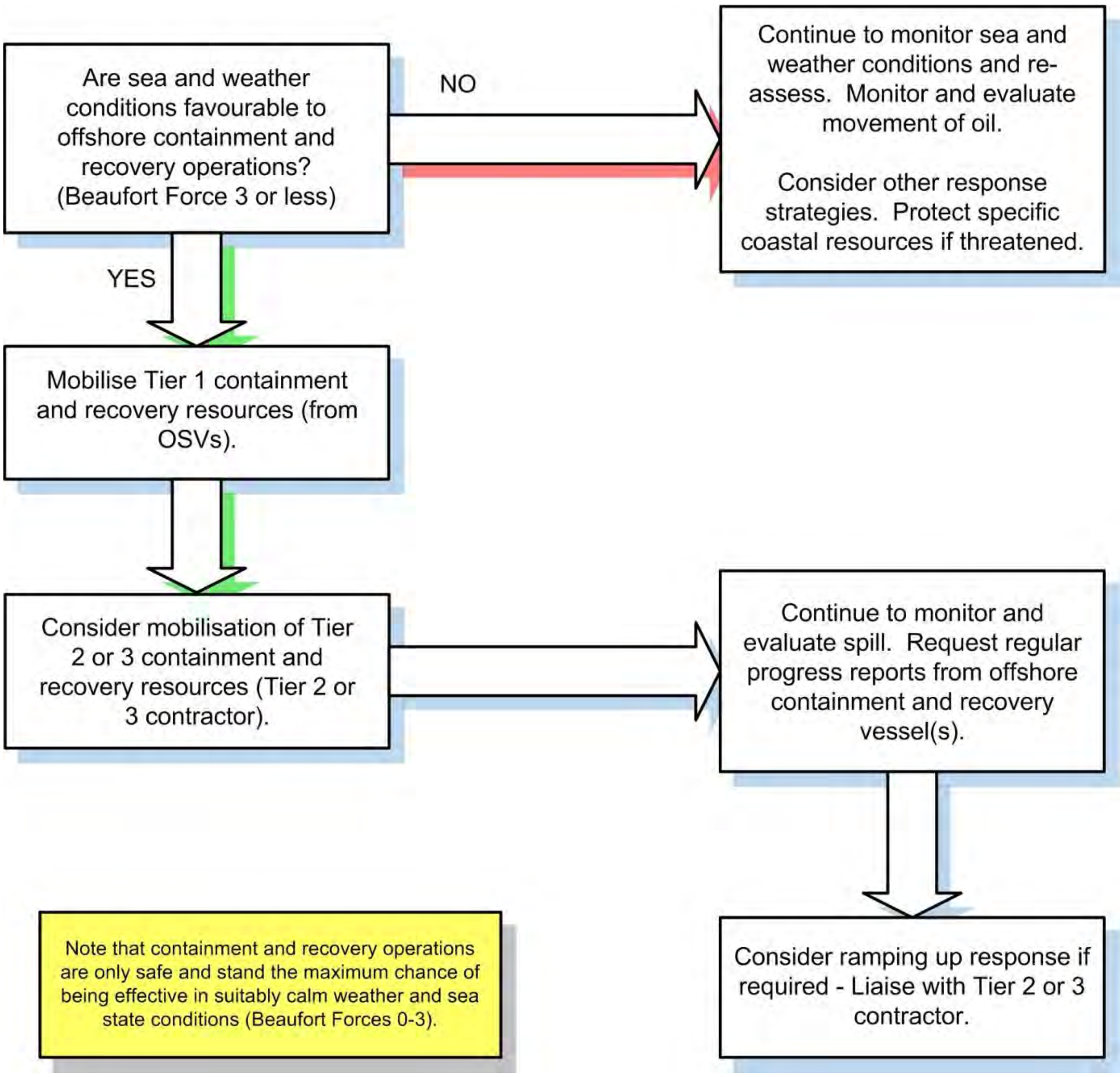
6.3.3 Containment & Recovery

For large spills in environmentally sensitive areas, or oils that are not amenable to dispersion at sea, mechanical containment and recovery may be considered as a response option. This would involve the deployment of oil recovery vessels with offshore oil containment booms and oil skimming equipment. Mechanical containment and recovery capability is available through NRC and /or OSRL.

Note that for successful containment and recovery operations, the sea state and weather conditions need to be suitably calm (between Beaufort force 0 and 3). Such calm waters are rarely seen in offshore Falkland Islands waters and therefore, containment and recovery is not considered to be the most practical response strategy in Falklands Offshore waters. Inshore Falklands waters may, however, be suitably calm and sheltered to enable containment and recovery operations to take place safely and successfully. Containment and recovery therefore should be considered as a primary response strategy for Falklands inshore waters where practicable, in line with the NOSCP. Tier 1 containment and recovery is available from one of the OSVs.

The containment and recovery decision chart shown in Figure 6.5 will help if containment and recovery is being considered as a response strategy. Further information on containment and recovery as a response strategy is given in **Part II, Section 13.4**.

Figure 6.5: Offshore containment and recovery decision chart



6.3.4 Dispersant Application

The dispersant application strategy is the application of chemical dispersant by air to aid and accelerate natural processes dispersing the oil, thus removing it from the sea surface.

The window of opportunity to use chemical dispersants will be dependent upon various factors including the quantity of oil, oil type, sea temperature, time of year, nature of the spill (i.e. instantaneous or continuous release), prevailing weather and environmental sensitivities.

Under Falkland Islands Government policy, dispersant use can be considered as a key response strategy, provided that permission is obtained from Incident Command, NOSCP (in accordance with the PON8). Operators must observe the following guidelines on when to use dispersants in the event of an oil spill from an offshore installation. Any special conditions attached to a particular licence should also be adhered to.

- In general, when a spill occurs at an offshore installation (including a pipeline) it should not automatically be treated with dispersants but should be reported to the Department of Mineral Resources and Department of Natural Resources immediately, and the slick should be tracked.
- However, if a spill occurs at an installation operating in any blocks wholly or partly within 25 miles of the coast or in an environmentally sensitive area (as established during the preparation of the oil spill contingency plan) and if the spill could contaminate the sea surface outside the immediate area (500 metre radius) of the installation, then the use of dispersants may be authorised by the Incident Command, NOSCP.

For the purpose of treating oil on the surface of the sea the product used must:

a) Be approved by a recognised licensing Authority (Incident Command NOSCP);

b) Be used in accordance with the conditions of that approval; and

c) The permission of the Incident Command NOSCP must be sought in advance on ALL proposals to use oil dispersants except in circumstances where a spill poses an immediate threat to human health or the safety of an installation.

Where the spill is, or seems as though it may become, extensive in size (e.g. a Blow-out, a fractured pipe or a damaged storage facility) there should be the earliest possible consultation with the Incident Command, NOSCP. Arrangements should be made to monitor the movement, spreading and emulsification of the oil so that a proper assessment can be made of whether and to what extent it is threatening the coast, fisheries, seabirds or other wildlife and of the action necessary to protect the threatened interest.

Where a spill is quite clearly small (less than 1 tonne) and not increasing in volume, urgent consultation with the Incident Command NOSCP need not take place (although the spill must always be reported in accordance with regulations and in accordance with the channels established in the operator's contingency plan). It will probably be unnecessary to use dispersants in these cases other than in exceptional circumstances.

In certain cases, however, because of the characteristics of the oil or the geographical location of an installation, it may be necessary to issue different and specific advice to the appropriate operator.

The form in **Part I, Section 7.8** contains information that the Department of Natural Resources (Fisheries) may find useful during consultation with NEFL on whether dispersant use is appropriate. This form should be filled out and sent to the Fisheries Department during consultation on dispersant use.

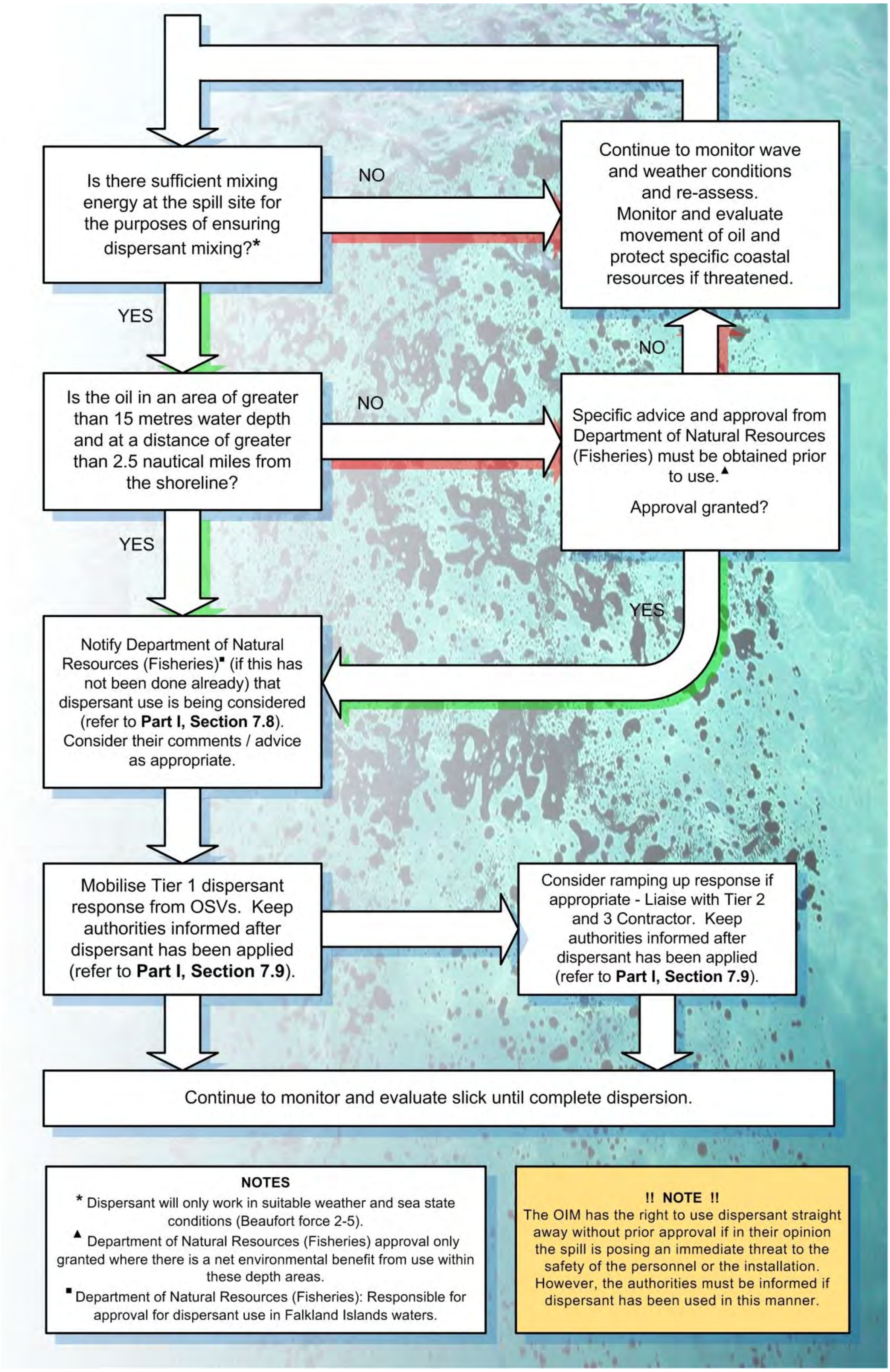
The form in **Part I, Section 7.9** contains information that the Department of Natural Resources (Fisheries) may find useful after dispersant has been applied. This form should be filled out and sent to the Fisheries Department after the application of dispersant as part of the ongoing monitoring of the slick and the dispersant effectiveness.

Tier 1 dispersant response resources are available from each of the three OSVs, which are each equipped with dispersant spray systems and a stock of $4m^3$ of dispersant. An aerial dispersant

response capability is available through OSRL. Mobilisation time to the Falkland Islands is approximately 28 hours.

The dispersant use decision chart shown in Figure 6.6 will help if the application of dispersant is being considered as a response strategy.

Figure 6.6: Dispersant use decision chart



7 Response Forms

7.1 PON 8 Oil Spill Reporting Form

According to FIG PON 8 requirements, all spills must be reported to the Falkland Islands Government (FIG) Department of Mineral Resources and Department of Natural Resources (Fisheries) immediately. The first notification should be made by telephone to both the Department of Natural Resources (Fisheries) and the Department of Mineral Resources, giving brief details of the incident.

Note that outside of office hours, the Fishops and Royal Falkland Islands Police contact numbers will double up as emergency out of hours contacts. Therefore, out of hours, these organisations should be contacted.

The Petroleum Operations Notice (PON) 8 Form should then be filled in and sent to both the Department of Natural Resources (Fisheries) and the Department of Mineral Resources. Submission of the PON 8 Form should not delayed, if certain information is lacking, this can be provided in an updated form at a later time.

It should be noted that the PON8 form is now available as an interactive pdf. It should be filled out and then emailed to:

- The Department of Natural Resources (Fisheries): fishops@fisheries.gov.fk
- The Department of Mineral Resources: reporting@mineralresources.gov.fk

The PON8 pdf form is available to download at the following link:
http://www.fig.gov.fk/minerals/index.php/component/jdownloads/finish/20/91?Itemid=0

In the event that email is unavailable for whatever reason, the below PON8 form can be used and faxed to the numbers specified.

To: Falkland Islands Government Department of Natural Resources (Fisheries)

VHF Channels: 16 and 10
Telephone: + 500 27266
Fax: + 500 27265
Email: fishops@fisheries.gov.fk

Out of office hours, call Fisheries Duty Officer as per monthly roster, or Marine Officer (tele. + 500 27266)

If unable to contact either of the above, contact the Royal Falkland Islands Police:

Telephone: + 500 28100
Fax: + 500 28110

Department of Mineral Resources

Telephone: +500 27322
Fax: +500 27321
Email: reporting@mineralresources.gov.fk

A. Date: Time (Local) pollution observed:

B. Identity of Observer/Reporter:

C. Name of installation/vessel:

D. Latitude: Longitude:

E. Location of spill (relative to installation) and water depth (metres):

F. Estimate of pollution extent (in m3 [1,000 litres/m3]):

G. Wind speed (knots): Wind direction (degrees):

H. Sea state (circle): Calm ☐ Slight ☐ Moderate ☐ Rough ☐ Very Rough ☐

Wave Height (metres)

I. Type of oil released to sea:
(e.g. crude, diesel, condensate, hydraulic fluid, kerosene, base oil, etc. N.B. For base oil give % oil content.)

J. Source of pollution:

K. Cause of pollution:

L. If ongoing spill, release rate (m^3 per hour)

M. Containment, dispersion or surveillance measures deployed

N. Photographs taken: Yes ☐ No ☐

Samples taken for analysis: Yes ☐ No ☐

Other Information

7.2 Oil Spill Incident Log Sheet (for general use by all personnel)

Name: Team: Role: Location:	
Date / Time	**Communication / Action Taken / Notes**

7.3 NRC Forms

7.3.1 NRC Initial Notification Form

DATE OF REPORT		**TIME OF REPORT**	
Person in Charge		Position	
Company		Contact tel #	
Contact fax number		E mail address	

INCIDENT DETAILS

Name of Facility, Vessel etc	
Location of the Incident	
Description of the Incident	
Latitude / longitude-	
Situation	☐ Land ☐ River ☐ Port ☐ Coastal ☐ Offshore ☐
Date and Time of the	☐ GMT ☐ Local Time
Source of the release	☐ Vessel ☐ Tank ☐ Pipeline ☐ Container ☐ Rail Transport ☐ Road Transport
Estimated Quantity	
Incident Status	☐ Ongoing (Rate of Release m3/hr) ☐ Controlled ☐
Action taken so far	

Substance and characteristics

OIL	Type		**HAZMAT**	Name	
	Viscosity			UN Number	
	API/ SG			UN Class	
	Flash Point			Packing Group	
	Pour Point			MSDS Available	

Weather

Wind Speed		Wind Direction	
Sea State		Swell Height	
Air Temp		Water Temp	
Current Weather	☐ Dry ☐ Rain ☐ Snow/ Ice ☐ Drizzle ☐ Fog ☐ Clear		

Other Information

Assistance Requested

Resources at Risk

7.3.2 NRC Situation Update Form

FAX NO	
24 HR PHONE	

To:	**Date:**
E mail:	WARNING Ensure telephone contact has been established with the Duty Manager before using email communication
From:	**Position:**
Company:	**Contact Number:**
Subject:	**Incident Name:**

OBLIGATORY INFORMATION REQUIRED – COMPLETE ALL DETAILS	
Name of person in Charge	
Position	
Company	
Contact telephone number	
Contact fax number	
E mail address	
INCIDENT DETAILS	
Name of Facility, Vessel etc	
Location of the Incident	
Description of the Incident	
Latitude / longitude-	
Situation	☐ Land ☐ River ☐ Estuary ☐ Coastal ☐ Offshore ☐ Onshore
Date and Time of the	☐ GMT ☐ Local Time
Source of the release	
Estimated Quantity	
Incident Status (Cross Box)	☐ Ongoing ☐ Controlled ☐ Unknown
Action taken so far	
Substance and characteristics	
Type of Oil/ Substance	
UN/ CAS Number	
Viscosity	
API/SG	
Pour Point	
Weather	
Wind speed and direction	
Sea State	
Sea Temperature	
Tides	
Forecast	

FAX NO	
24 HR PHONE	

ADDITIONAL INFORMATION REQUIRED – COMPLETE DETAILS IF KNOWN	
Resources at Risk	
Resources available	
Nearest Airport	
Runway Length	
Handling Facilities	
Customs/ Immigration	
Handling Agents	

Vessel Availability	
Equipment deployment	
Recovered Oil Storage	

Equipment Requested	

Personnel Requested	

Additional Requirements	

Special Requirements of arrival country

Security Information

Additional Information

7.3.3 NRC Authorisation to Proceed Form

Only NEFL authorised personnel matching the records held by NRC have the authority to mobilise NRC response resources.

For NEFL, NRC call-out is authorised by the NEFL Incident Commander (IMT).

AUTHORISATION TO PROCEED

Client authorisation of NRC

I hereby acknowledge receipt of NRC rate schedule effective Sept., 2012 and hereby authorise NRC to provide the goods and services for this job in the attached schedule and agree to pay according to said schedule and terms any and all monies due and owing within thirty (30) days from invoice date.

Initial Response payment status; Per Contarct terms

I will be responsible for all collection cost on past due accounts, inclusive of legal fees.

INCIDENT LOCATION :

INCIDENT DESCRIPTION:

AUTHORISED SIGNATURE

STAMP ____

DATE

NRC CASE #:

Rate sheet attached	Dated	YES ☐	NO ☐
F20-06 Confirmation to Proceed (Detailed) is attached		YES ☐	NO ☐

7.3.4 NRC Confirmation to Proceed Form

DATE		CLIENT	
CASE NUMBER		INCIDENT NAME	

INVOICING ADDRESS	
CONTACT PERSON	
CONTACT DETAILS	

The following resources are confirmed as being available to respond to the notified incident. The list is based on:

a Your requested equipment and personnel Spread ☐ (Tick appropriate box)
b Recommended equipment and personnel spread ☐

EQUIPMENT SECTION

ID#	Equipment Name	Location/ Owner	Mobilisation Time to Site	Day Rate	
				Use	Standby

PERSONNEL SECTION

ID#	Incident Role	Name	Mobilisation Time to Site	Day Rate

OTHER ITEMS

ID#	Equipment Name	Location/ Owner	Mobilisation Time to Site	Day Rate Use	Day Rate Standby

COMMENTS:

FOR NRC

INCIDENT MANAGER:			
DATE		TIME	

FOR CLIENT

APPROVED BY: ______________________________ POSITION: ________________________

DATE________________ TIME______________

7.4 OSRL Forms

7.4.1 OSRL Initial Notification Form

Notification Form

(Initial Incident Information)

Warning! Please telephone the Duty Manager before e-mailing or faxing this completed form

To	Duty Manager		
OSRL Base	Southampton, UK	Loyang, Singapore	Fort Lauderdale, USA
Telephone	+44 (0)23 8033 1551	+65 6266 1566	+1 954 983 9880
Emergency Fax	+44 (0)23 8072 4314	+65 6266 2312	+1 954 987 3001
Email	dutymanagers@oilspillresponse.com		

Safety and Security: Oil Spill Response Limited's safety policy requires us to work closely with the mobilising party to ensure all aspects of safety and security are addressed for our personnel.

Guidance: Please ensure the information given on this form is accurate at the time of completion. This information will be used to develop and recommend the most appropriate response strategy. If new information should become available, or the situation changes, please inform the Duty Manager as soon as possible.

Section 1 – Contact Details	**Mandatory Information Required**
Member Company	
Name of Person Notifying OSRL	
Position in Incident	
Direct Phone Number	
Mobile Number	
Fax Number	
Email Address	
Command Centre Address	
Date and Time of Notification	
Section 2 – Location	
Country / Region of Spill	
Latitude / Longitude of Spill Position	
Area Affected	☐ Inland ☐ River ☐ Estuary ☐ Shoreline ☐ Port ☐ Harbour ☐ Offshore ☐ Subsea ☐ Other
Depth of Water (if applicable)	
Section 3 – Spill Details	
Date and Time (of spill – GMT)	
Source of Spill	
Cause of Spill	
Status of Spill	☐ Secured ☐ Uncontrolled ☐ Unknown

Product Properties	**Product Name / Type**		**State Units** **Alternatively, provide an Assay sheet** ☐ **Assay sheet provided**
	SG or API		
	Pour Point		
	Wax Content		
	Asphaltene		
	Sulphur Content		
	Viscosity		
Release Rate	Instantaneous Release		**State Units**
	OR		
	Continuous Release	___ per hour for ___ ☐ Hours ☐ Days	

Section 3 – Spill Details cont.	**Mandatory Information Required**

Description of Observed Spill	Estimated Quantity		**State Units**
	Size		
	Appearance		
	Direction of Travel		

Section 4 – Weather

Wind Direction (wind direction given **from**)		**State Units** **Alternatively provide a local weather forecast** ☐ **Weather forecast provided**
Wind Speed		
Air Temperature		
Sea Temperature		
Sea State		
Visibility		
Cloud Base		

Section 5 – Oil Spill Model Request

Information you supply in Section 3 (Spill Details) and 4 (Weather) will be used for the modelling

Do you require Oil Spill Trajectory Modelling?	☐ Surface 2D	☐ Sub-surface 3D*	☐ Not at this time
Additional Information (please include start date and time)			
*Separate model request form required. Sub-surface models require additional time and costs.			

Section 6 – Safety and Security

Highlight any known Safety or Security Risks		☐ N/A
Describe Security arrangements for OSRL staff (if applicable)		☐ N/A

Additional information if available

Section 7 – Resources at Risk

Environmental or Socio-economic sensitivities that may be impacted (If possible provide the relevant oil spill contingency plan)	

Section 8 – Equipment

Equipment already deployed or being mobilised (other than OSRL resources)	

7.4.2 OSRL Mobilisation Authorisation Form

Only NEFL authorised personnel matching the records held by OSRL have the authority to mobilise OSRL response resources.

For NEFL, OSRL call-out is authorised by the NEFL Country Manager and Incident Commander (IMT).

Mobilisation Authorisation Form

Warning! Please Telephone the Duty Manager before e-mailing or faxing this completed form

Safety and Security

Oil Spill Response Limited's safety policy requires us to work closely with the mobilising party to ensure all aspects of safety and security are addressed for our personnel.

To	Duty Manager		
OSRL Base	Southampton, UK	Loyang, Singapore	Fort Lauderdale, USA
Telephone	+44 (0)23 8033 1551	+65 6266 1566	+1 954 983 9880
Emergency Fax	+44 (0)23 8072 4314	+65 6266 2312	+1 954 987 3001
Email	dutymanagers@oilspillresponse.com		

Details of Authorised Contact	
Subject	Mobilisation of Oil Spill Response Limited (OSRL)
Incident Name	
Mobilising Company	
Name of Person Authorising OSRL	
Position in Incident	
Direct Phone Number	
Mobile Number	
Fax Number	
Email Address	

Invoice Address	
Purchase Order Number	

I, authorise the activation of Oil Spill Response Limited and its resources in connection with the above incident under the terms of the Agreement in place between above stated Company and Oil Spill Response Limited.				
Signature:		Date / Time:		

If Oil Spill Response Limited personnel are to work under another party's direction please complete details below;

Additional Details	
Company	
Contact Name	
Position in Incident	
Direct Phone Number	
Mobile Number	
Fax Number	
Email Address	

7.5 Oil Spill Assessment Checklist

OIL SPILL ASSESSMENT CHECKLIST

This checklist is designed to assist those personnel who have the responsibility of assessing the oil spill incident. These personnel are likely to be:

- Offshore Installation Manager (OIM);
- Incident Management Team (IMT) Incident Commander;
- EHS Advisor;
- Drilling contractor's Rig Manager.

STEP	GUIDANCE
Determine Essential Details	Location of pollution incident; Source of spill; Oil type; Extent of oil spill; Time of incident; Potential hazardous circumstances; Any other relevant information (particularly: is spill contained or ongoing?).
Assess Safety Hazards	Until otherwise established, assume oil spill is giving off potentially dangerous VOCs (i.e. gas or hydrocarbon vapours). **ELIMINATE IGNITION SOURCES** Approach Oil Spill from upwind to reduce effects of vapours. **APPROACH ONLY IF SAFE TO DO SO!**
Determine Oil Spill Source	If source unknown, investigate with care. Instigate actions to stop spillage at source. **IF SAFE TO DO SO!**
Estimate quantity of Oil released if exact amount unknown	Refer to **Part II, Section 13.2.2**.
Predict oil fate; determine direction and speed of oil movement in addition to weathering characteristics	Refer to **Part II, Section 13.2.3**.
Assess prevailing and if possible future weather conditions	Determine: • Wind speed and direction; • State of tide and current speed; • Sea state.

7.6 Incident Briefing Checklist

BRIEFING CHECKLIST	
This checklist is designed to facilitate an effective response team briefing and should be used by the IMT Incident Commander when briefing other members of the IMT. **Completed briefing checklist(s) should be kept for inclusion in permanent records**	
STEP	**NOTES**
Extent of Problem Size of spillage, type of oil, source	
Specify Safety Hazards	
Oil Trajectory Tide and Wind conditions	
Response Actions Strategies to consider	
Resource Mobilisation Equipment and personnel	
Planning Cycle Meetings schedule	
Additional Information Communications, Waste Disposal, Weather Forecast	

7.7 Aerial Surveillance Observers Log

Survey Details				
Incident	Date	Observers		
Aircraft Type	Call Sign	Area of Survey		
Survey Start Time	Survey End Time	Average Altitude	Remote Sensing Used	
Weather Conditions				
Wind Speed (knots)		Wind Direction		
Cloud Base (feet)		Visibility (nm)		
Time High Water		Time Low Water		
Current Speed (knots)		Current Direction		

Slick Details							
Slick Grid Parameters by Lat/Long				Slick Grid Parameters by Air Speed		Slick Grid Dimensions	
Length Axis		Width Axis		Length Axis	Width Axis	Length	Nm
Start Latitude		Start Latitude		Time (seconds)	Time (seconds)	Width	Nm
Start Longitude		Start Longitude				Length	Km
End Latitude		End Latitude		Air Speed (knots)	Air Speed (knots)	Width	Km
End Longitude		End Longitude				Length	Km
						Total Grid Area	Km^2

Oil code	**Colour**	**% cover observed**	**Total grid area**	**Area per oil code**	**Factor**	**Oil volume**			
						Min		Max	m^3
0	Clean		Km^2	Km^2	0 m^3 /km^2		-		m^3
1	Silver		Km^2	Km^2	0.04 - 0.3 m^3 /km^2		-		m^3
2	Rainbow		Km^2	Km^2	0.3 – 5 m^3 /km^2		-		m^3
3	Metallic		Km^2	Km^2	5 - 50 m^3 /km^2		-		m^3
4	Discontinuous True Colour		Km^2	Km^2	50 - 200 m^3 /km^2		-		m^3
5	Continuous True Colour		Km^2	Km^2	200 - <200 m^3 /km^2		-		m^3

7.8 Required Information for Dispersant Use

The UK Marine Management Organisation (MMO) has published on its internet web site a list of the latest chemical dispersants approved for use on the UK Continental Shelf. Although the regulations do not cover the Falkland Islands out-with territorial waters, the list of dispersant provided by the MMO has been considered fit for use offshore the Falkland Islands by FIG Department of Natural Resources (Fisheries) in the event of an oil spill:

https://www.gov.uk/government/publications/approved-oil-spill-treatment-products.

During consultation with the Department of Natural Resources (Fisheries) on the use of dispersant, provision of the information in the below table may be useful.

THIS TABLE PROVIDES A CHECKLIST OF INFORMATION TO ASSIST THE DEPARTMENT OF NATURAL RESOURCES (FISHERIES) WHEN APPROVAL FOR THE USE OF CHEMICAL DISPERSANT IS SOUGHT	
Telephone Number: +500 27260 / 27266	**SENT BY: Noble Energy Falklands Limited**
Name of authority or organisation requiring approval: **Noble Energy Falklands Limited**	
Name of contact, telephone and fax number to be used:	
Locality of spill – (in degrees of Latitude and Longitude), plus distance from nearest land fall:	
Water depth in vicinity of spill:	
Oil type or description of appearance if not known. If crude oil, state type.	
Volume of oil spilled:	
Source of oil spill:	
Potential for further spillage:	
Description of oil appearance – including dimensions and colour:	
Name and volume of dispersant for which approval is requested:	
Other methods of response being applied or considered and assistance being sought:	
Local fisheries considerations (e.g. are longlines currently present in the vicinity):	
Local wildlife considerations (e.g. whether significant flocks of birds are present)	

Tide, type and speed and time of HW/LW:
Wind and weather (e.g. 'Moderate breeze NW' or 'Overcast drizzle'):
State of Seas:

7.9 Notification Following Use of Dispersant

The following information may be required by the Department of Natural Resources (Fisheries) following the use of dispersant.

DEPARTMENT OF NATURAL RESOURCES (FISHERIES) NOTIFICATION FOLLOWING DISPERSANT USE	
Telephone Number: +500 27260 / 27266	**SENT BY: Noble Energy Falklands Limited**
Incident no.:	
Volume and type of oil:	
Location:	
Remedial action taken:	
Name and type of oil treatment product:	
Date of manufacture:	
Efficacy last tested (if applicable):	
Comments on effectiveness:	
Report made by:	
Other remarks:	

8 Contacts Directory

CONTACT DETAILS REDACTED FOR PUBLICATION PAGE 1/3

CONTACT DETAILS REDACTED FOR PUBLICATION PAGE 2/3

CONTACT DETAILS REDACTED FOR PUBLICATION PAGE 3/3

PART II

SUPPORTING INFORMATION

Recommended response procedures and actions during an oil spill originating from the NEFL exploration drilling operations.

9 Risk Assessment

This Section identifies the type and size of oil spill that the NEFL oil spill response arrangements may have to cope with. It looks at the oil and gas industry-wide likelihood of spills that could occur from typical operations, gives an overview of the potential 'operational' and 'worst case' scenarios, the fate of the oils involved and the risk of this to the environment. Oil spill history and statistics are largely based on the UK offshore oil and gas industry.

The severity of effects from an oil spill are dependent on a very wide range of factors, including, but not limited to:

- Volume of oil spilled;
- Physical and chemical nature of the oil;
- Location of spill and proximity of shoreline or other sensitivities;
- Weather and sea state conditions during and following the spill;
- Hydrographic conditions;
- Time of year;
- Time of day.

Given this variety of factors, accurate predictions of impacts before an oil spill are difficult to make. In oil spill contingency planning, consideration of environmental resources potentially affected by a spill in conjunction with the results of oil spill modelling allows the identification of likely response options and resource needs. Rapid access to information on the environmental conditions and features is essential in actual or simulated oil spill response.

Two scenarios that could result in a large spill from offshore drilling operations include:

- An incident, such as collision, resulting in loss of oil containment, or
- A loss of well control when drilling in a hydrocarbon bearing formation (blow-out).

9.1 Vessel Collision

An incident, such as a collision, could potentially result in the entire inventory of hydrocarbons stored on a MODU being released to the sea. Statistics illustrate that for all mobile offshore unit types engaged in exploration and production operations on the UKCS between 1990 and 2007, a total collision accident frequency of 0.011 occurrences per unit year was recorded (*OGUK, 2009*). For all fixed unit types on the UKCS during the same period, which includes drilling, production, wellhead, compression, pumping, injection/riser and accommodation type units, a total collision accident frequency of 0.0085 occurrences per unit year was recorded (*OGUK, 2009*).

If a collision between vessels involved in the operations, or with a third party vessel, was to occur, the vessels' inventories of diesel could potentially be released to the sea. In practice it is most likely that any release of hydrocarbons would occur over a period of time. An immediate release could, however, occur in the unlikely event that all compartments/tanks containing hydrocarbons were instantaneously fractured in some way.

9.2 Loss of Well Control

Uncontrolled well flow can be caused by the formation pressures encountered being higher than the hydrostatic pressure exerted either by the drilling mud column or of the sea water. Typically this situation can be encountered in shallow gas pockets or in deeper over pressured formations. Over pressured gas can be exceptionally dangerous due to its extremely rapid expansion as it rises to surface, which can result in explosions and fires if an ignition source is found. Oil can also be over pressured, but liquid hydrocarbons expand far less than a gas as they rise to the surface.

However, in an uncontrolled well flow situation, oil has the potential to cause considerably more pollution.

Incidents such as the Deepwater Horizon Macondo exploration well blow-out in the US Gulf of Mexico in April 2010 and the Montara Platform wellhead incident off the northern coast of Western Australia in August 2009, have served as an unfortunate reminder to the global offshore oil and gas industry of the possibility of serious well control situations occurring. However, it should be noted that despite these significant past events, blow-outs are still extremely rare occurrences. For blow-out incidents on the UKCS for the period 1990-2007, OGUK reports an occurrence frequency of 0.001 per unit year (*OGUK, 2009*).

In response to the above two incidents, the International Association of Oil & Gas Producers (OGP) established the Global Industry Response Group (GIRG) to identify, learn from and apply the lessons of Deepwater Horizon, Montara and similar well control accidents (*OGP, 2011*). This joint industry review process incorporated three main teams, focusing on prevention, intervention and response. Of particular relevance is the output of the Well Engineering Design & Equipment / Operating Procedures Team, which focused specifically on incident prevention. Following the review process, the following general industry-wide recommendations were made on well control incident prevention:

- Creation of a new, permanent, OGP Wells Expert Committee;
- Introduction of a 3-tier review process;
- The promotion of human competency management systems to ensure individual staff and management teams always have the skills they need;
- The promotion of an operational culture that fosters adherence to standards and procedures;
- Recognition of existing international and nationally agreed standards as a baseline for industry improvements;
- New and improved technical and operational practices for the overall governance of well construction;
- Recommend to industry and regulators that a “two barrier” (independent and physical) policy is in place during the life of a well (during the drilling, completion, and abandonment phases of a well, a Blow-out Preventer (BOP) to be regarded as a barrier for the purposes of such a policy).

Despite their rarity and unlikely event of occurrence, very large spills resulting from blow-outs cannot be ruled out and as such, as a contingency for planning purposes, a worst case scenario for all wells is modelled for each project.

NEFL spends considerable time and resources investigating the area of blow-out contingency. This contingency is discussed in detail in **Part II, Section 10.0**.

9.3 Possible Spill Scenarios

The potential worst case spill scenarios are dictated by the oil and fuel inventories on the installation and associated vessels and, once the pay zone has been penetrated, by the reservoir characteristics. In practice, due to precautions such as training, operating procedures and engineered solutions, the majority of oil spills are small, with a low number of larger spills.

Worst case oil spill scenarios have been defined and modelled for the proposed NEFL drilling operations and are included in the relevant Project Specific Appendix located in **Part III** of this document. In all cases, modelling has been undertaken using metocean data obtained from scientifically-validated sources, with full references given.

The types of oil and typical cause of spill are summarised in Table 9.1.

Table 9.1: Potential initiating events that can result in oil spills – drilling phase

	Initiating Event
1	Reservoir blow-out releasing reservoir hydrocarbons
2	Loss of diesel or fuel oil containment during transfer or due to leakage
3	Loss of lubricating oil containment during transfer or due to leakage
4	Loss of hydraulic oil containment during transfer or due to leakage
5	Loss of hydraulic fluid from control equipment due to leakage

9.4 Spill Prevention & Mitigation

9.4.1 Policy & Training

It is NEFL policy that operations will be conducted in such a manner as to minimise the risk of oil spillage and pollution.

Efforts in operational planning are subjected to review to identify potential risks and to ensure that they are properly controlled. These include:

- Programme review meetings (involving all relevant contractors);
- A 'Drill the Well on Paper' (DWOP) held prior to commencement of operations to familiarize the NEFL team and Ocean Rig as well as key Service Companies to the proposed program and to identify any potential final operational issues and enhancements;
- Pre-spud and pre-job (drilling) meetings to review the final well programme(s) in detail, and;
- Hazard and risk identification to test the programme for likelihood and severity of all identified risks.

NEFL will ensure that appropriate oil spill response training is undertaken by key personnel (refer to **Part II, Section 11**). NEFL fully recognises that spills can and do occur and will take the following precautions to reduce the possibility of a spill occurring.

9.4.2 Well Kick

In the unlikely event that a well kick does occur, the well would be shut in using the blow-out preventer (BOP) and monitored. The correct remedial action to be taken will then be implemented. Training is carried out to ensure that the correct actions are taken on the rig in the event of a well kick and these will be in accordance with the drilling contractor's well control procedures or as otherwise specified in the relevant bridging documents.

9.4.3 Hydrocarbon Spills

The five main sources of potential spills, from historical oil spill records, are listed in Table 9.2 together with the measures being taken by NEFL to minimise or eliminate these risks. These are discussed further in the sections below along with the measures proposed by NEFL in the unlikely event that such a spill does occur.

Table 9.2: Sources of oil spills and control measures planned

Potential Source of Spill	Risk and Control Measures Taken
Oil based mud	Wells will be drilled entirely using water based mud (WBM).
Un-burnt hydrocarbons during well testing	No well testing will occur for this drilling programme.
Potential unintentional releases of fuel or other fluids (e.g. diesel, drilling mud, hydraulic oil or lubricants) during day-to-day operations (including re-fuelling)	The drilling rig will be fitted with closed drainage containment, treatment and monitoring systems in all environmentally critical areas as part of the rig specification. Procedures for drainage water management will be addressed within the drilling contractor's documentation and the Discharge Management Programme (DMPO). NEFL will ensure that the drilling and OSV contractors have procedures for fuel bunkering. These procedures will be subject to audit/assessment prior to drilling operations commencing. Offshore bulk materials and fluid transfers will be minimised where possible, making efficient use of OSV loads and voyages. Re-fuelling and transfer of bulk fluids will be undertaken during daylight hours only. Fluid transfer and crane operations will take place only in suitable weather conditions. Transfer operations will be supervised at all times both from the OSVs and drilling rig. Non-return valves will be installed on bulk fluid transfer hoses. Hoses will be tested and inspected as a part of the drilling contractor's planned maintenance system / procedure. Spill kits will be readily available on deck for mopping up any minor spills. Personnel will be trained in unintentional release prevention and the use of spill kits. Regular drills will be held to contain and clean up deck spills. To prevent losses of drilling mud, the marine riser system will be operated and maintained in good order as per NEFL and drilling contractor policies, including: • Lower Marine Riser Package (LMRP) to have integrated Remotely Operated Vehicle (ROV) remote interfaces for emergency use; • Use of low pressure alarms in the riser system; • Rig Emergency Disconnect System (EDS) locked-out in normal operation; • Regular LMRP inspection with rig ROV; and • Regular riser-tensioner system inspection. All contracted vessels will have a Ship-board Oil Pollution Emergency Plan (SOPEP) in place to define their response procedures in the event of a pollution incident. Drilling chemicals will be selected on the basis of environmental performance as much as possible within the mud programme, so as to reduce any potential environmental impacts. NEFL will have Tier 1 response packages available in order to provide a timely and efficient Tier 1 spill response effort. This equipment may be mobilized to augment a vessel contractor implementing their SOPEP.
An emergency incident (e.g. vessel collision), leading to potential unintentional releases	A 500 metre radial safety zone will be implemented around the drilling unit whilst on location which will be applicable to all third-party vessels, to reduce the potential for a collision with the drilling unit. The 500 metre safety zone will be patrolled and enforced by a Safety Stand-by Vessel (SSV), which will be in attendance in the vicinity of the drilling unit at all times. Up to 3 OSVs will be used throughout the drilling programme. At all times, the role of SSV will be undertaken by one of these OSVs to patrol the safety zone and warn of the presence of the drilling unit and vessel safety zone. All OSVs will be equipped with modern radar and radio equipment. A set of procedures will be established so that vessel masters, who need to deviate from their planned route based on their current sea passage trajectory, will

	be asked by the SSV via VHF radio to confirm that they intend to follow the requirements of the drilling rig Automatic Identification System (AIS) warnings. The SSV will maintain close contact with the third-party vessel until they have changed their course away from entering the safety zone. Due regard will also be given by the officers on watch on board the OSVs to fellow sea users at all times, in line with the International Regulations for Preventing Collisions at Sea (COLREGs). Any fishing vessel encountered by the OSVs in transit to/from the drilling unit shall be given a wide berth in full cooperation with any flags, symbols or other instructions that the fishing vessel may be displaying or may issue via VHF. The emergency management plans and procedures of the drilling unit and OSVs will be verified by NEFL for adequacy to respond to a potential collision threat. This shall include the threat of collision from icebergs. The Falkland Islands Fishing Companies Association (FIFCA), Consolidated Fisheries Limited (CFL) and Falkland Islands Government (FIG) will be notified, in writing, a minimum of 30 calendar days before the start of drilling activities, so that fishing vessels can plot the drilling location on marine charts, avoid the safety zone and plan their sea passage to/from any favoured fishing grounds accordingly. NEFL will liaise with the Fisheries Department and CFL with regard to the issue of navigation warnings advertising the presence of the drilling rig through the existing Fisheries Department Daily Shipping Forecast system. The information provided will include details on the current position of the drilling rig, presence of the OSVs, description of the 500 metre radial safety zone and the need for vessels to stay outside of this zone at all times. A message will be attached to the drilling unit's AIS to provide an identical set of information to the Daily Shipping Forecast described above. The drilling rig will be fitted with navigational lighting and a radar transponder to show its position to third-party vessels visually, and also through the use of radar equipment. Standard Marking Schedule provisions or International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) recommendations and guidelines will be adhered to during operations and transit to and from Stanley Harbour and the rig location by OSVs. Details of the as-built well locations will be provided to FIG and to hydrographic organisations to enable the location of the wells to be plotted onto navigational charts. Pre-mobilisation audits/assessments will be undertaken on all vessels. Vessels will be selected which comply with IMO codes for pollution prevention. All contracted vessels will have a SOPEP in place to enable fast and effective response to any potential pollution incident. In addition to this OSRP, an Emergency Management Plan (EMP) will be developed and implemented prior to drilling operations commencing. NEFL will have Tier 1 response packages available in order to provide a timely and efficient Tier 1 spill response effort. This equipment may be mobilized to augment a vessel contractor implementing their SOPEP.
Uncontrolled release of reservoir hydrocarbons (blow-out)	The drilling operations will follow established drilling safety standards to minimise the risk of loss of well control. Well control systems and procedures will be in place as per all NEFL and drilling contractor well control guidelines. The drilling crews will be adequately experienced, trained in well control techniques and supervised at all times. Emergency drills will be held regularly. Well designs will be reviewed by an independent well examiner. A Blow-out Preventer (BOP) will be in place and will be subject to regular maintenance and testing. BOP equipment/controls and emergency/contingency controls will be tested both prior to and

	immediately after deployment onto the wellhead. The BOP will be subject to a third party verification and audit prior to drilling operations commencing. The BOP specification will include one (1) shear ram, one (1) casing shear ram and a ROV remote interface to key BOP functions for emergency use. All key offshore personnel will have International Well Control Forum (IWCF) well control certification. NEFL is a FULL member of Oil Spill Response Limited (OSRL) and has a contract with National Response Corporation (NRC), providing an enhanced Tier 2 or 3 oil spill response capability (refer to Tier 2 or 3 response below). NEFL is a member of the Global Dispersant Stockpile provided by OSRL for the purpose of responding to unintentional releases. In addition to this OSRP, an Emergency Management Plan (EMP) will be developed and implemented prior to drilling operations commencing. Further information on well control contingency is provided in **Part II, Section 10**.

10 Well Control Contingency

A blow-out is the uncontrolled influx of reservoir fluids into a well. Due to the precautions taken to prevent their occurrence, they are very rare events. Uncontrolled flow is mostly associated with drilling into a shallow gas pocket or whilst drilling a deep gas well. The chance of uncontrolled flow occurring from an oil well during drilling is extremely small.

The testing and operation of the BOP system on board a rig is carried out in accordance with the NEFL's and the drilling contractor's well control procedures.

10.1 Insurance & Indemnity Provision

NEFL confirms that, in accordance with good industry practice, it is covered under an appropriate Energy Insurance package which includes Control of Well, Re-drilling, Pollution and Third Party Liability cover.

The limits procured by NEFL are in keeping with standard industry levels and are, for most covers, purchased as amounts per incident and not per annum.

10.2 Relief Wells

If primary[1] and secondary[2] well control is lost and oil flows uncontrollably from a well to the sea surface, then a relief well may be required to relieve reservoir pressure and bring the well back under control.

A relief well is a directional well, designed to intersect and communicate with a blow-out well in order to:

- Establish direct communication with the blow-out well bore;
- Provide a conduit through which kill fluids can be pumped to control the blow-out; and
- Provide a means to abandon a blow-out well (which may have been capped).

(*OGUK, 2012*)

The purpose of drilling a relief well is to kill an uncontrolled hydrocarbon flow from a blow-out well that cannot be reliably controlled by capping operations alone, either at the surface or at the wellhead. Relief wells may also be used to successfully abandon a blow-out well that has successfully been capped (*OGUK, 2012*).

In the event of a serious well control incident, threatening the safety of the installation and crew, the installation will disconnect from the well using the emergency disconnect system (EDS), and move away from location if possible. However, during a serious well control incident, the primary drilling rig may be damaged, or otherwise rendered un-useable. Therefore, an additional suitable drilling rig may be required to conduct relief well drilling operations.

Any decisions relating to the drilling of relief wells will be taken by the Offshore Drilling Director of NEI with support advice being provided by the NEFL Drilling Superintendent.

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[1] Primary well control is achieved by keeping the wellbore full of drilling fluid with an appropriate density so that the force exerted by the mass of the drilling fluid column is greater than the force exerted by the formation pore pressures encountered during drilling. The drilling fluid programme for an exploration well is designed to provide drilling fluids with adequate densities to exert a force greater than the formation pressures expected in the lithology, whilst at the same time limiting the mud densities to prevent formation breakdown and possible damage. Normal practice is to operate with approximately 200 psi of overbalance (positive differential pressure) between the mud column hydrostatic pressure and the estimated formation pressure.

[2] Secondary well control is provided by the Blowout Preventer (BOP) system and is required when primary control fails to prevent an influx of reservoir fluids into the well bore.

A number of elements are required in order to provide an effective relief well blowout contingency. These include relief well locations, relief well designs, relief well equipment, alternative rigs and access to well control specialist services and equipment.

10.3 Relief Well Locations

Suitable locations on the seabed for potential relief wells will be identified by NEFL based on a well design profile that optimally intersects the reservoir which is blowing out. Prior to spud of the primary well, a detailed shallow hazard assessment will be conducted to determine hazard free locations from where a relief well could be drilled. Where possible, at least two locations will be identified to provide multiple options in the event of an emergency incident.

Each relief well shallow hazard assessment will be modified / updated with the data obtained from the drilling of the reservoir interval on the primary well. The well design will remain largely unchanged regardless of which surface location is chosen. The final trajectory of any relief well will be modified to reflect the required azimuth dependant on the surface location chosen for the relief well. Relief well locations will also be selected to take account of the prevailing wind and current directions.

10.4 Relief Well Designs

Where possible, NEFL will undergo contingent relief well design based on the key design rationales of the well, and in accordance with the OGUK Relief Well Planning Guidelines (*OGUK, 2012*).

In a scenario where the relief well was required, this design would be reviewed and amended to incorporate key findings from the drilling of the primary wellbore and to meet the specific intersection objectives of the relief well, before the well design would be finalised and executed. This 'fine-tuning' of the well design would occur during the mobilisation of the relief well drilling rig and the specialist equipment required for the well. A final well trajectory for the relief well will be prepared during this time. The final trajectory design will need to be modified to reflect:

- The 'as-drilled' trajectory of the well being drilled in order to allow an intercept. Measurement while drilling (MWD) directional surveys of the primary well bore (to include inclination, azimuth and TVD) will have been measured and subject to QA/QC every 90 feet in order to accurately plot the main well trajectory. This will allow the relief well to be targeted accurately for a successful interception and ultimately a well kill operation.
- The depth at which intercept is required depending on the location of the blowout zone in the primary wellbore.

Any relief well would have casing set just above the primary well intercept point and would then require the drill string to be run with a retrievable packer, set just above the casing shoe. The BOPs would then be closed around the drill string prior to commencing kill operations by pumping kill weight fluid at a high rate using the rig's mud pumps. The precise amount of time to kill the primary well would depend very much on the condition of the damaged formations and the amount of exposed reservoir in pressure communication with the primary well.

Planning for the relief well will also include a review of why the original well blew out and changes to well design, well equipment and operating procedures may be included in the relief well drilling programme.

10.5 Well Control Specialist Services & Equipment

NEFL has in place a call off contract with Wild Well Control (WWC), a well control specialist services company. They specialise in drilling relief wells and controlling blowouts.

For relief well drilling, WWC will provide specialised drilling equipment such as magnetic ranging tools and expertise in planning and executing relief well operations.

WWC will also provide a variety of surface and subsea equipment to aid in tackling the surface effects of a blow-out. This includes fire fighting and debris clearance equipment. They also maintain close links with the owners and operators of specialised support vessels and heavy transport aircraft, which would be required to aid the control of blow-out wells and the drilling of relief wells.

10.6 Alternative Rigs for Relief Well Drilling

The water depths and environmental conditions encountered in the vicinity of the proposed exploration wells offshore the Falklands define the area as a harsh environment for drilling units. In the event that an alternative unit was required for relief well drilling, NEFL would initially be looking for a suitably equipped semi-submersible drilling unit that could be located at the relief well spud location.

It must be recognised that any negotiation for a rig to drill a relief well may take some time in order to agree legal, liability and insurance provisions. Furthermore, it would take some time for the rig to suspend operations on its current well (if applicable) before mobilising to the proposed relief well top-hole location. These activities may take several weeks to achieve before the rig was ready to mobilise. However, it should be noted that every effort would be made to reduce this timeframe, potentially commencing rig mobilisation whilst finalising contractual details pertaining to the drilling of the relief well.

10.7 Subsea Well Response Project

The Subsea Well Response Project (SWRP) is an international cooperation of major oil and gas companies to work together to strengthen existing capabilities and enhance the industry's subsea well intervention capabilities. Identifying, implementing and maintaining capping and/or containment solutions that can be used in different regions in the world is a complex and significant task for the experts that make up the SWRP team (*SWRP, 2014*).

Recent well control incidents have highlighted the need for the oil and gas industry to be able to cap and/or contain flowing wells with greater speed and efficiency. The Deepwater Horizon Macondo response involved the design and deployment of new technologies and methods, and the industry is now focusing on how to apply these to a range of potential circumstances in different regions of the world (*SWRP, 2014*).

Through collaboration with OSRL, new integrated subsea well intervention and capping equipment is now available worldwide to the wider industry. Four capping stack toolboxes (manufactured by Trendsetter Engineering) are available, positioned at four strategic locations around the globe:

- Two 18 3/4" bore capping stacks developed to handle pressure up to 15kpsi (positioned in Brazil and Norway);
- Two 7 1/16" bore capping stacks designed for pressure up to 10kpsi (positioned in Singapore and South Africa).

This equipment should enable the industry to cap most subsea oil wells in water depths of up to 3,000 metres. In addition to the above well intervention and capping equipment, two Subsea Incident Response Toolkits for the subsea application of dispersant are also available, located in Brazil and Norway. These two hardware kits include:

- Tools for site surveys prior to commencement of work (e.g. 2D and 3D sonar);
- Debris clearing equipment with cutting, grappling and dragging tools to gain access to the blowout preventer (BOP) where necessary;
- Flying leads, distribution manifold and dispersant wands to inject dispersant at multiple locations;
- High pressure, high volume accumulators for closing the existing BOP.

The above equipment is available to the industry through membership of OSRL, via the Subsea Well Intervention Service (SWIS) now offered by OSRL. Further information on the SWIS is provided on the OSRL website: http://www.swis-oilspillresponse.com/index.php/node/10000.

10.8 Lessons from the Macondo and Montara Well Control Incidents

NEFL has kept abreast of the investigations and reports pertaining to the two significant well control incidents that occurred in recent history; the Deepwater Horizon incident at the Macondo well in the US Gulf of Mexico in 2010 and at the Montara platform in the Australian waters of the Timor Sea in 2009.

A number of reports from the relevant government bodies, oil companies and drilling contractors pertaining to these two incidents have been made available in the years following the incidents. NEFL has reviewed the key findings from these reports and has addressed these findings as follows:

- A detailed gap analysis against the technical recommendations for subsea BOPs has been conducted to ensure that the chosen BOP and control systems include the recommended design features, such as:
    - Two sets of shear rams, including casing shear rams;
    - An Emergency Disconnect System (EDS) appropriate to the NEFL wells;
    - A dual dead-man emergency system;
    - ROV remote interfaces to key BOP functions, including shear rams and LMRP connector;
    - Acoustic backup system capable of operating key functions in the event of a loss of the primary BOP control system.
- A BOP Risk Assessment has been conducted to assess the required BOP configuration for the specific drilling conditions. This assessment also addressed the issues pertaining to surface equipment and procedures such as the use and line up of mud gas separators, trip tanks and similar systems;
- The BOP has been subject to a third party verification and audit prior to mobilisation;
- BOP equipment / controls and emergency / contingency controls will be tested on surface before deployment and again after the BOP has been landed on the wellhead. Regular pressure and function testing will be conducted thereafter to confirm the continued operation and reliability of the equipment;
- The chosen rig will have a Vessel Specific Safety Case. This document contains details of the rig's safety management, risk assessment process, safety observation programme, competence & training, and the written scheme of verification for safety critical elements. These elements are pertinent to a number of the findings from both the Deepwater Horizon and Montara Platform incidents;
- Two tested barriers will be required at all times where there is a potential for hydrocarbons in each section of a well. This is a requirement under both drilling contractor well control policy and NEFL drilling policies and well engineering guidelines;
- Two independent methods of monitoring well volumes will be provided and maintained at all times when the BOP is deployed;
- All work instructions will be issued in writing;
- Management of Change (MoC) processes will be followed for any changes that could affect the integrity of the well design. NEFL has well-defined MoC requirements applied to all offshore projects;

- All key onshore and offshore personnel will have International Well Control Forum (IWCF) well control certification;
- Briefing sessions will be held with key personnel prior to commencing operations in order to ensure that well plans, well hazards, well control plans and safety behaviour expectations (including the expectation to 'stop the job' due to safety / risk concerns) are clearly communicated.

11 Training & Exercises

11.1 Falkland Islands National Oil Spill Contingency Plan

It is NEFL's intent to maintain the capability for a rapid and effective response to a spill during its offshore operations. Key offshore and onshore personnel responsible for managing the response to an oil spill will receive appropriate training prior to commencement of drilling operations. This will include drilling rig personnel, OSV personnel, members of the NEFL Incident Management Team (IMT) and the NEI Corporate Support Team (CST). This will facilitate a good understanding of oil spill equipment and strategies throughout the emergency response structure such that robust support can be provided and sound decisions can be made in the event of a spill.

Specific training involves familiarisation with this OSRP. The objective is that the personnel required to respond in the event of a spill fully understand their particular responsibilities, as well as be familiar with the OSRP as a whole.

NEFL will familiarise contractors on the content of this OSRP and their expected actions prior to the commencement of operations. This will be achieved via bridging documentation, pre-mobilisation meetings and by inductions for rig personnel.

NEFL has a policy to maintain core personnel trained in oil spill response. Key offshore and onshore personnel responsible for managing the response to an oil spill will receive appropriate and periodic training and refresher courses as shown in Table 11.1. This will include key contractor personnel.

Table 11.1: Training level required according to responsibility

Responsibility	Training Level	Suggested Duration	Frequency
OIM	Offshore On Scene Commander (UK DECC Level 1)	4 hours	To be repeated every 3 years
NEFL IMT members	Onshore Emergency Responder (IMO Level 2 / UK DECC Level 4)	24 hours	Refresher course every 3 years (1 day)
NEI CST members	Corporate Management (UK DECC Level 2)	4 hours	To be repeated every 3 years

11.2 Exercises & Drills

There will be regular exercises wherein the OSRP as a whole is tested for a Tier 1, Tier 2 or Tier 3 oil spill, to familiarise personnel with the interfacing requirements between organisations and in co-ordination of the response as a whole.

NEFL will ensure that the exercises presented below in Table 11.2 will be conducted as a minimum.

11.3 Recording of Exercises

A record of all exercises undertaken by NEFL must be maintained at the location where the exercise was conducted, either onshore or offshore. Records should include the exercise scenario, aims of the exercise, lessons learned and actions put in place in response to lessons learned.

Table 11.2: NEFL oil pollution incident response exercise requirements

Type of Exercise	Frequency	Aim
Full Desktop Exercise/ Offshore OPEP	Once per shift per year	The aim of this exercise is to ensure that all personnel involved with pollution response are familiar with their OSRP and associated responsibilities. The scenario chosen must be realistic, leading to activation and therefore testing of the OSRP to at least a Tier 2 level. This must involve exercising the communication interfaces between response teams and include any contracted response provider. As a minimum, this must be tested annually. Any lessons learned should be fed back into the adjustment and improvement of the OSRP and any internal processes as necessary. If exercises are combined with a safety exercise, the scenario chosen must meet the above requirements.
OSRP Communications / Pre-spud Exercise	1 per well, once per year as a minimum	A small desktop exercise and communications test is conducted prior to commencing any new drilling operations, to ensure that lines of communication are clear and that all contact details are verified as correct. The main purpose of the exercise is to test communications between the rig, the IMT, CST, spill response contractors, and other principal contractors.
Offshore Deployment of Tier 1 Dispersant Spraying Equipment (if identified for use under Tier 1 response).	Monthly, or in accordance with manufacturers guidelines.	If included in the OSRP as part of a potential Tier 1 response strategy, dispersant spraying equipment must be tested at monthly intervals or in accordance with the manufacturer's guidance. Please note it is the spraying equipment which must be tested, NOT the dispersant; Equipment should be run up with water, NOT dispersant.
Offshore Deployment of Tier 1 Oil Recovery Equipment (if identified for use under Tier 1 response).	Once per year	Tier 1 oil recovery equipment held on the OSVs must be tested and deployed once per year.
Industry Deployment of Tier 2 or 3 Oil Spill Response Equipment (*to test Tier 2 or 3 Contractors*).	3 Yearly (takes place on the UKCS)	NEFL will ensure that their Tier 2 or 3 response equipment and resources are tested and deployed every three years. It is recognised that many operators utilise the same response companies and therefore each response company need only be tested once in every three years on behalf of each operator holding a contract with them. Results will be collated by the operator undertaking the exercise and feedback and learning will be shared with other operators contracted to the same response company. NEFL must be made aware by OSRL of any exercises taking place and be provided with a copy of the final exercise report*.

** Note: The last industry wide Tier 2 or 3 deployment exercise (Exercise 'Dragon') took place in the East Irish Sea in September 2014. The final exercise report is due to be released in Q2 2015.*

12 Fate & Effects of Oil in the Marine Environment

12.1 Oil Types

The International Tanker Owners Pollution Federation (ITOPF) has ranked oils according to their physical characteristics (API / SG) and likely spill behaviour:

ITOPF Categories

Group 1	SG <0.8	API >45	**Light**
Group 2	SG 0.8-0.85	API 45-35	↓
Group 3	SG 0.85-0.95	API 35-17.5	
Group 4	SG >0.95	API <17.5	**Heavy**

The expected short-term removal rates of these oils from the sea surface are shown in Figure 12.1. Group I oils are rapidly removed and Group II oils first undergo emulsification before being relatively quickly removed from the sea surface. Group III and IV oils have a greater tendency to persist for longer in the marine environment due to their greater density. Figure 12.2 illustrates some examples of common crude oils and their relevant oil group, according to the ITOPF group classification.

Figure 12.1: The Rate of Removal of Oil from the Sea Surface According to Type (the volume of oil and oil-in-water emulsion remaining on the sea surface is shown as a percentage of the volume spilled) (ITOPF, 2002)

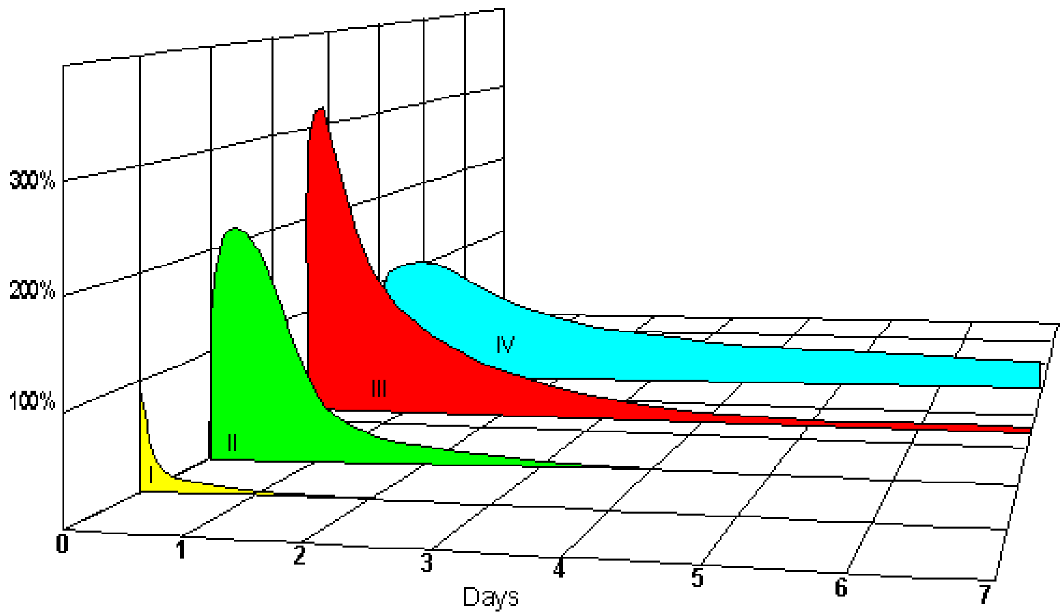


Figure 12.2: Classification of oils according to their specific gravity (ITOPF, 2014a)

Group 1 oils

A: °API >45 (Specific Gravity <0.8)
B: Pour point °C
C: Viscosity @ 10-20°C: less than 3 CSt
D: % boiling below 200°C: greater than 50%
E: % boiling above 370°C: between 20 and 0%

	A	B	C	D	E
Aasgard	49	-28	2 @ 10°C	58	14
Arabian Super Light	51	-39	2 @ 20°C		
Cossack	48	-18	2 @ 20°C	51	18
Curlew	47	-13	2 @ 20°C	57	17
F3 Condensate	54	<-63	1 @ 10°C	81	0
Gippsalnd	52	-13	1.5 @ 20°C	63	8
Hidra	52	-62	2.5 @ 10°C	60	11
Terengganu Condensate	73	-36	0.5 @ 20°C	>95	0
Wollybutt	49	-53	2 @ 20°C	55	4
Gasoline	58		0.5 @ 15°C	100	0
Kerosene	45	-55	2 @ 15°C	50	0
Naptha	55		0.5 @ 15°C	100	0

Group 2 oils

A: °API 35-45 (Specific Gravity 0.8-0.85)
B: Pour point °C
C: Viscosity @ 10-20°C: between 4 CSt and semi-solid
D: % boiling below 200°C: between 20 and 50%
E: % boiling above 370°C: between 15 and 50%

	A	B	C	D	E
Low pour point <6°C					
Arabian Extra Light	38	-30	3 @ 15°C	26	39
Azeri	37	-3	8 @ 20°C	29	46
Brent	38	-3	7 @ 10°C	37	33
Draugen	40	-15	4 @ 20°C	37	32
Dukhan	41	-49	9 @ 15°C	36	33
Liverpool Bay	45	-21	4 @ 20°C	42	28
Sokol (Sakhalin)	37	-27	4 @20°C	45	21
Rio Negro	35	-5	23 @ 10°C	29	41
Umm Shaif	37	-24	10 @ 10°C	34	31
Zakum	40	-24	6 @ 10°C	36	33
Marine Gas oil (MGO)	37	-3	5 @ 15°C	-	-
High Pour Point >5°C					
Amna	36	19	semi-solid	25	30
Beatrice	38	18	32 @ 15°C	25	35
Bintulu	37	19	semi-solid	24	34
Escravos	34	10	9 @ 15°C	35	15
Sarir	38	24	semi-solid	24	39
Statfjord	40	6	7 @ 10°C	38	32

Note: High pour point oils only behave as Group 2 at ambient temperatures above their pour point. Below this treat as Group 4 oils.

Group 3 oils

A: °API 17.5-35 (Specific Gravity 0.85-0.95)
B: Pour point °C
C: Viscosity @ 10-20°C: between 8 CSt and semi-solid
D: % boiling below 200°C: between 10 and 35%
E: % boiling above 370°C: between 30 and 65%

	A	B	C	D	E
Low pour point <6°C					
Alaska North Slope	28	-18	32 @ 15°C	32	41
Arabian Heavy	28	-40	55 @ 15°C	21	56
Arabian Medium	30	-21	25 @ 15°C	22	51
Arabian Light	33	-40	14 @ 15°C	25	45
Bonny Light	35	-11	25 @ 15°C	26	30
Iranian Heavy	31	-36	25 @ 15°C	24	48
Iranian Light	34	-32	15 @ 15°C	26	43
Khafji	28	-57	80 @ 15°C	21	55
Sirri	33	-12	18 @ 10°C	32	38
Thunder Horse	35	-27	10 @ 10°C	32	39
Tia Juana Light	32	-42	500 @ 15°C	24	45
Troll	33	-9	14 @ 10°C	24	35
IFO 180	18-20	10-30	1,500-3,000 @ 15°C		-
High pour point >5°C					
Cabinda	33	12	semi-solid	18	56
Coco	32	21	semi-solid	21	46
Gamba	31	23	semi-solid	11	54
Mandji	30	9	70 @ 15°C	21	53
Minas	35	18	semi-solid	15	58

Note: High pour point oils only behave as Group 3 at ambient temperatures above their pour point. Below this treat as Group 4 oils.

Group 4 oils

A: °API <17.5 (Specific Gravity >0.95)
B: Pour point >30°C
C: Viscosity @ 10-20°C: between 1,500 CSt and semi-solid
D: % boiling below 200°C: less than 25%
E: % boiling above 370°C: greater than 30%

	A	B	C	D	E
Bachaquero 17	16	-29	5,000 @ 15°C	10	60
Boscan	10	15	semi-solid	4	80
Cinta	33	43	semi-solid	10	54
Handil	33	35	semi-solid	23	33
Merey	17	-21	7,000 @ 15°C	7	70
Nile Blend	34	33	semi-solid	13	59
Pilon	14	-3	semi-solid	2	92
Shengli	24	21	semi-solid	9	70
Taching	31	35	semi-solid	12	49
Tia Juana Pesado	12	-1	semi-solid	3	78
Widuri	33	46	semi-solid	7	70
IFO 380	11-15	10-30	5,000-30,000@15°C		-

Example oils classified according to their °API (American Petroleum Institute gravity). Indicative ranges of expected viscosities and distillation characteristics are provided for each oil Group. Generally, persistence when spilled increases with Group number. However, if an oil, once spilled, cools to below its pour point temperature, it will change state from a liquid to a semi-solid (waxing point). This can occur for certain oils irrespective of whether they are classified as Group 2, 3 or 4. The pour points of oils classed as Group 1 oils are sufficiently low that this phenomenon does not occur.

12.2 Fate of Spilled Oil

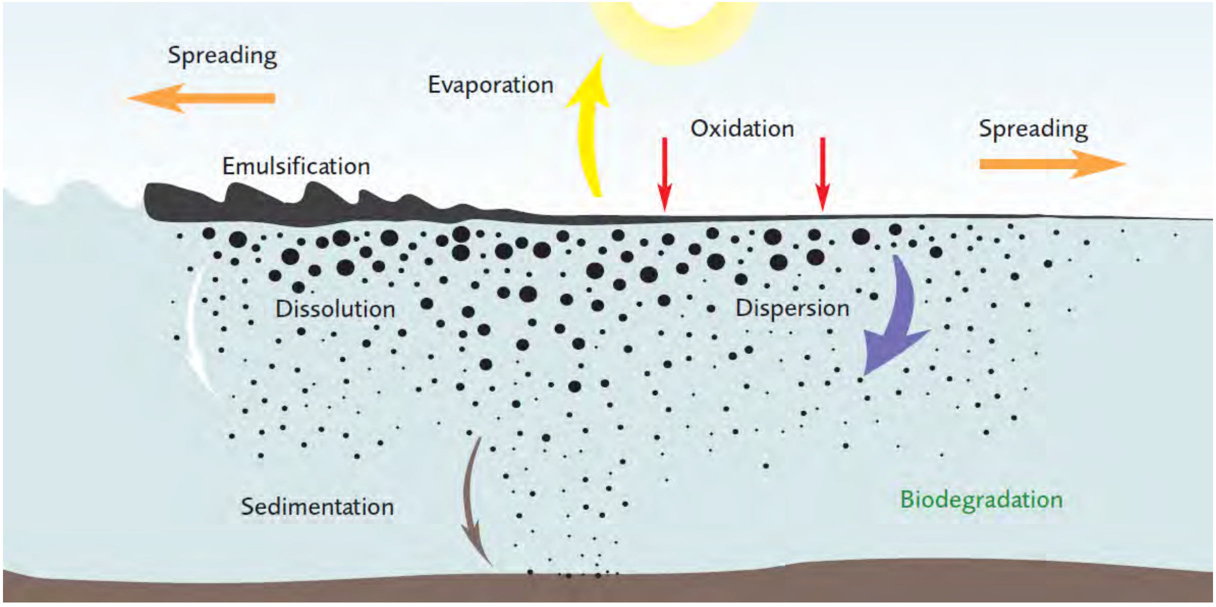
Oil, spilled offshore, will normally break up and dissipate into the marine environment over time. This dissipation is a result of several chemical and physical processes that progressively alter the make-up of the oil from when it was initially spilled. These processes are collectively known as weathering.

Figure 12.3 illustrates the main weathering processes. Oils are termed persistent or non-persistent depending on how quickly an oil slick breaks up and dissipates. Light products such as

diesel and kerosene under most conditions, evaporate and dissipate quickly and naturally, and rarely need cleaning-up. In contrast, persistent oils, such as many crude oils, break up and dissipate more slowly and may require a clean-up response. Physical properties such as the density, viscosity, wax content and pour point of the oil all affect its behaviour.

As soon as oil is spilled, it starts to spread out over the sea surface, initially as a single slick. The speed at which this takes place depends largely on the viscosity of the oil. Fluid, low viscosity oils spread more quickly than those with a high viscosity. Normally, slicks quickly spread over the sea surface. Typically, spreading is not uniform with large variations in the thickness of the oil. After a few hours the slick will begin to break up and, because of wind and wave action, will form narrow bands, or windrows, in parallel to the wind direction. The rate at which the oil spreads is also determined by the prevailing conditions such as temperature, water currents, tidal streams and wind speeds.

Figure 12.3: Fate of spilled oil (ITOPF, 2014b)



There are eight main oil weathering processes; these are described in Table 12.1.

Table 12.1: Oil spill weathering processes (ITOPF, 2014b)

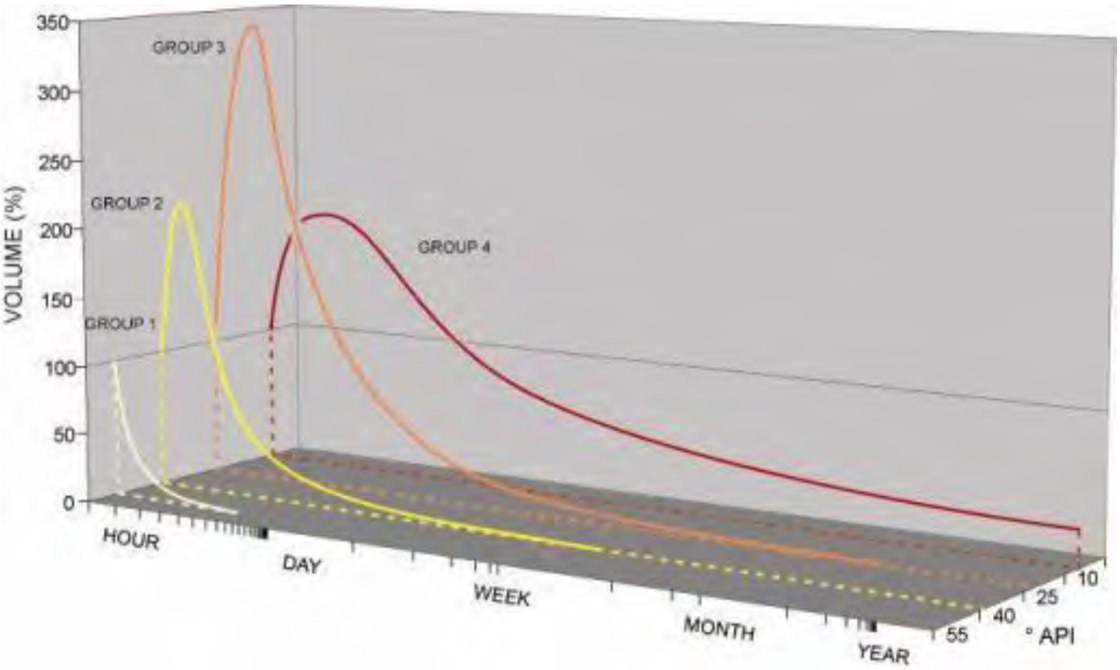
Process	Description
Evaporation	Lighter components of oil evaporate to the atmosphere. The amount of evaporation and the speed at which it occurs depend upon the volatility of the oil and the ambient temperature. Oil with a large percentage of light and volatile compounds will evaporate more than one predominantly composed of heavier compounds. For example, kerosene and diesel oils tend to evaporate almost completely within hours to days while little evaporation occurs from a heavy fuel oil. In general, in temperate conditions, those components of the oil with a boiling point under 200°C tend to evaporate within the first 24 hours. Evaporation can increase as the oil spreads, due to the increased surface area of the slick. Rough seas, high wind speeds and high temperatures tend to increase the rate of evaporation and thus the proportion of oil lost by this process.
Dispersion	Waves and turbulence at the sea surface can cause a slick to break up into fragments and droplets of varying sizes which become mixed into the upper levels of the water column. Some of the smaller droplets will remain suspended in the sea water while the larger ones, with greater buoyancy, will tend to rise back to the surface, where they may either coalesce with other droplets to reform a slick or spread out to form a thin film. Small droplets have a greater surface area which facilitates other natural processes such as dissolution, biodegradation and sedimentation. The speed at which an oil disperses is largely dependent upon the nature of the oil and the sea state, and occurs most quickly if the oil is light and of low viscosity and if the sea is very rough. A combination of these factors led to the complete dispersion of the oil (light Norwegian crude) spilled from the MV BRAER at the Shetland Islands in 1993. The use of chemical dispersants can accelerate the process of dispersion.
Emulsification	An emulsion is formed when two liquids combine, with droplets of one becoming suspended in the other. In emulsification of crude oils, seawater droplets become suspended in the crude. This occurs as a result of physical mixing promoted by wave action. The emulsion thus formed is usually very viscous and more persistent than the original oil and is often referred to as chocolate mousse because of its appearance. The formation of these emulsions causes the volume of the slick to increase between three and four times, and slows and delays other processes which cause the oil to dissipate. Emulsions are not normally amenable to chemical dispersants. Oils with an asphaltene content greater than 0.5% tend to form stable emulsions which may persist for many months after the initial spill has occurred. Oils with a lower asphaltene content are less likely to form emulsions and more likely to disperse. Emulsions may separate back into oil and water again if heated by sunlight under calm conditions or when stranded on shorelines.
Dissolution	Some compounds in oil are water soluble and will dissolve into the surrounding water. The proportion dissolving depends on the composition and state of the oil, and occurs most quickly when the oil is finely dispersed in the water column. Components that are most soluble in seawater are the light aromatic hydrocarbons compounds such as benzene and naphthalene. However, these compounds are also those first to be lost through evaporation, a process which is 10-100 times faster than dissolution. In contrast to diesel, crude oil contains only small amounts of these compounds making dissolution one of the less important processes.
Oxidation	Oils react chemically with oxygen either breaking down into soluble products or forming persistent tars. This process is promoted by sunlight. This process is very slow and even in strong sunlight, thin films of oil break down at no more than 0.1% per day. The formation of tars can form an outer protective coating of heavy compounds that result in the increased persistence of the oil as a whole. Tarballs, such as found on shorelines, have a solid outer crust surrounding a softer, less weathered interior and are a typical example of this process.

Process	Description
Sedimentation/ Sinking	Seawater has a density of approximately 1.025 and very few types of crude are dense enough or weather sufficiently, so that their residues will sink in the sea. Sinking is usually caused by the adhesion of sediment particles or organic matter to the oil. In contrast to offshore, shallow waters are often laden with suspended solids providing favourable conditions for sedimentation. Oil stranded on sandy shorelines often becomes mixed with sand. If this mixture is then washed off the beach into the sea it is likely to sink. In addition, if the oil is burned after it has been spilled, the tarry residues may be sufficiently dense to sink.
Biodegradation	Sea water contains a range of micro-organisms that can partially or completely break down the oil to water soluble compounds (and eventually to carbon dioxide and water). Many types of hydrocarbon bacteria exist and each tends to degrade a particular group of compounds in crude oil. However, some compounds in oil are very resistant to attack and may not degrade. The main factors affecting the efficiency of biodegradation are the levels of nutrients in the water, temperature and the level of oxygen present. The creation of oil droplets, either by natural or chemical dispersion, increases the surface area of the oil thus increasing the area available for biodegradation to take place.

The processes of spreading, evaporation, dispersion, emulsification and dissolution are most important early on in a spill whilst oxidation, sedimentation and biodegradation are more important later. To predict how different oils change over time whilst at sea, some simple models have been developed based on oil type. Generally, oils with a lower density will be less persistent. However, some apparently light oils can behave more like heavy ones due to the presence of waxes.

One such model uses the half-life (the time needed for 50% of the oil to disappear from the sea surface) for the four oil groups to describe the long-term persistence and the time needed for the oil to dissipate (Figure 12.4). After six half-lives have passed, about 1% of the oil will remain. Weather and climatic conditions will alter the rates shown. For example, in rough weather, a Group 3 oil may dissipate in a timescale similar to a Group 2 oil.

Figure 12.4: Volume of oil and water-in-oil emulsion remaining on the sea surface, as a percentage of the original volume spilled (ITOPF, 2014b)



12.3 Refined Product Oil Properties and Behaviour

Within the oil and gas industry there are a number of refined oil products in use offshore. These are commonly diesel fuel oil, lubricants and hydraulic oil, and jet fuel. These products are often difficult to classify in terms of the ITOPF oil groups described above. Therefore, a brief overview of their physical properties and behaviour in the marine environment once spilled is given here.

12.3.1 Diesel

Diesel Fuel Oil (also referred to as fuel oil or DERV), has very high levels of light ends (short-chained hydrocarbons), spreading rapidly and evaporating quickly upon release into the marine environment. The negligible asphaltene content inhibits the oil emulsifying, preventing the increase in volume and persistence of the oil.

DIESEL	
Physical Properties	**Chemical Properties**
High evaporative loss, ca. 15–20% or more within the first hour or so. Low density (ca. 0.83) ITOPF Group 2	Moderate volatility No asphaltenes Negligible wax content
Water in Oil Emulsion Properties	**Natural Dispersion**
Unlikely to form a stable emulsion.	Very rapid natural dispersion, 50% or more within the first few hours of spill especially with higher wind speeds.
Chemical Dispersants	**Mechanical Recovery**
Usually not necessary for diesel spills. May be appropriate response for very large spills if not dispersing rapidly and likely to impact an environmentally sensitive location.	Not appropriate – oil is too light. Spreads to form a sheen.

12.3.2 Lubricants / Hydraulic Oil

Lubricants and hydraulic oils will spread rapidly on the sea surface upon release to the marine environment. The demulsifier additives found in many common hydraulic oils tend to inhibit the formation of emulsions, preventing the increase in volume of the oil. However, due the nature of their application design, these oils can be fairly persistent when released into the marine environment. Fortunately, these oils are used and stored in relatively small quantities, thus reducing the overall threat to the marine environment.

LUBRICANTS / HYDRAULIC OIL	
Physical Properties	**Chemical Properties**
Low evaporative loss. Moderate density (ca. 0.87) ITOPF Group 2-3	Low volatility Possible asphaltenes – dependant on the product base stock. Very low wax content
Water in Oil Emulsion Properties	**Natural Dispersion**
Unlikely to form a stable emulsion.	Natural dispersion will occur. Higher wind speeds and sea states will accelerate dispersion.
Chemical Dispersants	**Mechanical Recovery**
Usually not necessary for operational hydraulic oil spills. May be appropriate response for very large spills if not found to be dispersing and likely to impact an environmentally sensitive location.	Generally unlikely to be necessary for hydraulic oil spills which usually spread rapidly to form a sheen.

12.3.3 Jet Fuel

Jet fuel (also referred to as 'Jet-A' or 'Jet A-1'), is sometimes stored on board offshore installations for refuelling crew change helicopters. It is similar in nature to diesel but contains a much higher proportion of light ends. Upon release to the marine environment, most if not all of the fuel would evaporate rapidly, leaving no residues.

JET FUEL	
Physical properties	**Chemical Properties**
High evaporative loss, may evaporate completely within a few hours of spillage. Low density (0.80) ITOPF Group 1	High volatility No asphaltenes Negligible wax content
Water in Oil Emulsion Properties	**Natural Dispersion**
No emulsion formed.	Very rapid natural dispersion, 50% or more within the first few hours of spill especially with higher wind speeds.
Chemical Dispersants	**Mechanical Recovery**
Not required	Not appropriate – oil is too light. Spreads to form a sheen.

13 Response Strategy Guidelines

This guide provides supporting information to personnel involved in planning and executing oil spill response for NEFL offshore operations.

This guide gives information on each type of response strategy available in the event of a spill at sea and provides details on factors affecting selection and deployment of response.

The response strategy adopted will depend upon the spill details and the prevailing environmental conditions. The essential information required as a basis for decision making is:

- Size and status of the oil spill (e.g. controlled or uncontrolled);
- Location of the oil slick;
- Type of oil and its characteristics;
- Meteorological information, current and predicted weather and sea state;
- Authorities informed;
- Action taken; and
- Evidence gathered, e.g. samples and photographs.

More information will be required as the situation develops, for example as a part of the monitoring process, a survey of the location of seabirds might be carried out to determine the advisability of using dispersants. Aerial surveillance and monitoring will also form an integral part of the response, for example in the case of a large oil spill where dispersant or containment and recovery operations are being used.

13.1 Options Available

The main response strategies are outlined below:

- Monitor and Evaluate;
- Natural dispersion – maintain the spill under observation but with no active intervention;
- Mechanical containment and recovery;
- Chemical dispersion, and;
- Onshore clean-up.

The appropriate response will depend not only on the potential limitations of each of the possible response options, but also on the type of oil spilled and the environmental sensitivities that are threatened by the spill.

13.2 Monitor & Evaluate

Monitor and evaluate is the primary response strategy for oil spills that pose no significant threat to the coastline or sensitive resources, as the normally higher energy conditions offshore will naturally break up the oil.

All oil spills must be monitored until they have completely dispersed. Tier 1 spills can be monitored by the SSV or OSVs. Where surveillance from a vessel is insufficient, aerial

surveillance should be undertaken. For Tier 2 or 3 oil spills, aerial surveillance is a requirement under the terms of the Falkland Islands NOSCP and FIG PON 8 guidelines.

13.2.1 Aerial Surveillance

Aerial surveillance is the method of choice for observation. Height allows visibility over a wide area, and combined with the high speed of aircraft, allows a large area to be covered and the 'big picture' to be seen. Aerial observation allows response units to be co-ordinated and directed to great effect and allows detection of environmental sensitivities in the path of the oil slick in 'real time'.

Sustained aerial observation should only be carried out using specialised, multi engine, fixed-wing aircraft suitable for this role. The observer for the flight must be experienced and be able to correctly identify surface and dispersed oil on the sea from amongst other sea surface 'phenomena' that have a similar appearance.

Prior to the flight, the observer and pilot must be briefed upon current weather conditions, weather forecast, surface water currents and the predicted position of the oil slick. A flight plan must be developed which may consist of a ladder search that will proceed across the expected track of the oil. The observer should be equipped with a suitable chart, already marked into grid sections and during the flight must communicate with the pilot to ensure that the aircraft's position at any time is known so that accurate position references can be passed on. The flight level will be determined by conditions on the day.

13.2.2 Guidelines for Detection, Investigation and Post Flight Analysis / Evaluation for Oil Spill Volume Estimation

If the volume of oil spilled is unknown, then an estimate of the volume of oil in a slick on water can be made by its size and appearance. This Section is based upon the internationally recognised Bonn Agreement Oil Appearance Code (BAOAC) (2004), used for oil spill volume estimation on water during aerial surveillance.

Detection & Investigation

For aerial surveillance over water, the main detection equipment is visual look out. Side Looking Airborne Radar (SLAR), Infra-red (IR) and ultraviolet (UV) systems are available on dedicated aerial surveillance aircraft. However, it is unlikely that an aircraft equipped to this specification will be available locally in the Falkland Islands. Therefore, the main method of observation will be visual lookout and photographs.

Following the positive identification of the slick, it should be thoroughly investigated. The aircraft should be flown directly over the oil to enable the 'plan' view (the most accurate view) of the slick to be recorded.

It is suggested that the aircraft is flown at a height that allows as much of the slick as possible to fall within the field of view of the observer.

Visual observation of the pollution on the water's surface provides essential information about the size, appearance and coverage of the slick that are used to calculate the initial estimate of volume. Slicks can be seen some distance down-wind/ down-current' of the pollution source due to the effect of winds and water currents.

Photographs of the oil slick are probably the most easily understood data for a non technical person. It is therefore essential to produce a complete set of pictures showing the spill. An ideal set of photographs will show an overall, long range view of the pollution and the pollution source and a series of detailed, close up shots.

It is recommended that the slick should be viewed from all sides by flying a racetrack pattern around the oil. The best position to view the oil is considered to be with the sun behind the observer and the observer looking at the subject from an angle of 40^0 to 45^0.

Volume Estimation – Overall Area Measurement

Trials have shown that both overall area and specific oil appearance area coverage measurement is the main source of error in volume estimation. Therefore observers should take particular care during this part of the volume estimation process.

The recommended procedure for visual observation is to estimate the length and width of the slick by either using GPS or making time and speed calculations. This forms an imaginary rectangle that encloses the slick. The coverage of the oil slick (expressed as a percentage or proportion) within this imaginary rectangle is then used to calculate the overall area of the slick. Inevitable inaccuracies in dimension estimates and estimated coverage within these dimensions can give rise to high levels of error in area estimation.

Oil slicks frequently contain 'holes' of clear water within the main body of the slick, especially near the trailing edge of the slick. The proportion of the overall area that is covered by oil of any thickness needs to be estimated. For compact slicks, this proportion may be high at around 90% or more, but for more diffuse oil slicks a much lower proportion of the overall area will be covered in oil. More accurate assessments of overall slick area can be made by a more thorough analysis of the photographs. The overall area calculations should be adjusted to take into account the areas of clear water within the main body of the slick, resulting in an estimated overall area covered with oil.

Bonn Agreement Volume Estimation

The Bonn Agreement Oil Appearance Code (BAOAC) (2004) is an internationally recognised standard used for oil spill volume estimation on water during aerial surveillance. When oil is spilled on water, it spreads out to varying thicknesses. The thickness of the oil is strongly related to how it absorbs, transmits and reflects visible light. Therefore the Bonn Agreement oil estimation method works on the principle of estimating the oil thickness (and therefore volume), in relation to the appearance of the oil to the eye of the aerial surveillance observer.

Description of the Oil Appearance Codes

The appearance of the oil cannot be precisely related to one thickness; they are either optical effects (codes 1 – 3) or true colours of the oil (codes 4 – 5) that appear over a range of oil thicknesses. For this reason there is no sharp delineation between the different codes; one effect becomes more diffuse as the other strengthens. Therefore, using the BAOAC to estimate oil volume gives a maximum and minimum quantity for each appearance. A certain degree of subjective interpretation is necessary when using the code.

The oil appearances will tend to follow a pattern. Thinner oil will normally be observed at the edges of thicker oil. It would be unusual to observe thick oil without the associated thinner oils; however, this can occur if the oil has aged and / or weathered. The oil appearance codes are illustrated in Figure 13.1. The codes are also described in detail below.

Figure 13.1: Thickness bands for allocation appearance in accordance with the Bonn Agreement Oil Appearance Code (Lewis, 2007)

		Description Appearance	Layer Thickness Range	Litres per km^2
CODE 1		Sheen (silvery / grey)	0.04 to 0.30 µm	40 – 300 Lkm^{-2}
CODE 2		Rainbow	0.30 to 5.0 µm	300 – 5,000 Lkm^{-2}
CODE 3		Metallic	5.0 to 50 µm	5,000 – 50,000 Lkm^{-2}
CODE 4		Discontinuous True Oil Colour	50 to 200 µm	50,000 – 200,000 Lkm^{-2}
CODE 5		Continuous True Oil Colour	200 to more than 200 µm	200,000 – more than 200,000 Lkm^{-2}

Code 1 – Sheen (< 0.3 µm thickness)

The very thin films of oil reflect incoming light slightly better than the surrounding water and can therefore be observed as a silvery or grey sheen. All oils in these thin layers can be observed due to this effect and not the oil colour itself. Oil films below approximately 0.04 µm thickness are invisible. In poor viewing conditions, even thicker films may not be observed. Above a certain height or angle of view the observed film may disappear.

Code 2 – Rainbow (0.3 µm – 5.0 µm thickness)

Rainbow oil appearance represents a range of colours, yellow, pink, purple, green, blue, red, copper, orange; this is caused by an optical effect and is independent of oil type. Depending on angle of view and layer thickness, the distinctive colours will be diffuse or very bright.

Oil films with thicknesses near the wavelength of different coloured light, 0.2 µm – 1.5 µm (blue: 400nm or 0.4 µm, through to red: 700nm or 0.7 µm) exhibit the most distinct rainbow effect. This effect will occur up to a layer thickness of 5.0 µm. Bad light conditions may cause the colours to appear duller. A level layer of oil in the rainbow region will show different colours through the slick because of the change in angle of view. Therefore if rainbow is present, a range of colours will be visible.

Code 3 – Metallic (5.0µm – 50 µm thickness)

The appearance of the oil in this region cannot be described as a general colour and is oil type dependent. Although a range of colours can be observed (blue, purple, red and green) the apparent colour is not caused by interference of light or by the true colour of the oil. The colours

will not be similar to 'rainbow'. Where a range of colours can be observed within a rainbow area, metallic will appear as a quite homogeneous colour that can be blue, brown, purple or another colour. The 'metallic' appearance is the common factor and has been identified as a mirror effect, dependent on light and sky conditions. For example blue can be observed in blue-sky conditions.

Code 4 – Discontinuous True Colours (50 µm – 200 µm)

For oil slicks thicker than 50 µm the true colour of the oil will gradually dominate the colour that is observed; brown oils will appear brown, black oils will appear black. The broken nature of the colour, due to thinner areas within the slick, is described as discontinuous. This is caused by the spreading behaviour under the effects of winds and currents.

'Discontinuous' should not be mistaken for 'coverage'. Discontinuous implies true colour variations and not non-polluted areas.

Code 5 – True Colours (>200 µm)

The true colour of the specific oil is the dominant effect in this category. A more homogenous colour can be observed with no discontinuity as described in Code 4.

This category is strongly oil type dependent and colours may be more diffuse in overcast conditions.

Bonn Agreement Specific Oil Appearance Code Coverage Estimation

During the observation flight, the aircrew should estimate the areas within the overall area that have a specific oil appearance, using the Bonn Agreement Aerial Surveillance Observers Log (refer to **Part I, Section 7.7**). The 'adjusted' overall area covered with oil should be sub-divided into areas that relate to a specific oil appearance.

This part of the volume estimation is very subjective, so great care should be taken in the allocation of coverage to appearance, particularly the appearances that relate to greater thicknesses (discontinuous true colour and true colour). It also highlights the importance of the use of trained and experienced aerial surveillance personnel.

Post Flight Analysis

The aim of post-flight analysis / evaluation is to provide a more accurate estimate of spilled oil volume than can be made within the confines of the aircraft during flight. It is based on measured oil slick areas and the estimated oil layer thickness in various parts of the oil slick using the information gained from the aerial surveillance mission.

Electronic methods or the use of grid overlays should be used to obtain accurate measurements of overall slick area from the recorded images. Where several images have been obtained during a period of time, the area should be calculated for each one.

The photographs and Bonn Agreement Aerial Surveillance Observers Log (refer to **Part I, Section 7.7**) should then be re-examined and the proportions of slick area of different BAOAC codes should be re-calculated.

It is particularly important that areas of any thick oil (Codes 4 or 5 in the BAOAC) – if present – be confirmed as accurate, since these will have a very large influence on the estimated volumes.

The final stage of post flight analysis is to calculate the estimated minimum and maximum volume by totalling the volume contributions of the different areas of the slick.

The below worksheet can be used for the estimation of oil slick volume during post flight analysis. This also includes a worked example of using the BAOAC.

Worksheet for estimating oil slick volume in accordance with the Bonn Agreement

Step 1. Total area: Estimate total size of the oil slick as a square or rectangle (in km²). [*For example 10x 2 km = 20km^2*].

Step 2. Oil Spill Area: Assess the area affected by the slick in km^2 calculated as a % of the total area. [*For example, the slick affects 90% of the total area, 90% of 20 km² = 18 km²*].

Step 3. Estimate slick area by colour: Estimate the area covered by each oil appearance colour as a % of the area affected in km². [*For example, 60% silvery sheen: 0.60 x 18 = 10.8km^2, 40% metallic: 0.40 x 18 = 7.2km^2 respectively*].

Step 4. Calculate minimum and maximum oil quantity by colour: Multiply the area covered by each oil appearance colour by the minimum and maximum possible volumes to get the minimum and maximum estimates of oil quantity. [*For example, silvery sheen; min: 10.8km^2 x 0.04 = 0.432m^3/km^2, max: 10.8km^2 x 0.3 = 3.24; metallic; min: 7.2 km^2 x 5 = 36, max: 7.2 km^2 x 50 = 360 m^3/km^2*].

Step 5. Total quantity: Add all the quantity by colour figures to get total estimated minimum and maximum quantities of oil in m^3.

Step 6. Conversion: If necessary, covert m^3 to tonnes by multiplying total quantity in m³ by the Specific Gravity of the spilled oil.

Average width (km)		Average length (km)	

STEP 1	Total Area (Width x Length) km^2	
STEP 2	Oil Spill Area (Estimated) km^2	

Colour	Code	Minimum (m^3 / km^2)	Maximum (m^3 / km^2)	STEP 3 % of Area Affected	STEP 3 Area Covered km^2
Silvery Sheen	1	0.04	0.3		
Rainbow Sheen	2	0.3	5.0		
Metallic	3	5.0	50		
Discontinuous True colour	4	50	200		
Continuous True Colour	5	200	200		

Note: Calculation for Area Covered: Km² = Oil Spill Area / 100 x % of Area Covered.

Colour	STEP 3 Area Covered (km^2)	STEP 4 Min Volume (m^3)	STEP 4 Max Volume (m^3)
Silvery Sheen			
Rainbow Sheen			
Metallic			
Discontinuous True Colour			
Continuous True Colour			

STEP 5	Total Volume (m^3)		
STEP 6	Total Volume in Tonnes (m^3 x SG)		

13.2.3 Prediction of Oil Spill Trajectory

Oil spill movement can be modelled to predict the movement and fate of spilled oil and to ‘monitor’ the slick when not under direct observation. This can be done by OSRL using oil spill modelling software.

For this purpose, the following **essential information** is required;

- The date and time of the spill;
- The type of oil;
- Estimated amount of oil;
- Spill location (latitude and longitude);
- Current and forecast weather;
- Air and water temperature (if available) and;
- Location of environmental sensitivities.

The computer model contains the relevant tidal data and a database of the characteristics of different oils. The output from the model will be a map showing the location of the slick at any desired time and prediction data about the fate (weathering) of the oil. This can also indicate the likelihood of the oil being amenable to chemical dispersion.

Predicting Slick Movement Manually

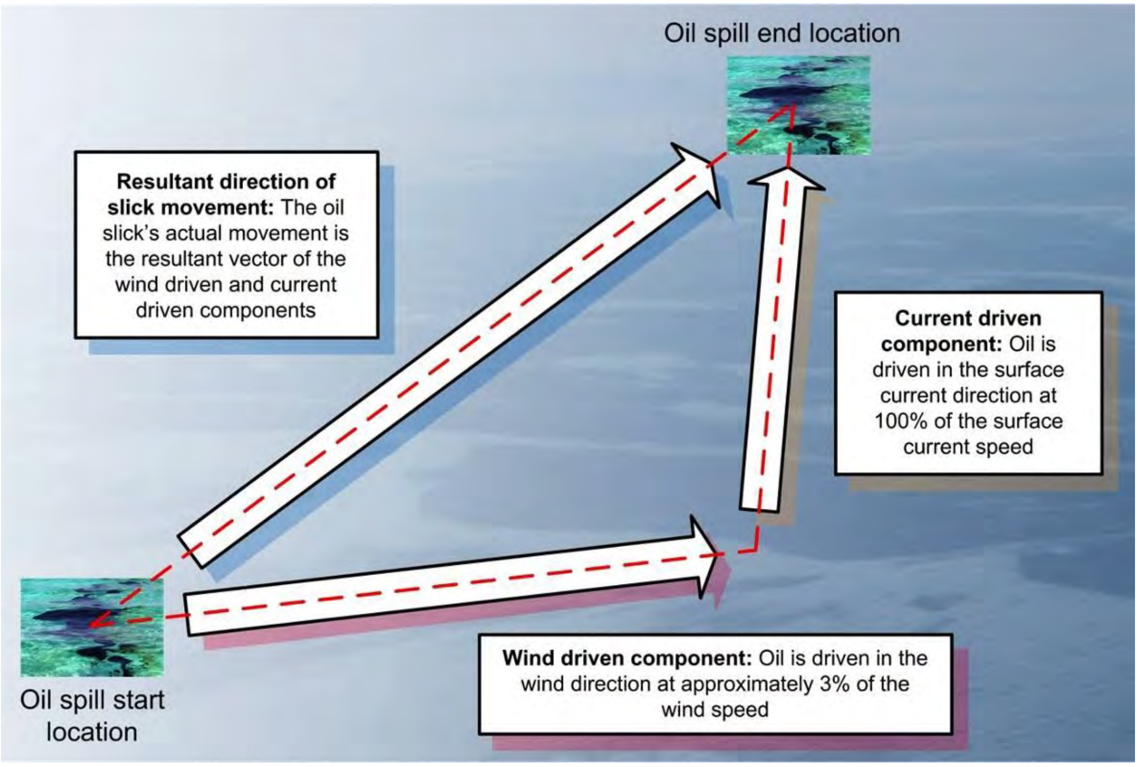
In the absence of computer models and aerial surveillance information (for example, during the very early hours of an incident) oil slick movement can be predicted manually to provide a rough guide to the likely direction and speed of movement, which may assist in developing an appropriate response strategy. However, it should not be considered as a substitute for visual monitoring of slick movement throughout the oil spill response in the field.

The movement of an oil slick can be estimated based on the surface water current speed and direction, and the wind speed and direction.

Spilled oil moves with 100% of the surface current speed in the direction of the surface current (the **current driven component**), and with approximately 3% of the wind speed in the direction of the wind (the **wind driven component**). An important point to note is that current directions are always given **in the direction the current is moving towards**, and wind directions are always given **in the direction the wind is blowing from**.

Assuming the current driven component and wind driven component are constant, and given the starting position of the oil slick, the resultant movement can be estimated for a given unit of time by using a marine chart and plotting a simple vector diagram (Figure 13.2).

Figure 13.2: Plotting spill track



Worked Example

The current driven component and wind driven component should first be found, with speeds given in knots. For the example given here, these are:

- **Current driven component:** Current flow in the direction of bearing 010^{O}, at a speed of 2 knots.
- **Wind driven component:** Air flow (wind) from the direction of bearing 260^{O}, at a speed of 35 knots.

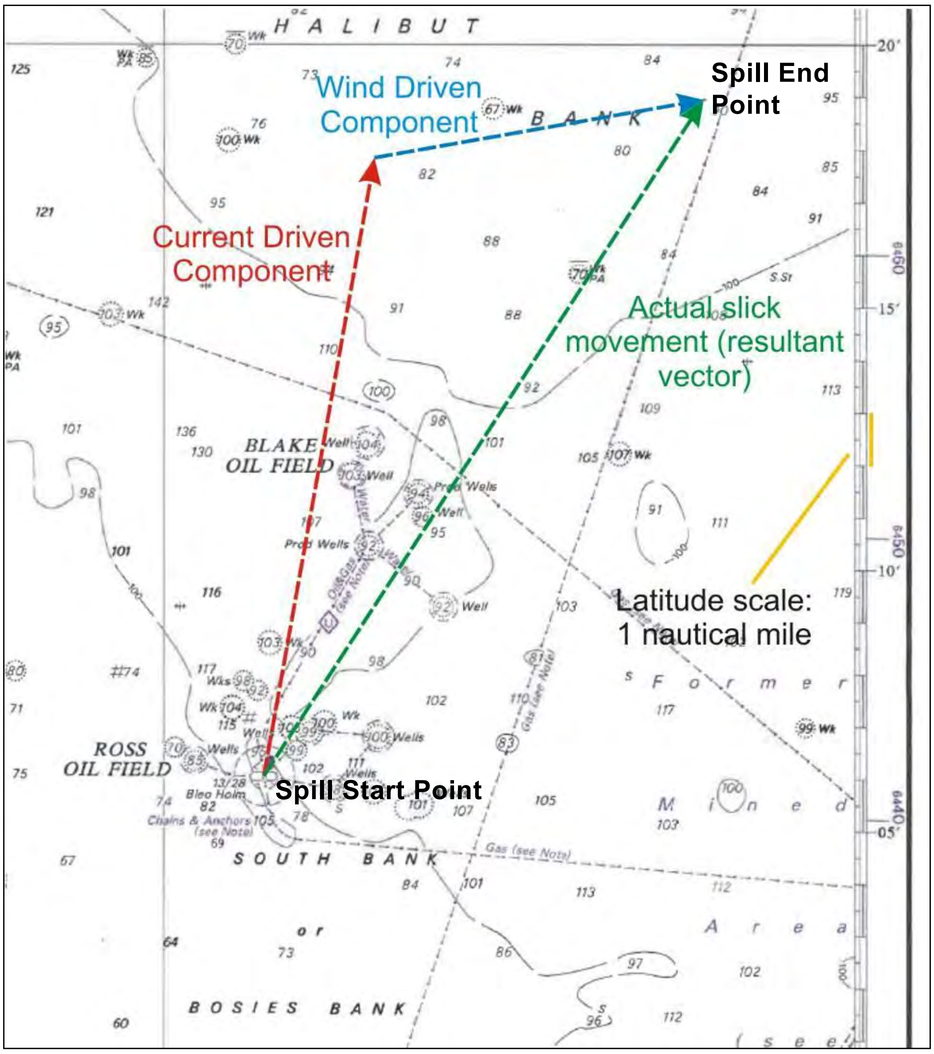
Given that 1 knot is equal to 1 nautical mile per hour, and that one degree of latitude is equal to one nautical mile, the above components can easily be plotted onto a marine chart for a given unit of time, using the chart's latitude scale (yellow line on Figure 13.3).

1. In this example, we want to see where the oil slick will be **in 6 hours time**. The starting position of the oil slick should first be plotted on the chart. In this example, this is the Ross Oil Field in the Central North Sea.
2. First, the **current driven component should be plotted**. Note that the oil will move in the direction of current flow at 100% of the current speed. In this example, the current will push the oil slick at 2 nautical miles per hour over a period of 6 hours. This will be a total movement of 12 nautical miles (2nm x 6hrs) in the direction of bearing 010^{O}. Measure out 12 nautical miles on the marine chart latitude scale and plot this distance from the spill start location in the direction of bearing 010^{O} (red line in Figure 13.3).
3. Next, the **wind driven component should be plotted**. Note that the oil will move in the direction of air flow at 3% of the wind speed. In this example, the wind will push the oil slick at 1.05 nautical miles per hour (3% of 35 knots) over a period of 6 hours. This will be a total movement of 6.30 nautical miles (1.05nm x 6hrs) in the direction of bearing 080^{O} (note that this is the **reverse bearing** of 260^{O}, as wind directions are always given in the direction they are blowing from). Measure out 6.3 nautical miles on the marine chart latitude scale and

plot this distance from the current driven component end location in the direction of bearing 080^{O} (blue line on Figure 13.3).

4. You now have the estimated end point of the oil slick. Join the start point and end point of the oil slick together in a line and note its direction. This line represents the actual movement of the oil slick (green line on Figure 13.3).

Figure 13.3: Plotting a vector diagram of predicted slick movement on a marine chart (extract of Chart 115, Hydrographer of the Navy, 2004)



The above method can be used for any given time step (in hours) as required. However, note that the above method assumes the current and wind driven components to be constant – in reality these values are likely to vary over time.

13.2.4 Sampling of Spilled Oil

It is good practice for samples of the spilled oil should be taken. The oil samples should then be sent for lab testing and analysis. The OIM should request the master of the SSV to collect a sample of the oil using the oil spill sampling kit provided.

Advice on the collection and handling of oil samples is summarised below in Table 13.1.

Table 13.1: Advice on collection and handling of oil samples

Sampling Location	Locations should be recorded using grid reference (e.g. latitude/ longitude), including maps, sketches and photographs as appropriate. The date and time of sampling should also be noted.
Sample Collection	*At sea* The simplest sampler is a narrow mouth bottle which can be used to skim the surface of the oil. After the bottle is closed, it can be inverted and the closure opened slightly to drain excess water. The oil can then be decanted into to a clean bottle if necessary. *On shore* Oil deposited on rocks or other impervious materials should be scraped off and placed directly into the sample container. Oil adhering to seaweed, wood, sand, plastic, sand or other debris should be dealt with by placing the complete specimen comprising oil and support material into the sample container where practical. When liquid samples are skimmed off the surface of the sea, care should be taken to ensure that the sample contains sufficient oil. Various techniques may be adopted to skim thin layers of oil from the waters' surface such as using a bucket with a hole. Care should be taken to minimise contamination of liquid samples by solid matter. Oil deposited on rocks or other impervious materials should be scraped off and placed directly into the sample container. Lumps of tarry or waxy pollutant should be placed directly into sample containers; no attempt should be made to heat or melt these samples to enable them to flow into a container. Oil adhering to seaweed, small pieces of wood, sand, plastic, material, cloth, vegetation or other debris should be dealt with by placing the complete specimen comprising oil and support material into the sample container.
Sample Quantities	An oil sample should be as large as is reasonably practical. The minimum amounts needed for full chemical analysis are as follows. Note that smaller quantities may still have value as limited analyses may still be possible: Un-weathered oils that are liquid and substantially free of water — 10 ml. Oil exposed to seas surface and forming water-in-oil emulsion "chocolate mousse" — 100 ml. Tarry lumps as found on beaches — 50 g. Three samples should be taken: *Sample 1* Sent to certified laboratories for appropriate chemical analyses; *Sample 2* Given to Authorities if requested; *Sample 3* Retained in storage for reference.
Bottling, Sealing, Packaging and Boxing of Samples	All samples should be securely packed and sealed, using screw topped containers and UN approved boxes to ensure safe carriage of the samples. As proof against unauthorised opening, the sample container should be sealed with adhesive security labels with a signature on the paper, stuck on the bottle top in such a way that they have to be broken to open the bottle. The bottle should then be placed inside a plastic bag, which should be sealed with a further adhesive label in the same way as for the sample bottle to ensure that it is not tampered with. If it is necessary to take an oil sample where one of the standard containers above is not available, the receptacle should be of glass construction with a screw-cover and a seal which would not be affected by the oil. Small (100ml) and medium (500ml) glass bottles are readily obtainable from chemists or hardware shops. The use of closed metal receptacles or plastic jars is strongly discouraged as oil contact with metal or plastic can, in some cases, interfere with the analysis. Avoid the use of any metal tool made of nickel or vanadium based alloys, as these metals occur naturally in crude oils and refined products and their levels may assist in the identification of the oil source. When boxing the sealed samples for transport, Dangerous Goods packing instructions (in accordance with IMDG/ ADR/ SI 1573) should be followed, to ensure the integrity of the package for transport under Dangerous Goods conditions. A suitable material should be used to surround the sample(s) in the box for added protection and to absorb any possible seepage. Make sure that the dangerous goods documentation is completed.

	Whenever possible, samples should be stored in refrigerators or cold rooms at less than 5 °C in the dark. These precautions are particularly important for samples containing water or sediment, but less so for bulk oil samples.
Labelling and Addressing of Samples	Care should be taken to ensure that every sample bottle is not only suitably sealed but also clearly labelled before being submitted to the laboratory. It is important that a sample is positively identified, particularly where more than one is taken during an incident. It is of vital importance to maintain continuity in the chain of evidence. It is recommended that each sample is labelled and is accompanied by more detailed information set out on a standard pro-forma. The form accompanying each container should therefore provide the following details: - • An identifying number, with the date of the sample taken and the name of the official in charge of sampling; • Description of samples; • Location from which sample was taken, grid reference if possible; • Date and time of sampling; • Purpose for which sample was taken; • If known, suspected source, e.g. name of tanker or ship; • Whether or not dispersants have been used and, if known, their type and make; • Method of sampling (description of sampling device); • Name, address and telephone no. of person taking the samples and of anyone witnessing the taking of it. If possible the following information would also be helpful: • Wind direction and velocity; • Air and water temperature; • Sample descriptions, i.e. viscosity, colour, odour and contaminants; • Description of the oil spill, i.e. distribution and consistency.
Transportation of Samples	Ensure that the samples are labelled correctly and securely packed in UN approved boxes to avoid breakage. It is important that the standard pro-forma described above should also be included with the sample along with all carriage documentation. To facilitate sample transportation, clear information on the number of samples in the consignment, the location they need to be collected from and a contact name and phone number need to be given.

13.3 Natural Dispersion

Natural dispersion is allowing the oil to disperse under natural weathering and degradation processes. If the oil slick does not immediately threaten any sensitivity or resource and prediction methods show that the oil will disperse by itself, then natural dispersion may be a valid response strategy. In such cases, the oil spill should be continually monitored until it fully disperses. In most situations, natural dispersion can often only be relied upon as the sole response strategy where a small amount of non-persistent oil has been spilled.

The future movement and behaviour of the oil should be predicted, as far as possible, using weather forecasts and computer modelling (available from OSRL), until it has completely dispersed. Oil on the sea should be monitored by direct observation.

Natural dispersion relies solely on weathering processes and their overall contribution to oil slick removal (refer to **Part II, Section 12.2, Table 12.1**). Table 13.2 relates the weathering processes described in Section 13.2 in the context of their contribution to oil slick removal if natural dispersion is selected as a response strategy.

If very light, non-persistent oil has been spilled on water, (e.g. diesel or gasoline), most of the oil will evaporate. Very light oils such as diesel and gasoline are often difficult to recover on water. Therefore it is often best to leave such spills to disperse naturally.

If heavier, more persistent oil (e.g. crude oil) is spilled on water, a limited volume of oil will evaporate. However, most of the oil will remain on the water’s surface. If the water is suitably rough, this will act to disperse the oil into the water. If only a small volume of oil has been spilled, it may be best to allow the oil to disperse naturally.

If a large volume of oil has been spilled, a considerable amount will remain on the water’s surface for long periods; in this situation natural dispersion may not be recommended as the sole response strategy and therefore, containment and recovery of the oil, or the application of dispersants, should be considered.

In all circumstances, if natural dispersion is selected as the key response strategy, it must be shown through close monitoring that natural dispersion is in fact taking place. If the oil persists, then an alternative strategy must be selected.

Table 13.2: Natural dispersion processes in the context of their contribution to oil slick removal (if natural dispersion is selected as a response strategy)

Weathering Agent	Description	Rate and contribution to slick removal	DIESEL	CRUDE
Spreading	Oil will tend to spread out on the surface of the water. The rate and degree to which it does will depend upon the viscosity of the oil and the surface tension between the oil and the water. The higher the temperature, the lower the viscosity and the greater the degree and speed of spreading. Under the influence of wind the oil will become unevenly distributed. It will tend to break up into patches or ribbons, thickest in the leading edge and thinnest at the trailing edge.	Rapid cover of large areas.	Very rapid spreading	Rapid spreading
Evaporation	Evaporation will remove the more volatile molecules from the surface of the oil slick into the atmosphere. It will act fastest when there is a large surface area of oil exposed to the air and will increase with temperature. It will be more predominant when the proportion of lighter to heavier molecules in the oil is high and the energy in the sea and atmosphere is high (rough conditions).	Rapid, particularly for lighter oils. It may account for 10 – 75% of removal of oil from the sea surface depending upon the initial type.	Major means of removal	Initially dominant means of removal
Dissolution	The soluble elements of the oil (the lighter molecules) will preferentially be removed from the slick into the water column and they will subsequently be diluted by dispersion. Aided by high energy in the sea.	Active soon after a spill occurs, but overall it is a relatively minor pathway.	Can be important	Can be important
Dispersion	The oil layer on the surface of the sea is broken into small droplets which then disperse into the water column. The rate at which this occurs and the degree to which it occurs will depend upon the composition of the oil and the amount of agitation available. Aided by high energy in the sea.	An important process for removing oil from the surface and facilitating bio-degradation. Most important for the less viscous oils.	Important	Important
Photolysis	Light energy acting upon oil breaks chemical bonds in the hydrocarbon chains and allows it to slowly oxidise. Aided by high levels of irradiation.	Negligible over the short term in high northern latitudes however important in the long term and lower latitudes.	Important	Important
Bio-degradation	Biodegradation is the ultimate means of removal of free oil from the environment. Aided by ample nutrient supply & Oxygen level, dispersion of oil, moderate temperatures, and high energy environments.	Minor importance in the short term but very important in the long term.	Not important	Important in long term
Drift	Drift of the oil slick is facilitated by wind, waves and surface water currents.	Important in distributing oil and moving it into or out of sensitive areas.	Can be important	Important

Diesel is a low viscosity distillate fuel made from light gasoil. Typically it has a density of 0.846 kilograms per litre. It contains a high proportion of light ends and so evaporation will play an important part in the removal of the oil from the surface of the sea. Spill evaporation rate will depend on the volume and rate of the spill.

Crude oil, accompanied by associated gas, comprises the reservoir fluids. Crude oil can be characterised according to its behaviour in the environment if spilled, according to its ITOPF Group (refer to **Part II, Section 12.1**).

Lube and hydraulic oils are refined products. They have no light ends and behave as viscous oil. Evaporation will be limited and spreading relatively slow, however, they are dispersed rapidly by natural wave action. Aviation fuel is a refined distillate hydrocarbon fuel and more volatile than diesel. It will evaporate quickly.

13.4 Containment & Recovery

Containment and recovery may be a viable response strategy when sea and weather conditions are suitably calm.

Mechanical containment and recovery is made up of a chain of operations consisting of:

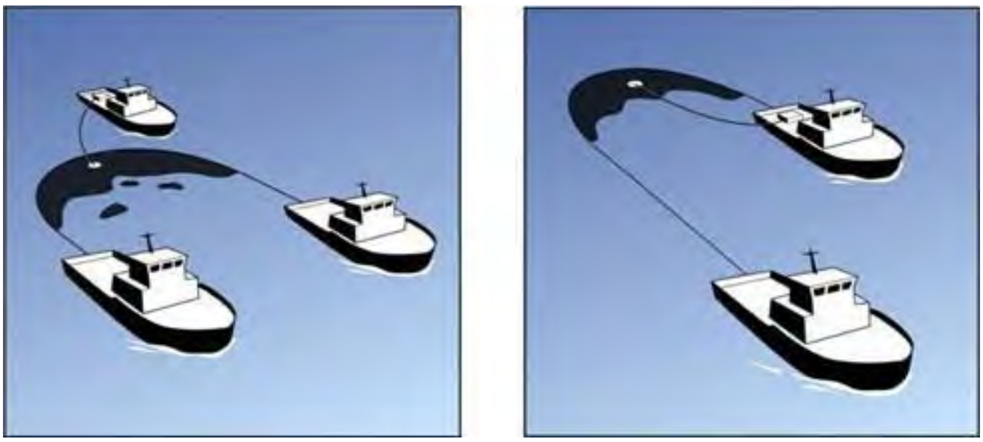
- Mobilisation of suitable vessels to use for the containment and recovery operations;
- Containment with some form of boom;
- Mechanical recovery with a skimming device or adsorbent;
- Temporary storage and transport of recovered oil; and
- Treatment, disposal or reuse of recovered oil.

Mechanical containment of oils involves containing all or part of the oil slick by deploying a boom from the response craft. The boom will form a barrier containing the oil floating on the surface of the water against the tendency of oil to spread and to drift. The boom must be attached at each end to a vessel or anchored. There are a variety of different booms available for use in different circumstances, each being designed, as far as possible, to overcome the problems associated with a particular environment.

The physical factors limiting the use of booms (Table 13.3) are that they cannot be deployed when wind and sea conditions are too rough and they cannot be held against a water current of more than 0.7 metres per second (1.3 knots). The physical barrier of the boom will fail to hold oil if the waves are too high, allowing oil to escape over the top of the boom, or by entrainment if the current is too strong, allowing oil to escape beneath the boom. The ideal conditions for containment and recovery operations are Beaufort Force 3 or less.

Offshore recovery typically requires two or more vessels to which are attached the ends of the boom to hold it stationary or tow it into the wind, in either a U or J configuration (Figure 13.4). The oil is recovered using a skimmer deployed by a third vessel, or by the vessel at the ‘base of the J’, where the oil will tend to accumulate at its thickest. There are a variety of different types and models of oil skimmers, each of which will function best in a certain set of conditions (Table 13.4). The recovered oil, normally mixed with some water, is then pumped to some form of tank for storage and transport.

Figure 13.4: Offshore recovery boom and vessel ‘U’ and ‘J’ configurations (OSRL, 2006)



U configuration – 2 x towing vessels, 1 x recovery vessel

J configuration – 1 x towing vessel, 1 x towing and recovery vessel

The oil must then be transported to shore for storage and final disposal. To prevent a recurrence of the pollution the storage location must be robust enough to allow transport ashore for disposal. There are a variety of temporary storage systems available, such as pillow tanks, or tankers. These must be appropriately rated for the job in hand and must be used within their design limitations.

In practice, the amount of oil which is generally recovered at sea through containment and recovery operations is only a small percentage of the total amount spilled. This is due to the spread of the oil, the great physical difficulties of carrying out a difficult operation in an uncontrolled environment and due to the limits of the containment and recovery systems. Acknowledging this, any oil that can be recovered, will reduce the potential for the oil slick to cause damage to the environment and is therefore useful.

Table 13.3: Physical limitations of booms for oil containment

Constraint	Limits	Reference
Visibility	Daylight hours	IOE, 1991
Wave Height	< 2.0 metres (conservatively)	IOE, 1991, Schulze, 1993; BMES/OSRL personal communication
Water Current	Daylight hours < 0.7m/s (1.35 knots) normal to the boom	CONCAWE, 1981; Schulze, 1993; OSRL personal communication

Table 13.4: Physical limitations of skimmers

Skimmer	Type of Oil	Capacity	Weather	Observations
Disc skimmers	All kinds of oil, poor efficiency in emulsions	10-400m^3/h collect 10-60% water with the oil	Claimed up to Beaufort Force 4-5 (1-3 metre waves)	Installed on board ship or a floating unit, best used with booms.
Band skimmers	Work in non viscous oils	10-300m^3/h 10-50% water with the oil	Efficient in calm water, low efficiency in waves	Tow speed is 1-2 knots max. The band can suffer from tearing with the presence of solids and too high towing speed.
Vortex skimmers	All oils except viscous oil and emulsion	10-700m^3/h 20-60% of water is recovered	Used with waves up to 1.5 metres	Must be towed by ship or fixed to the boats hull. To be efficient the apparatus must be towed at 1-8 knots.
Skimming barrier	All oils except highly viscous emulsions	100-2,700m^3/day	Efficiency reduces with waves >0.5 metres	Must be towed at speed sufficient to ensure adequate thickness of oil reaches pump.

13.5 Chemical Dispersant Application

Chemical dispersants are applied as a spray to floating oil to enhance the break-up of surface oil slicks into small droplets that disperse into the water column.

If dispersant use is being considered as a response strategy, the amenability of the oil to dispersion should be tested by shaking a sample of oil and water in a container with the appropriate amount of dispersant (refer to **Section 13.5.3** below). Dispersant treatment should only be considered if the oil sample demonstrates effective dispersion in this test.

13.5.1 Dispersant Use Guidelines

Shallow Water

Dispersant use is not recommended in water depths of less than 20 metres. This is due to the elevated oil concentrations in the upper layers of the water column (<10 metres) and therefore may have adverse effects (impact) on the seabed in shallow water depths.

Spills of Gasoline, Kerosene and Diesel

It is recommended that chemical dispersants **should not be used** on light products such as gasoline, kerosene and diesel for two reasons. Firstly, the natural processes of evaporation and dispersion will usually rapidly remove these oils from the sea surface without the need for chemical treatment. Secondly, chemical dispersion of these light oils will result in unnecessary increased concentrations of toxic components within the upper water column.

Sometimes it is suggested that chemical dispersion of diesel, which is observed not to be dispersing naturally, might be necessary in order to protect seabirds. It is agreed that this may be an appropriate response, but, as always, it is a question of balancing one outcome against another. Some fish species have pelagic eggs and/or larvae which are vulnerable to oil which is chemically dispersed into the water column. Inevitably, they would become exposed to higher oil concentrations of oil if dispersants were used than would be the case if the oil had been allowed to disperse naturally.

In the unlikely event that any released diesel oil does not disperse naturally, chemical dispersion can be considered, but this should only take place with the consultation and agreement of FIG Incident Command, NOSCP.

13.5.2 Dispersant Mechanics

Once in the form of small droplets, the surface area of oil open to attack by biodegrading agents is vastly increased. Dispersants work as wetting agents whose molecules are part hydrophilic and part oleophilic. On amenable oils (of viscosity of less than 5,000 centistokes or so) this has the effect of reducing the surface tension in the oil and makes it more amenable to breaking up into small droplets. The hydrophilic nature of the molecules makes the oil droplets more likely to disperse in to the water column and less likely to float. The lowering of the surface tension in the oil also makes it less likely that the oil will form an emulsion with water. In its turn this can reduce the time that oil will take to naturally disperse and can therefore reduce the threat to the environment.

In order to function, the dispersant must be delivered onto the surface of the oil as aerosolised droplets, which will then mix with the oil. This can be achieved from surface vessels equipped with a dispersant application system, or by an aerial delivery system. Specialist equipment for this function is commercially available for hire through spill response contractors. The oil must then be subjected to a degree of natural or artificial agitation, to break the oil film up.

To function effectively, the dispersant must be applied to the oil in the correct ratio of dispersant to oil. Normally the ratio used is 1:20, that is, one volume of dispersant to twenty volumes of oil. However, in practice the ratio chosen will depend upon the technical details of the dispersant being used (manufacturer's recommendations), the amount and type of oil to be dispersed and its state of weathering. For example, during the *Sea Empress* incident in the UK in 1996, following close monitoring of the response and its effectiveness, it emerged that the dispersant was effectively dispersing the oil at a ratio of 1:60. This high rate efficacy demonstrates the benefits that can accrue with a combination of favourable environmental conditions and a well conducted operation.

The key points for effective dispersant use are:

- Using dispersant upon an oil on which it is effective;
- Treating freshly spilled, un-weathered oil;

- Accurate targeting of the oil slicks for treatment;
- Optimal sea-state for enhanced dispersion of oil;
- Using as little dispersant as possible in order to achieve dispersion.

Dispersed oil in the water column increases the amount of oil, in droplets, in the first few metres below the sea surface. Sometimes this is visible as a characteristic plume spreading from the surface downwards. Studies have shown that despite the absence of the visible plume there may still be elevated oil concentrations below the surface following the use of dispersants, indicating that they are working. The toxic exposure of marine organisms to this oil has been demonstrated to have an effect at a concentration of more than 10 parts per million of dispersed oil with an exposure time of between two to four hours. Where rapid dilution of the dispersed oil is not possible, then dispersant should not be used, for example in sheltered bays and shallow waters. In open waters, dilution normally ensures that a toxic concentration is rarely exceeded for any significant length of time.

The relatively high toxicity of dispersed diesel in the water column means that there is no net environmental benefit to be achieved by the use of chemical dispersant upon it. Chemical dispersant would therefore only be used on diesel if the installation was threatened by the presence of the diesel oil slick, or if it was observed that the spill was not dispersing naturally. Dispersant use is therefore subject to certain limitations imposed by the nature of the oil to be dispersed, the delivery system and the weather conditions (Table 13.5).

Table 13.5: Limiting factors for dispersant application

Constraint	Limits	Reference
Visibility (for aircraft delivery)	Daylight hours (visibility > 5 nm)	*IOE 1991, MPCU personal communication*
Wind speed	Beaufort Force 4-5 (22 – 33 knots)	*CONCAWE 1988, IP 1987, Mackay et al. 1986, IOE 1991*
Wave height	0.5-2.5 metres	*Kvam 1986, IOE 1991*
Oil viscosity	<2000 mPa	*CONCAWE 1988, IP 1987, MPCU personal communication*

13.5.3 Field Testing Dispersibility of Spilled Oil by the Safety Standby Vessel

The amenability of the oil to dispersion should be tested by shaking a sample of oil and seawater in a container with the appropriate amount of dispersant. Dispersant treatment should only be considered if the oil sample is effectively dispersed.

If dispersant is to be used, the installation may be requested to instruct the SSV to conduct the following dispersibility test, described in Table 13.6, using a sample of the proposed dispersant. This test determines the effectiveness of dispersant on the spilled oil. Note that Government agencies may also require a dispersibility test prior to giving approval for dispersant use.

Table 13.6: Dispersant bottle test

Bottle Test – On Stand-By Vessel – Conduct ASAP	
Step	**Action**
1	¾ fill a screw top jar with seawater.
2	Add a 25 ml sample of the spilled oil (collected using the slick sampling procedure).
3	Add 2 or 3 drops (approx. 1 ml) of dispersant from the stock onto the surface.
4	Screw on the lid and shake the jar.
5	If the oil remains mixed throughout the seawater and does not rise again to the surface,

	the slick should be amenable to dispersant spraying.
6	Log the result, time and operator and relay the result to the OIM who will report the result to the Incident Management Team (IMT).

13.6 Shoreline Protection & Cleanup

Shoreline Protection and Cleanup is necessary if an oil slick reaches the coastline and beaches. It is useful when organising beach protection and clean-up activities to prioritise the most sensitive areas according to their Environmental Sensitivity Index (ESI) that have suitable access and where there is presence of wildlife or other environmental sensitivities that may be at risk of oiling. Also, areas where there is heavy contamination and floating oil should be prioritised to limit further oil mobilisation and contamination.

If oil reaches the coastline, the principal factors to consider during an onshore clean-up operation are:

- Environmental sensitivity of the coastline;
- The length of contaminated coastline;
- The volume of oil to be cleaned up;
- The access route to the areas to be cleaned;
- Good communications and planning;
- A suitable clean-up method for each length of coast; and
- Temporary storage of contaminated materials and liquid oil.

Shorelines have varying degrees of vulnerability to oil spills and the clean-up techniques must be selected accordingly. Where coastal protection and/or clean-up is recommended, the following options are available:

- Booms to protect specific areas or to contain oil;
- Skimmers to remove oil from the water near the shoreline;
- Cold/hot water hoses to wash down beaches;
- Dispersant treatment of beached oil at low tide (only with Local Authority approval);
- Bioremediation in situ (only with Local Authority approval);
- Physical removal of oil and contaminated debris, and;
- Natural degradation of oil.

The clean-up option should be chosen in relation to shoreline type (Table 13.7). Advice should be sought from experts and conservation agencies. Environmental sensitivities may vary throughout the year and change accordingly. Particular attention needs to be paid to these together with the organisation of beach cleanup teams, temporary storage of oil and debris and access routes to shore. Consideration should also be given to the following:

- The areas which should be given priority for protection by booms;

- The areas where the oil should be left to disperse naturally and monitored (high-energy shorelines);
- The areas or conditions under which the oil should be dispersed;
- The areas where the spill should be recovered mechanically, and;
- The location of temporary storage pits and treatment areas for oiled debris and oily water.

In practice, any inshore clean-up operations will be conducted in close consultation with Local Authorities, to ensure that existing priorities can be met and an effective clean-up operation executed.

Table 13.7: Vulnerability indices for various shoreline types (1 indicates lowest vulnerability and 10 indicates highest vulnerability)

Vulnerability Index	Shoreline type	Comments
1	Exposed rocky shores	Wave reflection keeps most of the oil offshore. High energy wave environment. No cleaning necessary.
2	Eroding wave cut platforms	Wave swept. High energy wave environment. Most oil removed by natural processes within weeks.
3	Fine grained sand beaches	Oil does not usually penetrate far into the sediment, facilitating mechanical removal if necessary. Oil may persist for several months. High/Medium energy wave environment.
4	Coarse grained sand beaches	Oil may sink or may be buried rapidly, making cleanup difficult. High/Medium energy wave environment. Under moderate to high energy (> sea state 4 or 5) conditions the oil will be removed naturally within months from most of the beach face.
5	Exposed compacted tidal flats	Most oil will not adhere to or penetrate into the compacted tidal flat. Medium energy wave environment. Clean-up usually unnecessary – recommend leaving oil to disperse naturally.
6	Mixed sand and gravel	Oil may undergo rapid penetration and burial; under moderate to low energy conditions. Medium/Low energy wave environment. Oil may persist for years.
7	Gravel beaches	As for 6. A solid asphalt pavement may form under heavy oil accumulations.
8	Sheltered rocky coast	Areas of reduced wave action; oil may persist for many years. Low energy wave environment. These areas should receive priority protection by using booms or oil-adsorbent materials.
9	Sheltered tidal flat	Areas of low wave energy and high biological productivity; oil may persist for many years. Low energy wave environment. Clean-up is not recommended unless oil accumulation is very heavy, due to causing more environmental damage by entering the site. These areas should receive priority protection by using booms or oil-adsorbent materials.
10	Salt marsh	Most productive of aquatic environments; oil may persist for many years. Low energy wave environment. These areas should receive priority protection by using booms or oil-adsorbent materials. Seek advice from appropriate conservation organisations.

13.6.1 Oiled Wildlife

13.6.2 NEFL Oiled Wildlife Response

NEFL's Tier 1 oil spill response equipment is available on the OSVs, at the rig location and in transit between the rig location and Stanley Harbour. There is also spill response equipment stationed at the TDF and at the NEFL shore base. Full details of the Tier 1 response equipment is given in **PART I, Section 6.2.1**.

Tier 2 response, by definition, relies on regional or national oil spill response resources, and as such, any oiled wildlife response would necessarily become a Tier 2 spill. FIG have made available the wildlife rehabilitation facility in Stanley, which will be maintained, stocked and available for use by NEFL, if required. It is understood that this facility has the capacity to care for up to 20 penguins. As such, anything more than 20 penguins raises the event to a Tier 3 spill. In the event that the facility is near or at capacity, NEFL will mobilise their Tier 3 response capabilities, as detailed below. It should be noted that, based on the capability of the Stanley wildlife facility, is capable of rehabilitation of up to 20 penguins; rehabilitation of other birds and marine mammals is unlikely to be feasible. In the event that Tier 3 resources are not yet in country, best efforts would be made to rehabilitate these birds, with the resources available. If no rehabilitation is possible, they would be euthanized.

Additionally, NEFL has the ability to conduct aerial surveillance (refer to **Part I, Section 6.3.1**) to attempt to locate any oiled wildlife along the coastline. This would be considered in the event of a spill attributable to NEFL, where wildlife might be affected.

Tier 3 oiled wildlife response would draw on the Sea Alarm foundation via OSRL, implementing the oiled wildlife procedures. Local providers will not be relied upon when responding to an oil spill although it is understood that FIG can enact the NOSCP and their own MOU with local wildlife responders, if this is deemed necessary by the Marine Officer.

13.6.3 Sea Alarm Foundation

Members of OSRL have access to an emergency oiled wildlife response and preparedness service, coordinated by the Sea Alarm Foundation, an international non-governmental organisation. The principle aim is to mitigate the effects of oil on wildlife including seabirds, marine mammals and sea turtles. Sea Alarm works by using its international network to lead or support all elements of an oiled wildlife response in cooperation with local authorities, experts and response groups. Figure 13.5 provides confirmation that NEFL have access to oiled wildlife response through OSRL.

Figure 13.5: Noble Energy Inc. OSRL Certificate if Entitlement

Oil Spill Response

Oil Spill Response Limited
1 Great Cumberland Place
London W1H 7AL
United Kingdom

TEL +44 (0) 20 7724 0102
FAX +44 (0) 20 7724 0103
Email london@oilspillresponse.com

Website www.oilspillresponse.com

January 2015

To whom it may concern

Certificate of Entitlement – Noble Energy Inc

This is to confirm that, under the terms and conditions of our Participant's Agreement between Oil Spill Response Limited and Noble Energy Inc; all subsidiaries and affiliates of 50% or more ownership, such as named above are entitled to access our services. It is therefore, to all intents and purposes, in contract with Oil Spill Response Limited directly and accordingly entitled to all rights and benefits as set out in the Participant's Agreement.

For the sake of clarity these services include hire of personnel and equipment in the event of an oil spill occurring or about to occur where Noble has an interest in the oil concerned. In the event that oil wildlife rehabilitation is required this can been obtained through Oil Spill Response Limited and its partner Sea Alarm Foundation.

For and on behalf of Oil Spill Response Limited

Rachel Bayliss
Membership Manager

A Global Company with a Strong Regional Focus

Estimated response times for a wildlife response from Sea Alarm are 96 hours for equipment and minimum personnel, mobilising from the UK, with additional personnel available within a week (best case) from their initial visit and assessment, if required. Sea Alarm response activities may include:

- Initial wildlife response assessment and response planning;
- Mobilisation of oiled wildlife response equipment (from OSRL or other);
- Hazing operations (techniques to deter wildlife away from oiled areas);

- Search and collection of oiled wildlife (alive and dead) on the beach or coastline;
- Setup of temporary rehabilitation facilities and/or transformation of existing rescue centres to handle large numbers of oiled animals;
- Transport of oiled wildlife to a forward holding centre or rehabilitation facility;
- Triage of animals for either long term rehabilitation or euthanasia;
- Cleaning and rehabilitation;
- Euthanasia of wildlife as appropriate and authorised by regulators;
- Monitoring and release;
- Scientific wildlife impact assessment; and
- Liaising and working with key representatives of the international compensation regimes (e.g. ITOPF, P&I Clubs, IOPC Fund) to maximise the probability of cost reimbursement.

Wildlife Response Mobilisation

In the event of mobilisation, the wildlife responders will:

- Determine the appropriate level of wildlife response and resource needs;
- Depending on the severity of the incident, provide distant expert advice and coach local responders (if available) remotely (via phone/email - Level 1 response, available immediately), mobilise an assessment team of 2-4 people to visit the site to determine which assistance is needed and at what scale (Level 2 response, available within 96 hours) and/or mobilise an appropriate team of responders that works on site to assist the local response (Level 3 response, best case available within a week);
- On the basis of information available, identify available wildlife response organisations and experts and propose a response team and a plan;
- Ensure contractual and insurance arrangements are in place;
- Coordinate the mobilisation of the wildlife response team and its subsequent activities on site and ensure the optimal integration of these activities into the overall oil spill response;
- Together with the EMT, co-ordinate mobilisation of stocks of oiled wildlife response equipment and provide a specialist to be responsible for use and maintenance on site;
- Coordinate downscaling, demobilisation and debriefing towards the end of the response assistance, and completing documentation, reporting and financial administration.

In the event of a spill in the Falkland Islands where Sea Alarm are called out to respond, they would be mobilised by the NEFL Country Manager and Incident Commander (IMT), through NEFL's contract with OSRL. The mobilisation times for OSRL and Sea Alarm to arrive in the Falkland Islands with oiled wildlife response equipment is 96 hours, with a worst case of 148 hours (if an aircraft is not available in Europe). This would provide a small Sea Alarm team and the equipment detailed in the Sea Alarm/OSRL capability statement and summarised below:

- 1 x Search and Rescue Package;
- 1 x Wildlife Medical Package;
- 2 x Cleaning and Rehabilitation Packages;
- 1 x Responder – The responder will have previous knowledge and experience in the wildlife equipment and will be able to assist in the setting up of the equipment when it has arrived on site;
- 1 x Senior Oil Spill Response Manager;

- 1 x Oil Spill Response Manager;
- 15 Oil Spill Response Specialists / Oil Spill Responders;
- 1 Logistics Service Branch Coordinator
- Plus 50% of the global oil spill equipment stockpile in accordance with the OSRL Service Level Agreement (SLA).

If additional personnel and equipment are required, Sea Alarm have the capacity to bring in experienced wildlife responders from their contacts around the world, these include:

- Aiuka;
- Focus Wildlife;
- International Bird Rescue;
- Oiled Wildlife Care Network, UC Davis;
- ProBird;
- RSPCA;
- Wildbase, Massey University;
- Wildlife Centre Ostende.

It is anticipated that, if required to mobilise, additional personnel and equipment would be available in the Falkland Islands within one week (best case, dependent on current and planned flight availability).

Table 13.7: Sea Alarm Mobilisation

Question	Response	Action
Is there a potential for more than 20 penguins to become oiled? Or is the current capacity of the wildlife rehabilitation facility less than the number of birds oiled?	Yes	Mobilise Sea Alarm
	No	Continue to monitor the situation and take a precautionary approach if the situation changes
	Unknown	Call Sea Alarm and prepare to mobilise
Are the local NEFL responders able to deal with current levels of oiled wildlife?	Yes	Continue to monitor the situation and take a precautionary approach if the situation changes
	No	Mobilise Sea Alarm
	Unknown	Call Sea Alarm and prepare to mobilise
Is there the potential for more oiled wildlife to occur, which local NEFL responders cannot deal with?	Yes	Mobilise Sea Alarm
	No	Continue to monitor the situation and take a precautionary approach if the situation changes
	Unknown	Call Sea Alarm and prepare to mobilise
In consultation with the Department of Natural Resources and other relevant stakeholders, has it been advised that additional wildlife response capability should be mobilised?	Yes	Mobilise Sea Alarm
	No	Continue to monitor the situation and take a precautionary approach if the situation changes
	Unknown	Consult with Department of Natural Resources and other relevant stakeholders

13.6.4 Cessation of Drilling

There is the potential for oil spills to occur in the final days of any drilling activity and thus any oiled wildlife to be identified after the event. As such, NEFL will ensure they have access to the Tier 2 wildlife response facilities (via a contract with FIG) for a period of one week after drilling has de-mobilised.

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PART III

PROJECT SPECIFIC APPENDICES

Project specific appendices for each exploration well.

APPENDIX A: Humpback-1 Exploration Well

Appendix A: Humpback-1 Exploration Well

A.1 Introduction

Noble Energy Falklands Limited (hereafter referred to as NEFL) is planning to drill the Humpback-1 exploration well in PL012. The purpose of this Appendix is to present:

- Basic well information pertaining to spill response;
- Well control contingency plans for the project;
- Oil spill modelling conducted for the project;
- Key environmental sensitivity maps in the vicinity of the proposed exploration well.

A.2 Well Information

The location of the Humpback-1 well is shown in Figure A.2.1. Humpback-1 is the first of the wells to be drilled in the NEFL programme, with an anticipated spud date of 01st May 2015.

The well will be drilled using the Ocean Rig semi-submerisble drilling rig *Eirik Raude*. The *Eirik Raude* is a 5th generation deep water semi-submersible drilling unit suitable for drilling in harsh and deepwater environments.

Following drilling, the well will be logged and evaluated, which may include vertical seismic profiling (VSP) operations. No well testing operations are planned. On completion of the operations, the well will be plugged and abandoned in accordance with Oil and Gas UK Guidelines and the well abandonment programme approved by FIG after consultation with the Health & Safety Executive (HSE). Details of the Humpback-1 well are provided in Table A.2.1.

Figure A.2.1: Humpback-1 exploration well location

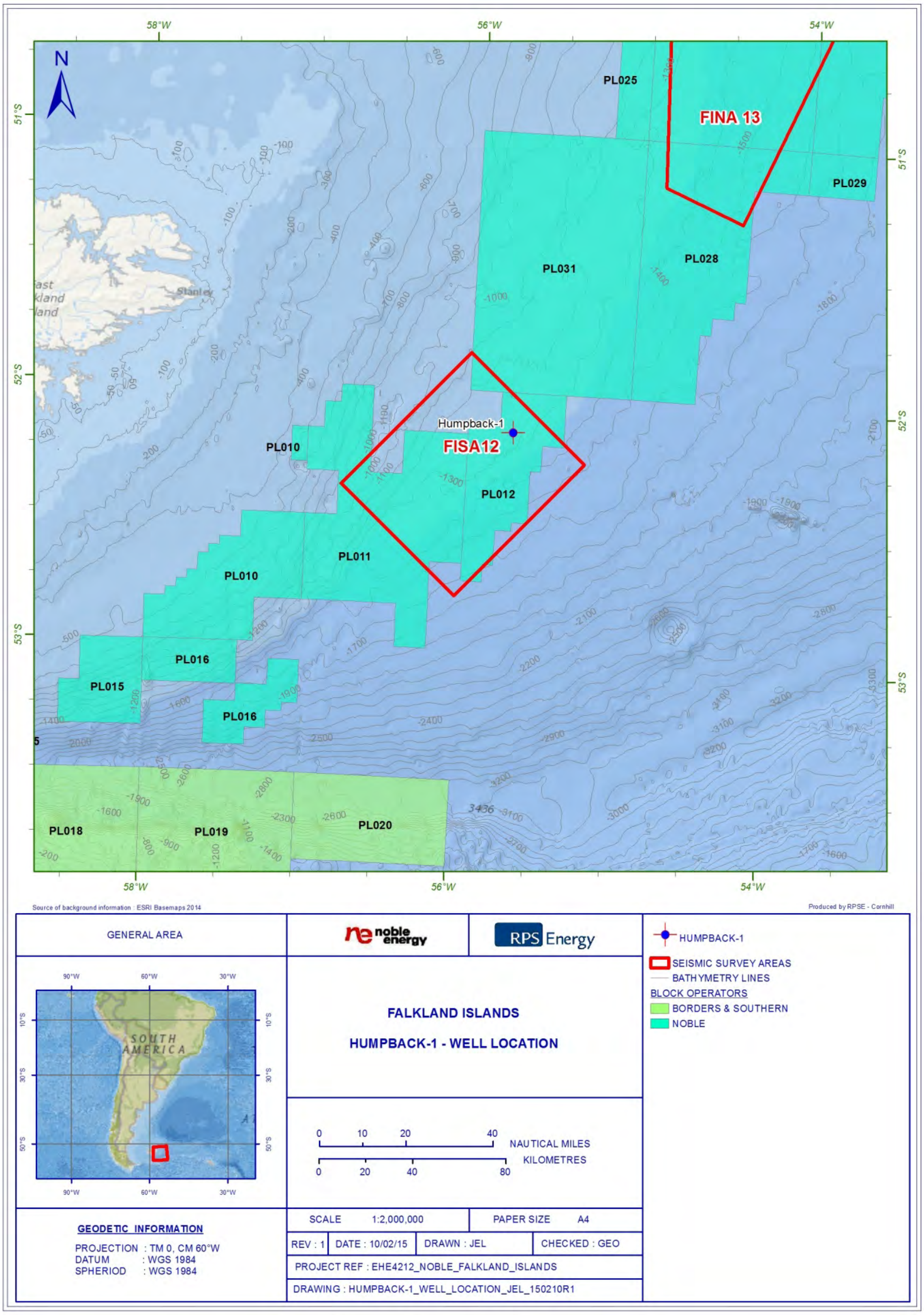


Table A.2.1: Humpback-1 exploration well details

	Humpback-1
Well Intent	Exploration
Well Trajectories	Vertical
Target Reservoir	Main Objective: APX Package (4,564m-4,910m TVB RKB) Aptian – Upper Cretaceous Secondary Objective: HBX Package (5,071m-5,358m TVD RKB) Hauterivian Barremian – Lower Cretaceous
Well Duration* (days)	65 Days (Drill, Evaluate, P&A)
Licence	PL012
Approximate Spud Date	01st May 2015
Well Top-hole Location	52° 09' 17.6953" S 55° 43' 08.1793" W (WGS84 Datum, Transverse Mercator Projection Central Meridian 60deg W)
Nearest Landfall	155 Kilometres (Stanley)
Distance to Nearest Trans-boundary Line	225 Kilometres (Falklands - Argentina)
Water Depth (m) (MSL)	1,268
Total Depth of Well (m TVD RKB)	5,366
Expected Reservoir Depth (if known) (m TVD RKB)	4,564 – 4,910
Expected Reservoir Pressure (psig)	8,237 @ TD
Expected Reservoir Temperature (°C)	113°C
HT/HP	No
Hydrocarbons Anticipated	Oil, API gravity 35 – 40
Drilling Fluid	Water Based Mud (WBM)
Maximum Open Hole Flow Rate	50,071 bopd (7,961.3 m^3) estimated
Well Test Planned	No
BOP specification	18 ¾" Cameron D (10,000psi) Annular Preventer
Support Vessels	3 x Offshore Supply Vessels (OSVs). A least one vessel will remain in the vicinity of the drilling rig at all times taking on the role of Safety Standby Vessel (SSV).
Capping Device Compatibility	Compatible with the SWIS 18 3/4" bore capping stacks (15k psi) pre-positioned by SWIS in Brazil and Norway.

*: Total time on station. Does not include rig movements.

A.3 Well Control Contingency

The purpose of this section is to ensure that appropriate contingencies are in place to mitigate and terminate a loss of well control and subsequent release of hydrocarbons. Whilst it is recognised that there is a very low likelihood of a major loss of well control, plans need to be in place for an appropriate response to remedy such a situation.

A blow-out is the uncontrolled influx of reservoir fluids into a well. Due to the precautions taken to prevent their occurrence, they are very rare events. An 18 ¾" Cameron D (10,000psi) Annular Preventer will be used for the Humpback-1 exploration well. The testing and operation of the BOP system on board the *Eirik Raude* will be carried out in accordance with the drilling contractor's well control procedures, and the Noble bridging documents.

A number of elements are required in order to provide an effective well control contingency. These include surveyed relief well locations, relief well designs, relief well equipment, alternative rigs and access to well control specialist services and equipment. Consideration of the available well capping systems is also required.

A.3.1 Assessment of the Situation

Prior to any well control operations commencing, a thorough assessment of the seabed and surface situation would be required, in order to inform forward planning.

Assessment of Seabed Condition

An assessment of the seabed situation will be carried out, using the services of Wild Well Control. This will include:

- Assessment of any debris and the equipment required to remove it (e.g. specialist shearing or cutting equipment);
- Assessment of the well-head, BOP and Lower Marine Riser Package (LMRP) condition for suitability of deploying a capping/containment device;
- Remedial actions and equipment required;
- Plan for forward work programme with estimated costs.

Assessment of Surface Conditions

Surface and current conditions will be assessed for operability of vessels and equipment with respect to:

- The possible oil spill and/or gas flow situation at the sea surface and any health and safety implications this may have on operations;
- Weather conditions including forecasts for the anticipated operational period (note that a weather forecasting service will already have been contracted for drilling operations purposes. Such forecasts will also be used for updated oil spill modelling);
- Current conditions - These will have been monitored during the drilling operations.

A.3.2 Relief Well Locations

A relief well plan has been drafted as part of the Humpback-1 well basis of design (BOD) package.

Suitable seabed areas for potential relief well locations have been identified based on the well design profile for an optimised intersect well trajectory.

Humpback-1 is a vertical wellbore allowing for locating relief well sites in any direction. A shallow hazards study for the Humpback-1 well location was completed in September 2014. The study identified a "Relief Well Zone in which potential seabed relief well locations could logically be located, as shown on Figure A.3.1. The study identified two potential relief well locations

(RW1 and RW2 on Figure A.3.1). Table A.3.1 provides the surface coordinates of these two locations. As the seabed is relatively flat, and there were no major hazards identified, the relief wells were located upstream of the pre-dominant winds and currents. Figure A.3.2 also provides the seabed features and hazards map produced for the Humpback-1 location.

Figure A.3.1: Identified relief well locations for Humpback-1 (NEI, 2015)

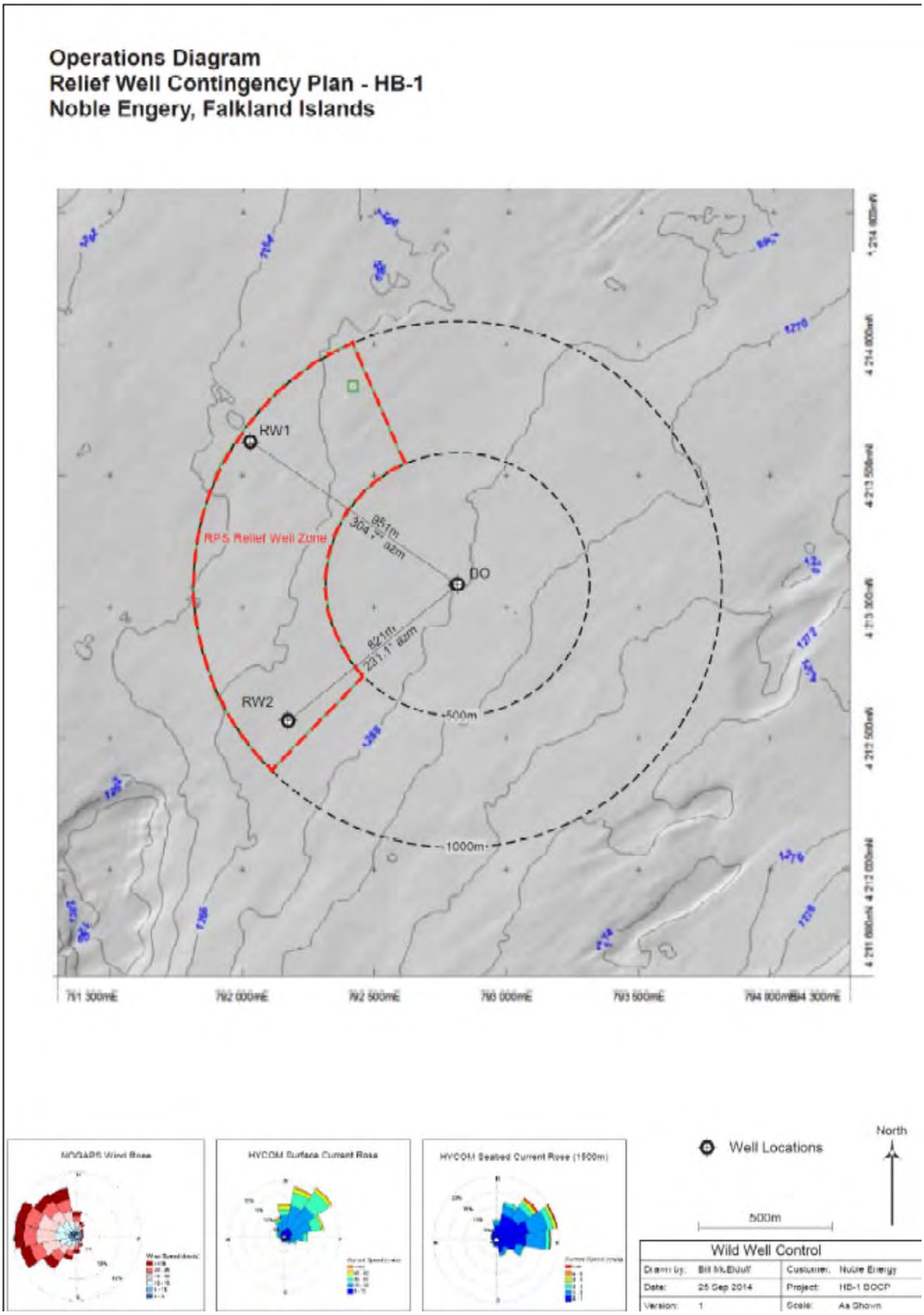


Figure A.3.2: Seabed features and hazards map for the Humpback-1 well location

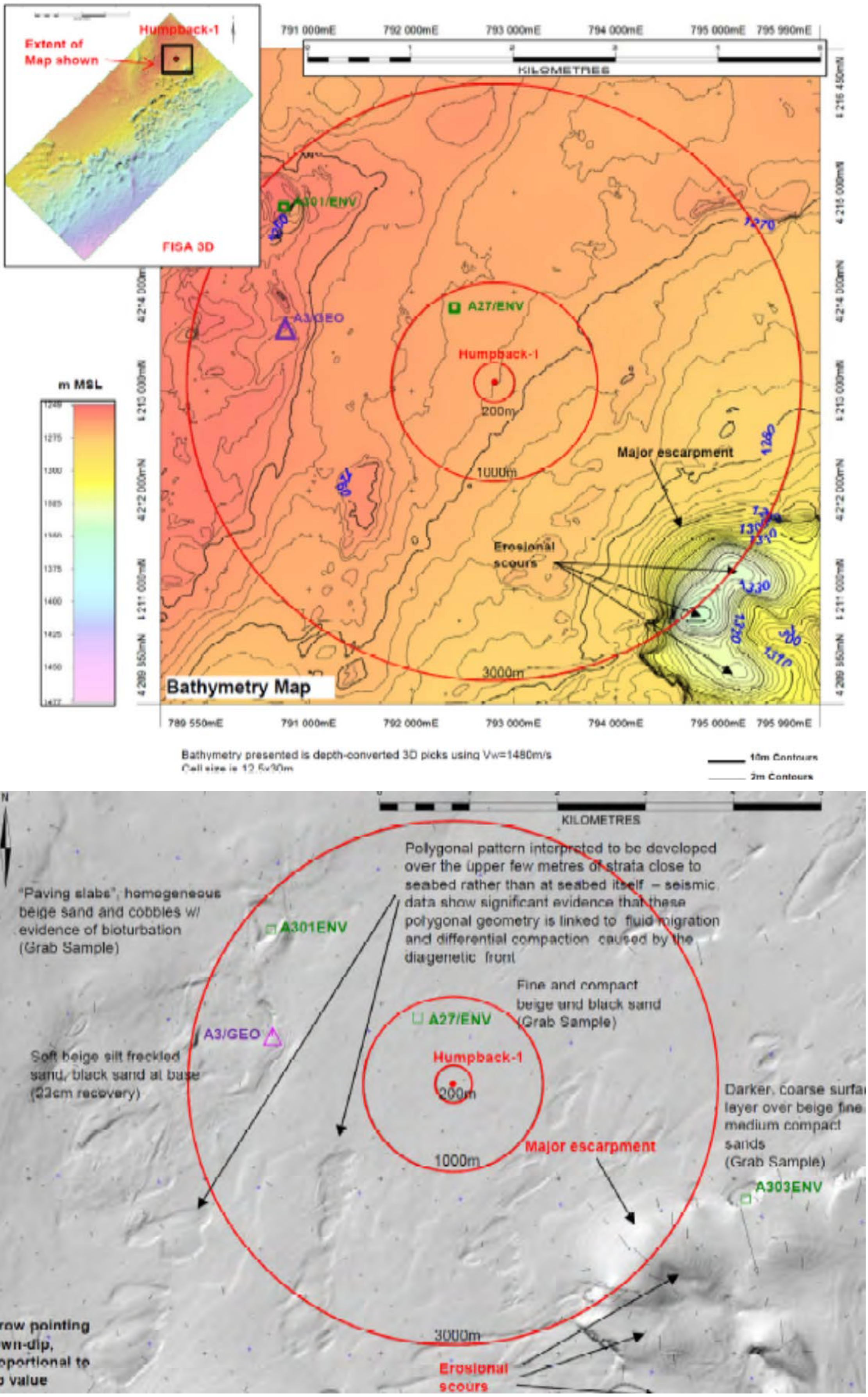


Table A.3.1: Humpback-1 relief well surface coordinates

Relief well	Location
RW1	52° 9' 1.720" S, 55° 43' 50.903" W
RW2	52° 9' 35.564" S, 55° 43' 40.128" W

A.3.3 Relief Well Designs

Contingent relief well designs, based on the key design rationale of the Humpback-1 well, have already been prepared for both identified relief well locations as part of the relief well plan.

The intersection target was selected at 10 metres below the 13⅜" casing shoe for both relief wells. In practice, the intersection point selection is based upon several variables and judgment based on actual conditions and with considerable input from the operations team. For RW1 and RW2 the 13⅜" casing is set at 3600 m TVD in a shale sequence. The Humback-1 wellbore will be at 60 metres proximity from the relief well (*NEI, 2015*).

The relief well trajectories utilize the prototypical relief well design used on modern relief well projects since the Saga blowout in 1989. The primary well design is a simple 2D “S” type well that closes with the target well. A cross by is utilized to triangulate and accurately fix the position of the target well. Thereafter, a parallel section is drilled followed by the final alignment and intersection with a 3° incidence angle (*NEI, 2015*).

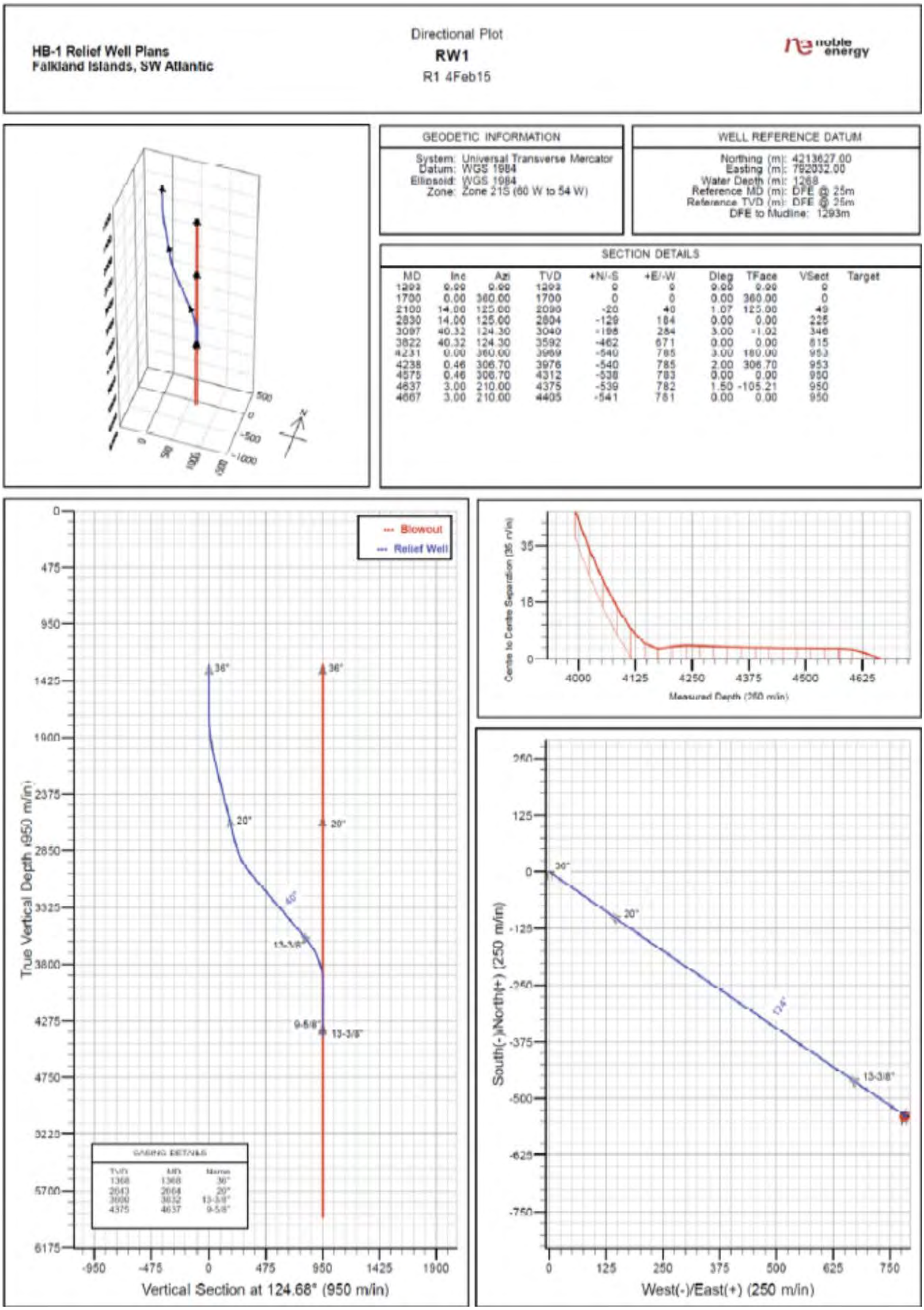
Due to the extensive wireline work required for ranging and gyro surveys, the maximum inclination was kept below 40° inclination. The combination of seabed location and limited available TVD required a nudge in the top-hole sections (*NEI, 2015*). Table A.3.2 below shows the key parameters of the relief well plans.

Table A.3.2: Relief well plans key parameters (NEI, 2015)

	KOP (m)	Build/Drop Rates (°/30m)	Max. Inclination (deg)	Intersection MD (m)	Intersection TVD (m)	Intersection Inclination / Azimuth (°)	Incidence Angle (°)
RW1	1,700	1-3 / 3	40	4,667	4,405	3 / 210	3
RW2	1,700	1-3 / 3	35	4,605	4,405	3 / 210	3

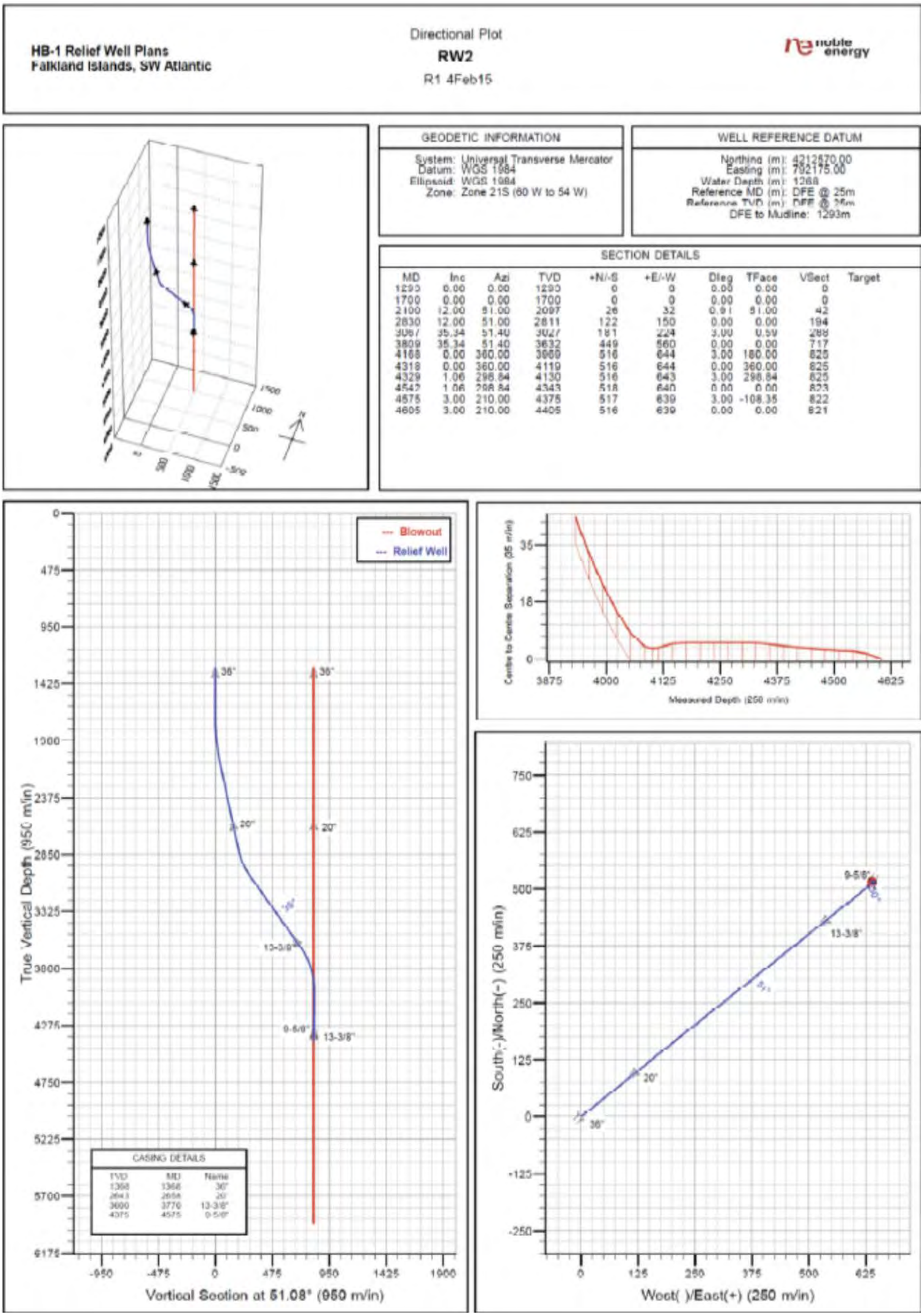
Provisional well trajectories for each relief well can be seen below in Figures A.3.3 and A.3.4. The well designs with regard to sub-sea setting depths for casing shoes will remain largely unchanged regardless of the final well trajectory.

Figure A.3.3: RW1 well plan plot (NEI, 2015)



MD	Inc	Azi	TVD	+N/-S	+E/-W	Dleg	TFace	VSect	Target
1293	0.00	0.00	1293	0	0	0.00	0.00	0	
1700	0.00	360.00	1700	0	0	0.00	360.00	0	
2100	14.00	125.00	2096	-20	40	1.07	125.00	49	
2830	14.00	125.00	2804	-129	184	0.00	0.00	225	
3097	40.32	124.30	3040	-198	284	3.00	-1.02	346	
3822	40.32	124.30	3592	-462	671	0.00	0.00	815	
4231	0.00	360.00	3969	-540	785	3.00	180.00	953	
4238	0.46	306.70	3976	-540	785	2.00	306.70	953	
4575	0.46	306.70	4312	-538	783	0.00	0.00	950	
4637	3.00	210.00	4375	-539	782	1.50	-105.21	950	
4667	3.00	210.00	4405	-541	781	0.00	0.00	950	

Figure A.3.4: RW2 well plan plot (NEI, 2015)



A.3.4 Equipment and Materials

It is critical that the equipment mobilised to the well location is appropriate for the specific situation encountered. Accordingly, a detailed assessment of the situation will be carried out before any specific equipment is mobilised.

Noble has procured a complete set of additional well equipment, including casing and wellheads, which would allow the drilling of a relief well if required (Table A.3.3). This equipment will be located in the Falkland Islands. There will also be a significant reserve of bulk mud and cement materials, as well as the necessary directional drilling equipment, held in the Falkland Islands.

Table A.3.3: Relief well equipment available to Noble

Equipment / Service	Location	Contract	Qty
Well Consumables			
Wellhead system	Stanley	Purchased. Noble stock.	1 set
36" conductor	Stanley	Purchased. Noble stock.	1 well + contingency
20" casing	Stanley	Purchased. Noble stock.	1 well + contingency
13-3/8" casing	Stanley	Purchased. Noble stock.	1 well + contingency
9-5/8" casing	Stanley	Purchased. Noble stock.	1 well +contingency
7" liner and liner hangers (contingency)	Stanley	Purchased. Noble stock.	1 well +contingency
Cement bulk and chemicals	Stanley	Purchased. Noble stock.	Stock maintained for 2-3 wells
Mud bulk and chemicals	Stanley	Purchased. Noble stock.	Stock maintained for 2-3 wells
Tools and Services			
Directional drilling equipment	Stanley	Drilling contractor	3 full sets
Electric logging	*Eirik Raude* + Stanley	Drilling contractor	
Cementing	*Eirik Raude*	Drilling contractor	
Casing running	*Eirik Raude*	Drilling contractor	
Drilling Fluids	*Eirik Raude*	Drilling contractor	
Mudlogging	*Eirik Raude*	Drilling contractor	
Fishing / milling	*Eirik Raude*	Drilling contractor	
Remote Operated Vehicles (ROV)	*Eirik Raude*	Drilling contractor	2
OSVs	Stanley	Drilling contractor	3
Helicopters	Stanley	Drilling contractor	3
Specialist Equipment			
Magnetic ranging equipment (vector drilling services)	Houston	Contract with Wild Well Control	as required
Well control and blowout services and equipment	Houston	Contract with Wild Well Control	as required
Oil spill equipment for Tier 1 response	Falkland Islands	Contract with NRC	3 x dispersant spray systems (Two fitted to OSVs and one stored ashore); dispersant stocks 4 x IBCs on each OSV, (total stock 20m^3 of type 2/3 dispersant).
Oil Spill Equipment for Tier 2 & 3 response	Southampton, UK	Contract with OSRL and NRC (Full membership)	as required

A.3.5 Alternative Rigs for Relief Well Drilling

During a serious well control incident, it is possible that the drilling rig may be damaged. Therefore, an additional suitable drilling rig would be required to conduct relief well drilling operations. In this scenario, another suitable rig will be sourced. If it is clear that an alternative rig is required, mobilisation of a deep water harsh environment (HE) dynamically positioned (DP) mobile offshore drilling unit (MODU) would be initiated as soon as possible.

Noble, through their association with the Global Rig Share Solutions network (GRSS), have very close contacts with all deep water operators. GRSS gives up-to-date information on the location and availability of all deep water drilling units worldwide. Noble has prepared a list of suitable deep water units (Table A.3.4) which could be utilised to drill a relief well in the Falkland Islands. These are all HE semi-submersible units, which have the best motion characteristics to cope with the swells in the South Atlantic.

Ocean Rig are the selected drilling contractor for the drilling of the Humpback-1 well and are providing the HE semi-submersible *Eirik Raude* to perform the work. Ocean Rig have a second HE semi-submersible drilling unit *Leiv Eiriksson*, which is the sister vessel to the *Eirik Raude* and is almost identical in specification. This rig would be one of the primary units which Noble would negotiate to secure if required.

Noble has also identified a list of suitable HE deepwater drillships that could be used for relief well drilling (Table A.3.5). Ocean Rig also has 8 deepwater units (drillships) in their fleet. Although a drillship is not the preferred MODU type due to poorer performance in heavy weather, Noble would include these units as part of the primary effort to secure a unit from Ocean Rig.

Given the remoteness of the well locations and the need for a high specification MODU to drill a relief well, it is envisaged that it would take up to 168 days to secure and mobilise a suitable drilling unit to location, the worst case being a rig mobilisation from the South Korea/Philippines area. In contrast, a best case scenario, where a rig is immediately available and located in the Brazil region, would be 53 days from incident to a rig on site (refer to Table A.3.6).

Table A.3.4: Harsh environment deepwater semi-submersible drilling units suitable for relief well drilling in the Falkland Islands

Rig Name	Current Location (Oct 2014)	Design (water depth)	Drilling Contractor	Operator	Approx. distance from Falkland Islands (nm)	Transit Speed (kts)	Estimated mobilisation transit time (days)
Leiv Eiriksson	Norway	Bingo 9000 (7,500ft)	Ocean Rig	Rig Management Norway	7,400	6	52
Deepsea Stavanger	Angola	GVA 7500 (10,000ft)	Odfjell	BP	4,320	6	30
Deepsea Atlantic	Norway	GVA 7500 (enhanced) (10,000ft)	Odfjell	Statoil	7,400	6	52
Deepsea Aberdeen	South Korea	GVA 7500 (enhanced) (10,000ft)	Odfjell	*Yard inspection*	11,000	6	76
West Phoenix	UK	Moss CS50 MkII (10,000ft)	Seadrill	Total	7,300	6	51
West Hercules	Norway	GVA 7500 (10,000ft)	Seadrill	Statoil	7,400	6	52
West Aquarius	Canada	GVA 7500 (10,000ft)	Seadrill	Exxon Mobil	6,450	6	45
West Eminence	Brazil	Moss CS50 Mk-II (10,000ft)	Seadrill	Petrobras	2,250	6	16
West Pegasus	Mexico	Moss CS50 Mk-II (10,000ft)	Seadrill	PEMEX	7,050	6	49
West Leo	Ghana	Moss CS50 Mk-II (10,000ft)	Seadrill	Tullow	4,530	6	32
Transocean Barents	Norway	AKER H-6E (10,000ft)	Transocean	Shell	7,400	6	52
Transocean Spitsbergen	Norway	AKER H-6E (10,000ft)	Transocean	Statoil	7,600	6	53
Scarabeo 8	Norway	Moss CD50 Mk-II (10,000ft)	Saipem	ENI	7,400	6	52
Scarabeo 9	Angola	HF Engineering Frigstad D90 (12,000ft)	Saipem	ENI	4,320	6	30

Table A.3.5: Harsh environment deepwater drillships suitable for relief well drilling in the Falkland Islands

Rig Name	Current Location (Oct 2014)	Design (water depth)	Drilling Contractor	Operator	Approx. distance from Falkland Islands (nm)	Transit Speed (kts)	Estimated mobilisation transit time (days)
Corcovado	Brazil	Saipem (10,000ft)	Ocean Rig	Petrobras	2,250	12	8
West Navigator	Norway	MST III-CADS (8,200ft)	Seadrill	Centrica	7,600	12	26
Stena DrillMAX	Ghana	Samsung (10,000ft)	Stena Drilling	Hess	4,530	12	16
Stena Carron	Angola	Samsung (10,000ft)	Stena Drilling	Statoil	4,320	12	15
Stena Forth	USA, GoM	Samsung (10,000ft)	Stena Drilling	Hess	7,030	12	24
Stena IceMAX	USA, GoM	Samsung Double Hull (10,000ft)	Stena Drilling	Shell	7,030	12	24

A.3.6 Time Estimate for Relief Well Drilling

It is estimated that the drilling of a relief well would take between 123 to 263 days at the Humpback-1 well location, which includes the estimated mobilisation time (refer to Table A.3.6). The time to drill the relief well is longer than the planned time to drill the primary well. This is not only due to the additional footage required but also due to the additional time that will be required to conduct magnetic ranging surveys on wireline and additional directional drilling work in order to get the relief well to intersect the original well at the 13 3/8 casing shoe.

There is also a significant amount of time taken up from securing and mobilising a suitable drilling rig. An estimate of between 5 and 7 days has been made for the actual well kill operations. Table A.3.6 illustrates the estimated worst case and best case timescales for the drilling of a relief well at the Humpack-1 well location.

Table A.3.6: Estimate for the drilling of a relief well at the Humpback-1 well location

Activity	Worst Case Scenario (Days)	Best Case Scenario (Days)
1. Source suitable MODU	14.0	7.0
2. Negotiate contractual terms, insurance, liabilities and indemnity provisions	28.0	14.0
3. Suspend current well operations	28.0	7.0
4. Mobilise rig to relief well location	76.0	16.0
5. Fuel Stops en-route	9.0	3.0
6. Stop in Falklands - load equipment, brief crews, refuel rig, crew change	10.0	5.0
7. Mobilise to relief well location	3.0	1.0
Total mobilisation time	**168.0**	**53.0**
8. Position rig and prepare to spud	1.5	1.5
9. Drill 42" hole	3.0	2.5
10. Run 36" conductor	3.0	2.0
11. Drill 26" hole	9.0	7.5
12. Run and cement 20" casing	3.0	1.5
13. Run BOP	4.0	3.0
14. Prepare to drill 17-1/2" hole	2.0	1.0
15. Drill 17-1/2" directional hole	14.0	10.0
16. Run and cement 13-3/8" casing	6.0	4.0
17. Drill directional 12-1/4" hole close to blow-out well	23.5	19.5
18. Trip-out and run magnetic ranging tools on wireline	4.0	2.0
19. Drill 12-1/4" hole to intersect blowout well. Trip-out.	4.0	2.0
20. Run drill string and RTTS packer assembly. Set RTTS and test	4.0	2.0
21. Pump kill weight fluid into blow-out well (well kill)	7.0	5.0
22. Allowance for additional ranging runs and for directional correction runs to intersect well	7.0	7.0
Total open hole flow time	**263.0**	**123.0**

A.3.7 Well Capping Devices

A recent industry development in response to the Deepwater Horizon Macondo well control incident in the US Gulf of Mexico is the Subsea Well Response Project (SWRP). The outcome of this project has resulted in the availability of:

- 4 x Capping Stack Toolboxes:
  - Two 18 3/4” bore capping stacks developed to handle pressure up to 15kpsi (positioned in Brazil and Norway);
  - Two 7 1/16” bore capping stacks designed for pressure up to 10kpsi (positioned in Singapore and South Africa).

There are also two Subsea Incident Response Toolkits for the subsea application of dispersant available, positioned in Brazil and Norway. The Capping Stack Toolboxes are available through

the Subsea Well Intervention Service (SWIS) through membership of OSRL (refer to **Part II, Section 10.7** for further information on the SWIS).

The capping devices are designed for deployment onto a blown-out subsea well and would interface with the rig's LMRP connector profile or possibly directly onto the wellhead at the top of the well.

Noble has reviewed the blow-out preventer equipment on the *Eirik Raude* rig to assess its compatibility with the SWIS capping devices. The SWIS capping device design is suitable for direct interface to the *Eirik Raude* LMRP Cameron HC connector profile at the top of the rig's main BOP stack. It is also compatible with the H4 wellhead profile, which will be used on the Humpback-1 well.

The use of a capping device presumes that the LMRP or wellhead profiles can be accessed. It also assumes that the gasket sealing faces are undamaged. It is possible that a considerable quantity of debris may prevent immediate access in the event of a major incident involving significant damage to the rig. Heavy duty cutting equipment and deployment vessels would therefore be required to assist in the removal of any debris and the subsequent deployment of a capping device.

Mobilisation

Following the situational assessment (Section A.3.1), a decision would be made on the feasibility of utilising a capping device and with a comparison against the relief well drilling rig situation, a decision made on mobilisation of the device. A specific plan for the device deployment and utilisation will be prepared during mobilisation, in close consultation with OSRL.

The closest capping device to the proposed operations is stored in a logistics base located in the port of Angra dos Reis, Rio de Janeiro, Brazil. An estimate has been made for the time to mobilise the capping device from Angra dos Reis and deploy it at the Humpback-1 well location (Table A.3.7). It is assumed that a suitable construction or well intervention vessel would be readily available in the region.

It is the responsibility of the incident owner to source suitable vessels for the incident with sufficient deck loading capability. The maximum gross weight of the capping stack system is 150,538 kg which includes the H4 connector, 3 metre spacer spool and test stand (130,790 kg without test stand).

Table A.3.7: Time breakdown estimate to cap the Humpback-1 well using the SWIS well capping device located in Angra dos Reis, Brazil

Mobilisation Timeline	Best Case (days)	Worst Case (days)	Responsibility
Source suitable well intervention/construction vessel	7	21	Noble
Transport equipment to Quayside	1	2	OSRL
Equipment assembly & testing	2	5	Noble
Load and install/stow equipment	1	3	Noble
Sail to Port Stanley* (1,840 nm)	6.5	10.5	Noble
Refuelling and crew briefing	1.0	2.0	Noble
Sail to location	0.5	1.0	Noble
Well Capping Operations	4	28†	Noble
Total Estimated Days	**23**	**72.5**	

* Based on sailing from Angra dos Reis (1,840 nautical miles) at an average transit speed of 12 knots. Worst case allows 4 days for poor weather.

† The figure of 28 days is based on an estimated worst case scenario of having to potentially remove the damaged tree, ancillary equipment and any debris to allow the cap to be installed.

Potential Issues

Potential issues with device availability, deployment and utilisation lead to the capping device being considered a secondary option as compared to a relief well, which is likely to be required in any case. The principal issues are:

- Availability – Although a number of devices are available, it is possible that the closest device (located in Brazil) could be committed to maintenance or a prior incident;
- Vessels – Specialist well intervention vessels will be required to deploy the capping device. Therefore, deployment will also depend on availability and mobilisation times of specialist vessels;
- Damage to the wellhead, BOP and/or LMRP could be such that it may prevent the use of a capping device;
- Weather conditions offshore the Falkland Islands are generally rough, particularly during the winter. Strong winds and swells/waves of 3 metres are not uncommon, and as such it may not be practicable or safe to deploy the device depending on the weather conditions.

A.3.8 Summary

Noble is confident that it has a robust plan for dealing with a well control incident and that it has taken the following into account:

- The well management contract between Noble and Ocean Rig is a term contract not a well specific contract and therefore in the scenario where a relief well was required, Ocean Rig would continue to support and manage the operation and provide all

necessary third party contracts – nothing would change from the current contractual arrangement;

- Suitable surface locations for a relief well will be identified. All locations will have complete shallow hazard assessments in place before commencing well operations on the primary well;
- A design review for relief wells has been carried out based on the design for the primary well. Directional plans have been prepared for the well and each potential hydrocarbon zone. The feasibility of drilling this well profile has been assessed with a competent directional drilling contractor;
- All necessary rental tools and services for the drilling of a relief well are readily available under the existing contracts. These contracts include, amongst others: directional drilling/measurement services, fluids engineering, cementing services and mud logging. The exception to this is the specialist ranging equipment which would be required to assist with the intersection of a primary blowout well. This equipment would be mobilised to the drilling location at the time of an incident if required;
- The call off contract with Wild Well Control (WWC) will be available to Noble for the provision of emergency well control and well kill services. This would take the form of onshore support, offshore supervision and the supply and operation of all necessary equipment;
- A detailed and prioritised list of suitable drilling rigs, capable of drilling a relief well, has been prepared. This list includes details of the current location, operator, drilling contractor and contact details for each rig. Noble, through their close links with the drilling community will continue to monitor the rig market for the current position of all suitable drilling units worldwide.

A.4 Oil Spill Modelling

A.4.1 Hydrocarbon Inventory

The main spill risks associated with drilling operations are accidental loss of hydrocarbons from the reservoir or an accidental loss from the drilling rig fuel oil inventory, the worst case being a total loss of well control (i.e. blow-out), or a total loss of the fuel oil inventory of the rig. The likelihood of such events occurring is in the range identified as low risk.

The crude oil expected from the Humpback-1 exploration well is classified as a Group 2 oil, according to the ITOPF oil group classification system (refer to **Part II, Section 12.1**).

In the unlikely event of a loss of well control, the amount lost per unit time would depend on the unrestricted open hole flow rate. For the purposes of oil spill modelling, the maximum theoretical open hole flow rates for the well has been estimated (Table A.4.1). These estimates are based on reservoir modelling. The total hydrocarbon inventory for the Humpback-1 exploration well is also shown in Table A.4.1.

Table A.4.1: Project inventory of hydrocarbons for the proposed Humpback-1 exploration well

Type of Oil	Specific Gravity and ITOPF Group	Maximum Quantity (tonnes)	Comments
Diesel	0.85, Group 2*	4,631m^3 (3,936 tonnes)	Used as fuel oil on rig.
Lube and Hydraulic Oil	0.911, Group 3†	15 tonnes (assumed)	Hydraulic oil volumes vary depending on work in progress. Hydraulic oil drums are stored in secure bunded areas on deck.
Jet A-1 Fuel	0.804, Group 2‡	2 tonnes (assumed)	Used for occasional re-fuel of helicopters. Stored in IBCs in secure bunded areas on deck.
Crude (expected 35-40° API)	0.850 – 0.825, Group 2	Maximum theoretical open hole flow rate 50,071 bopd≠ (Approx. 6,668 tonnes per day).	The worst case scenario would be the uncontrolled flow of reservoir hydrocarbons from the well (blow-out).

* The specific gravity of marine diesel fuel typically ranges from 0.83 to 0.875. A value of 0.85 has been used.
† Based on the properties of Mobil *EAL™ 32* hydraulic oil.
‡ Based on the properties of BP Jet A-1 turbine fuel.
≠ Obtained from reservoir modelling.

Once spilt in the marine environment, oil immediately begins to undergo weathering, a term used to describe many natural, physical, chemical and biological changes. The changes that the oil undergoes will often influence the effectiveness of response options. Prevailing meteorological and oceanographic conditions, as well as the type of oil spilt, will determine its ultimate fate. Further information on weathering processes is provided in **Part II, Section 12.0**.

Spill modelling of both diesel fuel oil and crude oil has been undertaken to estimate and illustrate the potential fate and movement of the oil for contingency planning purposes, using the RPS-ASA SIMAP model.

A number of scenarios have been modelled for the Humpback-1 exploration well and include both 2-Dimensional (2D) and 3-Dimensional (3D) scenarios.

A.4.2 The SIMAP Programme

SIMAP is a computer modelling software application that estimates physical fates and effects of releases of oil. The model is coupled to a geographic information system (GIS), which contains environmental and biological data, and also to databases of physical-chemical properties and biological abundance, containing the necessary inputs for the models.

Stochastic Modelling

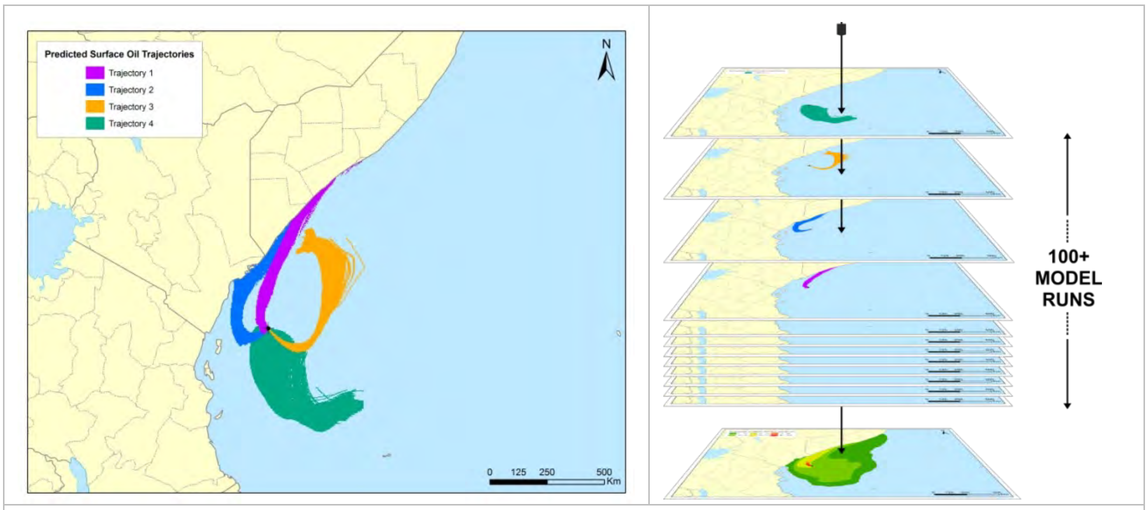
Stochastic simulations provide insight into the probable behaviour of potential oil spills in response to temporally and spatially varying meteorological and oceanographic conditions in the study area. The stochastic model compiles surface trajectories from the results of an ensemble of hundreds of individual deterministic modelling cases for each stochastic spill scenario. The simulation start time of each individual deterministic modelling case is selected randomly within the specified seasonal timeframe (in this case, October to February for summer, and March to September for winter), thus sampling the natural variability in the wind and current forcing.

In a stochastic modelling operation, SIMAP will first run each of the individual deterministic modelling cases (Figure A.4.1). It will then compile the results of all the deterministic cases to produce a statistical analysis of the results, which forms the basis of the stochastic model output. The stochastic modelling output provides two types of information:

- (1) The footprint of sea surface areas that the model predicts will become oiled and the associated probability of oiling (example in Figure A.4.2); and
- (2) The predicted shortest time for oil to reach any point within the areas predicted to be oiled.

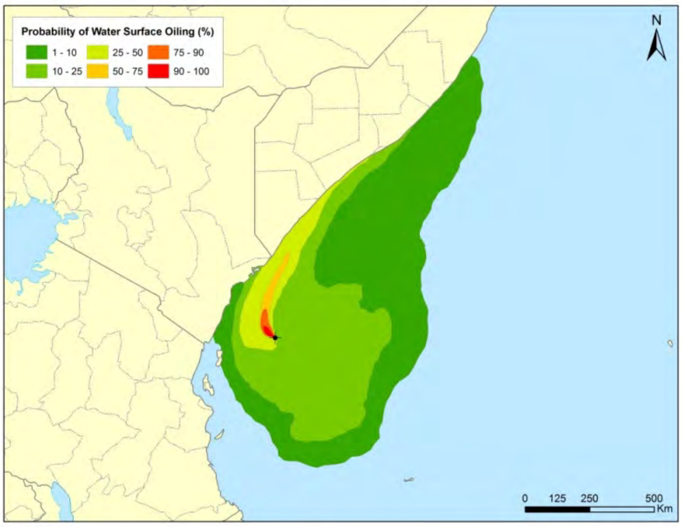
The probabilities of oiling and the stochastic footprint are generated by the statistical analysis performed by SIMAP during the stochastic modelling process. The footprint is the sum of the swept area of each individual deterministic modelling case (Figure A.4.1). It is important to note that a single deterministic modelling case will represent only a relatively small portion of the total footprint. The stochastic modelling simulations are also able to provide shoreline oiling data, expressed in terms of the percentage of simulations in which oil is predicted to reach shore, together with the minimum and average beaching times.

Figure A.4.1: Example stochastic modelling scenario showing four individual deterministic spill trajectories predicted by SIMAP



The swept area and frequency of contact with given locations is used to calculate the probability of impacts during a spill. Essentially, all 100+ model runs are overlain and compiled by SIMAP (shown as the stacked runs on the right) and the number of times that a trajectory reaches a given location is used to calculate the probability of oiling for that location.

Figure A.4.2: Example stochastic model output; Predicted probability of water surface oiling (%)



This figure is the result of the overlay and compiling process of the 100+ individual deterministic model cases to calculate the probability of water surface oiling in the study area. It is important to note that this figure does not depict the areal extent of a single model run/spill.

Deterministic Modelling

Individual deterministic cases from the stochastic analysis for each spill scenario can be further evaluated to select a *worst case* scenario to be analysed in more detail by performing a single worst case deterministic trajectory/fate simulation. This worst case scenario is selected from the pool of the results of the 100+ deterministic simulations used in the stochastic model.

The worst case scenario is normally selected based on the degree of shoreline oiling. Different parameters or indicators can be used to compare and assess the degree of shoreline oiling, for example, "*time to reach the coast*", "*total oil volume to reach the coast*" or "*total length of oiled coastline*". Often, a combination of these parameters is used to choose the worst case, which is usually the individual deterministic case with one of the largest volumes of shoreline oiling and the oil reaching the coast in the shortest time possible. The exact criteria for choosing the worst case may be slightly different each time depending on the stochastic modelling results, but selection of the worst case deterministic scenario is always based upon the fact that it will be a scenario where a large protection and/or clean-up response would be necessary.

Definition of the worst case trajectory scenario in this way is beneficial, as it is based on the historical database of real wind and current data for the study area. The selected worst case scenario is therefore based on real wind and current conditions that have actually occurred previously in the study area. This means that the selected worst case scenario has already taken into account the natural variability in meteorological conditions in the study area. It also means that the specific meteorological conditions that have produced the worst case deterministic scenario are credible and validated, as the conditions have actually occurred previously within the study area. This is preferable to using artificial wind forcings at a pre-determined speed and direction.

Traditionally, a worst case wind speed and constant wind direction have been used to define a worst case deterministic (trajectory) scenario. However, this method is not robust and may produce invalid results. This method is not based on background data which proves that the selected constant wind direction and wind speed have actually occurred previously within the study area for any length of time. In addition, selecting a constant wind direction and speed may not in itself give rise to the worst case scenario in terms of oil reaching the coastline; there may be other factors such as other combinations of wind speed, wind direction and current conditions, which may give rise to a worst case oil beaching scenario.

The chosen worst case scenario is then run again through a deterministic trajectory/fate simulation, to further investigate the single specific worst case spill event that could potentially occur, using the same combination of wind and current forcing used in the corresponding stochastic simulation from which it was identified. Further information on the worst case scenario can then be obtained from the results of this single deterministic simulation.

Modelling Limitations

SIMAP is a comprehensive modelling system that assesses impacts due to oil spills, from surface or seabed releases. The modelling system has been developed and improved over the past two decades to include as much information as possible to simulate the fates and effects of oil spills. Typically, assumptions based on available scientific information and professional judgment are made in the development of the output models, which represents a best assessment of the processes and potential mechanisms for effects (consequences) that would result from oil spills.

As with any numerical tool, the model has limitations. These limitations are taken into account when performing a modelling analysis and are strongly related to the fact that input data intrinsically contains uncertainties. Additionally, as with most science disciplines, the ability to simulate the detailed behaviour of organisms and ecosystems is a challenge.

The major sources of uncertainty in the oil fates and biological effects model are:

- Oil contains thousands of chemicals of varying physical and chemical properties that determine their fate in the environment. In addition, those chemicals (their properties) change over time. The model must treat the oil as a mixture of a limited number of hydrocarbon components, grouping chemicals by physical-chemical properties.
- The fates model contains a series of algorithms that are simplifications of complex physical-chemical processes. These processes are understood to varying degrees, but can dramatically vary depending on the environmental conditions (e.g. cold versus warm waters).
- Organisms are assumed uniformly distributed in the affected habitats they occupy for the duration of the spill simulation. The accuracy of this assumption varies between organisms, but the objective is to assess potential effects for an average-expected condition, which is what this assumption most closely resembles.
- Biological effects are quantified based on acute exposure and toxicity of contaminant concentrations as a function of degree and duration of exposure. The SIMAP model used is not designed to address long-term, chronic exposure to pollutants.
- The model treats each spill as an isolated pollution event and does not account for any potential cumulative effects.
- Various physical/environmental parameters including depth/sea bottom roughness, total suspended solids concentration, etc. were not sampled extensively at each location of the extended domain (hundreds of square kilometres). What limited data that did exist was applied to each location, leading to a certain degree of homogenisation of the environmental (marine/coastal) conditions.
- As in any other modelling exercise, when setting up the oil spill model, many ‘preliminary test cases’ are performed to understand the particularities of the spill scenarios to be simulated, testing the sensitivity of the different model inputs and parameters (e.g. resolution of the grids, model time steps, etc). By doing this sensitive analysis, the degree of uncertainties of the different modelling inputs can be evaluated and controlled.

In addition, in any given oil spill, the fates and effects will be highly related to the specific environmental conditions, the precise locations of organisms, and a myriad of details related to the event. Thus, the results are a function of the scenarios simulated and the accuracy of the input data used. The goal of the oil spill modelling is not to capture every detail that could

potentially occur, but to describe the range of possible consequences so that an informed analysis can be made as to the likely effects of spills under various scenarios. The model inputs are designed to provide representative conditions to such an analysis. Thus, the modelling is used to provide quantitative guidance in the analysis of the spill scenarios being considered. In addition, and in order to cover for existing uncertainties in the input data (e.g. winds, currents), the stochastic approach allows for the ability to sample through longer time series and account for the uncertainty/variability of the environmental forcings. From this stochastic analysis, a worst case event is selected from the stochastic ensemble, depicting a very particular event that aims at maximizing the potential impact into specific targets (e.g. coastal oiling). This conservative approach helps in 'overcoming' the uncertainties of the modelling.

In addition to the above, there are a number of general limitations to consider when interpreting the SIMAP modelling outputs, in particular:

- The resolution/quality of tidal and oceanic current data varies 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, although every effort has been made to select the most appropriate oil, particularly in terms of its weathering characteristics, where a conservative approach has been used.
- The properties and behaviour of the oil spilt in a dynamic marine environment may vary to those outputs produced using data held within the SIMAP programme. This is likely with all oils in the database and is intrinsic to all modelling.
- If the same scenario was conducted in another oil spill modelling programme of different manufacture, 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 SIMAP database is characterised from data obtained from the respective crude oil assay. The software uses the data in various algorithms to simulate the behaviour of the oil when spilled. Therefore, in consideration of the above, the information provided in the model outputs is illustrative only and is not intended to be relied upon in the event of a real oil spill incident.

Finally, it should be noted that modelling results are to be used for guidance purposes only and response strategies should not be based solely on modelling results alone. Actual aerial surveillance data should always be used over modelling outputs in a real oil spill situation to determine the fate of an oil spill and inform decisions on appropriate response strategies.

A.4.3 Oil Spill Modelling Inputs

Metocean Environmental Data

A metocean environmental data analysis was conducted in support of the modelling inputs for the oil spill modelling study. The environmental datasets used for the modelling study included the following:

- Wind dataset, NOGAPS (Navy Operational Global Atmospheric Prediction System), a product of the United States Navy;
- Current dataset, HYCOM (HYbrid Coordinate Ocean Model), a product of the National Oceanographic Partnership Program; and
- Water temperature and salinity dataset, WOA-13 (World Ocean Atlas 2013), hosted by the National Oceanographic and Atmospheric Administration (NOAA).

The subset of this data used in the modelling covers the time period from 01st January 2009 to 31st December 2012.

Wind Dataset

The annually averaged wind roses from the NOGAPS dataset for the study region are shown in Figure A.4.3, which illustrates the spatial variability of the dataset for the region. The monthly wind speed statistics for the Humpback-1 well location are displayed in Figure A.4.4. The annually averaged wind rose for the Humpback-1 well location is displayed in Figure A.4.5. The Monthly and annually averaged wind roses for the Humpback-1 well location are displayed in Figure A.4.6.

Figure A.4.3: Annually-averaged NOGAPS wind roses representing the spatial variability of the wind field in the area of interest (RPS-ASA, 2015)

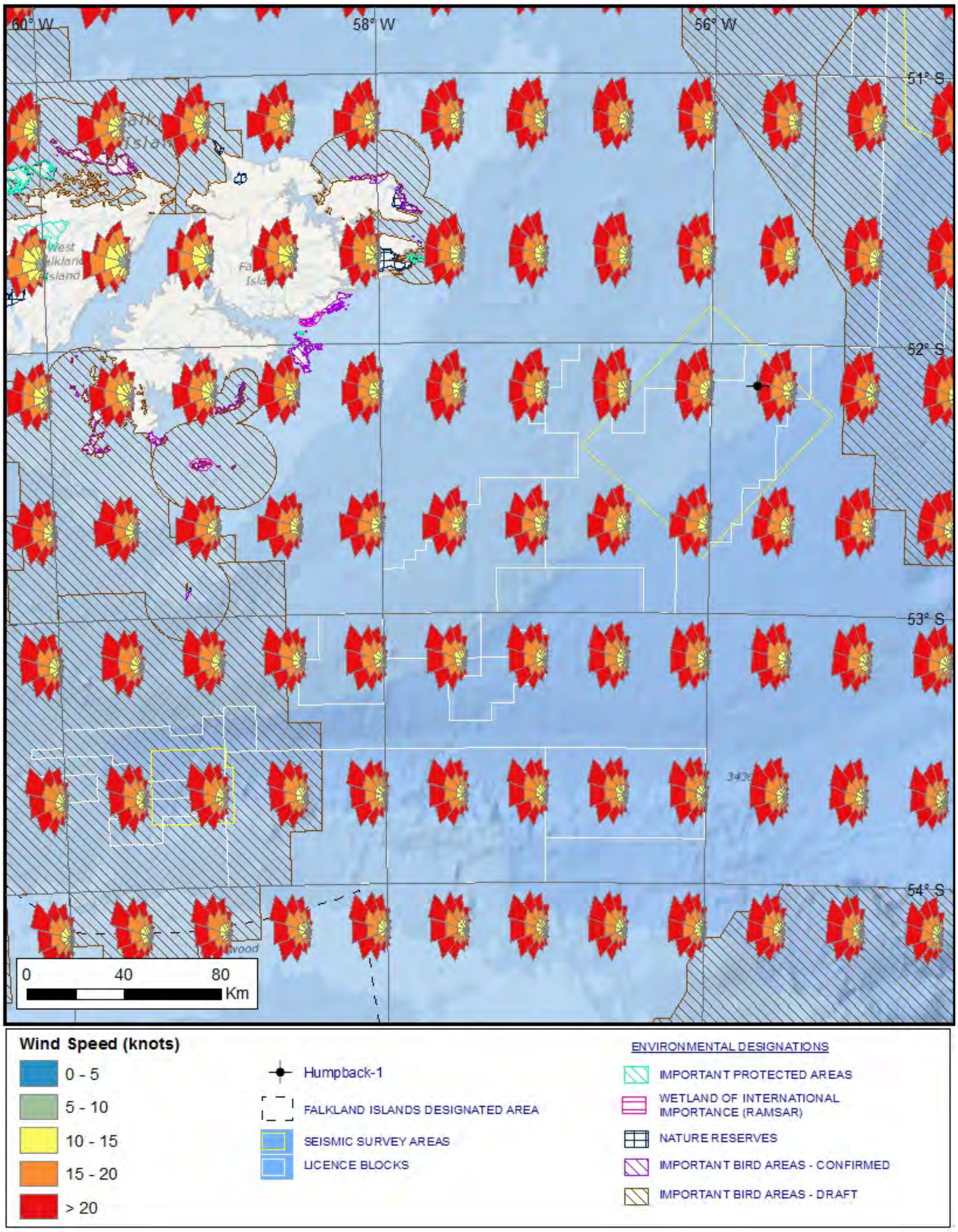


Figure A.4.4: NOGAPS monthly wind speed statistics for the Humpback-1 well location (RPS-ASA, 2015)

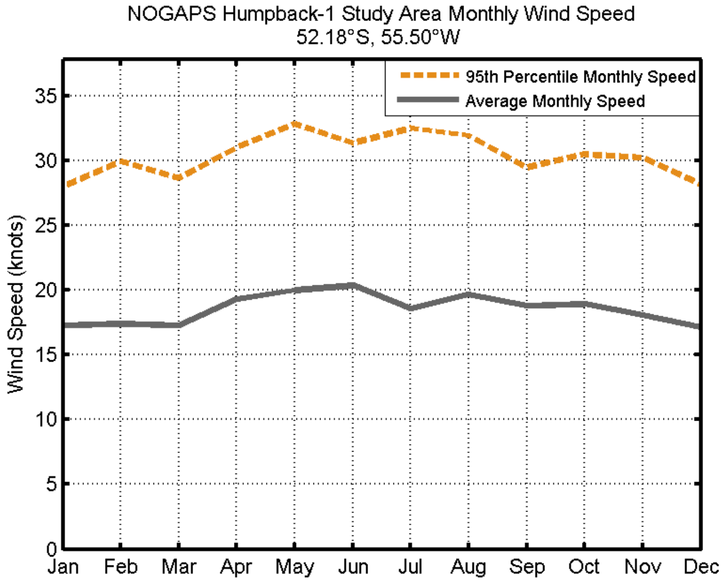


Figure A.4.5: Annually-averaged NOGAPS wind rose for the Humpback-1 well location (RPS-ASA, 2014)

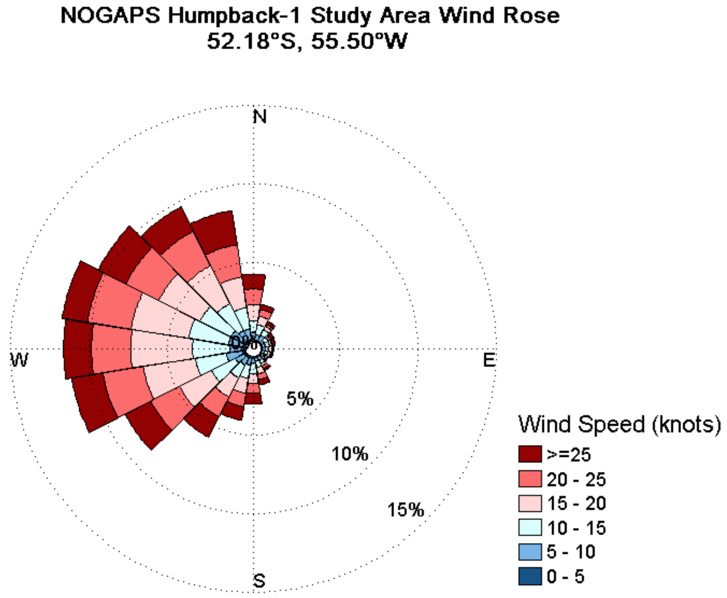
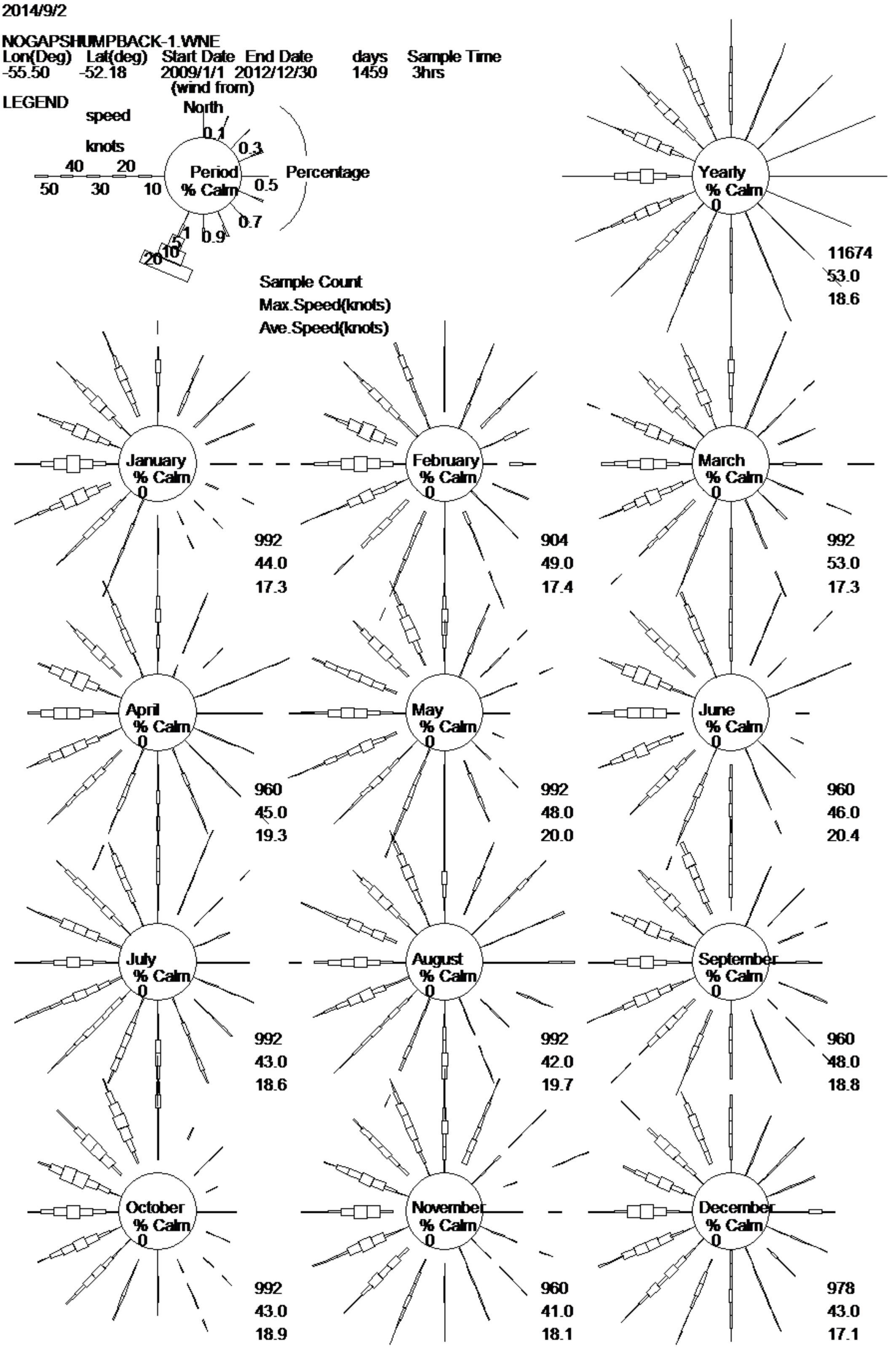


Figure A.4.6: Monthly and annually-averaged NOGAPS wind roses for the Humpback-1 well location (RPS-ASA, 2015)



Current Dataset

The annually averaged current roses from the HYCOM dataset for the study region are shown in Figure A.4.7, which illustrates the spatial variability of the current dataset for the region. The monthly current speed statistics for the Humpback-1 well location are displayed in Figure A.4.8. The annually averaged current roses for the Humpback-1 well location are displayed in Figure A.4.9. The Monthly averaged current roses for the Humpback-1 well location are displayed in Figure A.4.10. The annually averaged current speed statistics according to depth for the Humpback-1 well location are displayed in Figure A.4.11.

Figure A.4.7: Annually-averaged HYCOM current roses representing the spatial variability of currents in the area of interest (RPS-ASA, 2015)

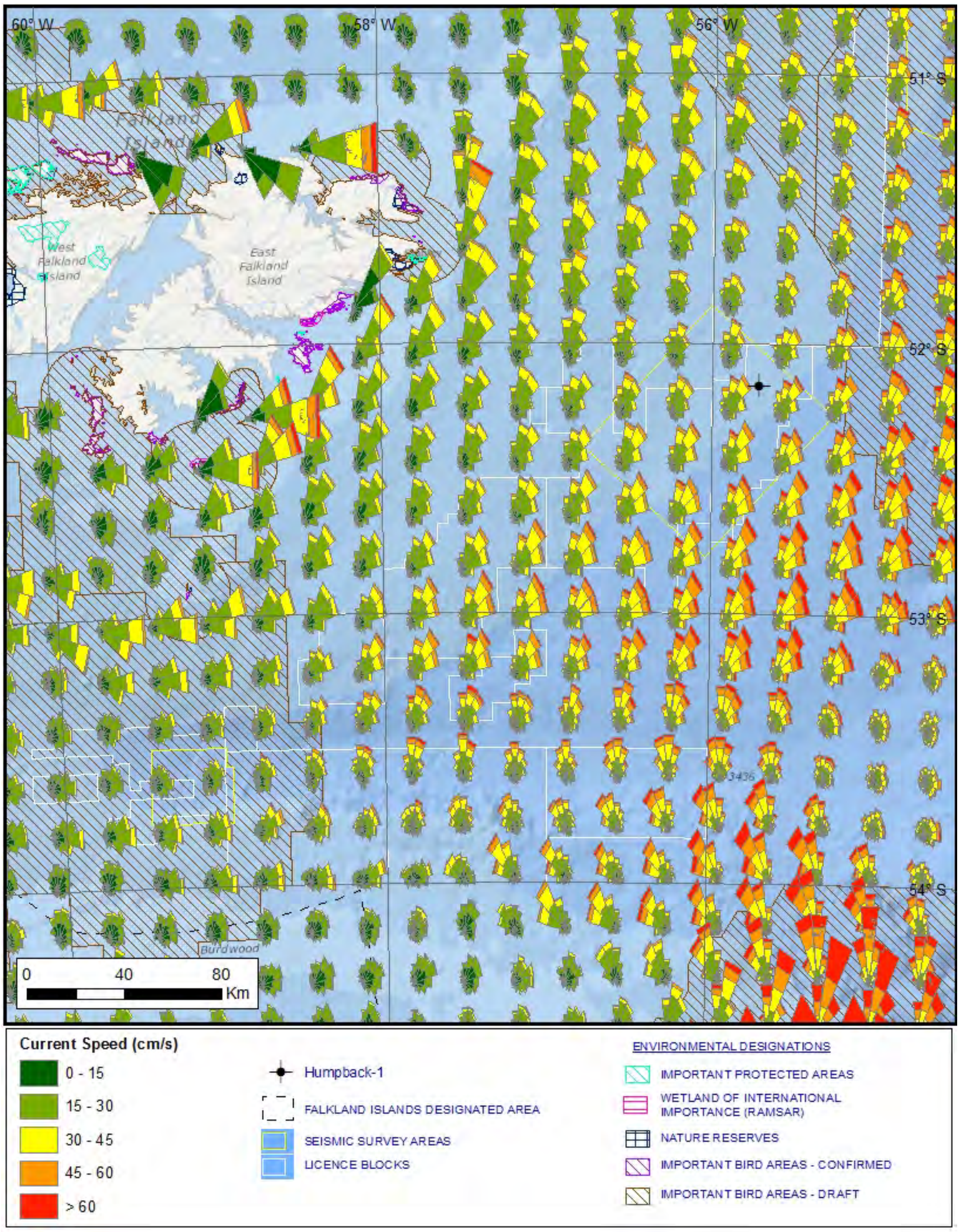


Figure A.4.8: Monthly current speed statistics from the HYCOM database for the Humpback-1 well location (RPS-ASA, 2014)

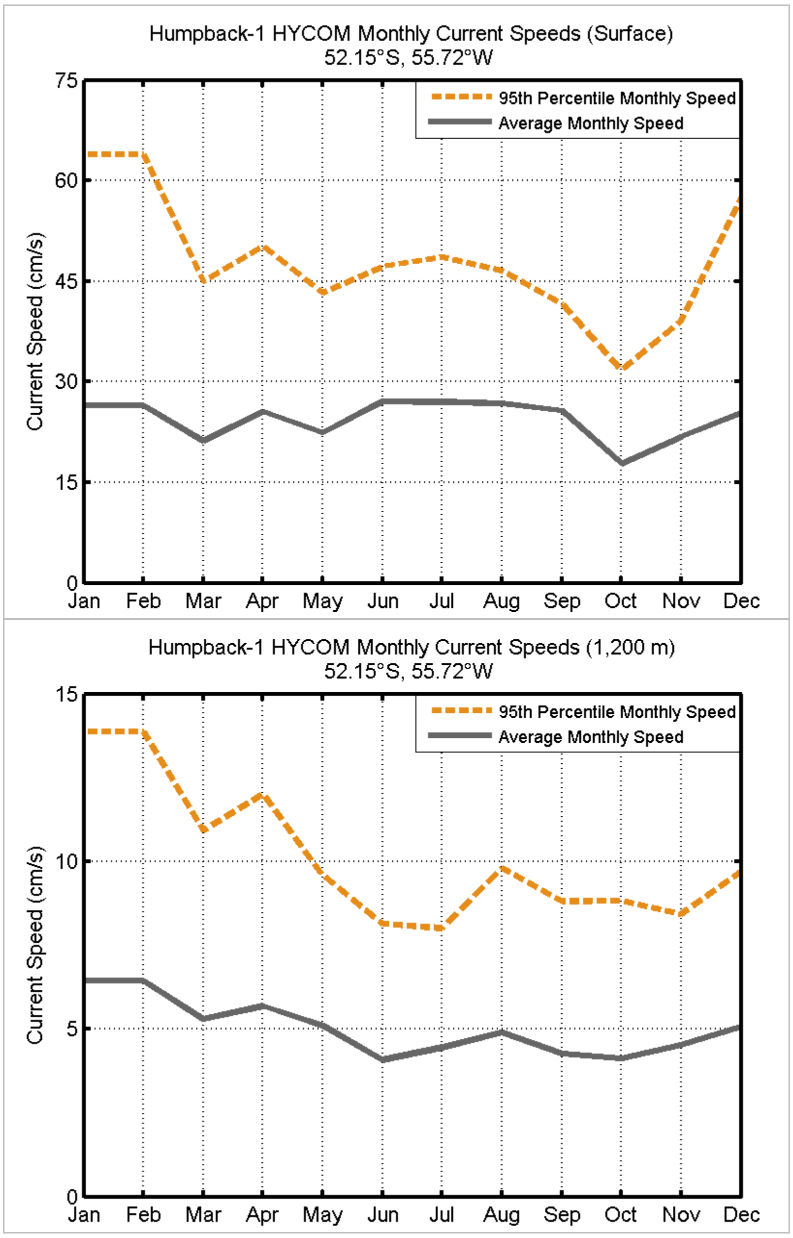


Figure A.4.9: Annually averaged current roses from the HYCOM database for the Humpback-1 well location (RPS-ASA, 2015)

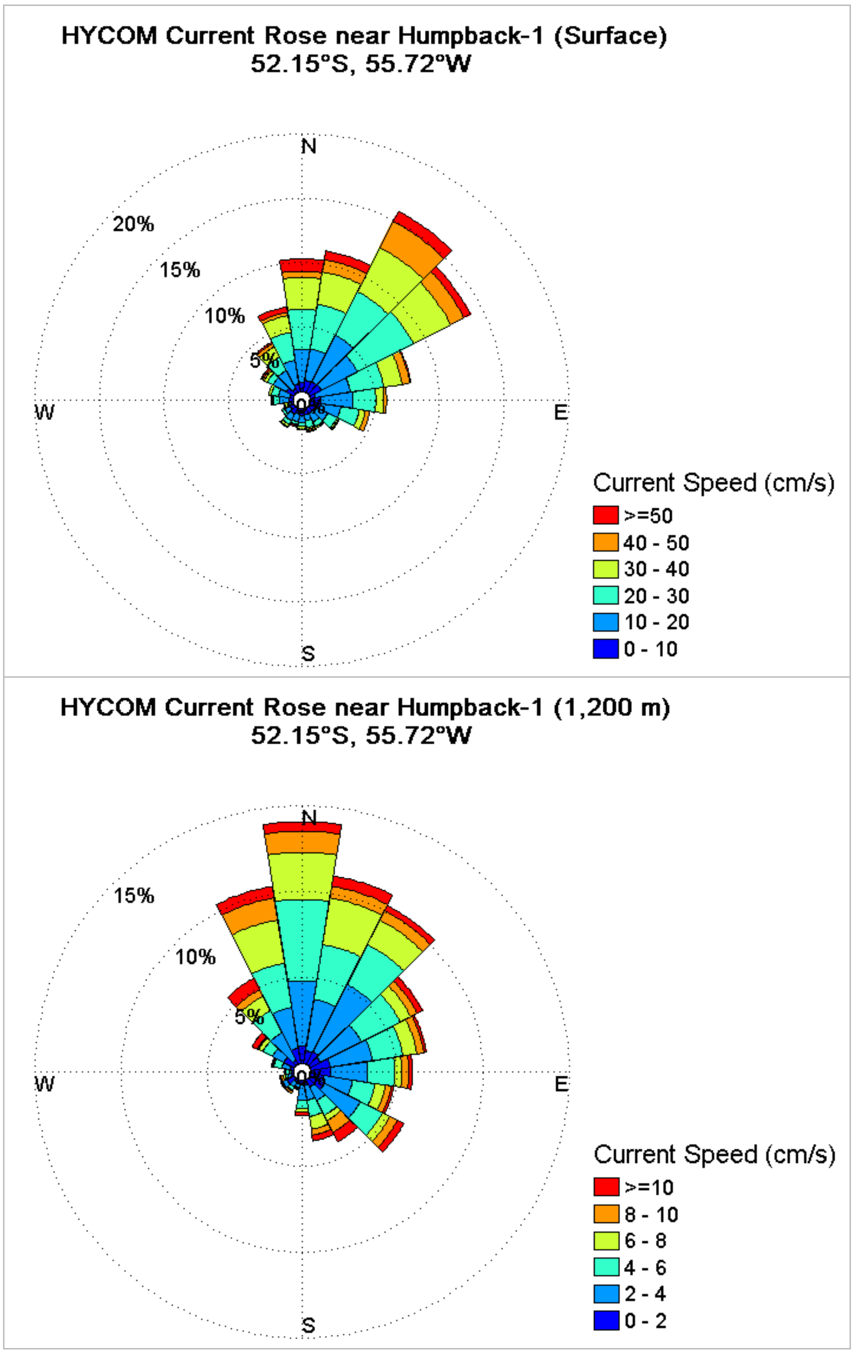


Figure A.4.10: Monthly averaged surface current roses from the HYCOM database for the Humpback-1 well location (RPS-ASA, 2015)

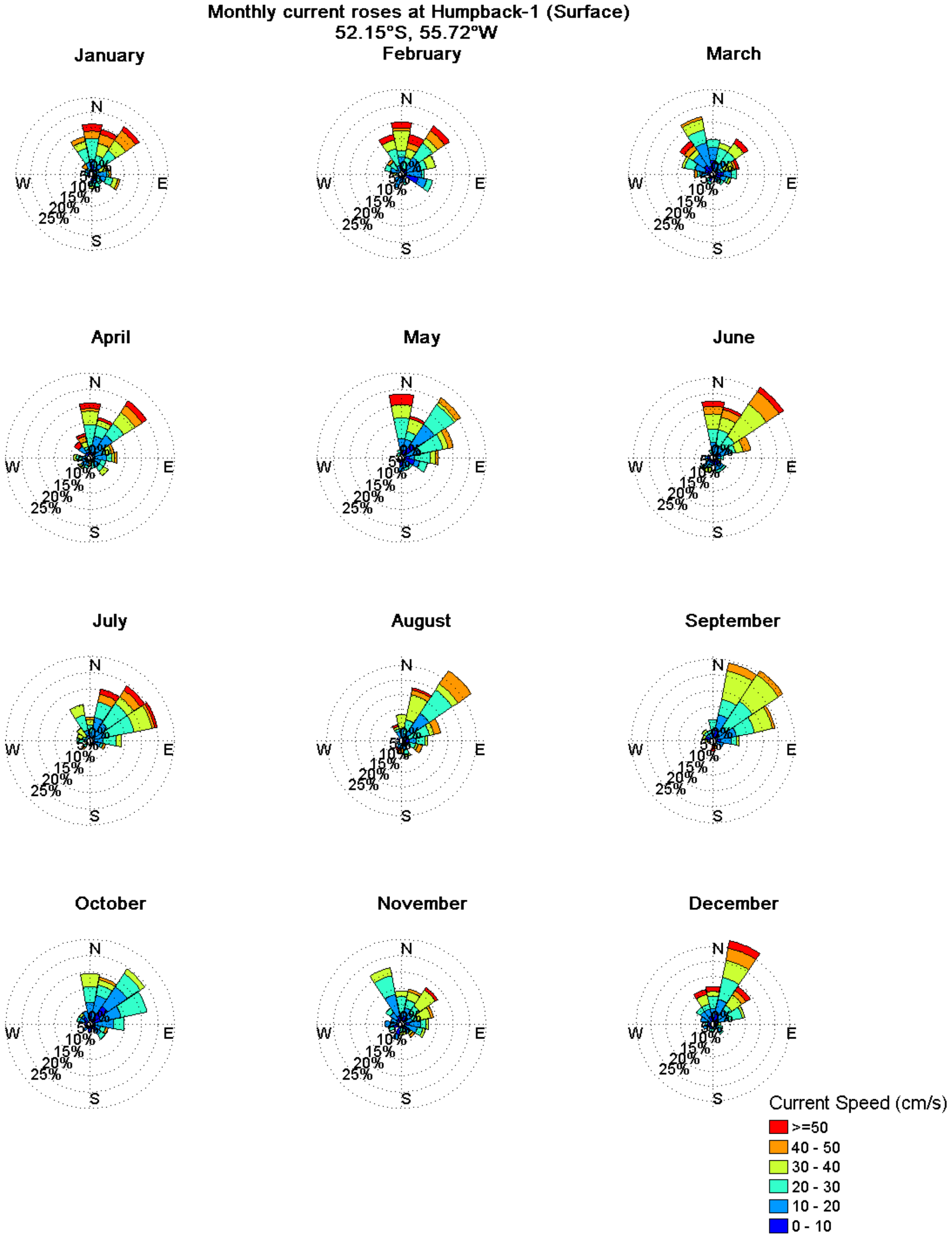
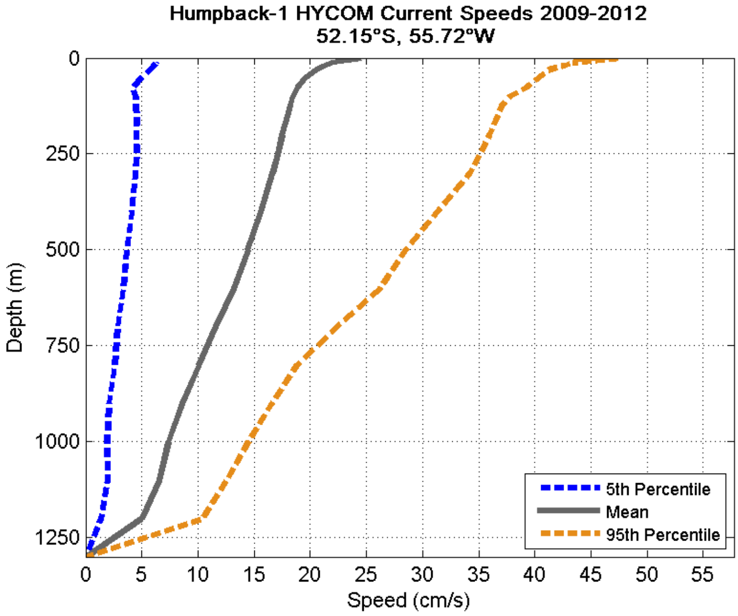


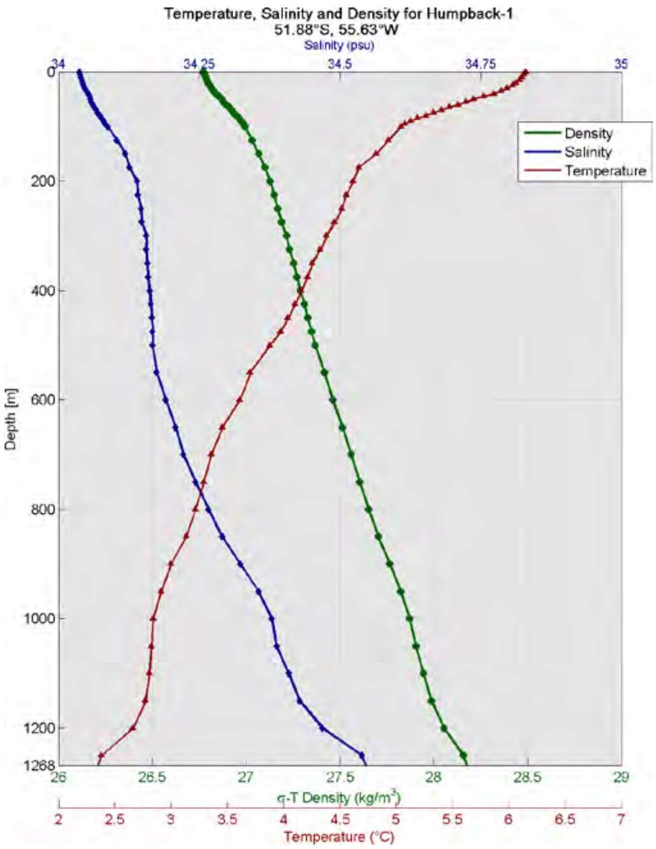
Figure A.4.11: Annually averaged current speed statistics in relation to depth for the Humpback-1 well location (RPS-ASA, 2015)



Water temperature and Salinity Dataset

The annually averaged temperature, salinity and density vertical profiles for the Humpback-1well location from the WOA-13 dataset is provided in Figure A.4.12.

Figure A.4.12: Annually averaged temperature, salinity and density vertical profiles for the Humpback-1 well location (RPS-ASA, 2015)



Modelling Parameters

The expected crude oil density from the explorations well lies within the range of 35-40 API. A light crude with the characteristics shown in Table A.4.2 was selected for the spill modelling, as this most closely matched the characteristics of the expected crude, determined through reservoir modelling. The properties of the selected crude oil were such that it can form a water-in-oil emulsion, with almost 90% of maximum water content, to represent a conservative case in terms of the persistence of the oil on release to the marine environment. A generic diesel fuel was selected for the diesel release scenarios.

Table A.4.3 displays the uncontrolled release conditions used in the subsurface (3D) simulation. The gas to oil ratio (GoR), opening diameter and discharge temperature were taken from reservoir hydrocarbon models.

Table A.4.4 displays the simulation periods used. These periods were selected after seasonality analysis of the metocean data.

Table A.4.2: Summary of oil properties used in the modelling simulations

Oil Type	API Gravity (°)	Viscosity (cP at 25°C)	Interface Tension (dyne/cm)	Emulsion maximum Water Content (%)
Light Crude	38.9	4.00	26.1	89.6
Diesel	38.8	2.76	27.5	0

Table A.4.3: Uncontrolled release (blowout) conditions used in the subsurface modelling simulations

Well Site	Water Depth of the release (m)	Gas to Oil Ratio (scf/bbl)	Opening Diameter (inches)	Discharge Temperature (°C)
Humpback-1	1,268	600 scf/bbl	13.375”	104

Table A.4.4: Seasonal simulation periods used in the modelling simulations

Period	Months Used
Period 1: Austral Summer	October - February
Period 2: Austral Winter	March - September

A.4.4 Stochastic Oil Spill Modelling Results

A number of stochastic spill modelling scenarios were run. These are presented below along with their results. A number of figures are presented alongside the modelling results that illustrate the spatial extent of surface and shoreline oiling probabilities and associated minimum travel times for the spills. Only oiling above a threshold of 0.04 µm is included. This is the threshold for the visible appearance of oil sheen on the water surface, according to the Bonn Agreement oil appearance code (refer to **Part II, Section 13.2.2**).

For each scenario, at least two figures are presented:

- **Probability of surface oil exceeding 0.04 µm:** The map defines the area in which sea surface oil has at least a 1% chance to exceed 0.04 µm and the associated probability of exceeding the threshold based on analysis of the resulting trajectories from the ensemble of individual simulations run for each spill scenario. The map does not imply that the entire contoured area would be covered with oil in the event of a spill. The map also does not provide any information on the amount of oil in a given area.
- **Minimum time for surface oil to exceed 0.04 µm:** The footprint on this map corresponds to the surface probability map, and illustrates the shortest time required for oil to reach

any point within the footprint. These results are also based on the ensemble of all individual simulations.

For scenarios where there is a model-predicted potential for shoreline oiling, two additional figures are presented:

- **Probability of shoreline oil exceeding 0.04 µm:** The map defines the area in which beached oil has at least a 1% chance to exceed 0.04 µm and the associated probability of exceeding the threshold based on analysis of the resulting trajectories from the ensemble of individual simulations run for each spill scenario. The map does not imply that the entire area would be covered with oil in the event of a spill. The map also does not provide any information on the amount of oil in a given area. In the absence of data, all shoreline segments are assumed to be 10 metre wide sandy beaches. Using actual shoreline data may alter the results, but the results provided are likely on the conservative side for shoreline impacts.
- **Minimum time for shoreline oil to exceed 0.04 µm:** The footprint on this map corresponds to the shoreline probability map, and illustrates the shortest time required for oil to reach any point within the footprint. These results are also based on the ensemble of all individual simulations. In the absence of data, all shoreline segments are assumed to be 10 metre wide sandy beaches. Using actual shoreline data may alter the results, but the results provided are likely on the conservative side for shoreline impacts.

Diesel Stochastic Results

Diesel stochastic oil spill modelling was conducted to determine the fate of a large unintentional release of hydrocarbons to the marine environment, representing a catastrophic failure of the fuel oil tanks on board the drilling rig. A number of stochastic scenarios were modelled and are displayed in Table A.4.5. Modelling for two seasonal periods was conducted (refer to Table A.4.4) to examine any potential effects of seasonality. The results of the diesel stochastic modelling scenarios are displayed in Table A.4.6 and in Figures A.4.15 and A.4.16.

Table A.4.5: Diesel stochastic oil spill modelling scenarios

Scenario ID	Spill Site	Spill Event	Oil Type	Period (month)	Spill Rate	Spill Duration	Total Spilled Volume	Simulation Duration
1	Humpback-1	Drilling Rig Fuel Oil Inventory	Diesel	Period 1 (10-2)	Instant	Instant	4,631 m^3	14 Days
2	Humpback-1	Drilling Rig Fuel Oil Inventory	Diesel	Period 2 (3-9)	Instant	Instant	4,631 m^3	14 Days

Table A.4.6: Diesel stochastic oil spill modelling results

Scenario ID (Figure)	Spill Site	Oil Type	Spill Type	Simulation Period	Total Volume Released	Sims. Reaching Shore (%)	Time to Reach Shore (days)	
							Min.	Avg.
1 (A.4.15)	Humpback-1	Diesel	Drilling Rig Fuel Oil Inventory	Period 1 (10-2)	4,631 m^3	0	-	-
2 (A.4.16)	Humpback-1	Diesel	Drilling Rig Fuel Oil Inventory	Period 2 (3-9)	4,631 m^3	0	-	-

Figure A.4.15: Stochastic scenario 1 (instantaneous 4,631 m^3 diesel spill from the Humpback-1 well location from October to February [summer]); maps for potential water surface contamination

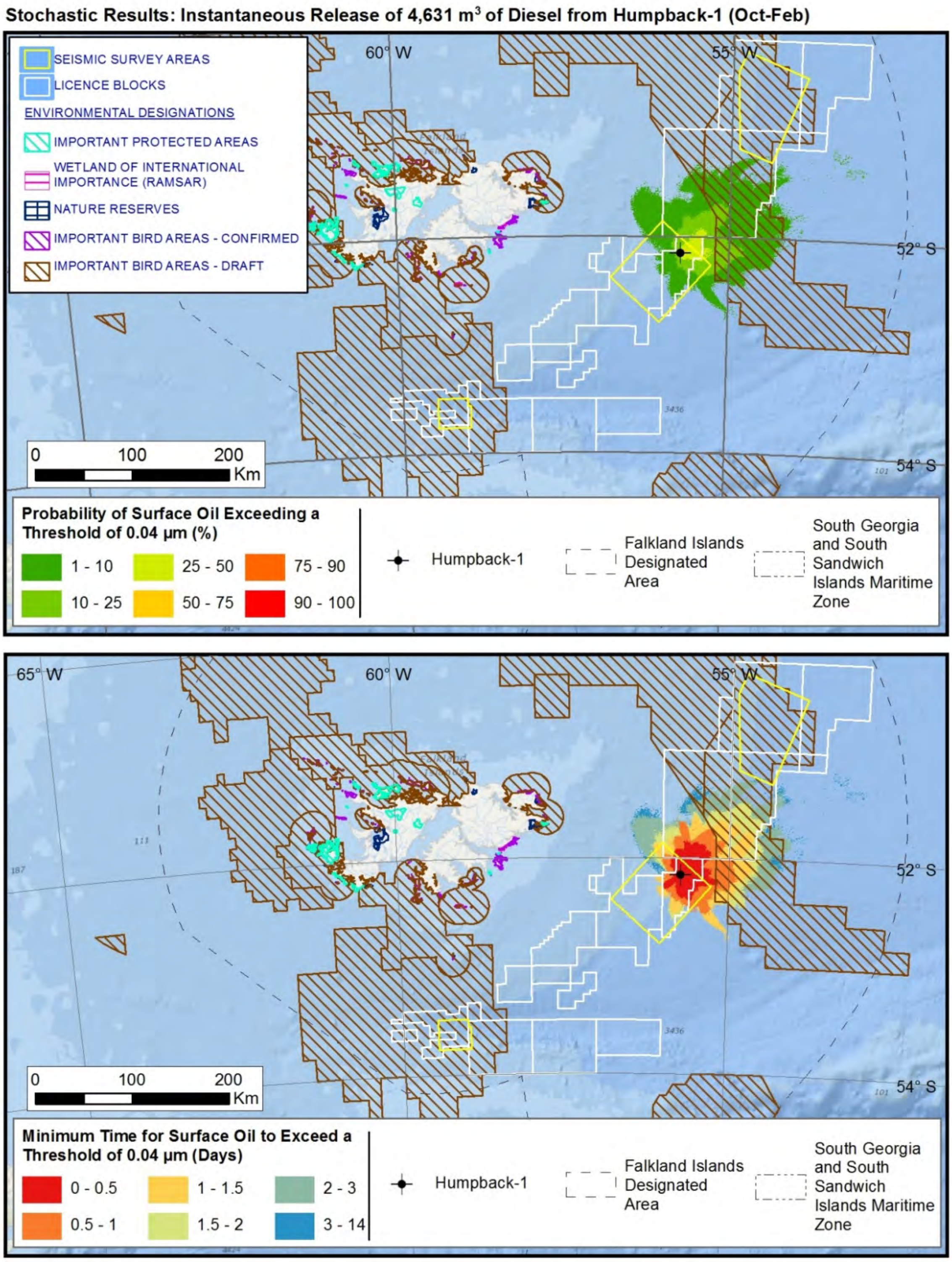
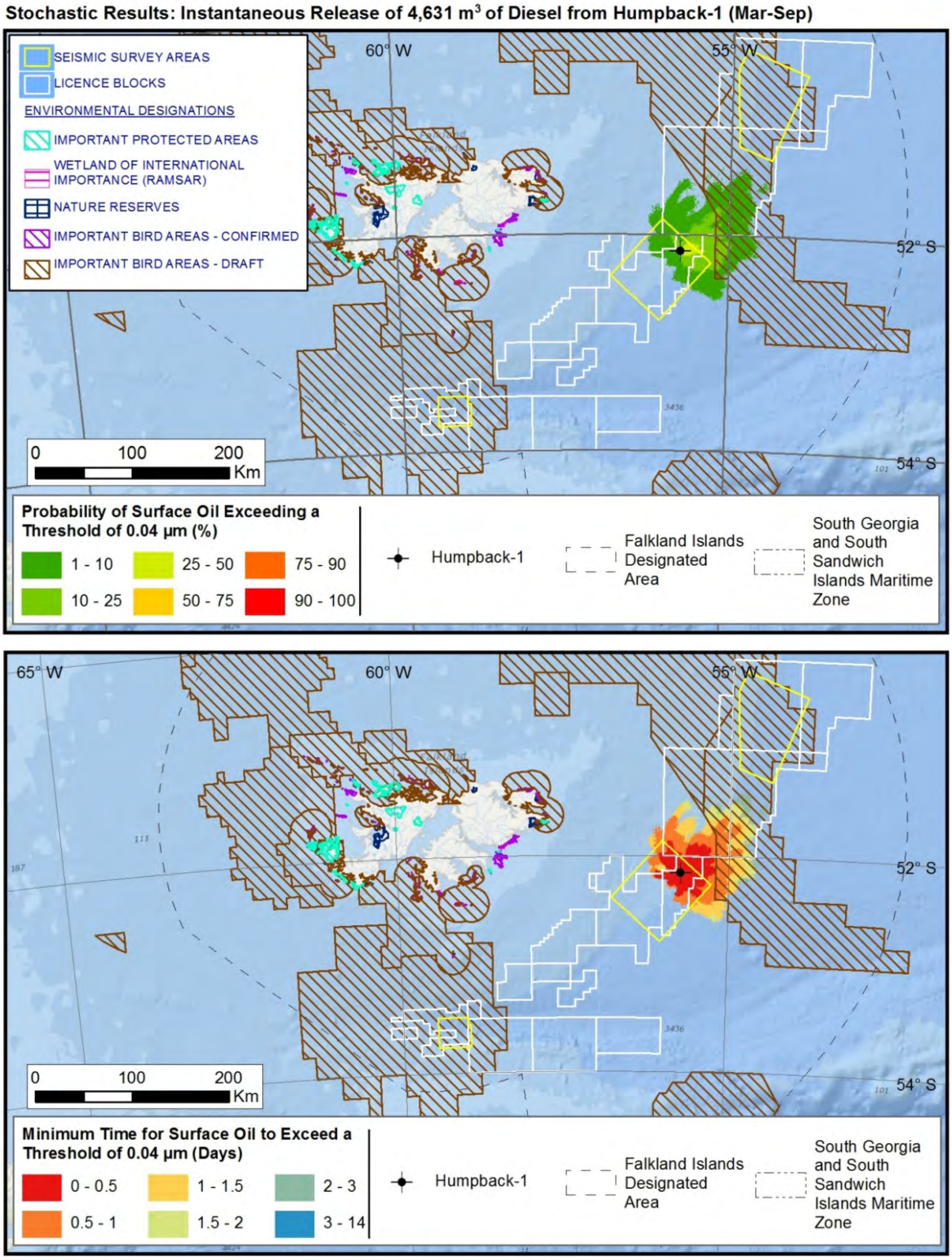


Figure A.4.16: Stochastic scenario 2 (instantaneous 4,631 m³ diesel spill from the Humpback-1 well location from March to September [winter]); maps for potential water surface contamination



Crude Oil Surface (2D) Stochastic Results

2D crude oil stochastic spill modelling was conducted to determine the fate of a large unintentional release of hydrocarbons to the marine environment, representing an uncontrolled release of hydrocarbons (blow-out) from the wellbore. This scenario represents catastrophic failure of the barriers in the wellbore and BOP equipment, but with the drilling rig still in communication with the riser, resulting in crude oil being released at the sea surface. A spill rate of 50,071 barrels per day was used, obtained from reservoir modelling.

A number of stochastic scenarios were modelled and are displayed in Table A.4.7. Modelling for two seasonal periods was conducted (refer to Table A.4.4) to examine any potential effects of seasonality. The results of the crude oil stochastic modelling scenarios are displayed in Table A.4.8 and in Figures A.4.17 to A.4.19.

Table A.4.7: Crude oil surface (2D) stochastic oil spill modelling scenarios

Scenario ID	Spill Site	Spill Event	Oil Type	Period (month)	Spill Rate	Spill Duration	Total Spilled Volume	Simulation Duration
3	Humpback-1	Surface Blowout	Crude Oil	Period 1 (10-2)	50,071 bbl/d	10 days	500,710 bbl	30 Days
4	Humpback-1	Surface Blowout	Crude Oil	Period 2 (3-9)	50,071 bbl/d	10 days	500,710 bbl	30 Days

Table A.4.8: Crude oil surface (2D) stochastic oil spill modelling results

Scenario ID (Figure)	Spill Site	Oil Type	Spill Type	Simulation Period	Total Volume Released	Sims. Reaching Shore (%)	Time to Reach Shore (days)	
							Min.	Avg.
3 (A.4.17)	Humpback-1	Crude Oil	Surface Blowout	Period 1 (10-2)	500,710 bbl	0	-	-
4 (A.4.18 & A.4.19)	Humpback-1	Crude Oil	Surface Blowout	Period 2 (3-9)	500,710 bbl	2	12	12.5

Figure A.4.17: Stochastic scenario 3 (50,071 bopd crude oil spill surface release for 10 days from the Humpback-1 well location from October to February [summer]); maps for potential water surface contamination

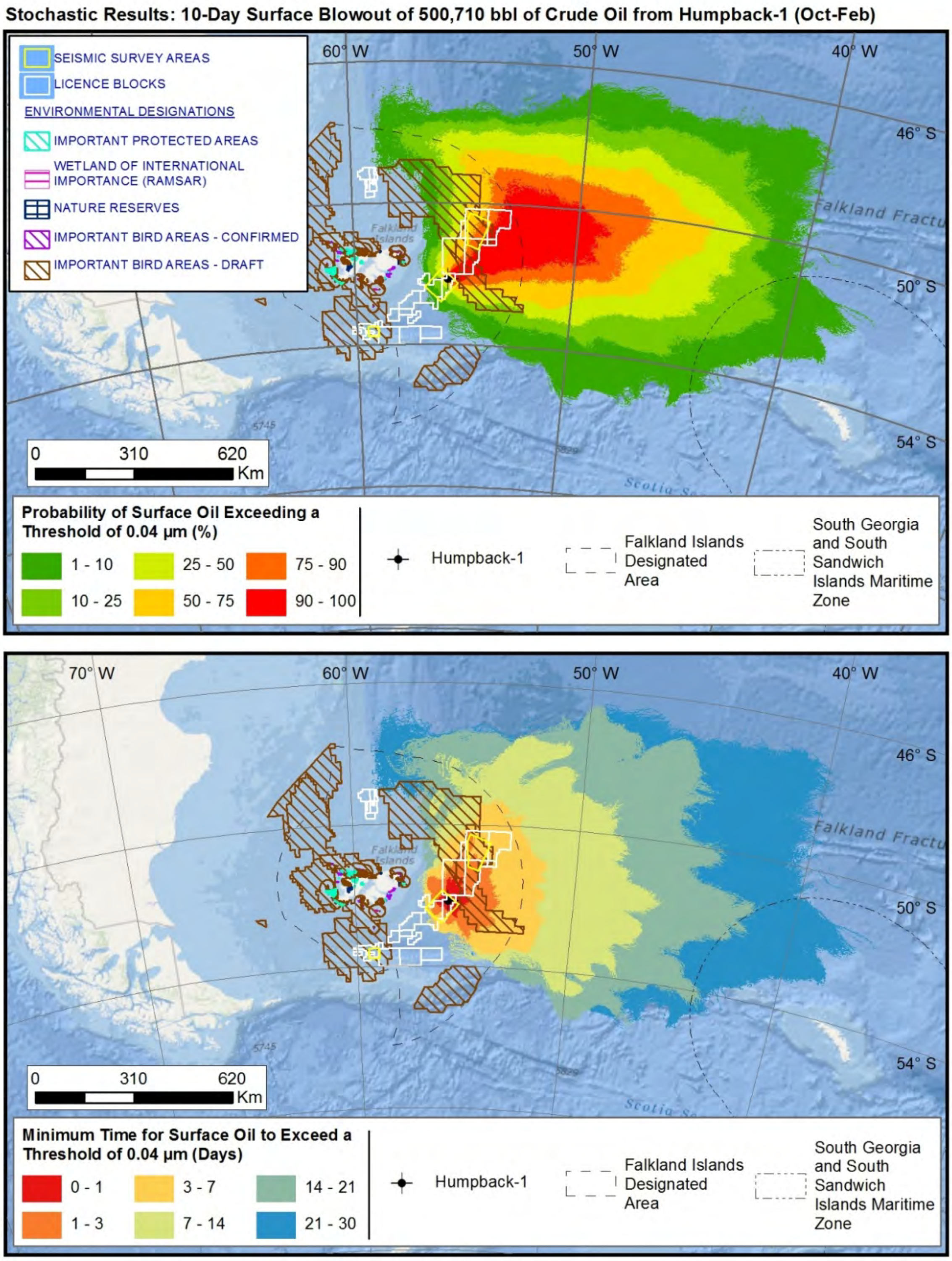


Figure A.4.18: Stochastic scenario 4 (50,071 bopd crude oil spill surface release for 10 days from the Humpback-1 well location from March to September [winter]); maps for potential water surface contamination

Stochastic Results: 10-Day Surface Blowout of 500,710 bbl of Crude Oil from Humpback-1 (Mar-Sep)

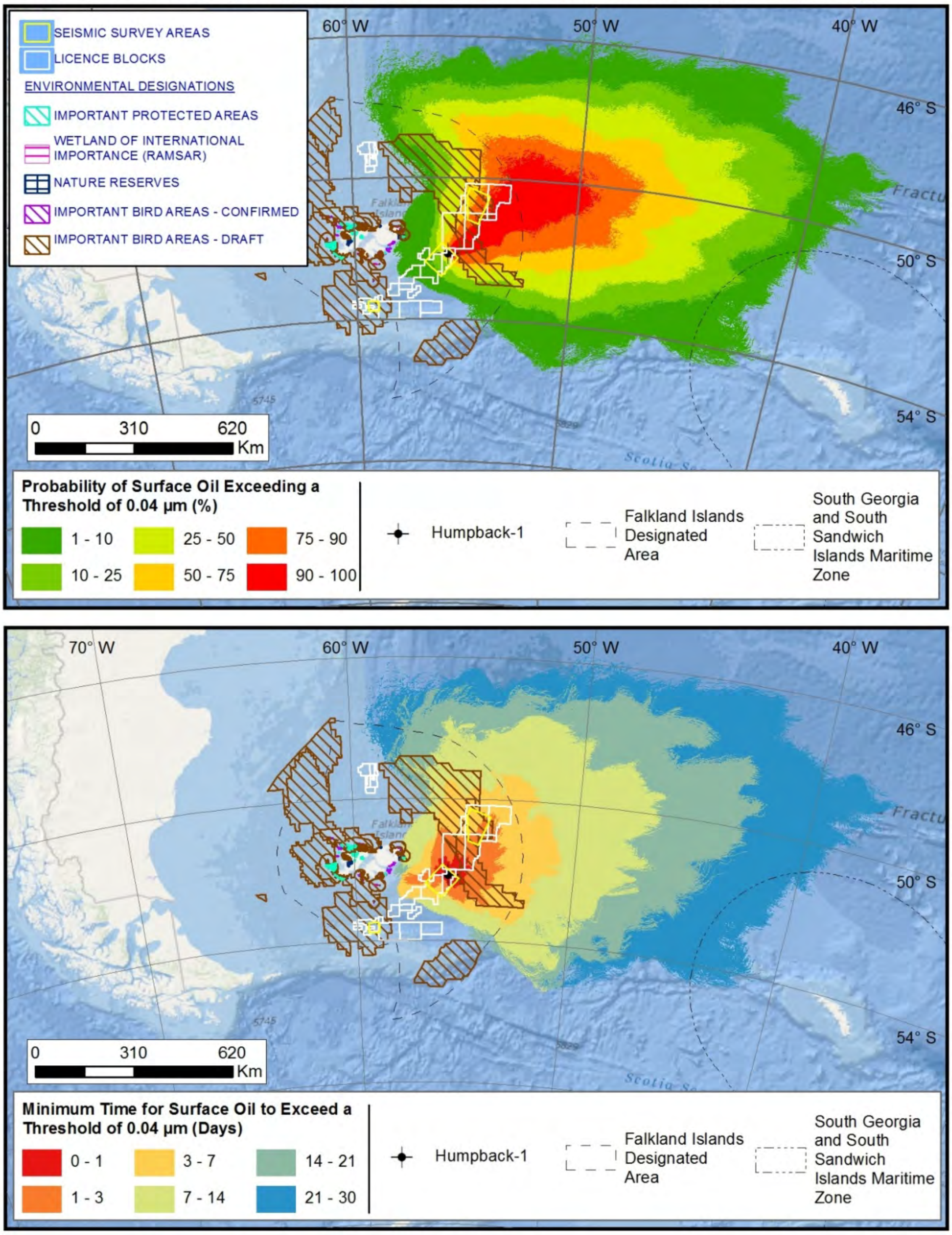
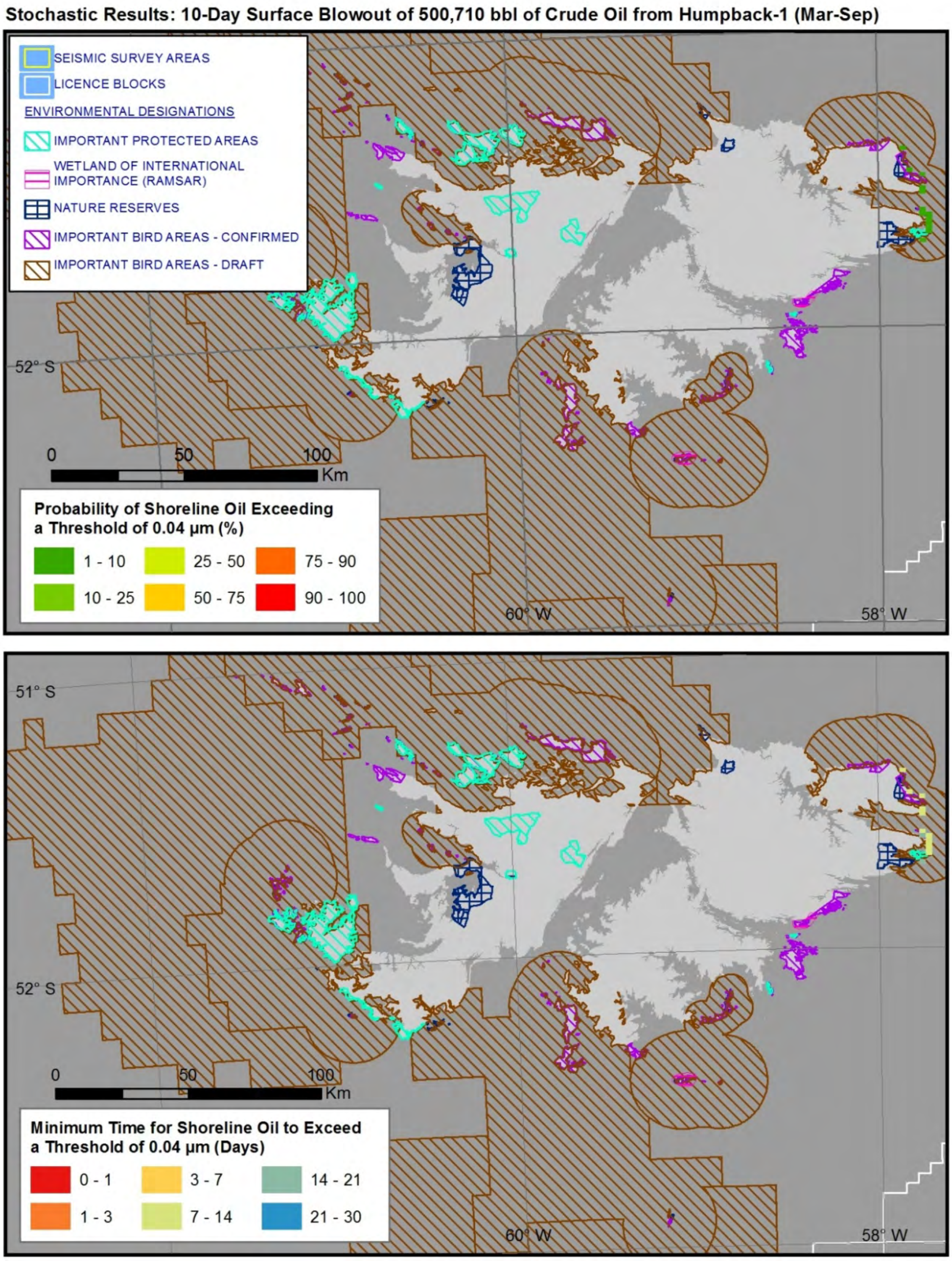


Figure A.4.19: Stochastic scenario 4 (50,071 bopd crude oil spill surface release for 10 days from the Humpback-1 well location from March to September [winter]); maps for potential shoreline contamination



Crude Oil Sub-surface (3D) Stochastic Results

3D crude oil stochastic spill modelling was conducted to determine the fate of a large unintentional release of hydrocarbons to the marine environment, representing an uncontrolled release of hydrocarbons (blowout) from the wellbore. This scenario represents catastrophic failure of the barriers in the wellbore and BOP equipment, with the drilling rig and marine riser no longer in communication with the Lower Marine Riser Package (LMRP), resulting in crude oil being released at the seabed. A spill rate of 50,071 barrels per day was used, obtained from reservoir modelling.

One stochastic scenario was modelled and is displayed in Table A.4.9. Modelling for the sub-surface scenario was conducted using period 2 (winter), which represented the worst case in terms of oil beaching for the 2D scenarios. The result of the crude oil stochastic modelling scenario is displayed in Table A.4.10 and in Figure A.4.20. Figures A.4.21 and A.4.22 show the near-field modelling results, which shows the predicted behaviour of the released oil in the water column.

Table A.4.9: Crude oil sub-surface (3D) stochastic oil spill modelling scenarios

Scenario ID	Spill Site	Spill Event	Oil Type	Period (month)	Spill Rate	Spill Duration	Total Spilled Volume	Simulation Duration
5	Humpback-1	Sub-surface Blowout	Crude Oil	Period 2 (3-9)	50,071 bbl/d	10 days	500,710 bbl	30 Days

Table A.4.10: Crude oil surface (2D) stochastic oil spill modelling results

Scenario ID (Figure)	Spill Site	Oil Type	Spill Type	Simulation Period	Total Volume Released	Sims. Reaching Shore (%)	Time to Reach Shore (days)	
							Min.	Avg.
5 (A.4.20)	Humpback-1	Crude Oil	Subsurface Blowout	Period 2 (3-9)	500,710 bbl	0	-	-

Figure A.4.20: Stochastic scenario 9 (50,071 bopd crude oil spill sub-surface release for 10 days from the Humpback-1 well location from March to September [winter]); maps for potential water surface contamination

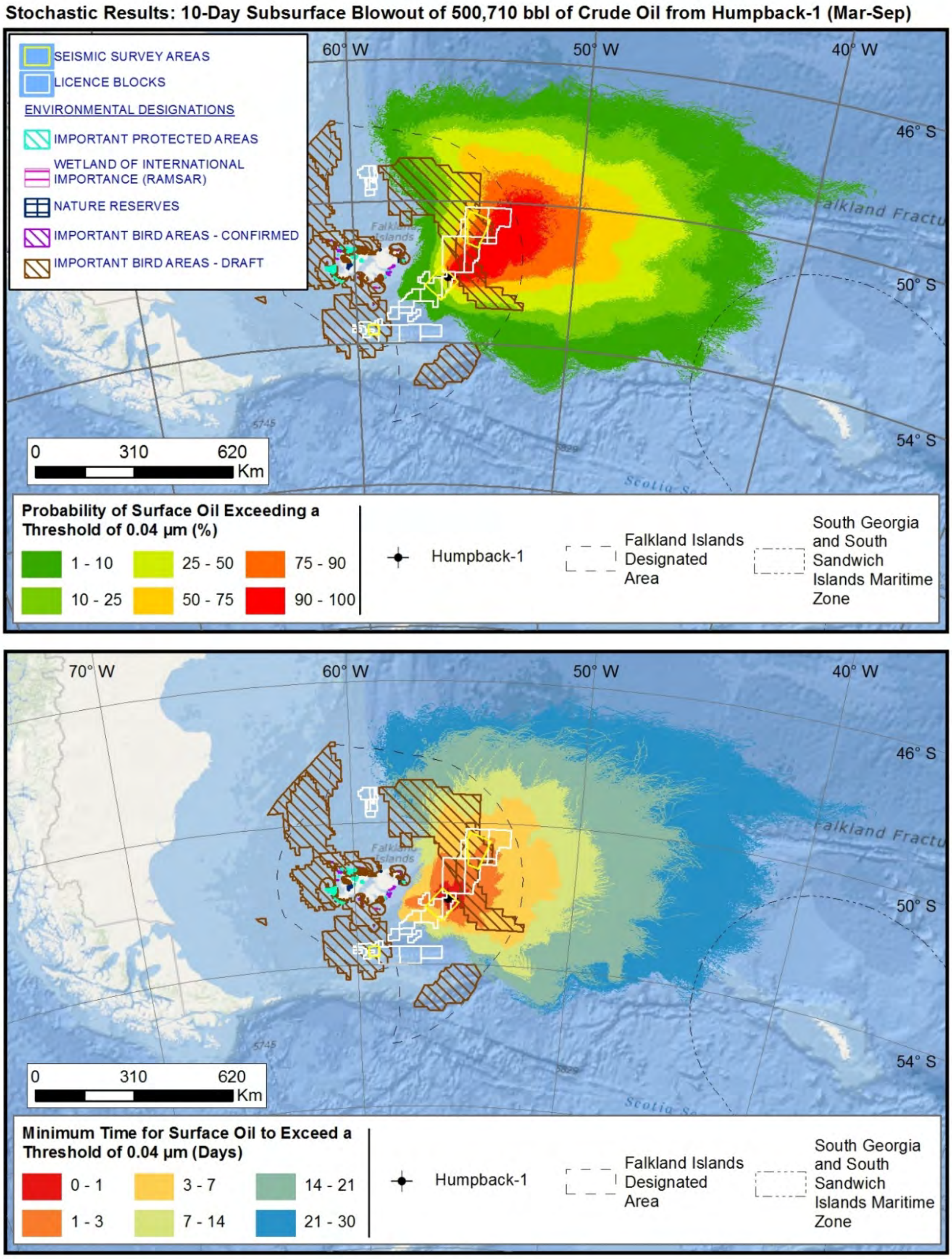


Figure A.4.21: Predicted blowout plume radius and plume centreline velocities for the subsurface blowout scenario from the Humpback-1 well location

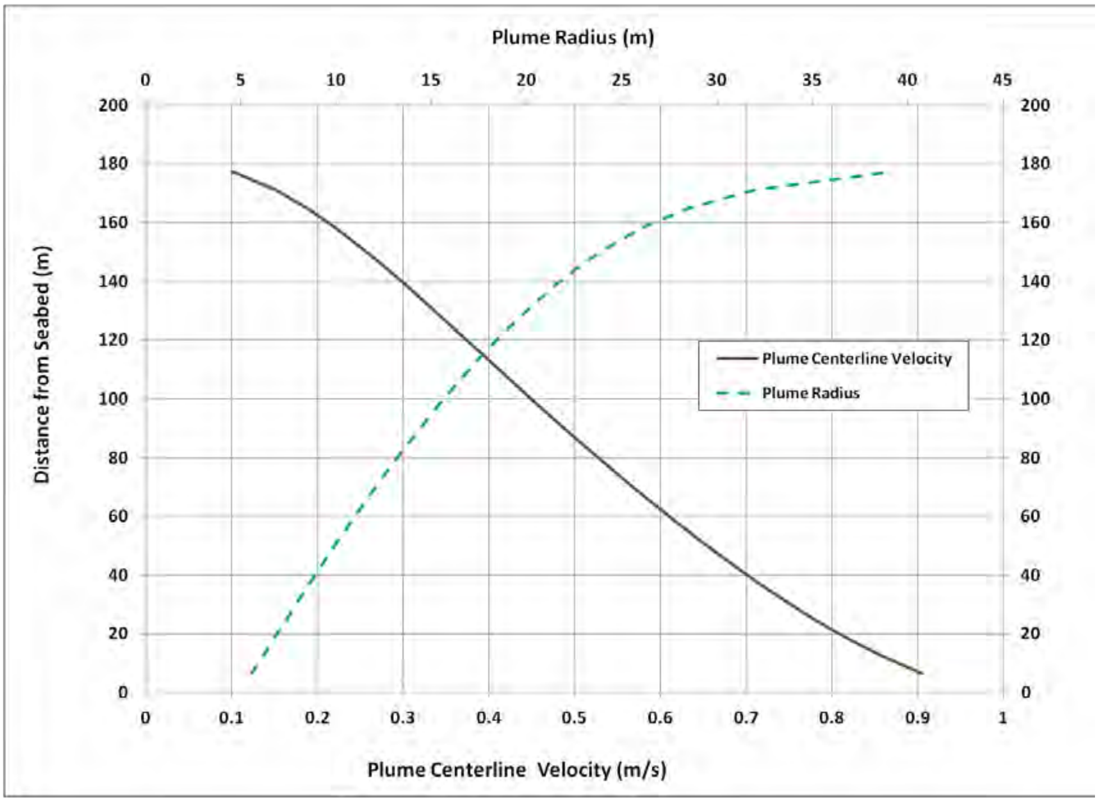
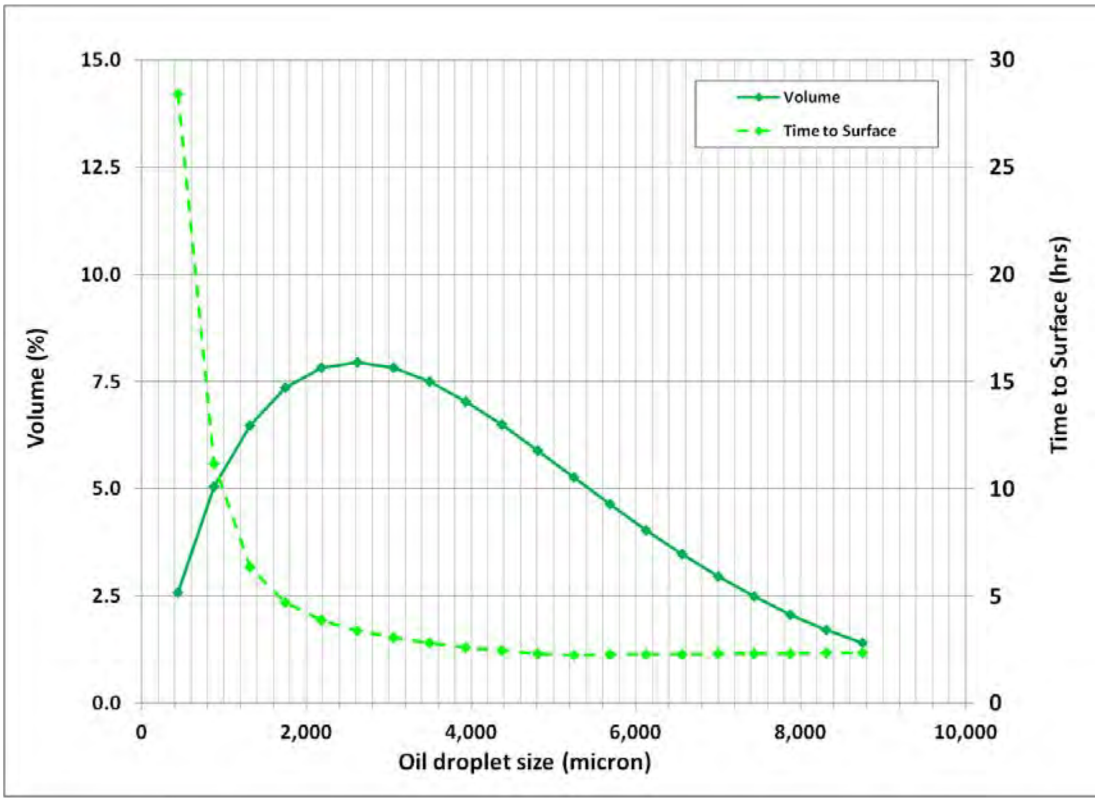


Figure A.4.22: Predicted droplet size distribution and droplet rise time for the subsurface blowout scenario from the Humpback-1 well location



A.4.5 Stochastic Oil Spill Modelling Conclusions

Diesel Stochastic Oil Spill Modelling

The diesel modelling scenarios presented above (Figures A.4.15 and A.4.16) have shown that the total loss of the fuel oil inventory of the drilling rig (4,631m^3) is unlikely to result in beaching, and will weather offshore.

Crude Oil Surface (2D) Stochastic Oil Spill Modelling

The uncontrolled release scenario from the Humpback-1 well location in the summer period (Figure A.4.17) showed that no simulations result in oil beaching. However, the same scenario in the winter period (Figures A.4.18 and A.4.19) showed oil to beach, with 2% of simulations reaching the shoreline, and a minimum time to beaching of 12 days (average 12.5 days).

Further deterministic modelling has been undertaken for the worst case simulations from the above 2D models to examine further the conditions that result in oil beaching (refer to Deterministic Oil Spill Modelling Results below in Section A.4.6).

Crude Oil Sub-surface (3D) Stochastic Oil Spill Modelling

Modelling using typical wind conditions in uncontrolled sub-surface release (blowout) situations has also shown that the majority of oil will weather offshore under the influence of the residual current and wind conditions. The scenario for the sub-surface simulations use the winter period, as this showed to be worst case for oil beaching from the 2D scenarios.

The uncontrolled sub-surface release scenarios for the Humpback-1 well location (Figure A.4.20) shows that the oil is predicted to weather offshore, under the influence of the residual winds and currents. The scenario does not predict that the oil would beach. Compared to the result from the same 2D surface release scenario, the result in terms of beaching is different, as the 2D scenario for the same time of year predicted that some oil would beach. This suggests that the influence of the time that oil spends in the water column on release from the well at the seabed (between approximately 2 and 30 hours - refer to the near-field modelling results in Figures A.4.21 and A.4.22) is significant in terms of its long term behaviour over the entire model run time.

A.4.6 Deterministic Oil Spill Modelling Results

Crude Oil Surface (2D) Stochastic Oil Spill Modelling Deterministic Analysis

For each stochastic surface blowout scenario where there was any shoreline impact, a worst case scenario was selected based on the time it took for oil to arrive at the shore. From each of these stochastic scenarios, the individual trajectory that impacted the coast in the shortest time was chosen for the deterministic modelling scenario. This criterion was chosen to represent the worst case, because it would require the quickest response efforts to be implemented. For the surface blow-out scenarios where no shoreline oiling was predicted, the trajectory that came closest to impacting the Falkland Islands was chosen as a representative case.

All deterministic simulations were run using the same variable wind and current forcing used for the corresponding stochastic simulation from which it was identified. For each deterministic scenario, three figures are supplied:

- **Maximum mass of floating oil per unit area (oil slick thickness):** This map depicts the maximum mass per unit area of oil on the water surface that passed by a given area at some point during the simulation.
- **Maximum mass of shoreline oil per unit area (for trajectories that impacted the coast):** This map is displayed only for those scenarios that predicted oil beaching. This map depicts the maximum mass per unit area of oil that beached on a given area of the shoreline at some point during the simulation. In the absence of data, all shoreline segments are assumed to be 10 metre wide sandy beaches. Using actual shoreline data

may alter the results, but the results provided are likely on the conservative side for shoreline impacts.

- **Predicted mass balance:** This graph shows the model-predicted mass balance for the spilled oil. The mass balance graph shows the degree of weathering that the oil undergoes during the period of the simulation.

The selected worst case deterministic runs chosen for further analysis are shown in Table A.4.11. The results of the deterministic analyses are shown in Table A.4.12 and in Figures A.4.29 to A.4.34.

Table A.4.11: Selected worst case deterministic runs from the 2D stochastic models

Scenario ID	Spill Site	Oil Type	Spill Type	Total Spilled Volume (bbl)	Selected Deterministic Case	Run Type
3	Humpback-1	Crude	Surface Blowout	500,710	**29/01/2011**	Representative*
4	Humpback-1	Crude	Surface Blowout	500,710	**12/08/2009**	Worst Case

* For the scenarios where no shoreline oiling was predicted, the trajectory that came closest to impacting the Falkland Islands was chosen as a representative case.

Table A.4.12: Deterministic analysis results; predicted shoreline contamination information for the selected deterministic runs

Scenario ID (Figure)	Spill Site	Oil Type	Spill Type	Total Spilled Volume (bbl)	Time to shore (days)	Amount of oil Ashore (bbl)	
						Peak	End
3 (A.4.23 & A.4.24)	Humpback-1	Crude	Surface Blowout	500,710	-	-	-
4 (A.4.25 & A.4.26)	Humpback-1	Crude	Surface Blowout	500,710	12	2,212	1,747

Figure A.4.23: Deterministic analysis of stochastic scenario 3: 29/01/2011; map for potential water surface contamination

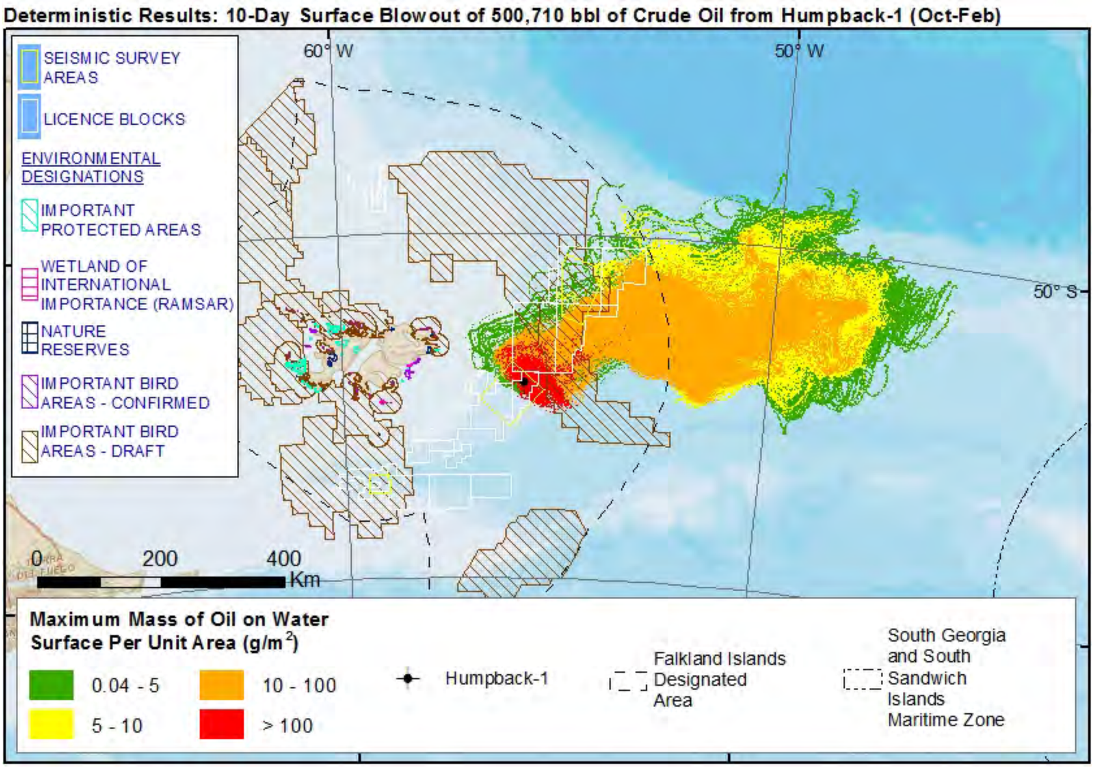


Figure A.4.24: Deterministic analysis of stochastic scenario 3: 29/01/2011; mass balance graph

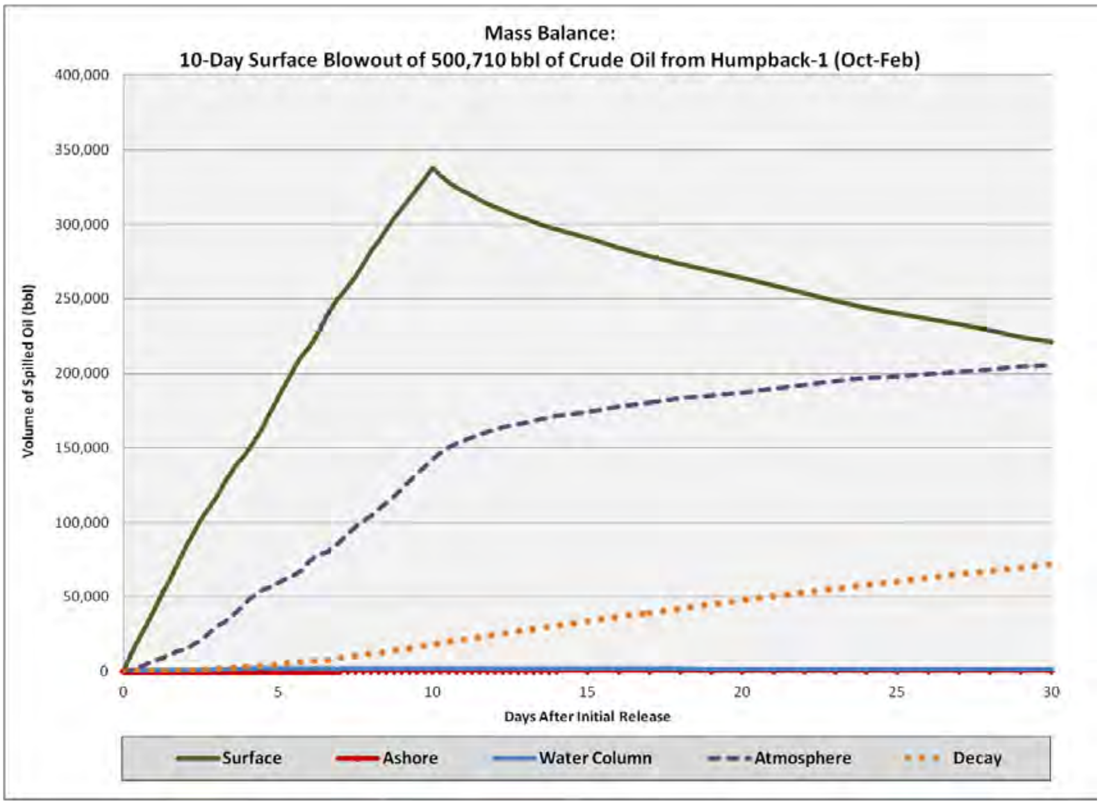
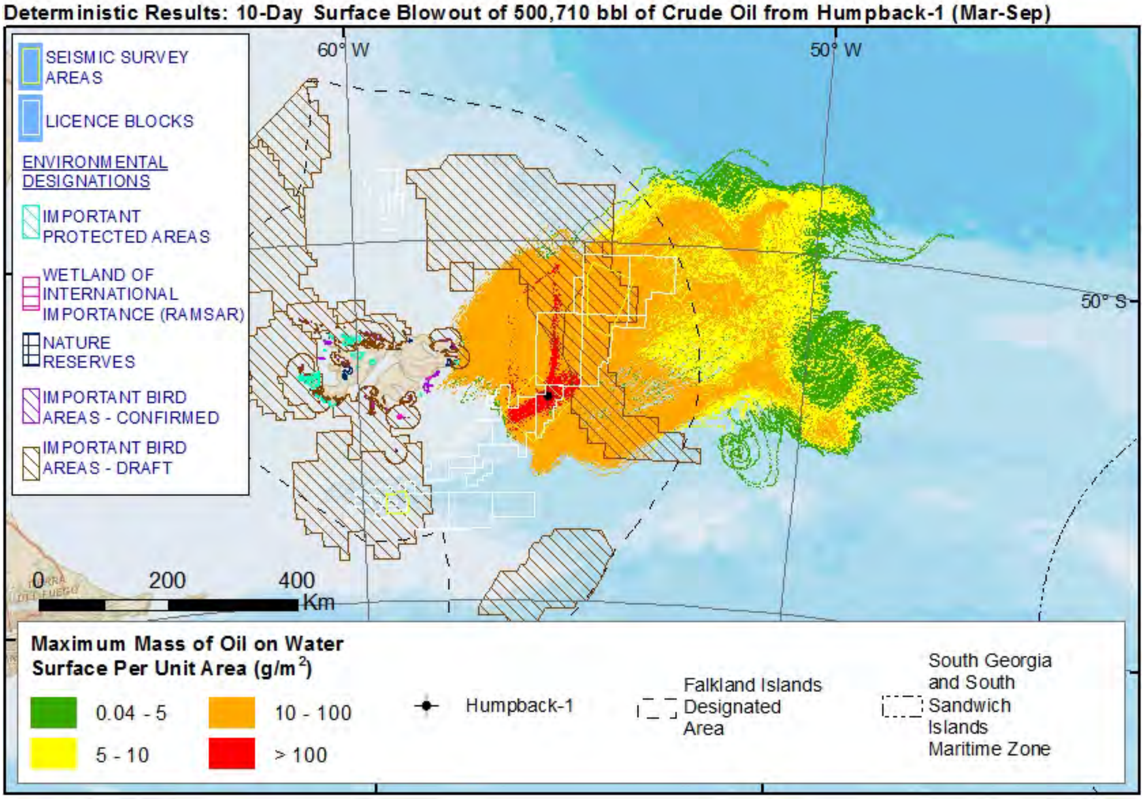


Figure A.4.25: Deterministic analysis of stochastic scenario 4: 12/08/2009; map for potential water surface contamination



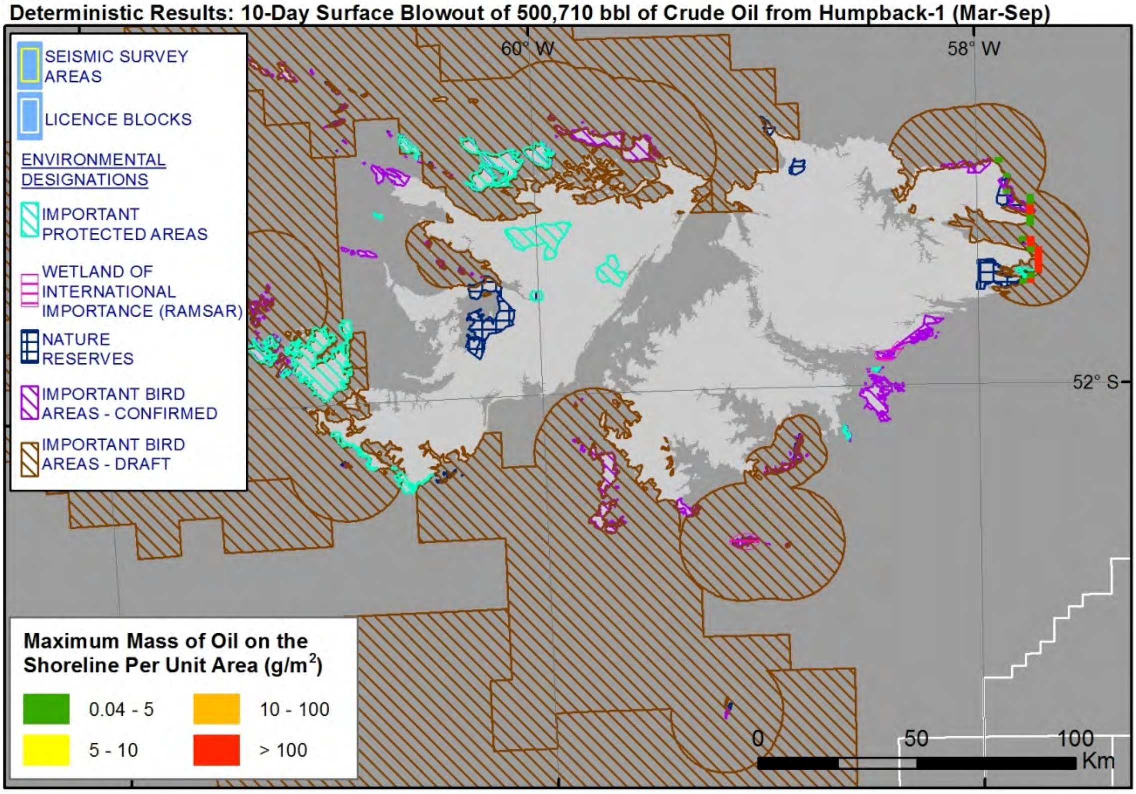
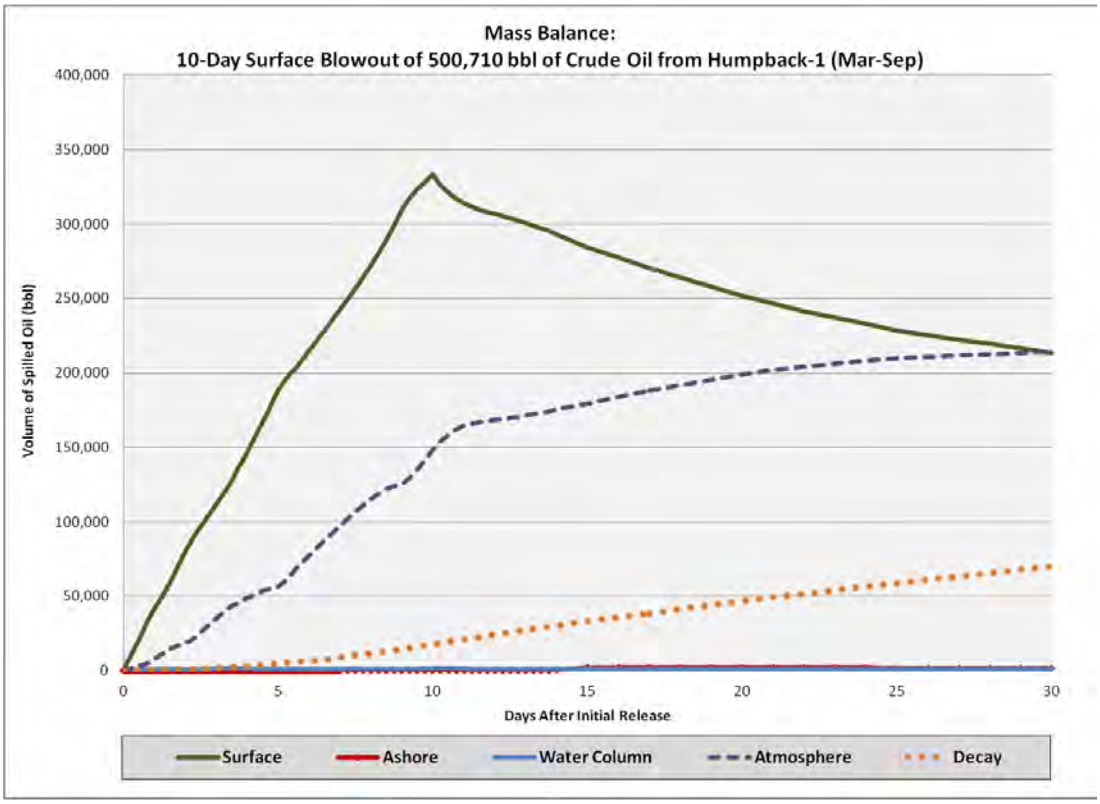


Figure A.4.26: Deterministic analysis of stochastic scenario 6: 12/08/2009; mass balance graph



Crude Oil Surface (2D) DECC 30 knot Wind Deterministic Scenarios

In accordance with the UK Department of Energy and Climate Change (DECC) Oil Pollution Emergency Plan (OPEP) Guidelines (July 2012 version), worst case trajectory modelling has also been undertaken from the Humpback-1 well location using a constant 30 knot onshore wind, and a 30 knot wind towards the nearest international trans-boundary line. The scenarios modelled are displayed in Table A.4.13. The results are displayed in Tables A.4.14 and A.4.15, and in Figures A.4.27 and A.4.28. Due to the uniform wind direction, oil slowly beaches in the same location until the holding capacity of the shoreline is met. After that point, additional oil collects on the water surface against the shoreline. This excess oil is referred to as “shoreline overflow” in Table A.4.15. Under normal environmental conditions, the wind and current variability may result in more extensive transport along the shore, thereby increasing the amount of shoreline oil and decreasing shoreline overflow. It should be noted that the volumes listed in Table A.4.15 are specific to artificial parameters (30 knot onshore winds) and in reality, the natural variability of environmental conditions in the area would likely result in very different volumes.

Table A.4.13: Parameters of the 30 knot wind trajectory oil spill scenarios

Scenario ID	Spill Site	Spill Event	Wind Direction	Oil Type	Spill Rate	Spill Duration	Total Spilled Volume	Simulation Duration
6	Humpback-1	30 knot onshore wind speed (surface)	From ESE	Crude Oil	50,071 bbl/d	10 days	500,710 bbl	30 Days
7	Humpback-1	30 knot wind speed towards median line (surface)	From NE	Crude Oil	50,071 bbl/d	10 days	500,710 bbl	30 Days

Table A.4.14: Predicted impact information for the 30 knot wind trajectory oil spill scenarios

Scenario ID	Spill Site	Wind Direction	Total Spilled Volume (bbl)	Time To Shore (days)	Time To Trans-boundary Line (days)	Countries Impacted	
						Water Surface	Shore
6 (Figure (A.4.27)	Humpback-1	Onshore (from ESE)	500,710	3.2	-	Falkland Islands	Falkland Islands
7 (Figure (A.4.28)	Humpback-1	Median Line (from NE)	500,710	-	5.9	Falkland Islands; Argentina	Argentina

Table A.4.15: Predicted volumes of oil ashore (including shoreline overflow) for 6 time steps (Figures A.4.37 to A.4.40)

Scenario ID	Time step: Approximate Volume Ashore + Shoreline Overflow (bbls)					
	Day 1	Day 3	Day 7	Day 10	Day 20	Day 30
6 (Figure (A.4.27)	-	-	106,284	186,148	235,104	207,866
7 (Figure (A.4.28)	-	-	-	-	-	-

Figure A.4.27: Scenario 6 - 30 knot onshore wind towards the nearest landmass (from ESE) from the Humpback-1 well location. Figure shows six time steps of the model.

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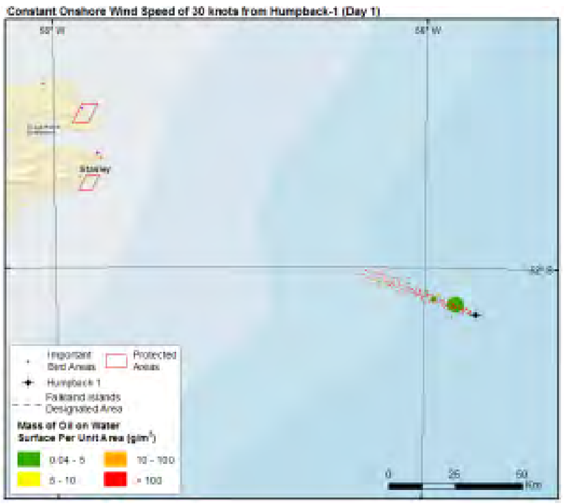
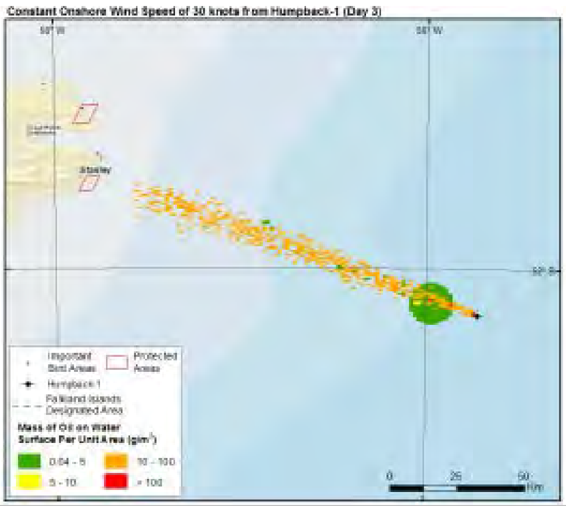
<tr><td>
</td><td>
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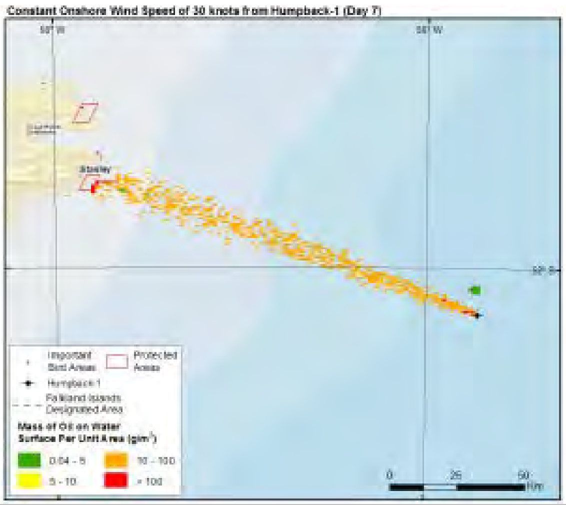
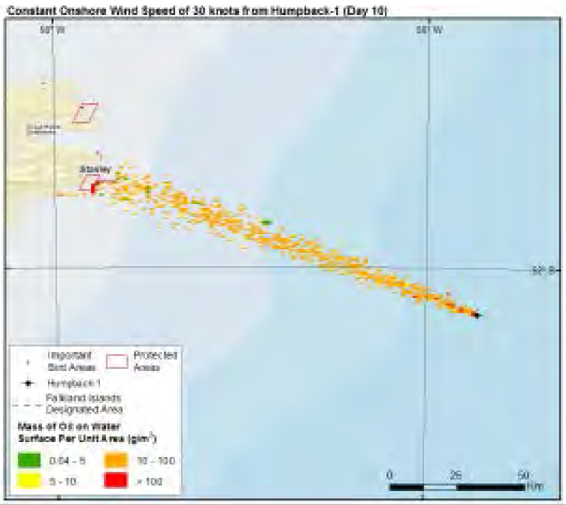
<tr><td>
</td><td>
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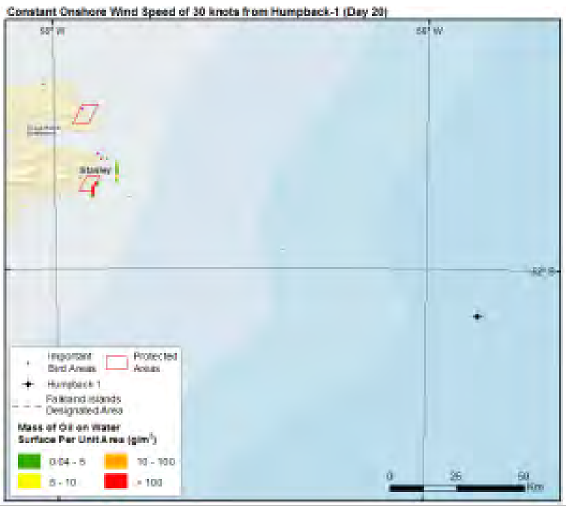
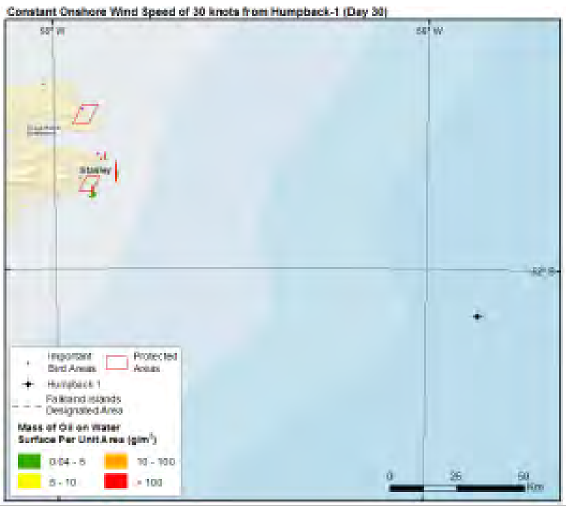
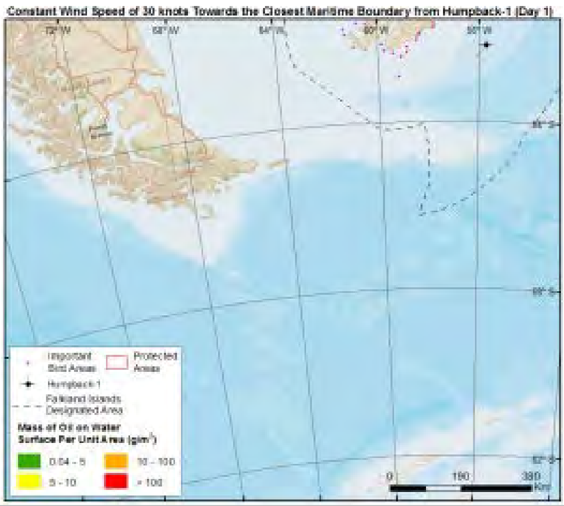
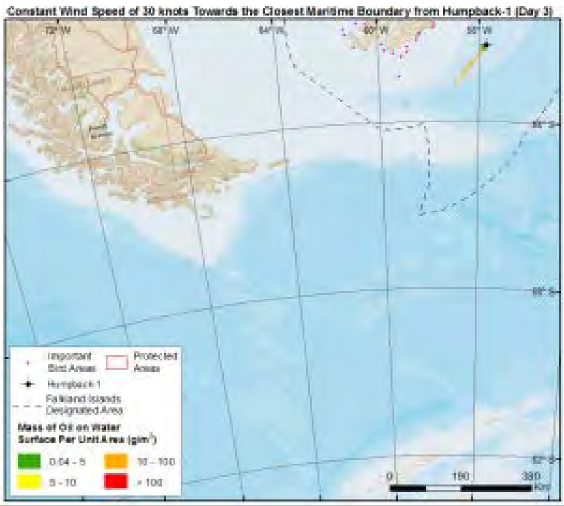
<tr><td>Day 20</td><td>Day 30</td></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Figure A.4.28: Scenario 7 - 30 knot offshore wind towards the nearest trans-boundary line location (from NE) from the Humpback-1 well location. Figure shows six time steps of the model.

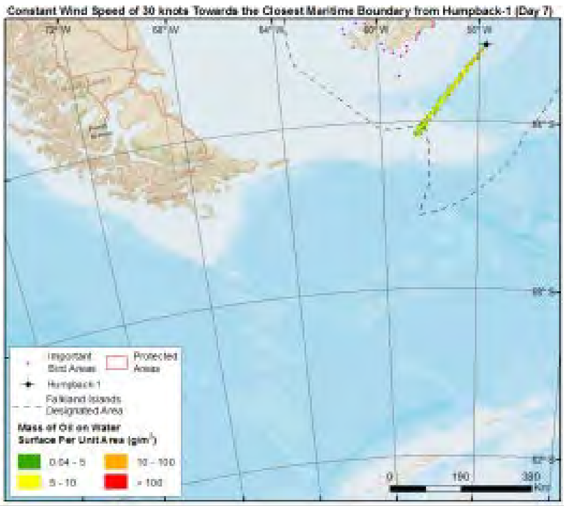
Day 1



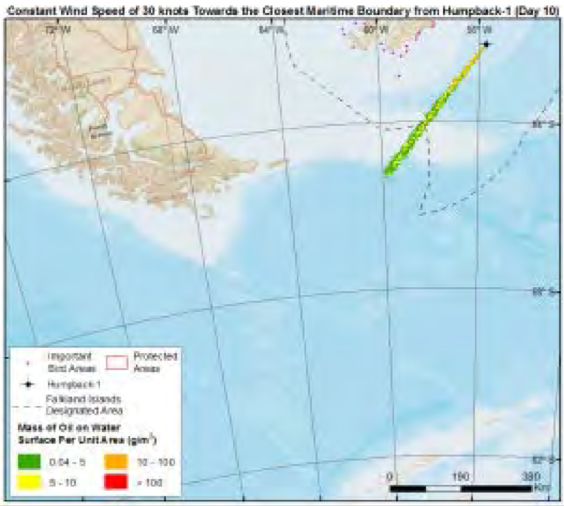
Day 3



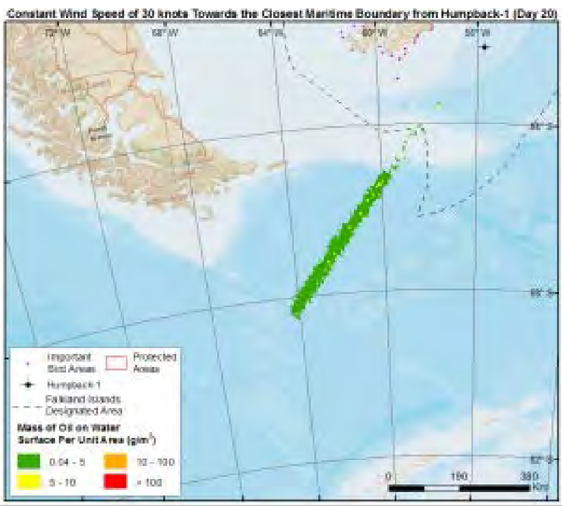
Day 7



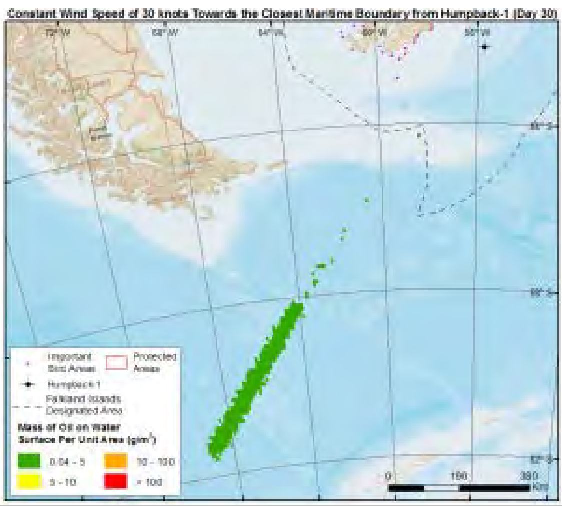
Day 10



Day 20



Day 30



A.4.7 Deterministic Oil Spill Modelling Conclusions

Crude Oil Surface (2D) Stochastic Oil Spill Modelling Deterministic Analysis

As no beaching was observed in scenario 3 (2D blowout from the Humpback-1 well location during the summer period), the deterministic case was selected that encroached closest to the shoreline, since no oil was predicted to beach from any of the scenarios. The deterministic worst case selected for analysis occurred on 29/01/2011. The results of the deterministic analysis are shown in Figures A.4.23 and A.4.24, where it can be seen that the oil continues to weather offshore. The majority of the oil remains on the surface, whilst a significant volume of the oil is lost to the atmosphere through evaporation.

For scenario 4 (2D blowout from the Humpback-1 well location during the winter period), the deterministic worst case selected for analysis occurred on 12/08/2009. The results of the deterministic analysis of this case are presented in Figures A.4.25 and A.4.26. It can be seen that the time taken to reach shore was 12 days, with a peak volume of oil ashore of 2,212 bbls (Table A.4.12). The oil is predicted to beach on the north-eastern coast of East Falkland.

It should be noted that these cases represent the worst cases from the stochastic scenarios, and in the majority of cases, the oil weathers offshore without beaching.

Crude Oil Surface (2D) DECC 30 knot Wind Deterministic Scenarios

From the Humpback-1 well location, a constant 30 knot onshore wind (towards the Falkland Islands blowing from the east-south-east) results in an estimated oil beaching time of 3.2 days, landing at Cape Pembroke, Stanley, on East Falkland Island. The total volume of oil ashore (including shoreline overflow) is predicted at day 30 to be 207,866 bbls. A 30 knot wind towards the nearest trans-boundary line with Argentina results in oil crossing the line and into Argentinean waters estimated at 5.9 days. However, no oil is predicted to beach during the 30 day period for which the model was run.

It should be noted that the volumes listed in Table A.4.15 are specific to artificial parameters (30 knot onshore/offshore winds) and in reality, the natural variability of environmental conditions in the area would likely result in very different volumes. The constant wind conditions are very unlikely to be realistic and do not accurately represent the observed trends of the wind conditions in the area. In reality, they are highly unlikely to occur constantly for 30 days. The constant 30 knot wind requirements therefore greatly exaggerate the potential coastal and trans-boundary impacts.

A.4.8 Oil Spill Modelling Summary

Table A.4.16 summarises all oil spill modelling results.

Table A.4.16: Summary of all spill modelling results

ID	Spill Site	Spill Event (selected date*)	Oil Type	Period	Spill Rate	Spill Duration	Total Spilled Volume	Model Run Duration	Runs Reaching Shore (%)	Estimated Time to reach shore (days)		Estimated Amount of oil Ashore (bbls)	
										Min.	Avg.	Peak	End
Stochastic Scenarios													
1	HB-1	Drilling Rig Fuel Oil Inventory	Diesel	Period 1 (10-2)	Instant	Instant	4,631 m^3	14 Days	0	-	-	n/a	n/a
2	HB-1	Drilling Rig Fuel Oil Inventory	Diesel	Period 2 (3-9)	Instant	Instant	4,631 m^3	14 Days	0	-	-	n/a	n/a
3	HB-1	Surface Blowout	Crude Oil	Period 1 (10-2)	50,071 bbl/d	10 days	500,710 bbl	30 Days	0	-	-	n/a	n/a
4	HB-1	Surface Blowout	Crude Oil	Period 2 (3-9)	50,071 bbl/d	10 days	500,710 bbl	30 Days	2	12	12.5	n/a	n/a
5	HB-1	Subsurface Blowout	Crude Oil	Period 2 (3-9)	50,071 bbl/d	10 days	500,710 bbl	30 Days	0	-	-	-	-
Deterministic Scenarios (Worst Cases from Stochastic – shortest time to oil beaching, or closest to Falkland Islands if no beaching predicted)													
3	HB-1	Surface Blowout (29/01/2011)	Crude Oil	Period 1 (10-2)	50,071 bbl/d	10 days	500,710 bbl	30 Days	n/a	-	n/a	-	-
4	HB-1	Surface Blowout (12/08/2009)	Crude Oil	Period 2 (3-9)	50,071 bbl/d	10 days	500,710 bbl	30 Days	n/a	12	n/a	2,212	1,747
Deterministic Scenarios (DECC 30 Knot Wind Scenarios)													
6	HB-1	Surface Blowout	Crude Oil	30 kt wind (from ESE)	50,071 bbl/d	10 days	500,710 bbl	30 Days	n/a	3.2	n/a	235,104 (day 20)	207,866 (day 30)
7	HB-1	Surface Blowout	Crude Oil	30 kt wind (from NE)	50,071 bbl/d	10 days	500,710 bbl	30 Days	n/a	5.9†	n/a	-	-

*: Selected date only applicable to worst case analysis of deterministic scenarios.

n/a: Result parameter not valid for this model type.

†: Time to closest maritime trans-boundary line.

On consideration of the results in Table A.4.16, it can be seen that the shortest estimated predicted beaching time is 3.2 days (approximately 76 hours) at Cape Pembroke, Stanley, on East Falkland Island. This result is from scenario 6 (blowout scenario from the Humpback-1 location with a 30 knot constant onshore wind). The estimated mobilisation time for Tier 2/3 OSRL spill response resources to the Falkland Islands is 28 hours for OSRL and 35 hours for NRC (refer to **Part I, Section 6.3**), which is within the timeframe before oil is predicted to beach in the worst possible case.

However, as stated above, the DECC scenarios greatly exaggerate the potential shoreline impact as these specific wind conditions are unrealistic and are unlikely to occur in reality. For this reason, it is more informative to consider the worst case from the stochastic modelling. The worst case beaching time from the deterministic analysis of the stochastic modelling was scenario 4 (blowout scenario from Humpback-1 using the metocean parameters on 12/08/2009). This scenario predicted a minimum beaching time of 12 days (288 hours) at Cape Pembroke, Stanley, on East Falkland Island. The estimated time for mobilisation of Tier 2/3 OSRL resources to the Falkland Islands is therefore well within this timeframe.

A.5 Environmental Sensitivities

In this section the environmental resources within the vicinity of the proposed Humpback-1 exploration well have been summarised, and the potential impact of oil spills assessed in respect of Tier 1, 2 and 3 type spills (Table A.5.1).

Seabirds and fisheries are among the environmental aspects most at risk in the unlikely event of an oil spill. The overall impact of spilt oil on the marine environment will vary seasonally due to variations in species abundance and behaviour.

Table A.5.1: Summary of environmental sensitivities within the vicinity of the Humpback-1 exploration well

<table>
<tr><th>Feature</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th><th>Impact of Small Spill (Tier 1)</th><th>Impact of Medium Spill (Tier 2)</th><th>Impact of large Spill (Tier 3)</th><th>Impact of Response Tactics</th></tr>
<tr><td rowspan="4">PLANKTON</td><td colspan="12">Plankton numbers offshore rise sharply during austral spring and summer months, peaking in January and February.</td><td rowspan="4">Negligible</td><td rowspan="4">Minor</td><td rowspan="4">Moderate</td><td rowspan="14">Chemical dispersion of the oil will increase the impact.
Natural dispersion of the oil will have little impact.
Discuss possible strategies with FIG and Incident Command, NOSCP. FIG would discourage the use of chemical dispersant unless other considerations of human safety or the presence of vulnerable seabirds gave a net environmental benefit through its use.</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="12"></td></tr>
<tr><td colspan="2">key</td><td></td><td colspan="3">Peak bloom period</td><td></td><td colspan="5">Summer bloom period</td></tr>
<tr><td rowspan="10">FISH AND FISHERIES
(Figures A.5.1 to A.5.4)</td><td colspan="12">Fish species known to spawn in the vicinity of the Noble license areas include Patagonian toothfish (Dissostichus eleginoides) (peaks in occurrence in May and July through to August), and grenadier (Macrouridae) (peaks in occurrence during March-April). Other species occurring regularly across the Noble license areas include skates and rays (Figures A.5.1 to A.5.3).</td><td rowspan="9">Minor</td><td rowspan="9">Minor</td><td rowspan="9">Moderate</td></tr>
<tr><td colspan="12">Grenadier (Macrourus sp.)</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="12">Skates & Rays</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="12">Patagonian toothfish (Dissostichus eleginoides)</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="12"></td></tr>
<tr><td colspan="2">key</td><td></td><td colspan="2">Present</td><td></td><td colspan="6">Peak occurrence</td></tr>
<tr><td colspan="12">Commercial Fisheries
Commercial fisheries are active across all of the Noble license areas, with the key species being Patagonian toothfish (Figure A.5.4). Catches of grenadiers, skates, rays and other by-catch species are also made across the license areas (Figures A.5.1 to A.5.3).</td><td>Negligible</td><td>Minor</td><td>Major</td></tr>
<tr><td>SEABIRDS
(Figures A.5.5 and A.5.6)</td><td colspan="12">Penguin
Of the penguin species recorded offshore the Falkland Islands, king penguin (Aptenodytes patagonicus), rockhopper penguin (Eudyptes chrysocome), magellanic penguin (Spheniscus magellanicus), macaroni penguin (Eudyptes chrysolophus) and chinstrap penguin (Pygoscelis antarctica) may be present across the Noble license areas. Gentoo penguins (Pygoscelis papua) are predominantly inshore foragers and generally do not venture more than several kilometres from the Falkland Islands coast.
Albatross
The following species of albatross are likely to be present in the vicinity of Noble licenses throughout the year: black-browed albatross (Thalassarche melanophris), grey-headed albatross (Thalassarche chrysostoma), northern and southern royal albatross (Diomedea sanfordi and Diomedea epomophora), yellow-nosed albatross (Thalassarche chlororhynchos), light -mantled sooty albatross (Phoebetricia palpebrata), wandering albatross</td><td>Minor/ Moderate</td><td>Minor/ Moderate</td><td>Moderate/ Major</td><td>Mechanical removal or chemical dispersion of the oil will reduce the impact.
Natural dispersion of the oil will increase the impact if sensitive features are present and in the path of the oil. To find this out it would be necessary to survey the sea surface from a vessel or aircraft to identify sensitive seabird colonies and to predict the movement of the</td></tr>
</table>

Feature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Impact of Small Spill (Tier 1)	Impact of Medium Spill (Tier 2)	Impact of large Spill (Tier 3)	Impact of Response Tactics
	(*Diomedea exulans*) and sooty albatross (*Phoebetria fusca*). **Petrels and Shearwaters** Petrels known to be present in the vicinity of the Noble license areas include: southern giant petrel (*Macronectes giganteus*), northern giant petrel (*Macronectes halli*), Antarctic petrel (*Thalassoica antarctica*), cape petrel (*Daption capense*), blue petrel (*Halobaena caerulea*), Kerguelen petrel (*Pterodroma brevirostris*), soft-plumaged petrel (*Pterodroma mollis*), Atlantic petrel (*Pterodroma incerta*), grey petrel (*Procellaria cinerea*), white-chinned petrel (*Procellaria aequinoctialis*), Wilson's storm petrel (*Oceanites oceanicus*), grey-backed storm petrel (*Garrodia nereis*), black and white bellied storm petrel (*Fregetta tropica* and *F. grallaria*) , magellanic diving petrel (*Pelecanoides magellani*), common diving petrel (*Pelecanoides urinatrix*), great shearwater (*Puffinus gravis*) and sooty shearwater (*Puffinus griseus*). The great shearwater and cape petrel were the most frequently observed species during recent Noble commissioned seismic surveys. **Other Species** Other seabird species that may be present across the Noble license areas include various prion species; skua species including *Catharacta* skuas, long-tailed skua (*Stercorarius longicaudus*); gull species including kelp gull (*Larus dominicanus*); and tern species including Arctic tern (*Sterna paradisea*). **Seabird Vulnerability Indices** Illustrated below is a summary of seabird vulnerability to oiling in the vicinity of the Humpack-1 exploration well (Figure A.5.5). The data have been sourced from '*Vulnerable Concentrations of Seabirds in Falkland Islands Waters*' (1998–2000), a report produced by JNCC (*White et al., 2001*).															oil by using oil spill modelling and weather forecasting. Discuss possible strategies with FIG and Incident Command, NOSCP. FIG would discourage the use of chemical dispersant unless other considerations of human safety or the presence of vulnerable seabirds gave a net environmental benefit through its use.
			ND	ND	ND	ND										
	key	ND	*No data*			*Low*		*Med*		*High*		*V.high*				
CETACEANS (Figures A.5.7 to A.5.11)	The results of the marine mammal observations that occurred during the seismic surveys conducted in FISA12 and FIST13 (*RPS, 2013*) correlate well with the JNCC survey results (*White et al., 2002*). Both data sets suggest that the species most frequently encountered across the Noble license areas include: sei whale, fin whale, Antarctic minke whale, sperm whale, southern bottlenose whale, long finned pilot whale, southern right whale, killer whale, Commerson's dolphin, Peale's dolphin and hourglass dolphin (refer to Figures A.5.7 to A.5.11).												Negligible	Minor	Moderate	Chemical dispersion of the oil will increase the impact. Natural dispersion of the oil will have little impact. Discuss possible strategies with FIG and Incident Command, NOSCP. FIG would discourage the use of chemical dispersant unless other considerations of human safety or the presence of vulnerable seabirds gave a net environmental benefit through its use.
	Sei whale (*Balaenoptera borealis*)															
	Fin whale (*Balaenoptera physalus*)															
	Antarctic minke whale (*Balaenoptera bonaerensis*)															

Feature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Impact of Small Spill (Tier 1)	Impact of Medium Spill (Tier 2)	Impact of large Spill (Tier 3)	Impact of Response Tactics
	Sperm whale (*Physeter macrocephalus*)															
	Peak occurrence	Peak occurrence	Peak occurrence	Peak occurrence	Peak occurrence	Peak occurrence	Peak occurrence	Peak occurrence	Peak occurrence	Peak occurrence	Peak occurrence	Peak occurrence				
	Southern bottlenose whale (*Hyperoodon planifrons*)															
	Peak occurrence	Peak occurrence	Present	Present	Present	Present	Present	Present	Peak occurrence	Peak occurrence	Peak occurrence	Peak occurrence				
	Long-finned pilot whale (*Globicephala melas*)															
	Present	Present	Present	Present	Peak occurrence	Present	Present	Present	Present	Present	Present	Present				
	Southern right whale (*Eubalaena australis*)															
	Present	Peak occurrence	Peak occurrence	Present	Present	Present	Present	Present	Present	Present	Present	Present				
	Killer whale (*Orcinus orca*)															
	Peak occurrence	Peak occurrence	Peak occurrence	Present	Present	Present	Present	Present	Present	Present	Peak occurrence	Peak occurrence				
	Commerson's dolphin (*Cephalorhynchus commersonii*)															
	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present				
	Peale's dolphin (*Lagenorhynchus australis*)															
	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present				
	Hourglass dolphin (*Lagenorhynchus cruciger*)															
	Peak occurrence	Peak occurrence	Peak occurrence	Present	Present	Present	Present	Present	Peak occurrence	Peak occurrence	Peak occurrence	Peak occurrence				
	Key		(Present)	*Present*		(Peak occurrence)	*Peak occurrence*									
PINNIPEDS (Figures A.5.12 and A.5.13)	Pinnipeds of the wider Falkland Islands region include the South American sea lion, southern elephant seal, South American fur seal and the leopard seal. With the exception of the leopard seal, which is an occasional visitor to the Falkland Islands, these species spend some time during the summer months ashore on the Falkland Islands to breed. Of these, the South American fur seal has been sighted within the vicinity of the Noble license areas. Sightings of other species are unlikely, but may be possible in the event of long foraging trips that the animals sometimes make.												Minor	Minor/ Moderate	Moderate/ Major	Chemical dispersion of the oil will increase the impact. Natural dispersion of the oil will have little impact. Discuss possible strategies with FIG and Incident Command, NOSCP. FIG would discourage the use of chemical dispersant unless other considerations of human safety or the presence of vulnerable seabirds gave a net environmental benefit through its use.
	South American fur seal (*Arctocephalus australis*)															
	Peak occurrence	Present	Present	Present	Present	Present	Present	Present	Present	Present	Peak occurrence	Peak occurrence				
	key		(Present)	*Present*		(Peak occurrence)	*Peak occurrence*		(Occurrence unlikely)	*Occurrence unlikely*						

Feature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Impact of Small Spill (Tier 1)	Impact of Medium Spill (Tier 2)	Impact of large Spill (Tier 3)	Impact of Response Tactics
PROTECTED SITES (Figure A.5.14)	Numerous sensitive areas exist on the Falkland Islands coastline related to seabirds and seal colonies. The closest of these to the Humpback-1 well location are Cape Pembroke (146 km), Lively Islands group (180 km), Sea Lion Islands (218 km) and Beauchêne Island (250 km).												Negligible	Minor / Moderate	Moderate / Major	Discuss possible strategies with FIG and Incident Command, NOSCP. FIG would discourage the use of chemical dispersant unless other considerations of human safety or the presence of vulnerable seabirds gave a net environmental benefit through its use.
SHIPPING (Figure A.5.15)	The commercial shipping traffic within the Noble license areas is closely aligned with the commercial fishing activities. There are some commercial shipping routes that traverse the Noble license areas; however, shipping activity in general is very low.												Negligible	Negligible	Minor	
TOURISM	Over the last 5 years, the tourism industry in the Falklands has grown rapidly, with large numbers of passengers arriving in Stanley each year from cruise ships during the main tourist season (from October to early April). The main attractions are the Falkland Islands' unique environment and wildlife. Up to 2,500 passengers can arrive on a single cruise ship.												Negligible	Minor	Moderate / Major	

Figure A.5.1: Fisheries catch mass (tonnes) for Grenadier (Macrouridae), total catches for years 2008 to 2013 (FIG Department of Natural Resources – Fisheries Department, 2014)

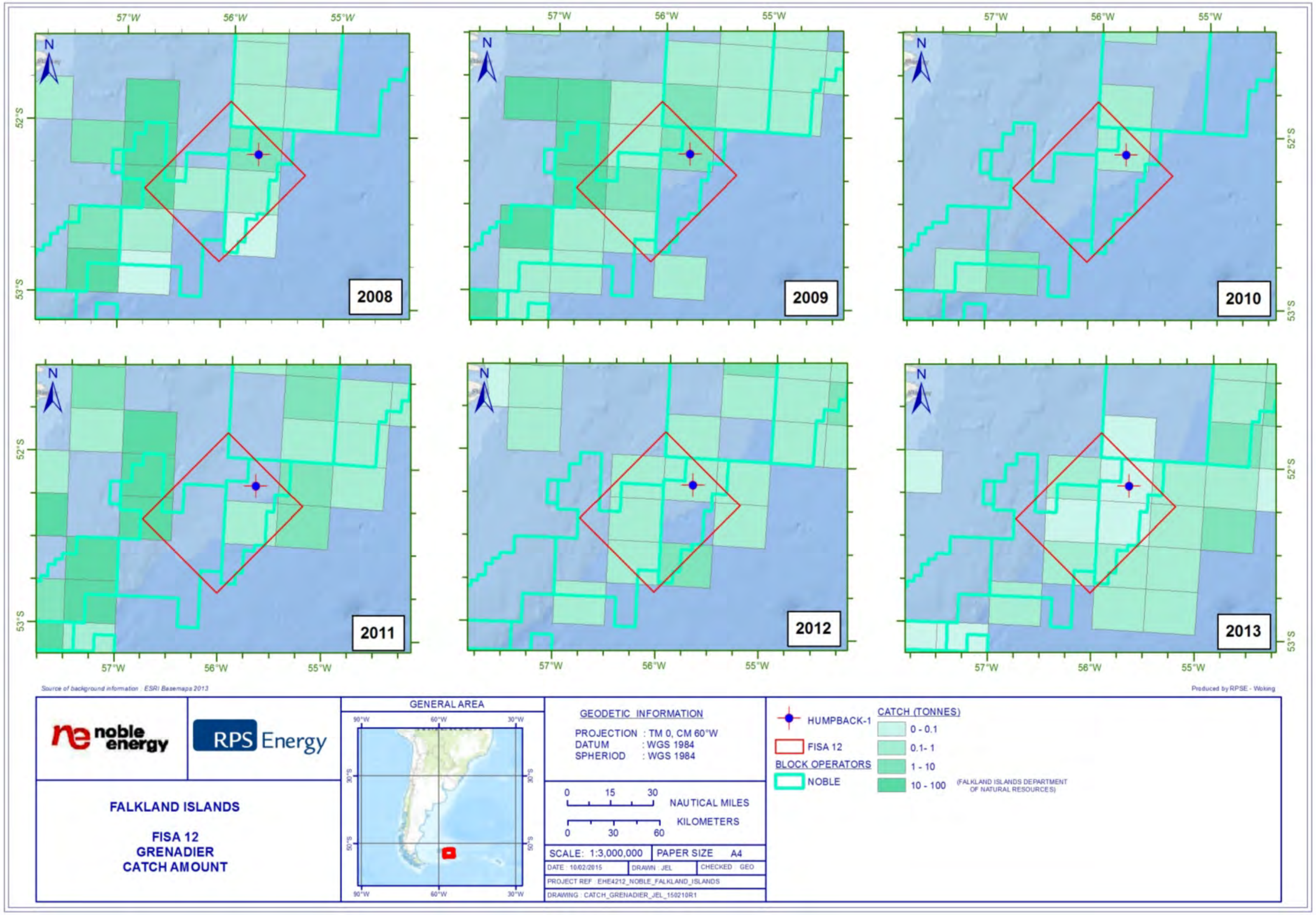


Figure A.5.2: Fisheries catch mass (tonnes) for skates and rays, total catches for years 2008 to 2013 (FIG Department of Natural Resources – Fisheries Department, 2014)

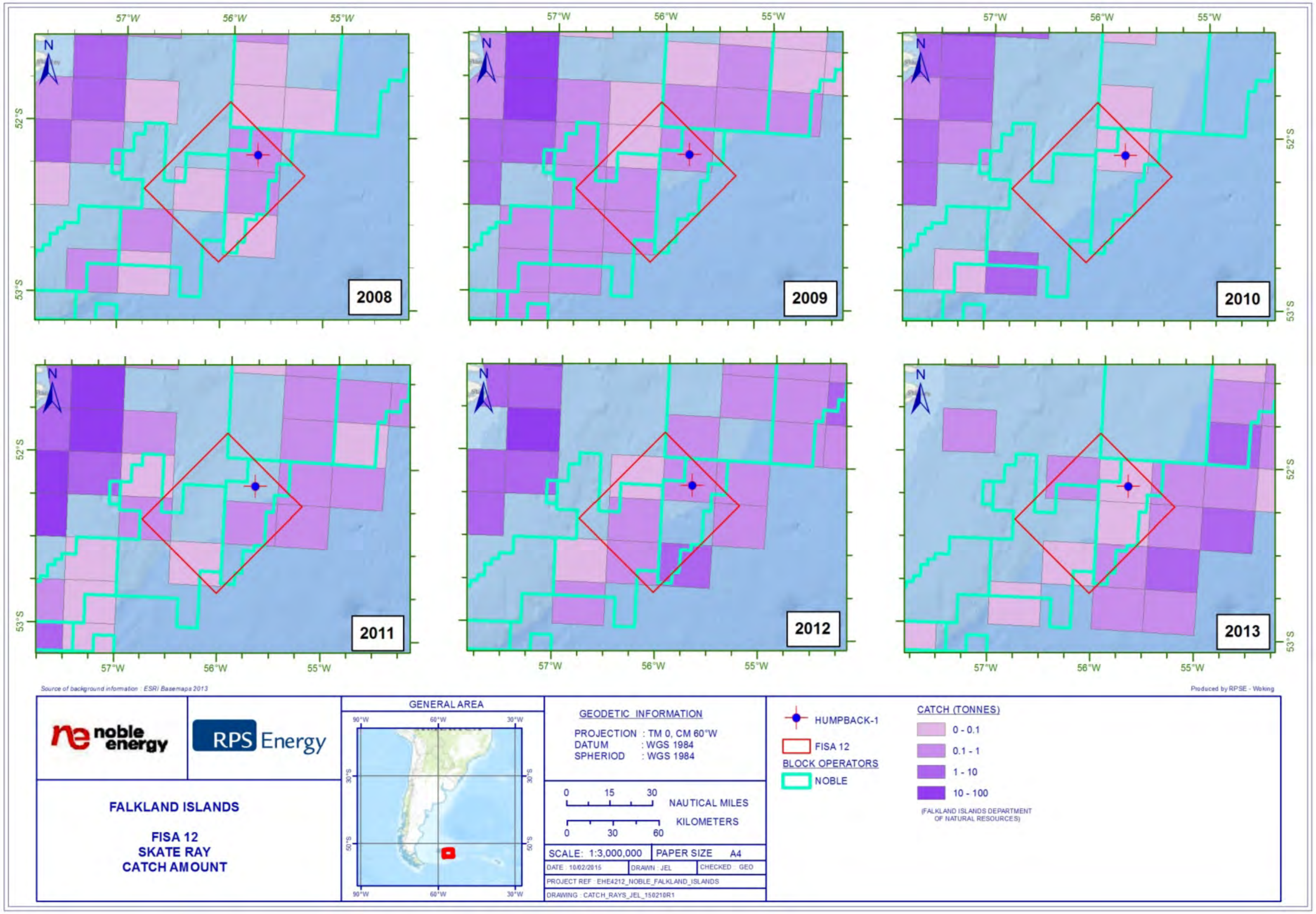


Figure A.5.3: Fisheries catch mass (tonnes) for Patagonian toothfish (Dissostichus eleginoides), total catches for years 2008 to 2013 (FIG Department of Natural Resources – Fisheries Department, 2014)

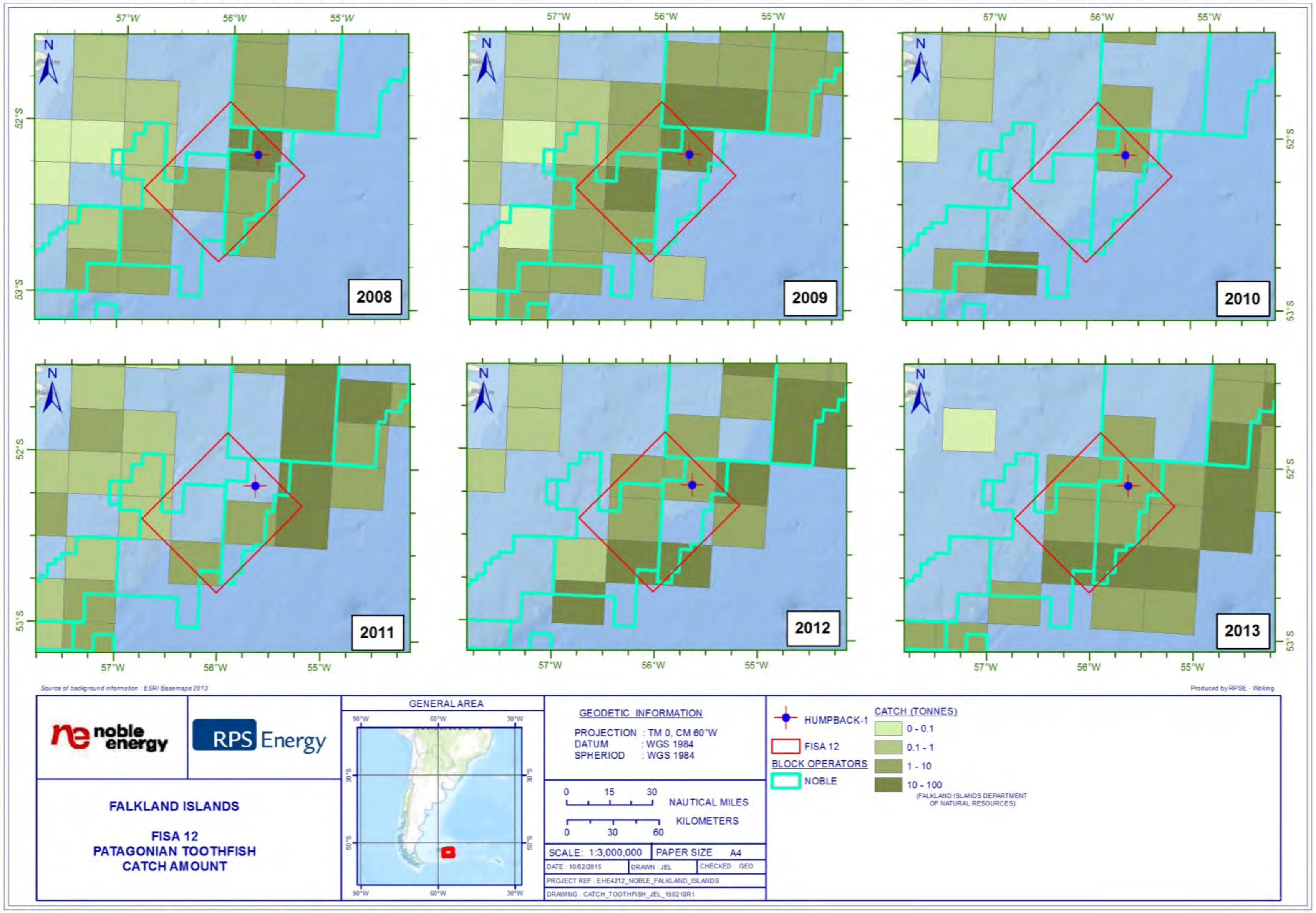


Figure A.5.4: Fishing effort in the vicinity of the FISA12 area and proposed Humpback-1 well location, total effort for years 2008 to 2012 (FIG Department of Natural Resources – Fisheries Department, 2014)

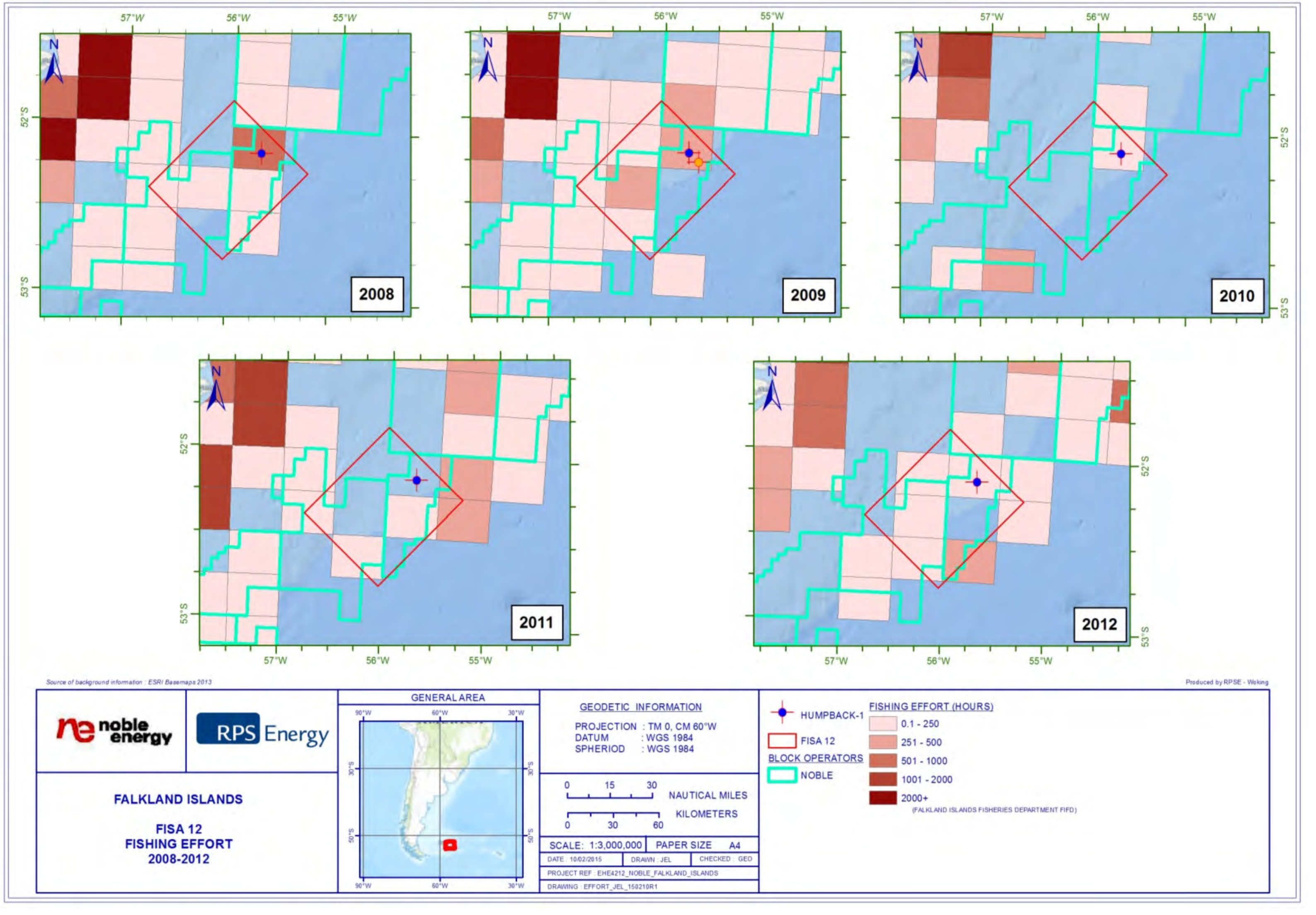


Figure A.5.5a: Seabird vulnerability to oiling in the vicinity of the Humpback-1 well location from January to April (White et al., 2001)

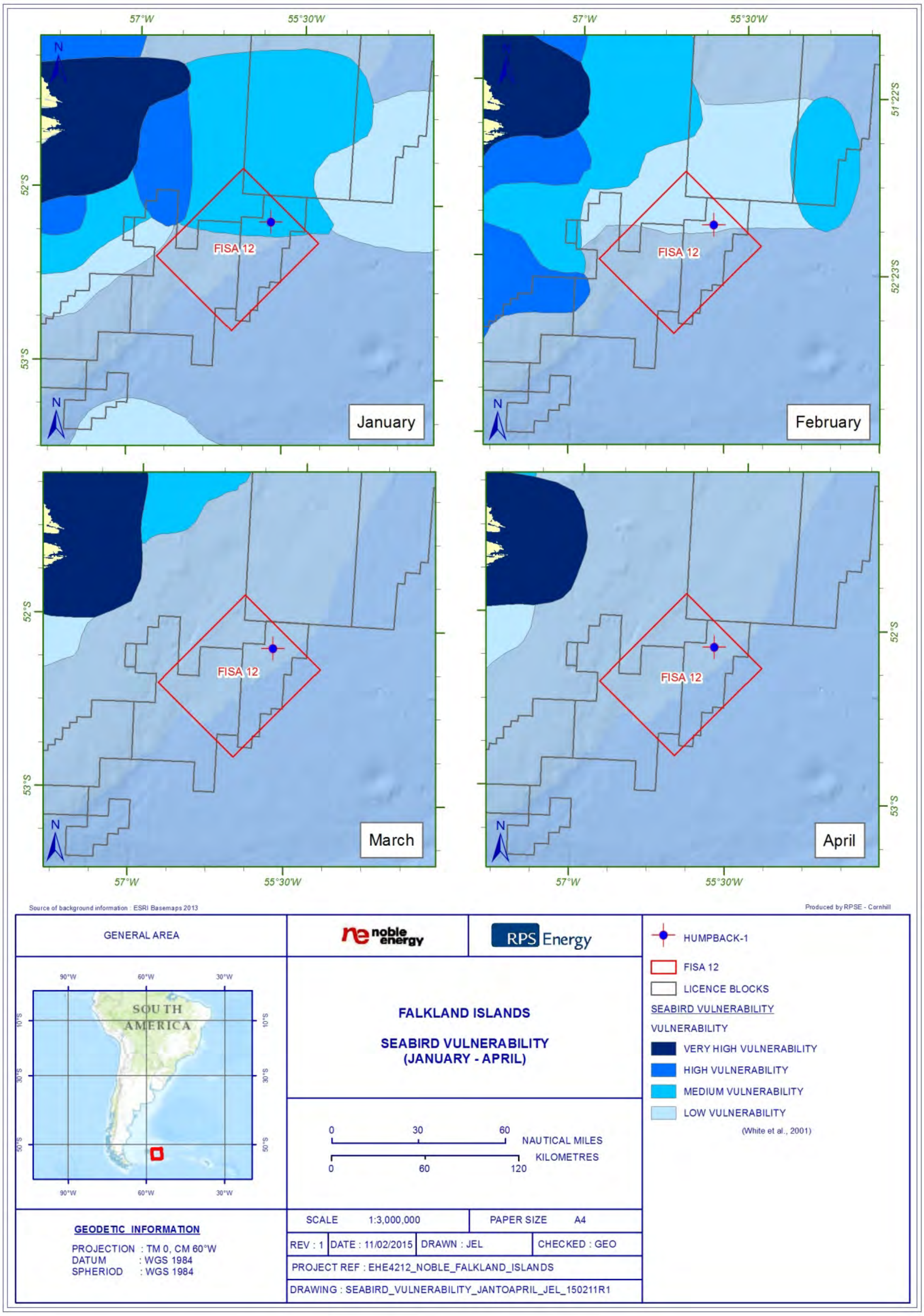


Figure A.5.5b: Seabird vulnerability to oiling in the vicinity of the Humpback-1 well location from May to August (White et al., 2001)

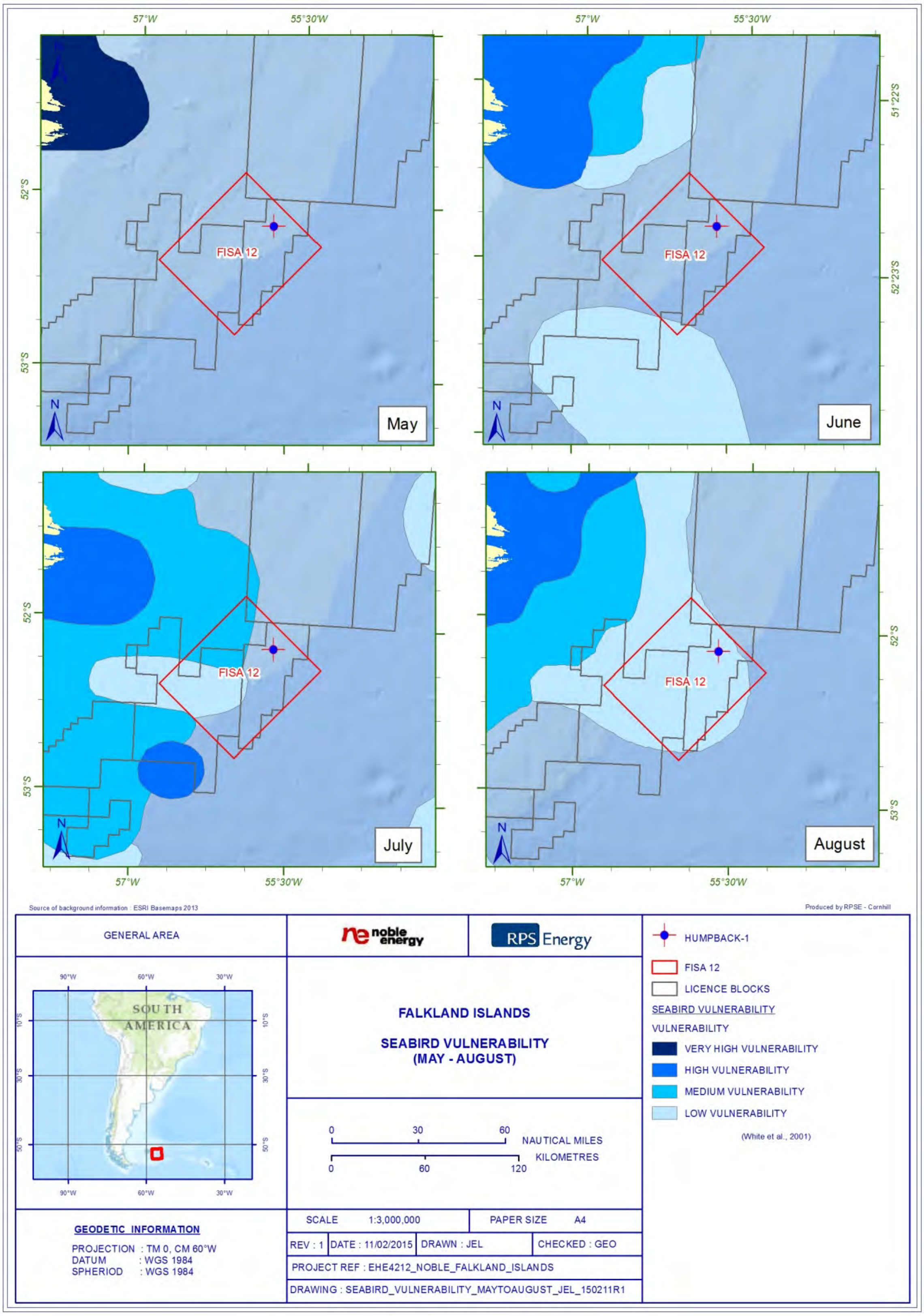


Figure A.5.5c: Seabird vulnerability to oiling in the vicinity of the Humpback-1 well location from September to December (White et al., 2001)

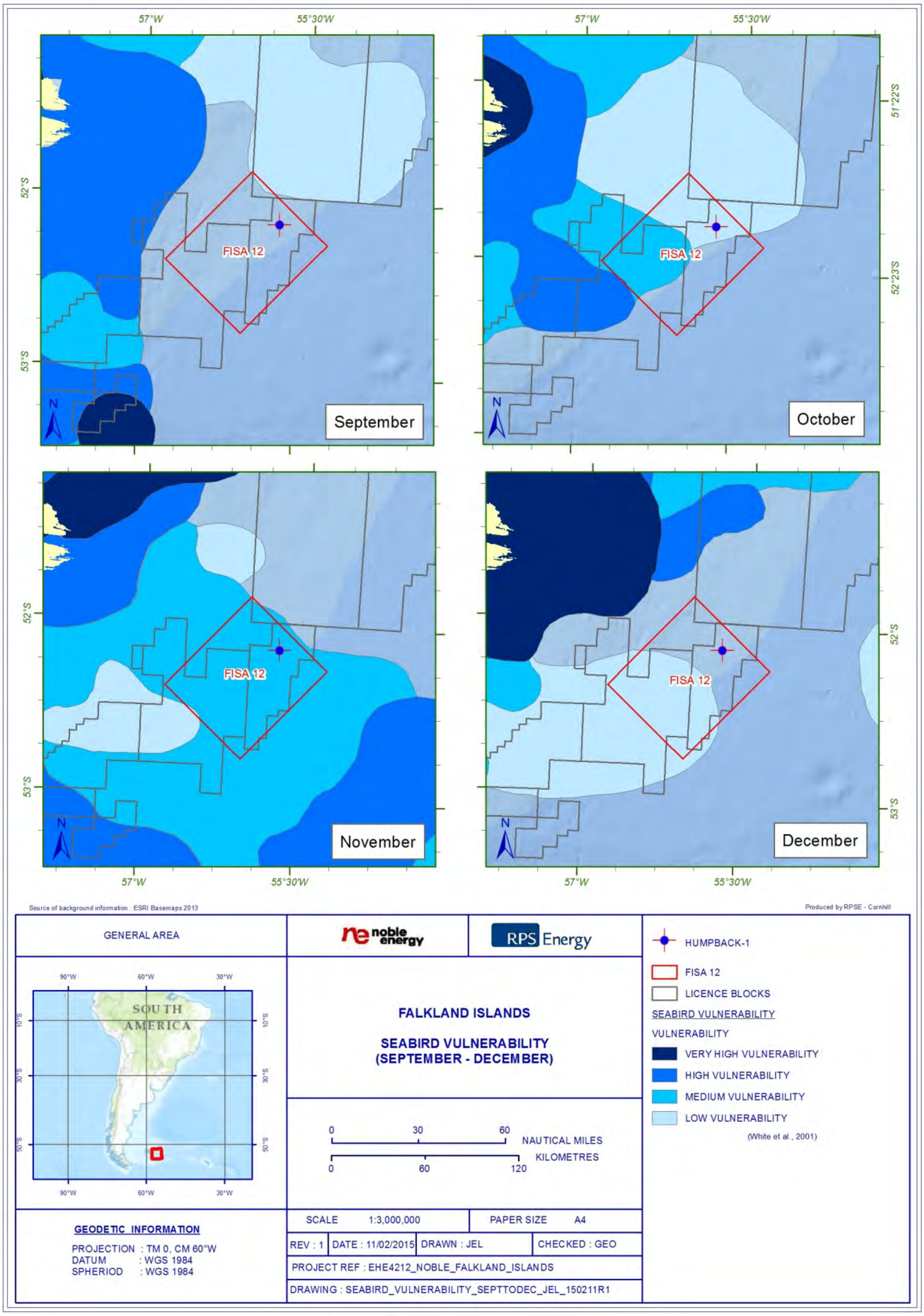


Figure A.5.6: Protected areas and Important Bird Areas around the Falkland Islands

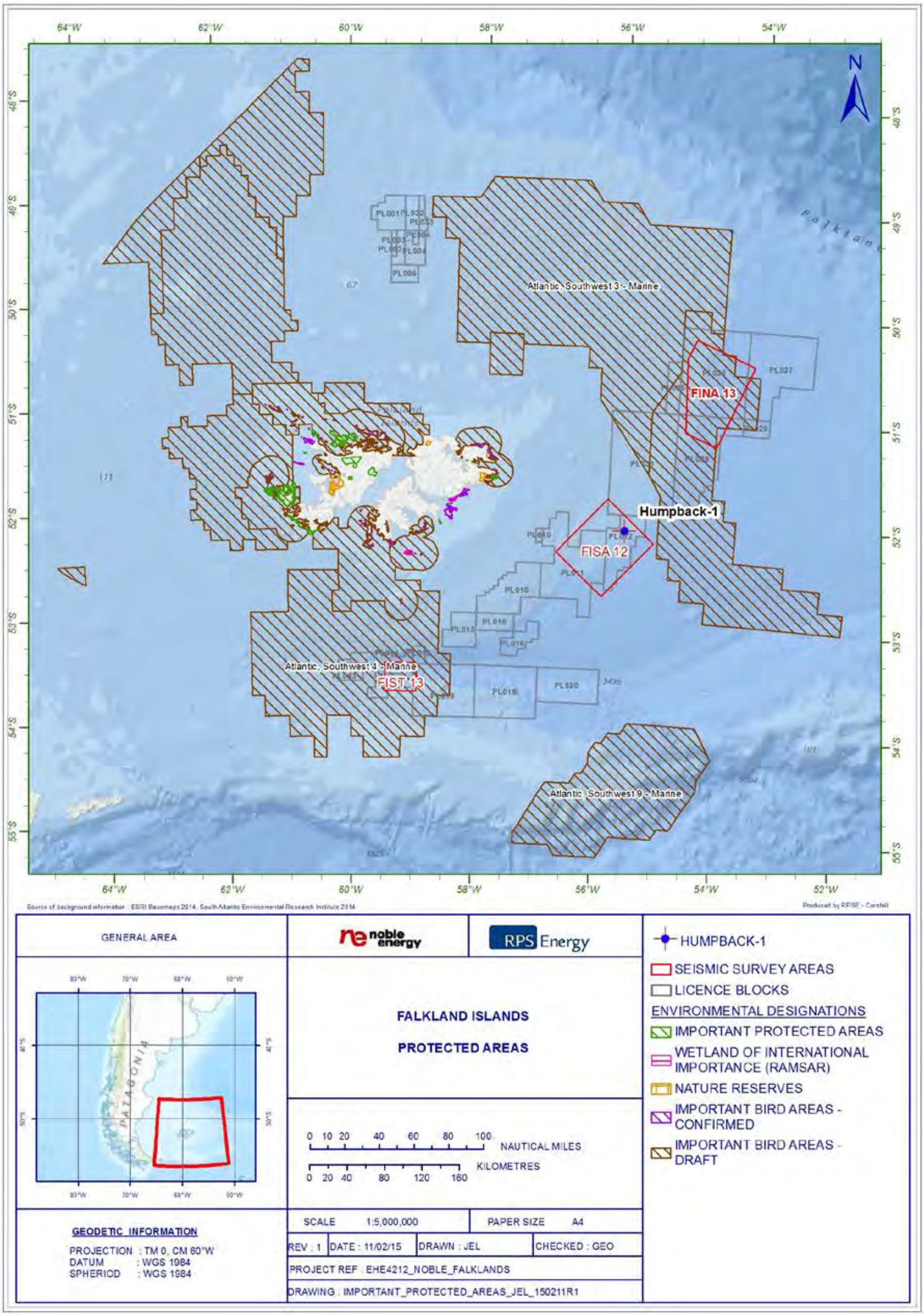


Figure A.5.7: Distribution of whale species sightings (all months) during the JNCC 'Seabirds at Sea' survey in relation to the Humpback-1 well location (White et al., 2002)

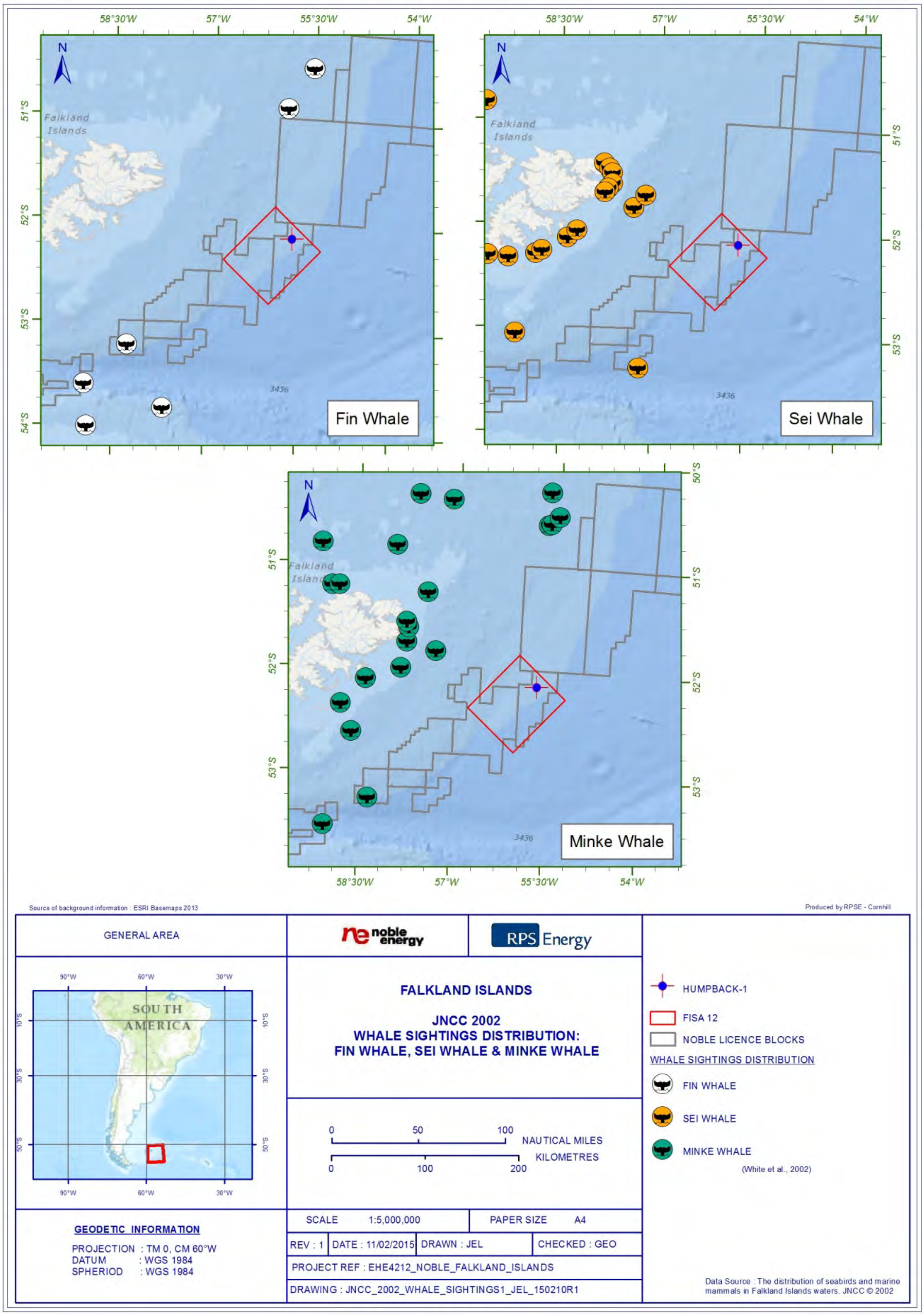


Figure A.5.8: Distribution of whale species sightings (all months) during JNCC 'Seabirds at Sea' survey in relation to the Humpback-1 well location (White et al., 2002)

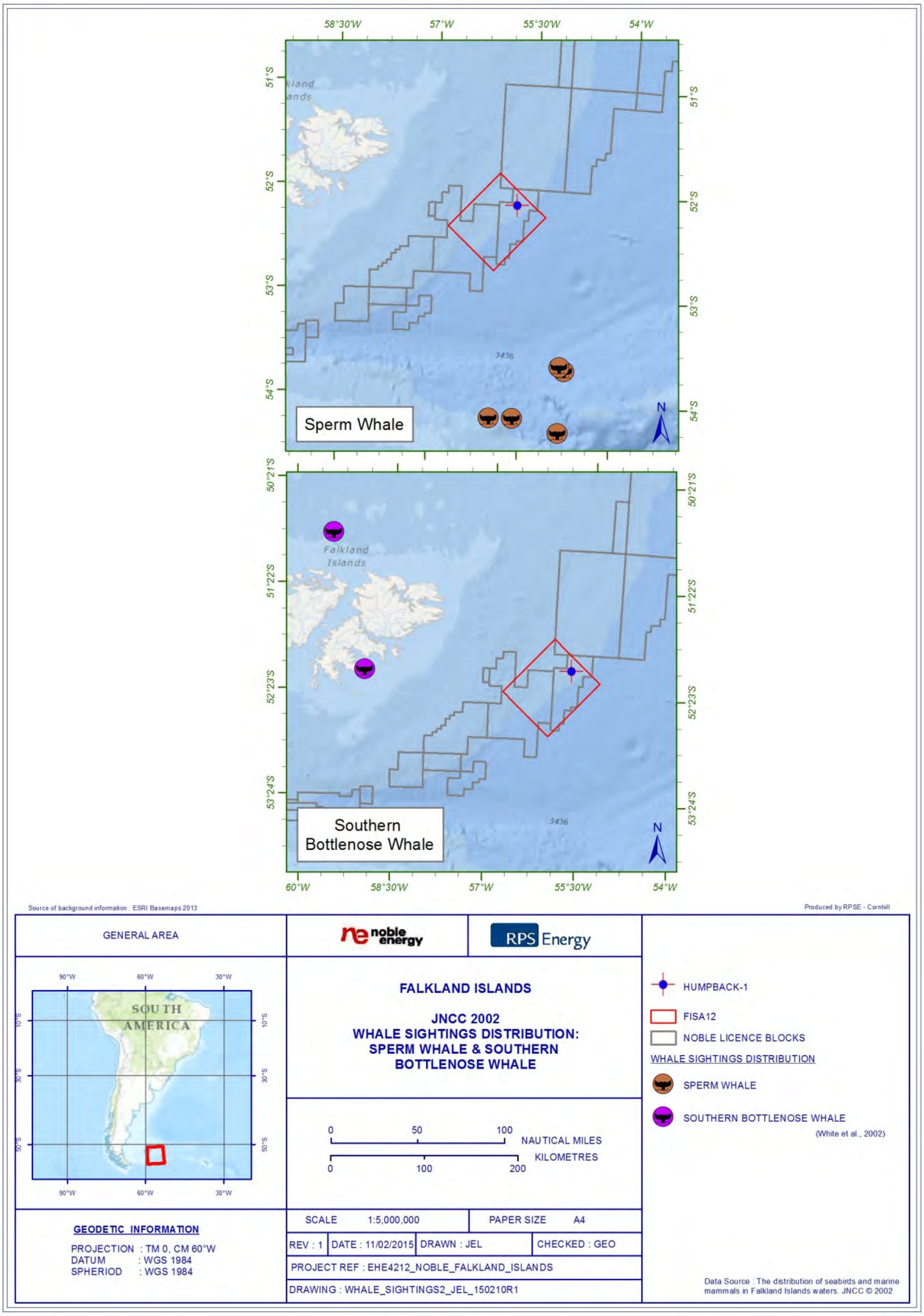


Figure A.5.9: Selected whale and dolphin species density (all months) based upon the JNCC 'Seabirds at Sea' survey sightings data in relation to the Humpback-1 well location (White et al., 2002)

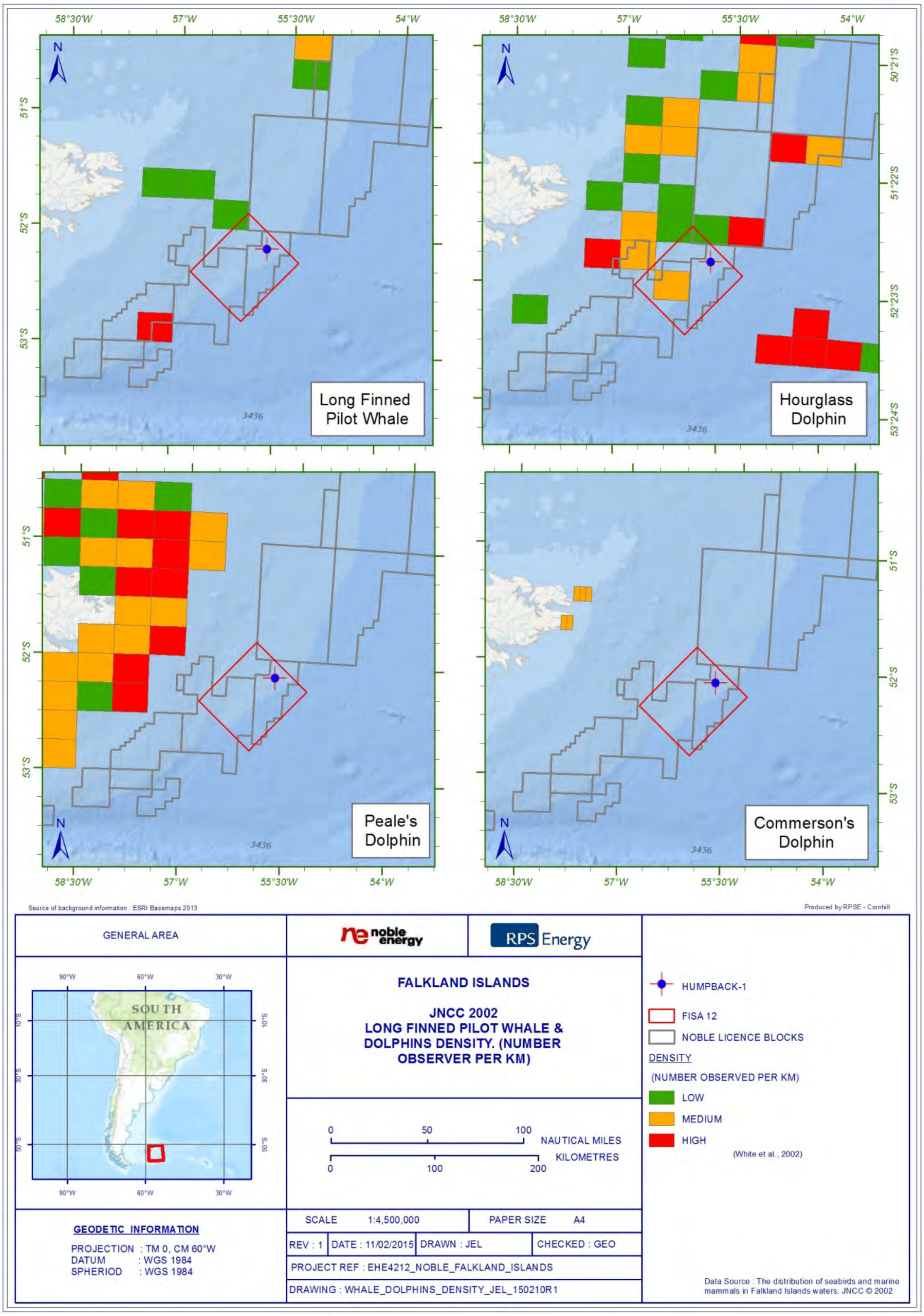


Figure A.5.10: Whale species sightings and acoustic detections recorded during recent Noble-commissioned seismic surveys of the FISA12, FIST13 and FINA12 areas in relation to the Humpback-1 and well locations (RPS, 2013 and 2014)

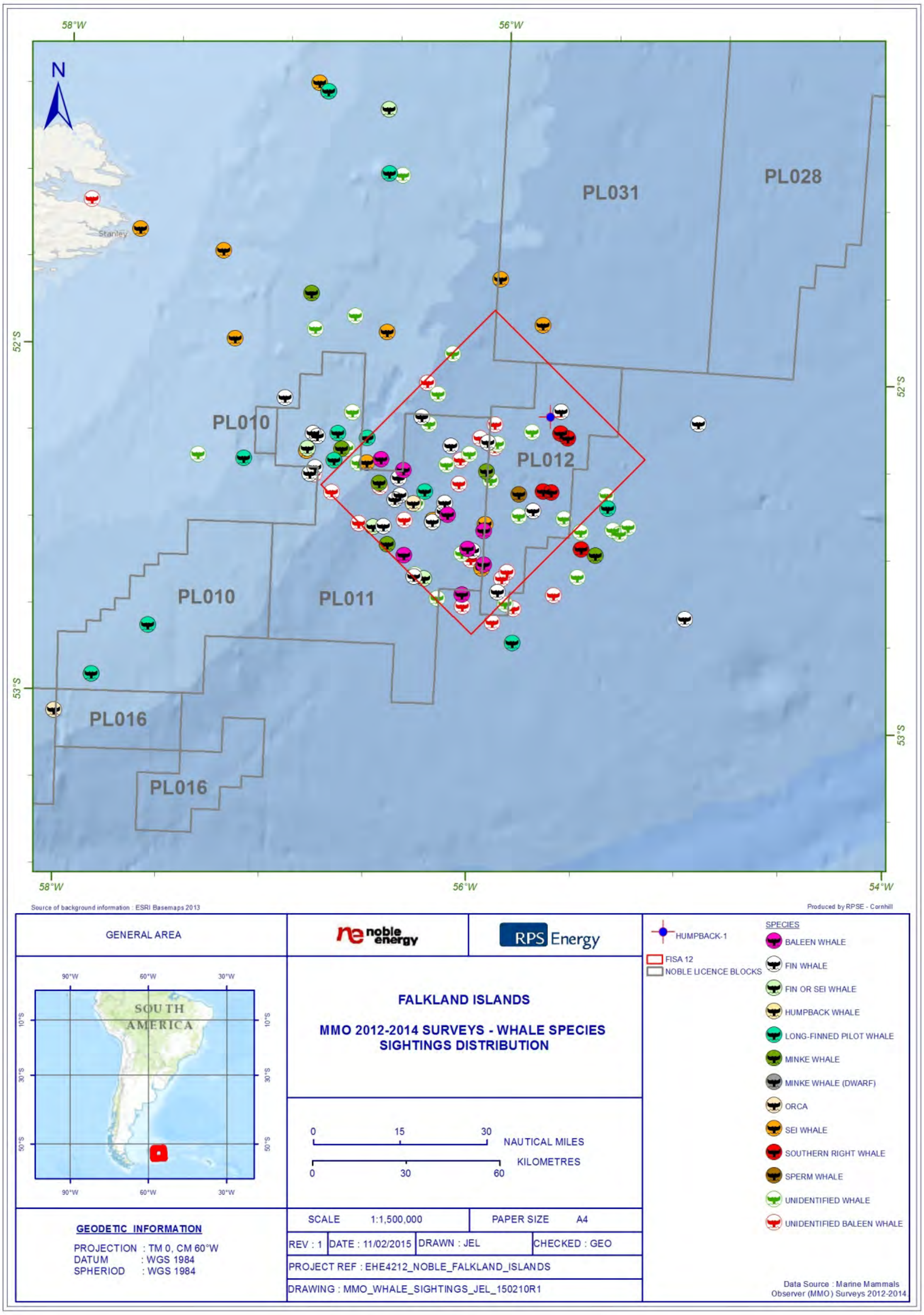


Figure A.5.11: Dolphin species sightings and acoustic detections recorded during recent Noble-commissioned seismic surveys of the FISA12, FIST13 and FINA12 areas in relation to the Humpback-1 well location (RPS, 2013 and 2014)

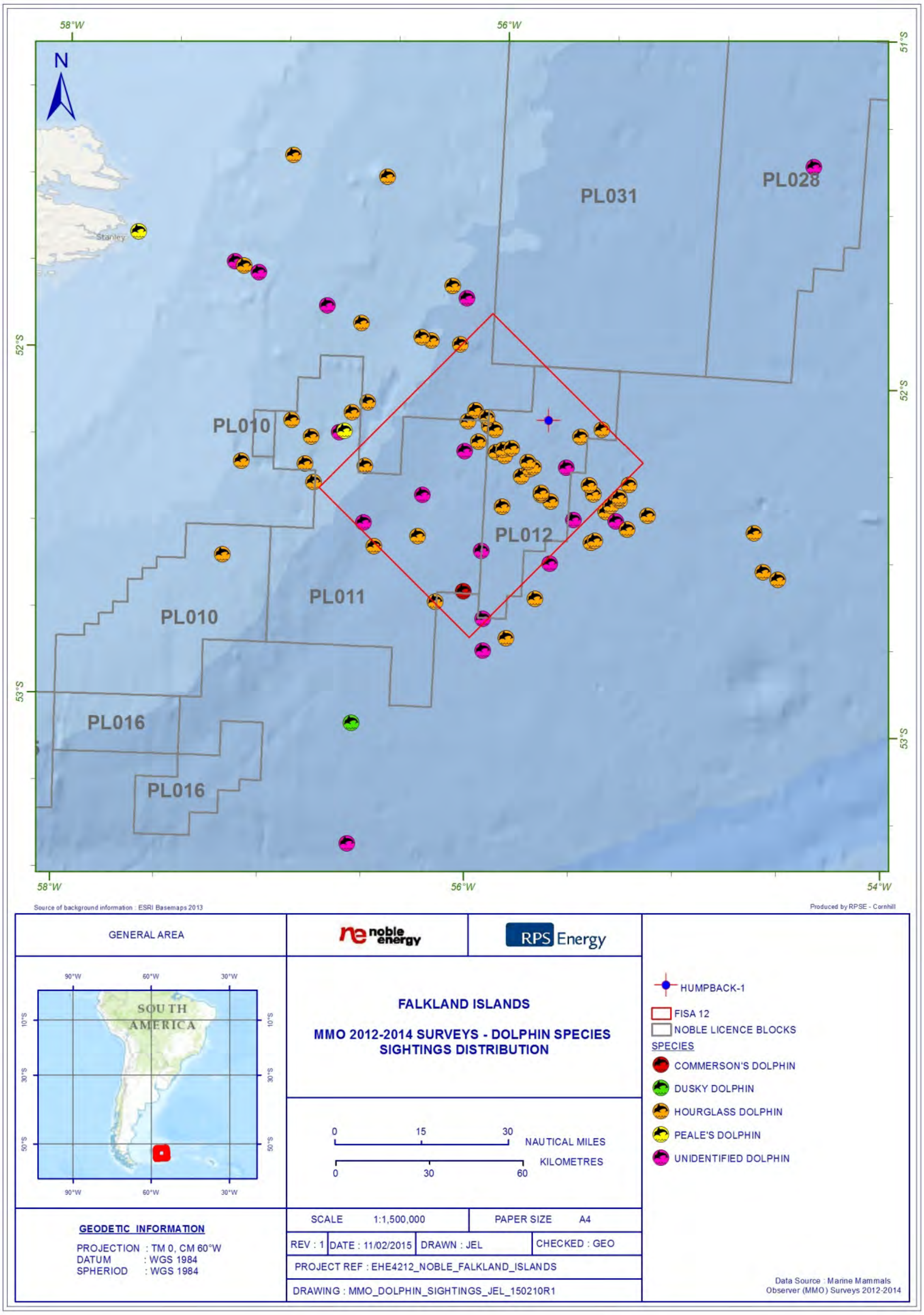


Figure A.5.12: Pinniped sightings during the 'Seabirds at Sea' Survey 1998-2001 in relation to the Humpback-1 well location (White et al., 2002)

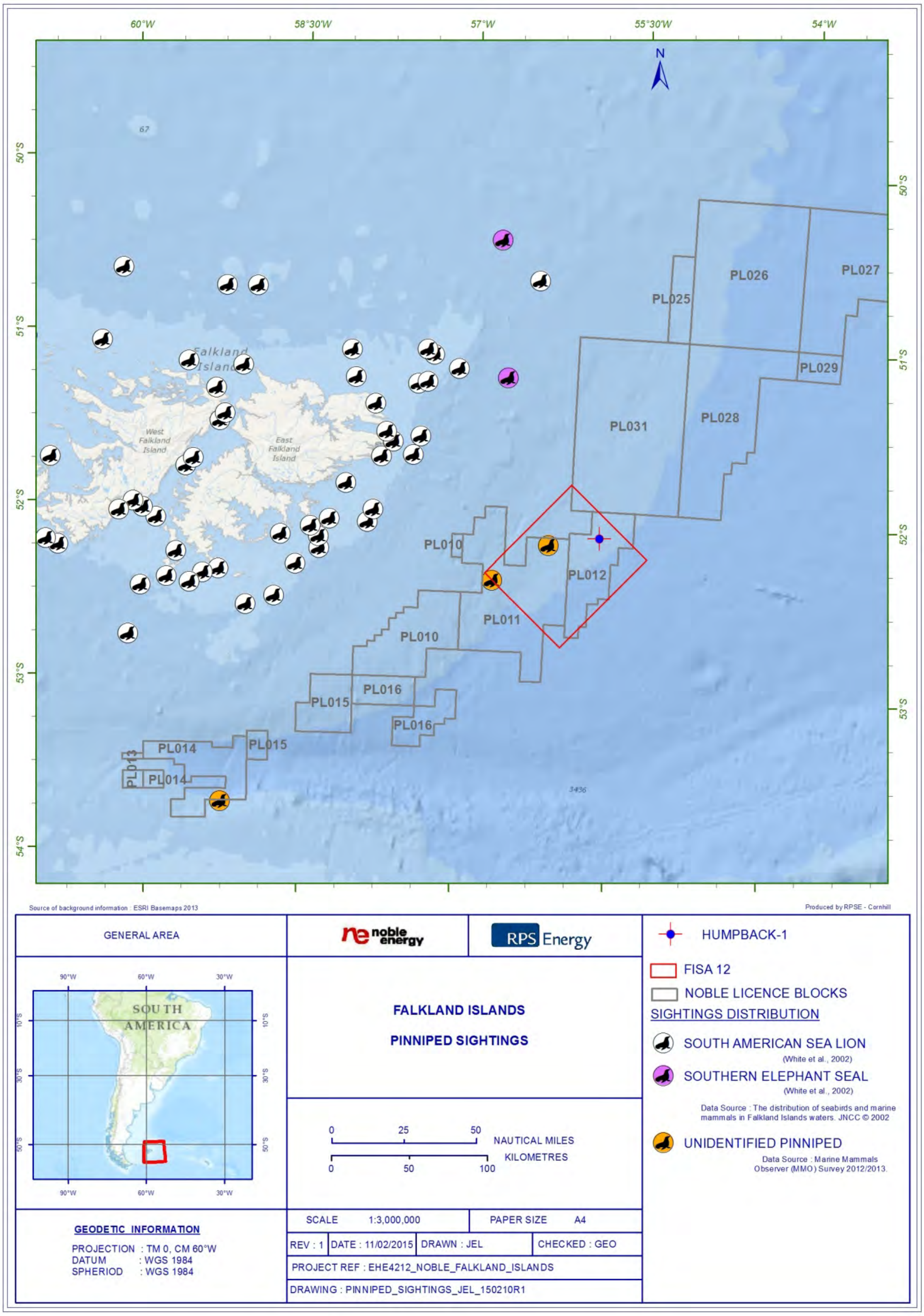


Figure A.5.13: South American fur seal density based upon the JNCC 'Seabirds at Sea' Survey sightings data in relation to the Humpback-1 well location (White et al., 2002)

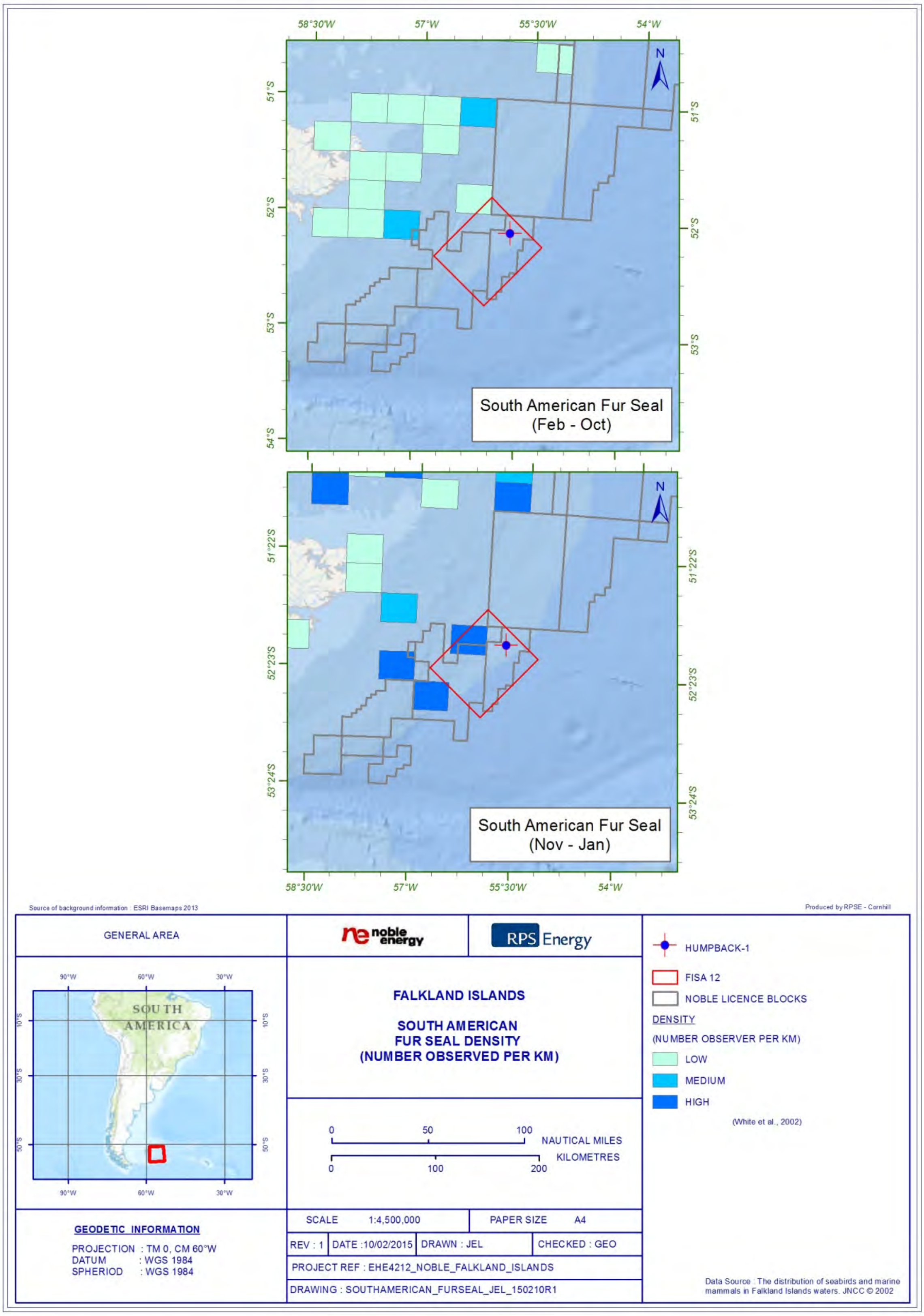


Figure A.5.14: Protected areas around the Falkland Islands

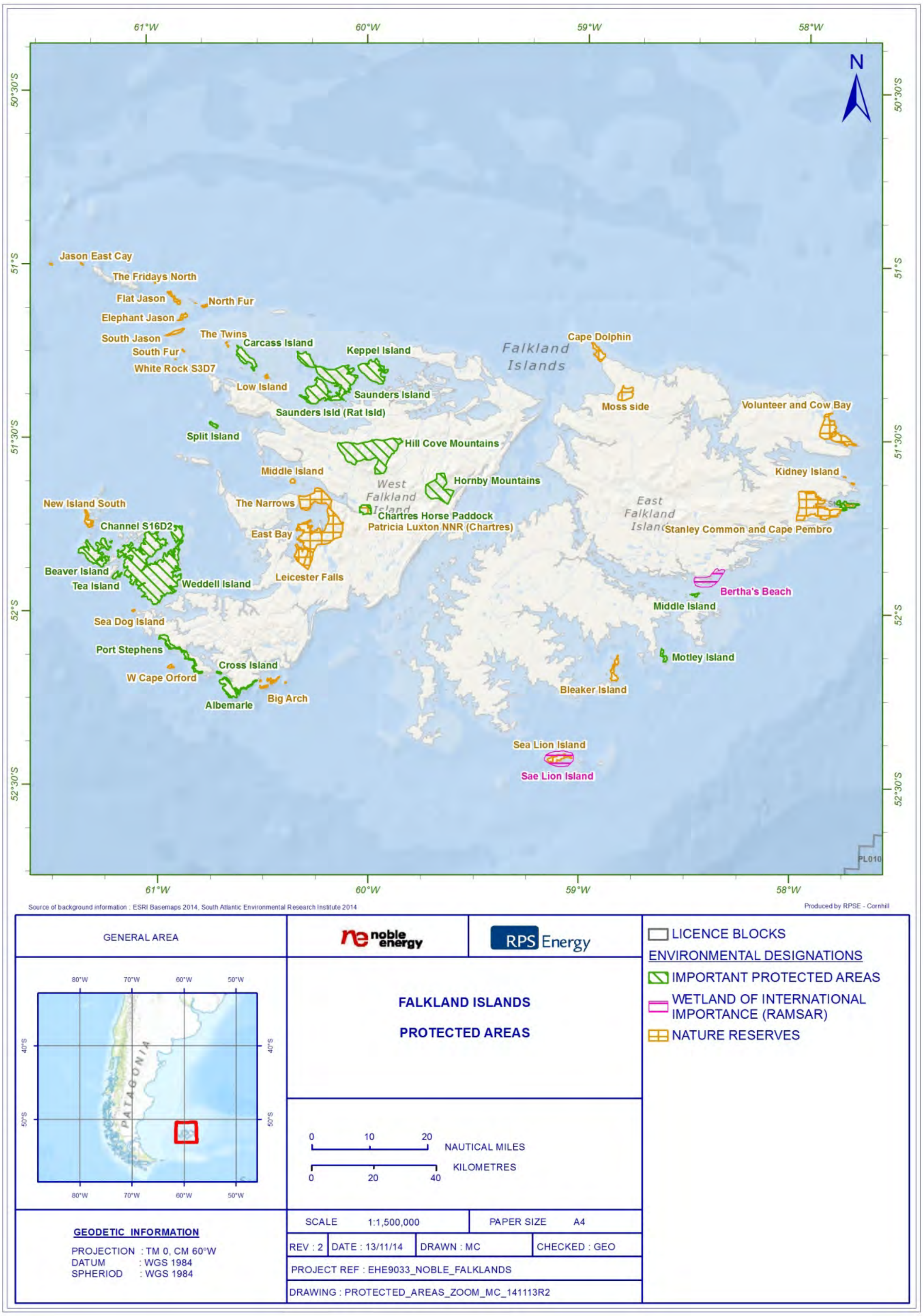
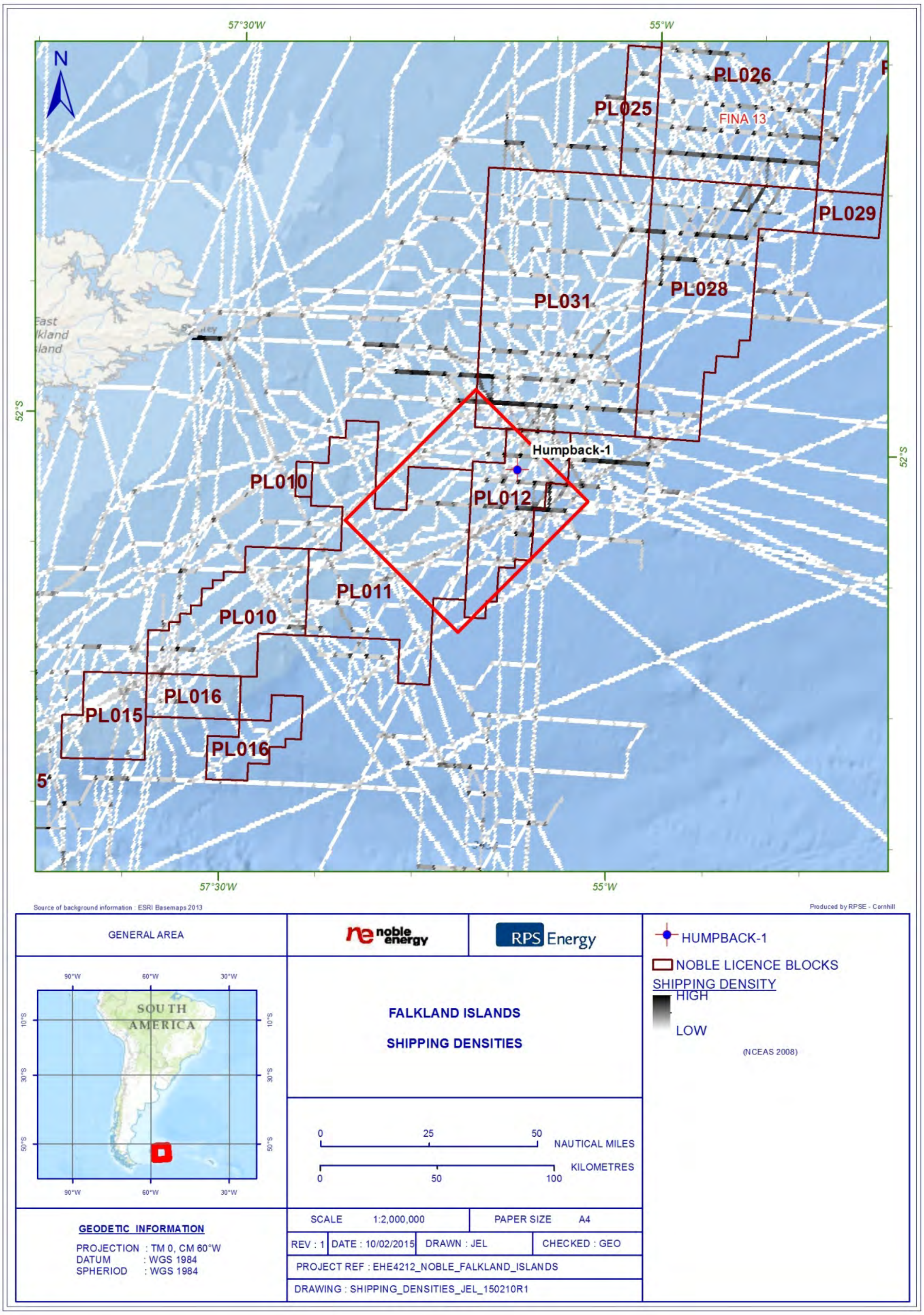


Figure A.5.15: Commercial shipping activities (routes and density) in the vicinity of the Humpback-1 and well locations (Halpern et al., 2008)



PO Box 26
Stanley
Falkland Islands
Tel: +500 22247
E-mail: ceo@conservation.org.fk
www.falklandsconservation.com

5 March 2015

Dear Steve

Noble Energy Falklands Limited Oil Spill Response Plan (OSRP) for Exploration Drilling Offshore the Falkland Islands Rev 03.

Please find below Falkland Conservation's (FC) comments with regard to the above document.

- The Plan provides a lot of detail regarding the overall response, but is still felt to be very lacking regarding wildlife/environmental response.

- There is mention of the usefulness of Environmental Sensitivity Indexes (ESI) and a generic index classification provided, but this does not seem to be taken any further. Have the various shoreline types been mapped, and should not they be provided for this to be a useful statement?

- Given the approach in previous chapters of the Plan, FC would like to see a flow chart of decision making to inform who would be responding as each critical stage is reached for the various Tiers.

- Could it be clarified who the local responders are with an MOU with FIG?

- There are two inaccuracies within the oiled wildlife chapter on pg. 120, namely:

    - The capacity of the Rehabilitation Centre is 20 'penguins' not 'birds'
    - The Rehabilitation Centre is not designed for marine mammals and rehabilitation there is unlikely to be feasible, as stated

- FC appreciate that there is uncertainty associated with any spill event in terms of actual impacts; however, it still appears that this uncertainty unnecessarily pervades throughout the approach to oiled wildlife. Who will take legal responsibility for responders and volunteers for example? What hazing might be effective and how would it be delivered. Will birds processed be marked/tracked to establish survival rates post rehabilitation? **There is not enough information in the Plan to be confident that an appropriate response would be delivered**.

With the information provided within the Plan, there is little reason to see why it could not have been submitted well in advance, along with the EIS and with the necessary information, such as ESI work. The issues raised could likely have been avoided through earlier discussion. **In summary, FC do not feel that the Plan is Fit-for-Purpose. FC are not satisfied with the Environmental/Wildlife Response element of the Plan in its current form, and do not feel that consent to drill should be granted on the basis of this submission.**

FC are more than willing to discuss any of the above.

Yours sincerely

Andrew Stanworth
Conservation Officer

UK Office:
14 East Hatley
Sandy, Bedfordshire, SG19 3JA
Telephone: +44 (0)1767 650 639
sarah.brennan@conservation.org.fk