RPS Energy

Desire PETROLEUM PLC

# ENVIRONMENTAL IMPACT ASSESSMENT
# FOR
# OFFSHORE DRILLING
# THE FALKLAND ISLANDS
# TO
# DESIRE PETROLEUM PLC




**Report No. : EOE0534**

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# EXECUTIVE SUMMARY

## Background and Framework

This report, also referred to as an Environmental Impact Statement (EIS), presents the findings of an Environmental Impact Assessment (EIA) conducted by RPS Energy with regard to exploratory drilling in the North Falkland Basin. The EIA has been carried out on behalf of Desire Petroleum PLC, who are planning a three well drilling campaign in Tranches C and D of the North Falkland Basin. A non-technical summary of this report has also been prepared and provides a concise version of the principal findings and recommendations presented here.

The Falkland Islands are a UK Overseas Territory located on the edge of the Patagonian Shelf in the South Atlantic Ocean. Desire Petroleum PLC (Desire) have been awarded Production Licences by the Falkland Islands Government for the exploration and production of oil and gas in Tranches C and D of the North Falkland Basin. Tranches C and D lie approximately 150km north of the main Islands, with proposed operations taking place in water depths of 350-420m.

Once a suitable drilling rig has been contracted, Desire plan to drill three wells, each +/- 3000m and each taking +/- 22 days (excluding well tests). The prime objective of the drilling programme is to evaluate the prospects identified by 3D seismic acquired in 2004. Of the prospects so far identified it is most likely that drilling will take place in three prospects out of Liz, Beth, Ninky or Ann (see **Figure 6**).

A consortium of oil companies drilled six wells in the North Falkland Basin during 1998. An EIA was carried out prior to drilling and identified significant gaps in the level of environmental data for this area. As a result of this drilling programme a number of environmental studies were commissioned, focussing primarily on the North Falkland Basin (the area of the proposed drilling campaign). Environmental studies conducted around the earlier drilling included:

- Seabird, penguin and cetacean studies
- Current modelling and drill cuttings dispersion modelling
- Benthic surveys (before and after drilling)
- Metocean (Meteorological and Oceanographic) studies
- Oil spill modelling

These studies have greatly increased knowledge of the baseline environment in this area. The proposed drilling campaign will expand on the level of environmental knowledge to the north of the Falkland Islands by facilitating seabird and marine mammal recording, providing seabed ROV footage, 3D seabed surveys and offshore meteorological data.

The significant level of baseline data now available for this area has allowed this environmental assessment to be carried out based on currently available data. No additional environmental monitoring or sampling has been commissioned for this assessment, although both information gathering and consultation exercises have been undertaken in the Falkland Islands. A large number of publications and websites have been used and referenced within this EIS and particular recognition is extended to Falklands Conservation, both for the commissioning of seabird and marine mammal at-sea surveys and for compiling the "Falkland Islands Environmental Baseline Survey 2004" (Munro 2004).

As the choice of drilling contractor and drilling unit has not been finalised, an addendum to this EIS will be produced once these are known in order to verify the assessment is both accurate and up-to-date. Any change to the proposed operations likely to significantly alter the environmental impact, will lead to a reassessment of relevant impacts. The addendum will also provide an operations-specific Environmental Management Plan and detailed mitigation measures and controls.

**Operations and Impacts**

The main sensitivities and environmental constraints identified in the licence area (Tranches C and D) are the highly important seabird populations, presence of marine mammals and fisheries interests. In addition, the benthic (seafloor) habitat is considered to be both sensitive to disturbance and relatively unstudied, although benthic surveys have revealed a relatively homogeneous (uniform) macrofauna in a relatively homogenous environment, with no significant indication of pollution from previous drilling.

Although not in the licence area, the near-shore and coastal environments are also included within this assessment and are considered to be both extremely important and sensitive to any forms of pollution.

An assessment of the likely environmental impacts of the three well drilling programme in Tranches C and D has been undertaken. The principal results of this assessment (Section 7 of this report) are as follows:

The environmental aspects of the operations that have been assessed as resulting in potential impacts of high significance include the discharge of drill cuttings, the risk of offshore and near-shore spills and the onshore disposal of waste material.

Environmental aspects assessed as resulting in potential impacts of medium significance include emissions to air from routine operations and potential well tests, the risk of chemical spills during drilling, waste management options other than onshore disposal (e.g. incineration, shipment to the UK, storage and re-use), the physical presence of the rig and potential for interference with other sea users and seabed disturbance from anchoring.

The potential impacts of these operations will be mitigated in a number of ways, including:

- Maintaining a spirit of openness and ongoing consultation with the Falkland Islands Government (FIG), the public and key stakeholders.
- Applying International best practice and established UK standards to operations, particularly in offshore chemical use and emissions reporting.
- Using only water based drilling muds and low toxicity chemicals approved under the UK Offshore Chemical Notification Scheme.
- Implementing a high level of environmental management offshore and applying environmental procedures for potentially impacting operations (chemical storage, bunkering, waste handling, maintenance programmes, seafloor surveys etc).
- Monitoring and reporting consumption and emission figures in accordance with the UK Environmental Emissions Monitoring System (EEMS).
- Establishing and implementing a project specific Oil Spill Response Plan and carrying out training of key personnel in spill response. Employing Oil Spill Response Ltd in the UK to provide outside assistance in the case of a major spill.
- Implementing a detailed waste management plan to minimise the quantity of waste going to landfill, prevent unsuitable disposal of waste, maximise the re-use of materials and establish the Best Practicable Environmental Option (BPEO) for storage, treatment, transfer and disposal of waste materials.
- Collecting and sharing environmental data wherever possible, for example in offshore sightings, seabed surveys and metocean conditions.

A more detailed description of recommended mitigation measures and environmental management is provided in Sections 7 and 8 of this report.

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# ABBREVIATIONS

| | |
|---|---|
| APF | Antarctic Polar Front |
| API | American Petroleum Institute |
| BAT | Best Available Technique |
| BOD | Biological Oxygen Demand |
| BOP | Blow Out Preventer |
| BPEO | Best Practicable Environmental Option |
| BS | British Standard |
| CFC | Chlorofluorocarbon |
| CHARM | Chemical Hazard Assessment and Risk Management |
| $CH_4$ | Methane |
| CITES | Convention on the International Trade of Endangered Species |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon Dioxide |
| EA | Environmental Assessment |
| E&P Forum | The International Exploration and Production Forum (now OGP) |
| EEMS | Environmental Emissions Monitoring System |
| EIA | Environmental Impact Assessment |
| EMP | Environmental Management Plan |
| EMS | Environmental Management System |
| ERT | Environment & Resource Technology |
| ES | Environmental Statement |
| EU | European Union |
| GHG | Greenhouse Gases |
| GIS | Geographic Information System |
| HFCs | Hydrofluorocarbons |
| HQ | Hazard Quotient |
| HSE | Health, Safety & Environment |
| IAGC | International Association of Geophysical Contractors |
| IMO | International Maritime Organisation |
| ISO | International Organisation for Standardisation |
| IUCN | International Union for the Conservation of Nature |
| JNCC | Joint Nature Conservation Committee |
| MARPOL | International Convention for the Prevention of Pollution by Ships |

| | |
|---|---|
| MOU | Memorandum of Understanding |
| MSDS | Material Safety Data Sheet |
| $N_2O$ | Nitrous Oxide |
| NGO | Non-governmental Organisation |
| $NO_X$ | Nitrogen Oxides |
| NWBM | Non Water Based Mud |
| OBM | Oil Based Mud |
| OCNS | Offshore Chemical Notification Scheme |
| OECD | Organisation for Economic Cooperation and Development |
| OGP | International Association of Oil and Gas Producers (prev. E&P Forum) |
| OSCP | Oil Spill Contingency Plan |
| OSIS | Oil Spill Information System |
| OSRL | Oil Spill Response Limited |
| PAH | Polycyclic Aromatic Hydrocarbons |
| PCBs | Polychlorinated Biphenyls |
| PNEC | Predicted No Effect Concentration |
| PON | Petroleum Operations Notices |
| PSA / PSC | Production Sharing Agreement / Production Sharing Contract |
| PSI | Pounds per square inch |
| QA | Quality Assurance |
| ROV | Remotely Operated Vehicle |
| SBM | Synthetic Based Mud |
| SEPA | Scottish Environmental Protection Agency |
| $SO_2$ | Sulphur Dioxide |
| SOLAS | Safety of Life at Sea |
| Stbd | Standard barrels per day |
| TPH | Total Petroleum Hydrocarbons |
| UK | United Kingdom |
| UKOOA | United Kingdom Offshore Operators Association |
| UN | United Nations |
| UNCLOS | United Nations Convention on the Law of the Sea |
| VOC | Volatile Organic Compound |
| WBM | Water Based Mud |

# COMMON FALKLAND ISLANDS ACRONYMS

| | |
|---|---|
| AG | Attorney General |
| BAS | British Antarctic Survey |
| BAT | British Antarctic Territory |
| BFSAI | British Forces South Atlantic Islands |
| CBFSAI | Commander (of the) British Forces South Atlantic Islands |
| CE | Chief Executive (of FIG) |
| CMO | Chief Medical Officer |
| CO-OP | Falkland Islands Co-operative Society |
| DOA | Department of Agriculture |
| DPW | Director of Public Works (see PWD) |
| EOD | Explosive Ordnance Disposal |
| EPD | Environmental Planning Department |
| EPO | Environmental Planning Officer (see EPD) |
| ESD | East Stanley Development |
| EXCO | Executive Council |
| FC | Falklands Conservation |
| FCO | Foreign & Commonwealth Office |
| FI | Falkland Islands |
| FIC | Falkland Islands Company Limited |
| FICZ | Falklands Interim Conservation Zone |
| FIDB | Falkland Islands Development Board (see FIDC) |
| FIDC | Falkland Islands Development Corporation |
| FIDF | Falkland Islands Defence Force |
| FIG | Falkland Islands Government |
| FIGAS | Falkland Islands Government Air Service |
| FIGO | Falkland Islands Government Office (in London) |
| FIMCO | Falkland Islands Meat Company Limited |
| FIMNT | Falkland Islands Museum & National Trust |
| FINN | Falkland Islands News Network |

| | |
|---|---|
| FIPASS | Floating Intermediate Port And Storage System |
| FIRS | Falkland Islands Radio Station |
| FIT | Falkland Islands Tourism Limited |
| FITB | Falkland Islands Tourism Board (superseded by FIT) |
| FITT | Falkland Islands Tourism & Travel Limited |
| FLH | Falklands Landholdings Limited |
| FOCZ | Falklands Outer Conservation Zone |
| FOSA | Falklands Offshore Sharing Agreement (between oil operators) |
| FS | Financial Secretary (of FIG) |
| GH | Government House (see FCO) |
| GS | Government Secretary (of FIG) |
| HMSC | Health and Medical Services Committee (see FIG) |
| HQ-BFSAI | Headquarters (of the) British Forces South Atlantic Islands |
| KEMH | King Edward VII Memorial Hospital |
| ITT | International Tours & Travel Limited |
| LEGCO | Legislative Council |
| MOD | Ministry of Defence |
| MPA | Mount Pleasant Airport |
| MPC | Mount Pleasant Complex (alternative name for MPA) |
| PBC | Planning and Building Committee (see FIG) |
| PWD | Public Works Department |
| RFIP | Royal Falkland Islands Police |
| RG | Registrar General |
| SAMS | South Atlantic Marine Services Limited |
| SCA | Special Co-operation Area |
| SLC | Stanley Lands Committee (see FIG) |
| SSA | Stanley Sports Association |
| SSL | Stanley Services Limited |
| UKFIT | United Kingdom Falkland Islands Trust |

# 1. INTRODUCTION

## 1.1. Location

The Falkland Islands are a United Kingdom Overseas Territory located on the edge of the Patagonian Shelf in the South Atlantic Ocean, approximately 480km from the South American mainland. The Islands have a total land area of some 12,173 sq. km (East Falkland approximately 6700 km$^2$, West Falkland approximately 5300 km$^2$, plus over 700 smaller islands) and a permanent population of approximately 3,000 (2001 census, FCO 2005).

The Falkland Islands' designated exploration area extends to over 400,000 km$^2$. Under the first Competitive Round for Production Licences in October 1996 Desire Petroleum PLC (Desire) was awarded Production Licences by the Falkland Islands Government (FIG) for the exploration and production of oil and gas in Tranches C and D of the North Falkland Basin (Production Licences 003 and 004). As a result of various assignments Desire now has a 92.5% interest and Rockhopper Exploration Limited a 7.5% interest in these licences.

The North Falkland Basin is located immediately north of the islands, with Tranches C and D approximately 150km from the nearest land. Tranche C originally encompassed Blocks 14/12, 14/13, 14/14, 14/17, 14/18 and 14/19. Tranche D originally encompassed Blocks 14/15, 14/20, 15/11, 15/12, 15/16 and 15/17. Following relinquishment Tranche C now covers blocks 14/14 and 14/19 while Tranche D covers blocks 14/15, 14/20 and part 15/11 and 15/16:

| Tranche C licence coordinates | | | | Tranche D licence coordinates | | | |
|---|---|---|---|---|---|---|---|
| NW | 49°20'S 59°24'W | NE | 49°20'S 59°12'W | NW | 49°20'S 59°12'W | NE | 49°20'S 58°54'W |
| SW | 49°40'S 59°24'W | SE | 49°40'S 59°12'W | SW | 49°40'S 59°12'W | SE | 49°40'S 58°54'W |

**Table 1:** Licence coordinates for Tranches C & D.

Under the terms of the Production Licences, Desire will move to the 2nd Exploration Term in May 2006. Together the two Tranches encompass an area of approximately 1339 km2 (Figure 2). All the obligations of the 1st Exploration Term have been fulfilled on Tranches C and D.

During the first round of licensing, Desire was also awarded Tranches I and L, which it still holds 100% and Tranche F, which it now also holds 100%. Tranches F, I and L will move to the 2nd Exploration Term in November 2005.

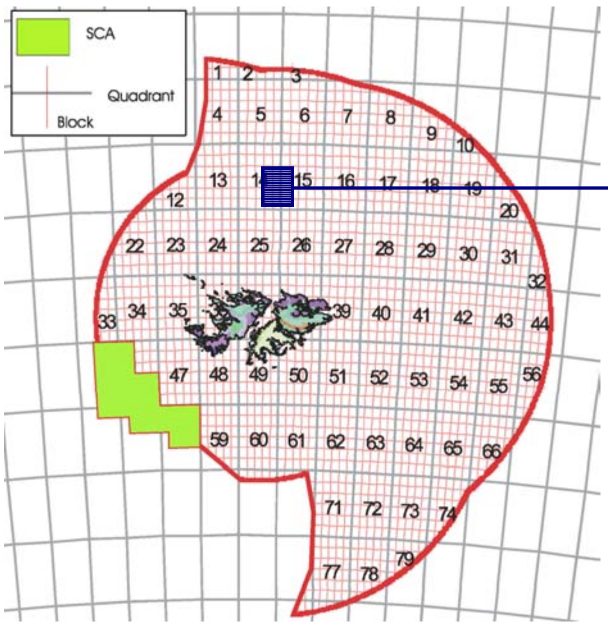



**Figure 1:** Falkland Islands Designated Area and Special Co-operation Area

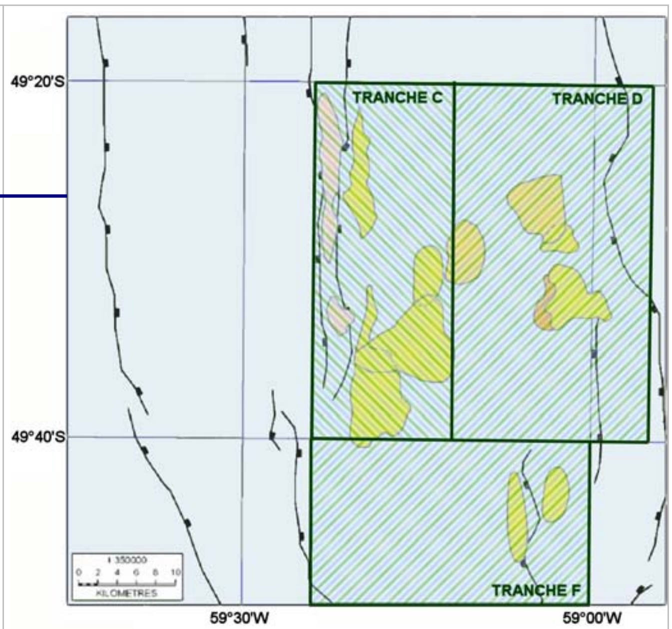
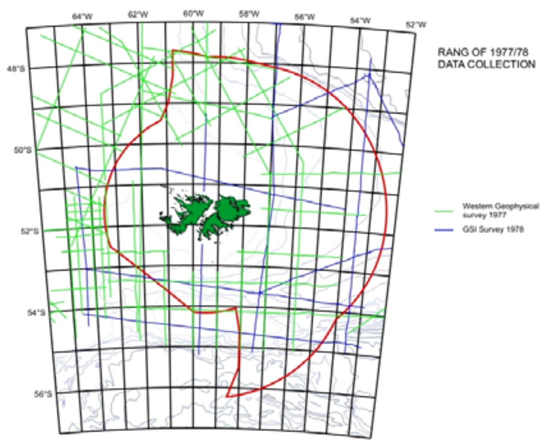



**Figure 2:** Tranches C, D and F showing identified prospect areas.

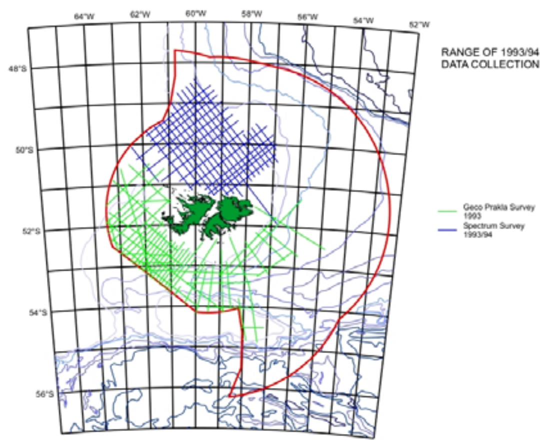
## 1.2. Exploration History - North Falkland Basin[1].

To put the proposed drilling programme into historical context and identify potential pre-existing impacts from oil industry activity, it is important to examine previous oil and gas operations in this area. **Table 2** below summarises the exploration history of the North Falkland Basin associated with the oil and gas industry. **Table 3** shows the current and previous Production Licences in the North Falkland Basin with details of the Production Licences currently held by Desire. **Table 4** shows the location and results of wells drilled in the North Falkland Basin.

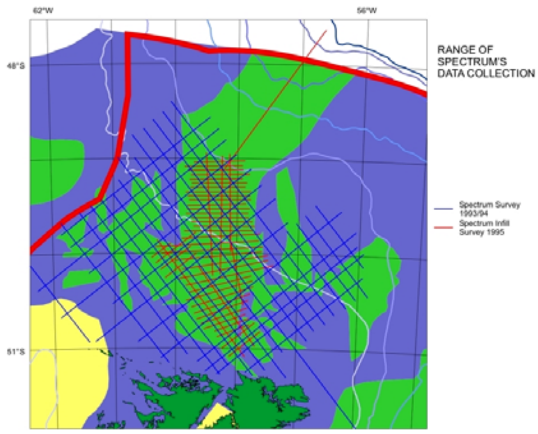
Six exploration wells were drilled in the North Falkland Basin over an eight month period in 1998. No commercial finds of hydrocarbons were located, however five of the six wells had oil shows and live oil was recovered at surface. Significant levels of gas were also recorded.



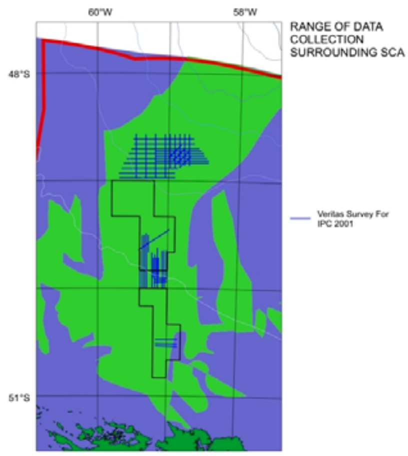

1977-78 - two speculative, regional seismic surveys shot by Western Geophysical and GSI - some 21,652 km of data.




1993 and 1994 - Geco-Prakla and Spectrum acquired regional reconnaissance speculative seismic data with a combined total of 15,558 km.




1995 - Spectrum acquired infill speculative seismic data to the north of the Islands; comprising 3,650 km of data with a five kilometre line spacing.




2001 - Lundin Oil acquired 1,250 km of seismic data over the unlicensed area immediately north of Tranches A and B in the North Falkland Basin.

**Table 2:** Speculative seismic data (1977 - 2001)

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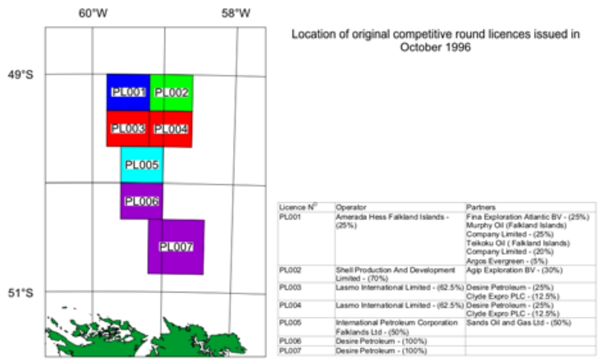
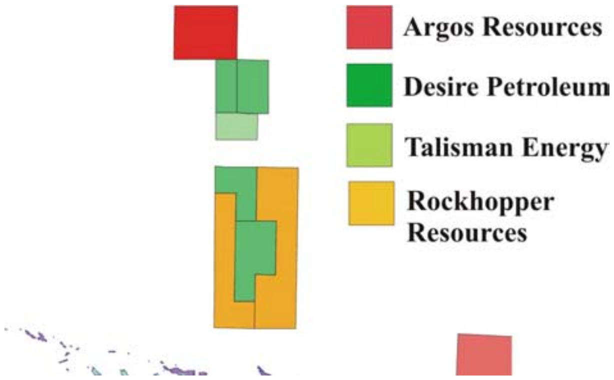
[1] Adapted from FIG, Department of Mineral Resources website: www.falklands-oil.com



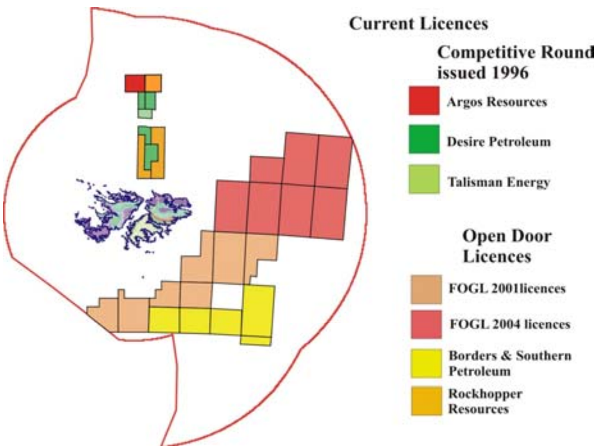

1996 - seven Production Licences awarded (to 14 companies) in the North Falkland Basin as a result of a competitive bidding round. The licences covered 48 blocks (some 12,800 square kilometres).




1999 onwards – several phases of relinquishment and operator changes to original licence.

2004 – two new licences covering 16 blocks in the southernmost part of the North Falkland Basin awarded to Rockhopper Exploration.

2005 - two new licences covering 6 blocks in the northern part of the North Falkland Basin awarded to Rockhopper Exploration.



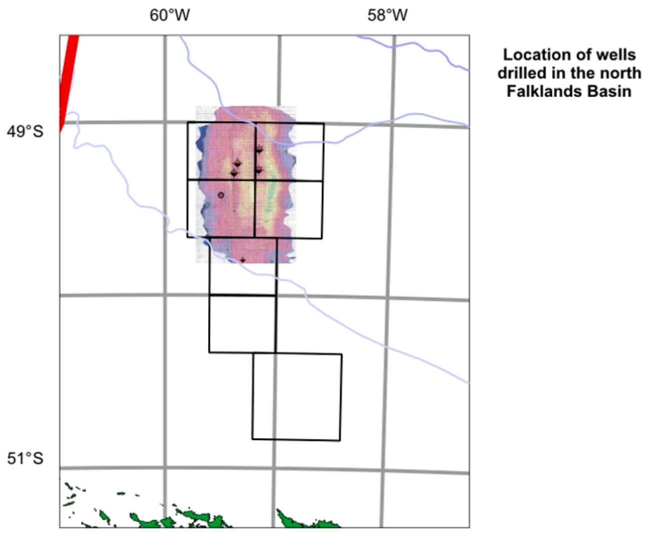

**The Falklands Offshore Sharing Agreement (FOSA)**

FOSA was established before drilling in the North Falkland Basin, and disbanded in 1999, it comprised Shell, Amerada Hess, Lasmo and IPC and their respective partners.

FOSA undertook the logistics and support work to facilitate a multi-well drilling campaign. FOSA managed the sharing of a single rig, supply base, aviation link, site survey facility and operations/logging staff.

| Licence | Original Operator | Current Operator | Tranche | 2nd Phase minimum work programme | Status of licence |
|---|---|---|---|---|---|
| PL003 | Lasmo | **Desire** | Tranche C | Acquire and process 3D seismic. This seismic commitment has already been fulfilled. Drill 1 firm plus 1 contingent well. | Moving to Phase 2 |
| PL004 | Lasmo | **Desire** | Tranche D | Acquire and process 3D seismic. This seismic commitment has already been fulfilled. Drill 1 firm well. | |
| PL005 | IPC | **Desire** | Tranche F | Acquire 2D seismic plus drill 1 well | |
| PL006 | Desire | **Desire** | Tranche I | Acquire 2D seismic plus drill 1 well | |
| PL007 | Desire | **Desire** | Tranche L | Acquire 2D seismic plus drill 1 well. | |

**Table 3:** Desire Production Licences - North Falkland Basin.




Six wells were drilled in the North Falkland Basin over an eight month period during 1998, using a shared rig on a back to back basis. Five of the six wells drilled had oil shows.

Most wells found oil within post-rift sandstones located immediately above the main source rock interval, but this reservoir was under-charged as it lies above the main regional source-seal couplet.

Live oil was recovered to surface from one of the Shell wells: the oil has an API gravity of 27°. Significant levels of gas were recorded in one of the Shell wells.

| Well | Result |
|---|---|
| 14/09-1 | Oil shows |
| 14/13-1 | Dry hole |
| 14/05-1A | Oil and gas shows |
| 14/24-1 | Post-well shows |
| 14/09-2 | Oil shows |
| 14/10-1 | Oil recovered at surface |

**Table 4:** Wells drilled in the North Falkland Basin.

## 1.3. Overview & Structure

Desire Petroleum PLC has commissioned RPS Energy to undertake the EIA for the proposed drilling operations in the North Falkland Basin. This document was prepared in order to meet the requirement for environmental impact assessment under Falkland Islands legislation governing offshore exploration and production activities (The Offshore Minerals Ordinance 1994, Amended 1997).

Information for this EIA was gathered using a dual approach:

- Stakeholder consultation and survey of onshore facilities in the Falkland Islands.
- Collation of data from available charts, reports and documents from government and non-government organisations in both the Falkland Islands and the UK.

The structure of this report is as follows:

- **Section 2** summarises the legal framework for drilling activity and environmental protection.
- **Section 3** provides a broad description of planned operations.
- **Section 4** depicts the framework for environmental management.
- **Section 5** summarises the key aspects of these operations.
- **Section 6** describes baseline environmental conditions.
- **Section 7** assesses the probable impacts of operations on the environment.
- **Section 8** looks at mitigation measures & **Section 9** examines project alternatives.
- **Section 10** provides a summary and conclusions, with references in **Section 11**.

## 1.4. Scope

The scope of this EIA is focussed on the proposed drilling campaign and does not extend to potential future oil and gas activities in the Falkland Islands. A study examining the socio-economic impacts of oil and gas development in the Falkland Islands was commissioned by the FIG and completed by Coopers & Lybrand in August 1997. Following consultation with the FIG, further consideration of socio-economic impacts is therefore restricted to activities directly associated with the current drilling programme. Health and Safety issues are also excluded from this assessment, except where they are considered to have a direct impact on the environment.

Drilling operations are being organised and managed by Peak Well Management (Peak) on behalf of Desire Petroleum. As the choice of drilling contractor and drilling unit have not been finalised at the time of writing, the operational description and impact assessment are based on a combination of known details (well locations, depths, type of rig etc), established factors and models (atmospheric emissions, sewerage discharge per person, volume of cuttings produced etc) and assumptions based on currently available information. Any assumptions made or models used are highlighted within the text. In order to ensure that the assessment of impacts remains fully valid and up-to-date, an operational addendum to this EIA and updated Environmental Management Plan will be produced once the operational sequence and choice of drilling unit has been finalised.

The baseline description within this EIA describes the offshore area encompassed by Tranches C and D of the North Falkland Basin and focuses on the most likely drilling locations identified in pre-operational planning. The baseline description also encompasses relevant areas of coastline and other areas on which the proposed operations could potentially impact.

Prior to the drilling of six wells by a group of oil companies in the North Falkland Basin during 1998, gaps were identified in the level of baseline environmental information for this area. As a result, extensive environmental studies were commissioned by the consortium of oil companies 'FOSA' (The Falklands Offshore Sharing Agreement) including:

- Seabird, penguin and cetacean studies
- Benthic & metocean surveys, current modelling and drill cutting dispersion

Based on these studies and subsequent environmental surveys, the level of baseline environmental information now available for this area is considered sufficient for a full assessment of the environmental impacts associated with the proposed operations. No additional environmental sampling or monitoring has been carried out for this EIA.

## 1.5. Contributors and Consultees

We would like to thank the following consultees and organisations for their cooperation with and contributions to this study:

- Phyl Rendell, Director of Minerals and Agriculture, FIG.
- Dominique Giudicelli, Environmental Planning Officer, FIG
- David Lang, Attorney General, FIG
- Anne Brown, Falklands Conservation (London Office)
- Mark Gillard, Senior Drilling Engineer, Peak Well Management
- Ian Duncan, CEO, Desire
- Colin Phipps, Chairman, Desire
- Lewis Clifton, Byron Group
- Grant Munro, Director, Falklands Conservation
- Jon Clark, Marine Officer, Fisheries Department, FIG
- Chris Simpkins, Chief Executive, FIG
- John Barton, Director of Fisheries, Fisheries Department, FIG
- Harriet Hall, Acting Governor, UK Foreign and Commonwealth Office
- Tim Miller, Stanley Growers Limited
- Manfred Keenleyside, Public Works Department, FIG

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# 2. LEGISLATIVE FRAMEWORK

This section summarises the international and national legal context of the proposed drilling programme, together with the Falkland Islands' environmental legal framework where relevant to offshore drilling operations. It is not intended to provide a complete analysis of the wider legal framework within the Falkland Islands. Legislation specific to health and safety, the Special Co-operation Area, tax and finance are also outside of the scope of this EIA.

The Falkland Islands are a United Kingdom Overseas Territory by choice. Supreme authority is vested in HM The Queen and exercised by a Governor on her behalf, with the advice and assistance of the Executive and Legislative Councils, and in accordance with the Falkland Islands Constitution (FCO 2005).

Falkland Islands law governs petroleum exploration and exploitation on the Falkland Islands Continental Shelf. The licensing system for offshore exploration and production activities applies to the entire Falkland Islands Designated Area (see Figure 1) with the exception of the Special Co-operation Area, a zone licensed jointly with Argentine authorities.

Both Exploration and Production Licences can be awarded, in either competitive rounds or at any time under an open-door system. Desire hold Production Licences for Tranches C, D, F, I and L under the 1st Production Licensing Round in 1996 allowing drilling and exploitation (further to specific approvals) in this area.

## 2.1. International Conventions and Agreements[2]

International conventions and agreements to which the Falkland Islands is a party, pertinent to the activities associated with the offshore drilling are described in Table 5 below.

| Known as | Full Title | Status | Summary |
|---|---|---|---|
| ACAP | Agreement on the Conservation of Albatross and Petrels | Ratified* April 2004. | Seeks to conserve albatrosses and petrels by co-ordinating international activity to mitigate known threats. ACAP has been developed under the umbrella of the CMS (see below). |
| CITES or The Washington convention | Convention on International Trade in Endangered Species | Ratified* October 1976. | Aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. |
| CMS or The Bonn Convention | Convention on the Conservation of Migratory Species of Wild Animals | Ratified* in 1985. | Aims to conserve terrestrial, marine and avian migratory species (those that regularly cross international boundaries, including international waters). Concluded under the aegis of the United Nations Environment Programme (UNEP). All cetacean species are listed in the CMS, as are all Southern Hemisphere albatross species. |
| MARPOL 73/78 | 1973 Convention for the Prevention of Pollution from Ships, as modified by the Protocol of 1978 | Most of the subsidiary agreements ratified. | Considers and seeks to prevent pollution by oil, chemicals, harmful substances in packaged form, sewage and garbage from ships. |
| The London Convention | 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. | Ratified* 1980. The 1996 Protocol does not yet extend to the | Aims to prevent pollution of the sea from the dumping of waste and other matter liable to create hazards, harm living resources and marine life, damage amenities or to interfere with other legitimate uses of the sea. The dumping of Annex I materials is prohibited, |

[2] Adapted from FIG spreadsheet "The Principal Environmental Conventions and Agreements Relevant to the Falkland Islands and Foreign and Commonwealth Office (FCO) online database.

| | | | |
|---|---|---|---|
| | | Falkland Islands. | Annex II materials require a prior special permit and all other wastes require a prior general permit. |
| UNCLOS (or Law of the Sea) | The United Nations Convention on the Law of the Sea (1982) | Ratified* July 1997 | Comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources. |
| Ramsar Convention | 1971 Convention on Wetlands of International Importance especially as Waterfowl Habitat | Ratified* in 1976 | Aims to halt the world-wide loss of wetlands and promote the conservation of wetlands through wise use and management. Both Bertha's Beach and Sea Lion Island have been accepted by the Convention of Parties and listed as having Ramsar status (see Figure 3). Wetlands can include marine waters up to a depth of 6m at low tide. |
| World Heritage Convention | 1972 Convention for the Protection of the World Cultural and National Heritage | Ratified* May 1984 | Aimed at the identification, protection and preservation of cultural and natural heritage around the world. No natural and cultural sites of outstanding global value have so far been designated with the Falkland Islands. |
| IUCN | International Union for the Conservation of Nature | *Not a legal agreement* | The IUCN assess the conservation status of animal and plant species and assigns a threat level to each. Lists of threatened species status (IUCN red lists) are published for different countries. The list of species identified as under threat by IUCN is given in Appendix I. |
| The following Conventions are currently being considered by the FIG:<br>• 1992 United Nations Framework Convention on Climate Change (Climate Change Convention);<br>• 1998 Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention)<br>• The Kyoto Protocol<br>• MARPOL Annex IV. | | | |
| * Ratified by the UK and ratification extended to the Falkland Islands | | | |

**Table 5:** International Conventions and Agreements applicable to offshore drilling

In addition, through the 1992 Convention on Biological Diversity (UNCED, 1992), ratified by the UK in 1992 but not yet ratified by the Falkland Islands, UK dependencies are included within the "UK: Biodiversity Action Plan" (HMSO, 1994). In connection with the UK's goals to encourage implementation of the Convention, partnerships are formalised in Environmental Charters between the UK and various Overseas territories (Falkland Islands Environmental Charter, signed 2001).

The first Environment Charter, laying out mutual responsibilities of the UK and its Overseas Territories was signed on 26 September 2001 by Councillor Mike Summers, representing Falkland Islands Government, and Baroness Valerie Amos, Minister of UK Overseas Territories.

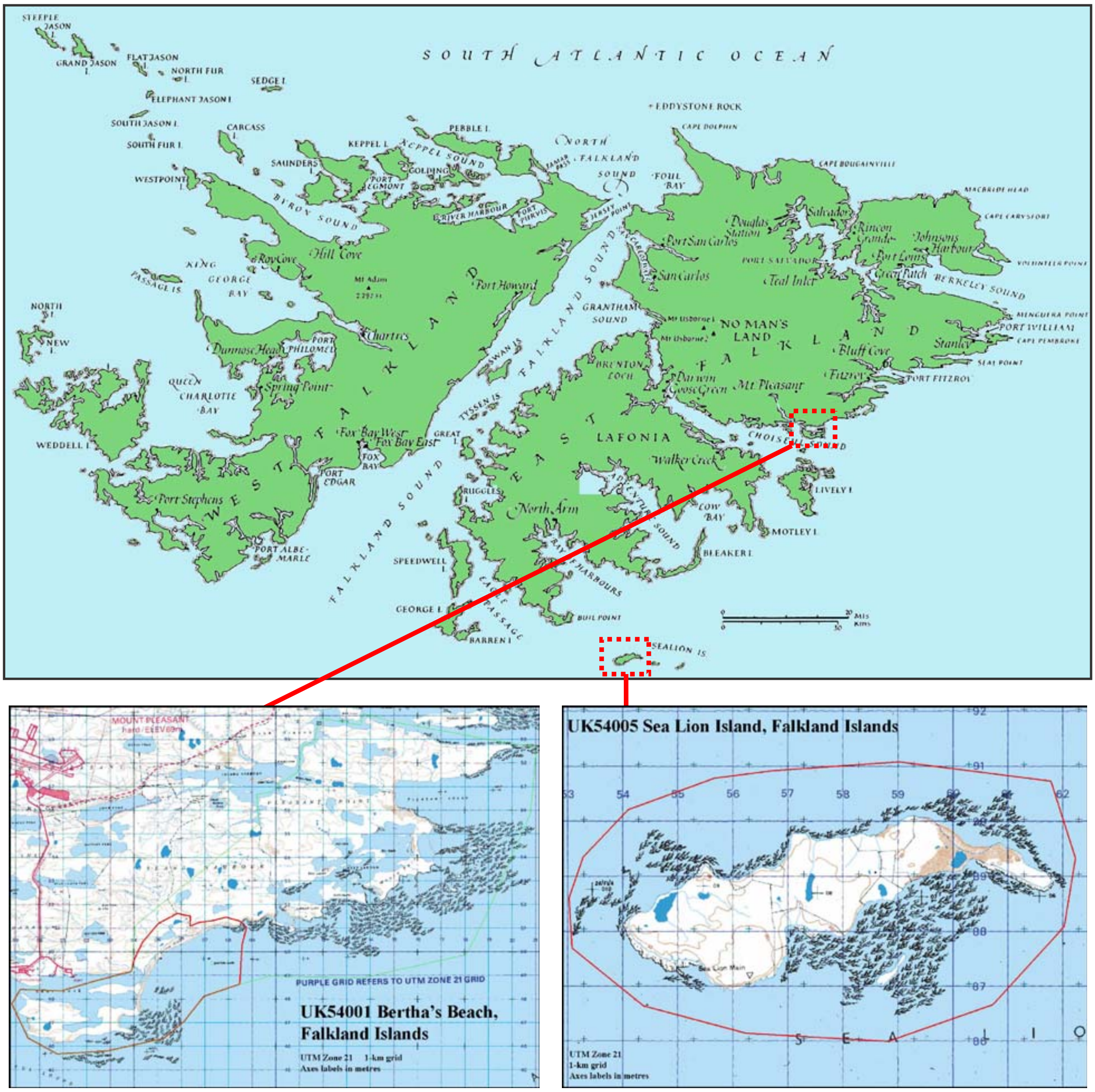


**Figure 3:** Designated Ramsar Sites within the Falkland Islands (adapted from UK Overseas Territories Conservation Forum: www.ukotcf.org)

## 2.2. National Legislation

Table 6 below provides a summary of relevant items of legislation enacted within the Falkland Islands. The following subsections provide additional details on the regulatory framework specific to Environmental Impact Assessment and environmental protection. The system of Petroleum Operations Notices are not legally binding but have been approved by the Mineral Resources Committee as best practice.

| Legislation | Key requirements / relevance to proposed operations |
|---|---|
| 1) Relevant to offshore operations: | |
| Petroleum Survey Licences (Model Clauses) Regulations 1992 | Provides the regulatory framework governing offshore exploration activity, including; field observations, geological and geophysical investigations and the use of remote sensing techniques; plus the obtaining of any sample from the sea floor. |
| The Offshore Minerals Ordinance 1994 | Provides the licensing framework for offshore exploration and |



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| | |
|---|---|
| | production. Regulates offshore installations and pipelines, health and safety offshore, oil pollution, liability for environmental damage and abandonment issues. Sets out the requirement for Environmental Impact Assessment and preparation of Environmental Impact statements. Production Licences (PL003 and PL004) are issued under this Ordinance. |
| The Offshore Minerals (Amendment) Ordinance 1997 | Amends the Offshore Minerals Ordinance 1994 to make further provision in relation to the application of provisions of the Health and Safety at Work etc. Act 1974. |
| Offshore Petroleum (Licensing) Regulations 1995 | Provide the schedule, model clauses and format for applying for exploration or production licences in Falkland Island waters, as well as conditions for record keeping, sampling and drilling. |
| Offshore Petroleum (Licensing) Regulations 2000 | Updates the schedule, model clauses and format for applying for exploration or production licences in Falkland Island waters, as well as conditions for record keeping, sampling and drilling. |
| Offshore Petroleum (licensing) Regulations 2000 - Invitation to apply for open door licences | Invites applications for production licences in respect of blocks specified within Schedules 1 and 2. Specifies exploration terms, conditions, financial terms and application criteria. |
| Petroleum Operations Notice No.1 | Specifies the record and sample requirements for surveys and wells, including reporting requirements and sampling details. |
| Petroleum Operations Notice No.2 | Specifies reporting procedures including monthly and daily reports, drilling reports and changes to the work programme. |
| Petroleum Operations Notice No.3 | Provides guidance on the procedure to follow for notification prior to carrying out a geophysical survey. |
| Petroleum Operations Notice No.4 | Comprises the pro-forma and accompanying guidance notes to use for an application for consent to drill exploration, appraisal and development wells. |
| Petroleum Operations Notice No.5 | Comprises the pro-forma and accompanying guidance notes to use for an application to abandon or temporarily abandon a well. |
| Petroleum Operations Notice No.6 | Comprises the pro-forma and accompanying guidance notes to use for an application to complete and/or workover a well. |
| Petroleum Operations Notice No.7 | Specifies the definition of a well and the system to be used for numbering a well. |
| Petroleum Operations Notice No.8 | Specifies reporting requirements in the event of an oil spill, guidance on the use of dispersants and provides contact numbers and reporting forms to use in case of oil pollution. |
| Merchant Shipping (Oil Pollution) Act 1971 | Applied to the Falkland Islands by 1975 order in council (SI 1975/2167 as amended by SI 1976/2143 and SI 1981/218). This Act regulates responsibility for oil pollution from ships. |
| 2) Relevant to environmental protection: | |
| The Marine Mammals Protection Ordinance 1992 | Prohibits the killing or taking of marine mammals on land or in internal waters, territorial sea or fishery waters of the Falkland Islands. Makes it unlawful to import or export marine mammals without a licence. |
| Marine Environment Protection Ordinance 1995 | Implements the conditions of the London Dumping Convention 1972 and prohibits, other than under license, the deposition or incineration of materials in Falkland Island waters. |
| Conservation of Wildlife and Nature Ordinance 1999 | Replaces the Wild Animals and Birds Protection Ordinance of 1964. This legislation deals with the protection of wild birds, wild animals and wild plants, egg collection, prohibiting the introduction of new species and the designation of conservation areas (National Nature Reserves) |
| National Parks Ordinance 1998 | Establishes the system for designation of National Parks, based on natural beauty and recreation value. No marine areas are being considered under this ordinance. |

| | |
|---|---|
| The Control of Kelp Ordinance 1970 | Makes provision for the licensing of seaweed harvesting and export |
| Endangered Species Protection Ordinance 2003 / Endangered Species Protection (Amendment) Bill | Awaiting clarification of new ordinance. |
| Waste Management Framework | Apart from the siting of disposal sites under the 1991 Planning Ordinance, there is currently no regulatory framework within the Falklands specifically for waste management and disposal. |

**Table 6:** Falkland Islands' legislation relevant to offshore drilling and the environment.

In addition to currently active national legislation regarding environmental protection and the offshore oil and gas industry, other relevant documents produced or currently in production by, or on behalf of, the FIG and Falklands Conservation include:

- Falkland Islands Structure Plan 2001-2016 (FIG 2004).
- Conservation & Biodiversity Strategy for the Falkland Islands (DRAFT), FIG 2005.
- Falkland Islands Trends & Pressures document (DRAFT), FIG 2005.
- Falkland Islands Environmental Baseline Survey (DRAFT), Falklands Conservation 2004.
- Falkland Islands Sustaining a Secure Future, FIG 2002.
- Socio-Economic Study of the Falkland Islands, Coopers & Lybrand 1997.
- Falkland Islands Waste Disposal, Halcrow 1998, on behalf of the FIG.
- Falkland Islands Environmental Baseline Survey Desk Study Report, Brown & Root Environmental 1997.

### 2.2.1. Environmental Impact Assessment

The Offshore Minerals Ordinance 1994 PART VI 'Miscellaneous and General' provides the regulatory framework for Environmental Impact Assessment (EIA) in the Falkland Islands. Under this Ordinance; "The Governor may, if he considers that the environment might be substantially affected…cause an environmental impact assessment to be prepared and submitted to him...in relation to the likely adverse and beneficial effects upon the environment if the application were to be granted"

Schedule 4 of the Ordinance specifies the information that may be required within an EIA or Environmental Impact Statement (EIS):

- a description of the development proposed comprising information about the site or location and the design and size *or* scale of the development;
- the data necessary to identify and assess the main effects which the development is likely to have on the environment;
- a description of the likely significant effect, direct and indirect, on the environment of the development, explained by reference to its possible impact: human beings; flora; fauna; the seabed and subsoil; the soil; water; the atmosphere and the quality of the air; climate; the seascape *or* landscape; the inter-action between any of the foregoing; material assets; the cultural heritage;
- where significant effects are identified with respect to any of the foregoing, a description of the measures envisaged in order to avoid, reduce or remedy those effects; and
- a summary in non-technical language of the information specified above.

Following submission to the Falkland Islands Government, the EIA is published in the Falkland Islands Gazette for a period of 42 days. Public discussion and dissemination of information will also be carried out in the Falkland Islands on any issues raised, with opportunities for feedback from the public and stakeholders. In addition to the period of public notification, the EIA will also be presented to the Executive Council (ExCo), see Figure 4 below.

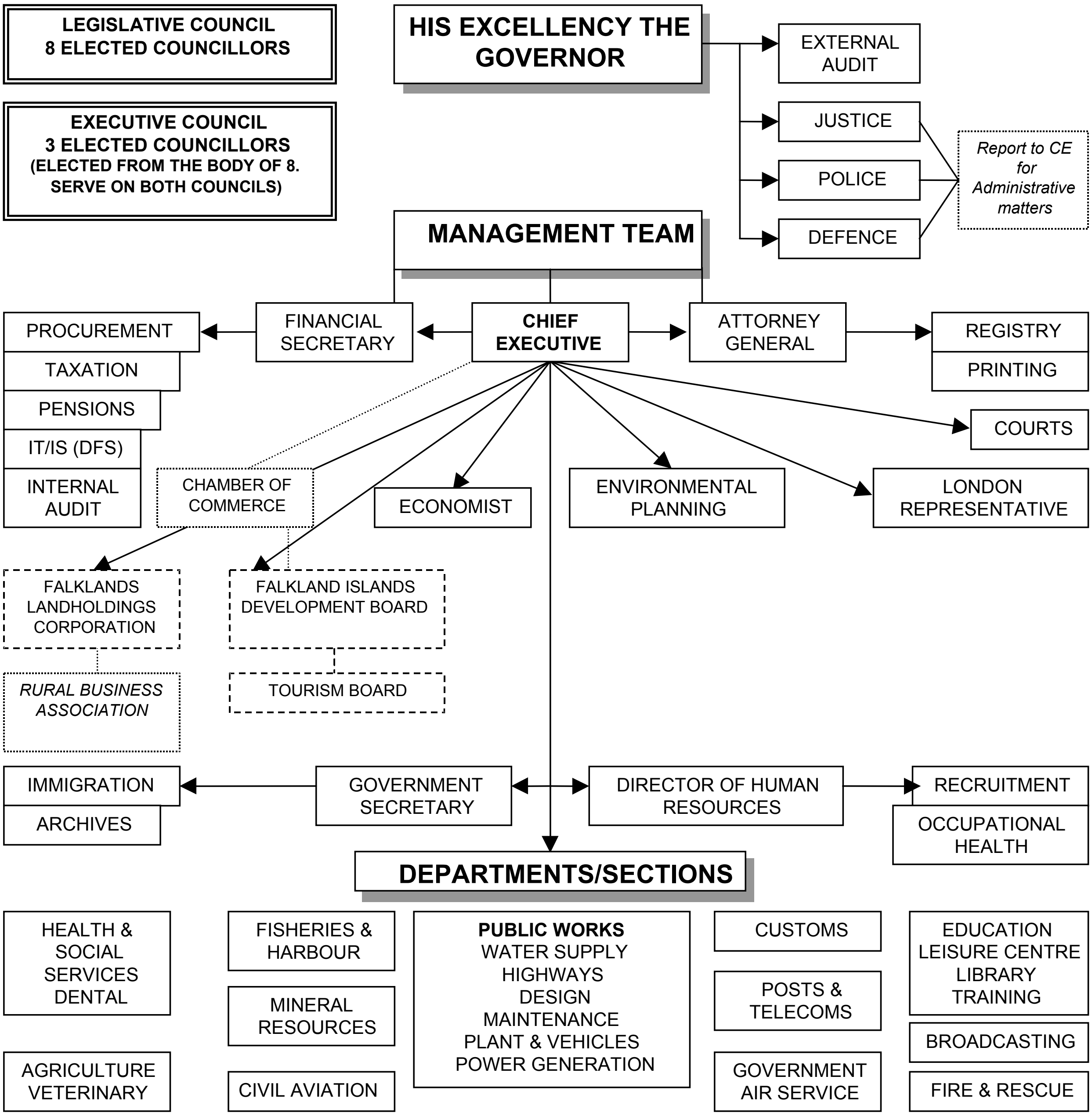


**Figure 4:** Falkland Islands Government Organogram.
(Adapted from diagram provided by FIG)

### 2.2.2. Environmental Protection

The principal items of legislation dealing with environmental protection are summarised in the previous table. Good operating practices for the protection of people and the environment are also prescribed in the system of Petroleum Operations Notices (1 to 8) and in the specific terms and clauses of the production licences applied to these operations by the FIG.

Under the Conservation of Wildlife and Nature Ordinance 1999, wild birds, animals and plants are afforded protection from damage, disturbance or mortality. Certain species of wild bird are excluded at certain times of the year to allow for hunting and control of these species. Collection of eggs for personal consumption is also licensed for certain species. The only animals so far specified for protection within the Ordinance are two species of trout and all species of butterflies. Protection of wild plants extends to 29 listed species, including those species listed as under-threat on the Falklands Red List (Broughton, 2002). The introduction of new species is also prohibited.

National Nature Reserves can be designated under this legislation on any area of Crown land, marine area or privately owned land with the agreement of the owner. Marine areas may be designated as National Nature Reserves to the extent of Falkland Islands territorial waters (12 nautical miles) or 3 nautical miles beyond, however no marine areas have so far been designated in this manner.

The Marine Mammals Ordinance (1992) protects all marine mammals including whales, porpoises, dolphins, otters, seals, fur seals, sea lions and elephant seals. It is an offence to take, wound or kill any marine mammal in Falkland Islands waters (the FOCZ which encompasses the FICZ, Figure 5 opposite), or to use explosives within the FOCZ where this is likely to cause harm to any marine mammal.

The Offshore Minerals Ordinance (1994) provides environmental protection through a system of licensing and licence offences and through strict liability for certain loss or damage in relation to polluting incidents.

The Deposits in the Sea (Exemptions) Order 1995, as approved under the Marine Environment Protection Ordinance specifies categories of material exempt from requiring a licence for deposition. This includes disposal of sewage or domestic waste from a vessel or platform, drill cuttings or muds under specific circumstances and the incineration of hydrocarbons.

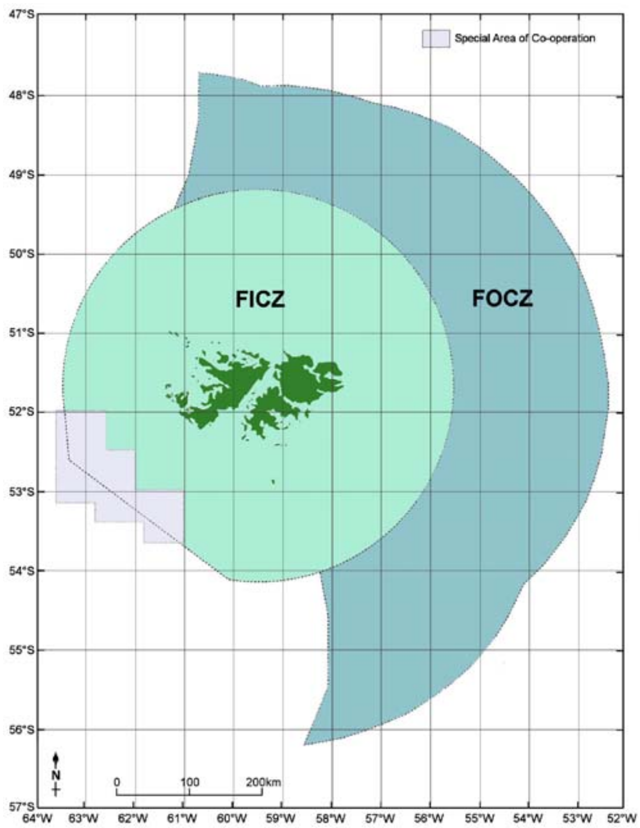


**Figure 5:** Falkland Islands Interim Fishery Conservation and Management Zone (FICZ) and Outer Conservation Zone (FOCZ).

## 2.3. Industry standards & guidelines

The following standards and guidelines are produced by various bodies operating within the Exploration and Production (E&P) sector and are available either publicly via their websites, or to members of the relevant association. Elements of these guides to best practice will be utilised in the development of the operations specific Environmental Management Plan (EMP).

### 2.3.1. E&P Forum:

**Exploration and Production (E&P) Waste Management Guidelines (Report No. 2.58/196, Sept 1993)**

Guidance is provided on area-specific waste management planning and methods for the handling and treatment of primarily drilling and production related waste streams.

### 2.3.2. E&P Forum / UNEP:

**Joint Technical Publication; Environmental Management in Oil and Gas exploration and Production 1997**

This publication provides an overview of the environmental issues and technical and management approaches to achieving high environmental performance in oil and gas exploration and production.

### 2.3.3. IAGC:

**Environmental Manual for Worldwide Geophysical Operations (2001)**

This manual contains general operating procedures and standards for different environments where seismic acquisition may take place. These guidelines are most relevant to offshore seismic acquisition and survey work, although they are also applicable to vessel operations and general issues such as minimising risk and waste management.

The following guidelines were written for operations in UK waters, but the principles, standards and operating procedures are applicable in other parts of the world.

**Environmental Guidelines for Exploration Operations in Near-Shore and Sensitive Areas (UK Offshore Operators Association Ltd (Environment Committee) Sept 1995)**

Useful guidance is provided regarding the planning and execution of seismic and drilling operations including liaison with government authorities and fishing organisations, preparation of contingency plans and waste management.

### 2.3.4. UKOOA:

**Guidelines for Fisheries Liaison, Issue 2 (UKOOA, April 1995)**

Although most relevant to offshore seismic and survey work, these Guidelines are also applicable to vessel operations in support of the drilling campaign.

Where commercial fishing activities may be impacted, liaison with fishing organisations is recommended. The guidelines suggest that due consideration should be given to the following: peak times of fishing activity, fish spawning and migration and other important factors relating to fish or fishing which have been identified through the consultation process or environmental assessments of the area.

# 3. PROJECT DESCRIPTION

Details of the proposed operations are provided below. Although the drilling rig and contractor have not been finalised at the time of writing, most operational parameters have been established (well locations and target depths, support infrastructure, supply routes and drilling schedule). Where specific operational details were not available at the time of writing this is explained within the text. In these instances, the expected methods and specifications have been given, together with the probable effect of any deviation from the current plans. An addendum to update this EIA with finalised operational parameters will be produced prior to drilling.

## 3.1. Drilling Programme

### 3.1.1. Objective

Under the terms of the Production Licences Desire are committed to acquire and process 3D seismic over Tranches C and D, as well as drill a minimum of 2 wells. The 3D seismic acquired in 2004 fulfilled the seismic commitment.

As soon as a suitable rig can be secured, Desire plan to drill 3 wells in Tranches C and D. It is anticipated that the drilling programme will last approximately 90 days. The prime objective of the drilling programme is to evaluate the prospects identified on the 3D seismic. It is most likely that three of the following prospects will be drilled, Liz, Beth, Ninky or Ann.

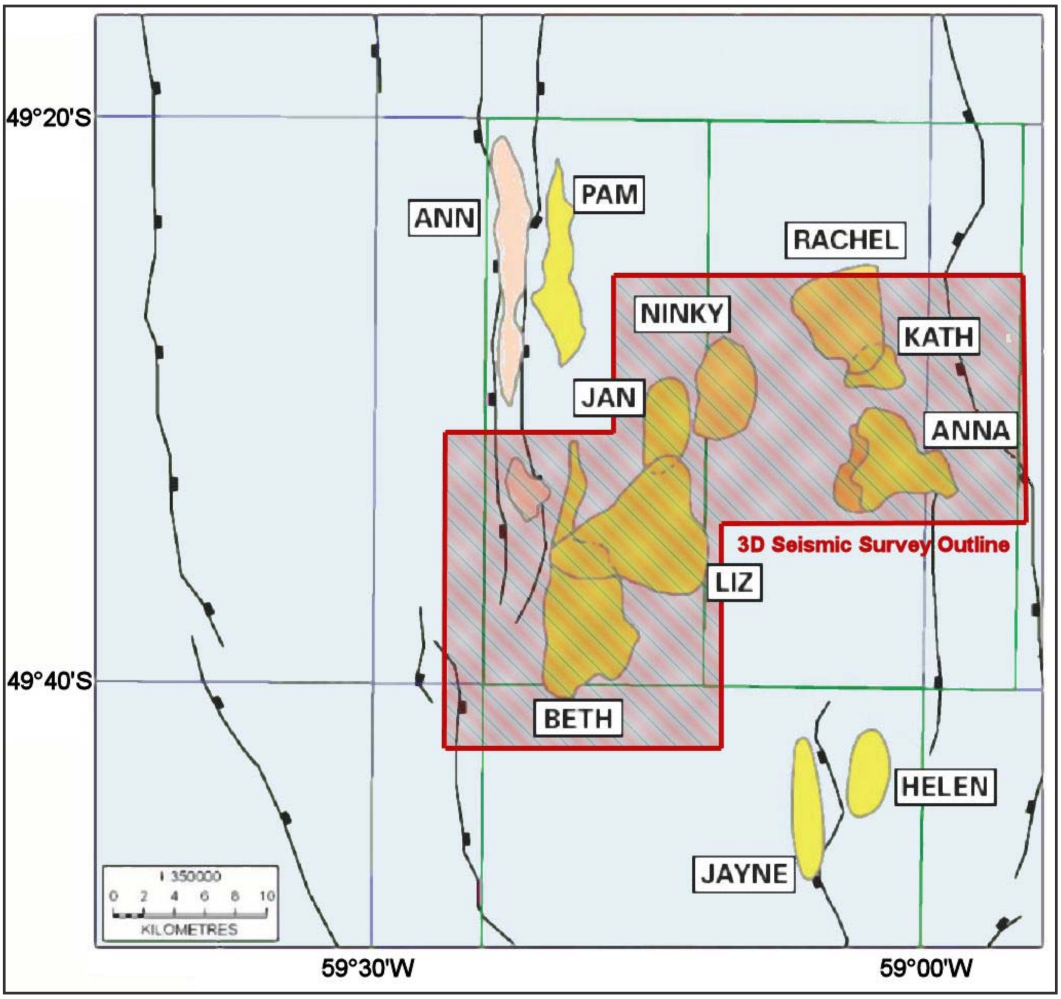


**Figure 6:** Prospect areas and latest 3D seismic survey area.



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### 3.1.2. Prospectivity

In simple terms, the basin contains thick, Lower Cretaceous, non-marine claystones with oil source potential. These source rocks are of world-class quality.

Only the basal part of this source rock is mature and it is believed that the overlying, immature source rock has prevented the upward migration of the oil into the overlying sandstone reservoir targets. These sandstones were the main objective of the wells drilled in 1998. The untested play concepts and three of the previously drilled wells are shown in Figure 7 below.

Up to 60 billion barrels of oil may have been generated in this basin (Richards and Hillier 2000).

Having reviewed all the data from the previous 6 wells in the area Desire now believes that the hydrocarbon potential of this basin may be located at the base of the mature oil source rock. The 2004 3D seismic survey was designed to target this level and a number of prospects have been identified.

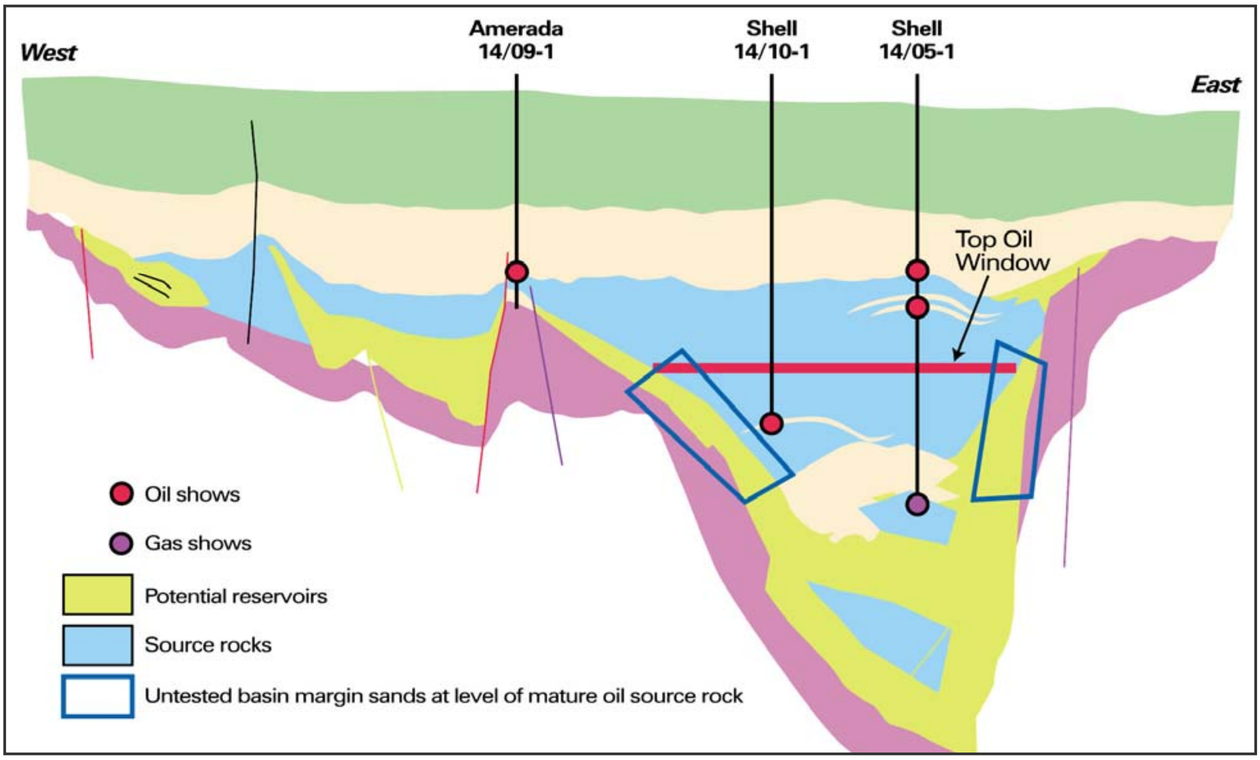



**Figure 7:** Untested play concepts.

### 3.1.3. Overview

Drilling is expected to commence as soon as a suitable rig becomes available. The total programme is likely to comprise of three wells, each of around 3000m and each lasting approximately 22 days (excluding well testing). The proposed drilling schedule is shown in Figure 9. Water depths for the proposed drilling locations are likely to be between 350m and 420m.

As a drilling rig has yet to be finalised, the drilling contractor and point of mobilisation is also currently unknown. This assessment therefore focuses on the potential impacts of the operation once the rig has been mobilised to Falkland Island waters. The impacts associated with mobilisation of the drilling unit and personnel will be re-assessed in the operations-specific addendum once these details have been finalised.

### 3.1.4. Drilling

It is intended to drill using a semi-submersible rig similar in type to the Borgny Dolphin, the rig used for the previous drilling campaign in this area.

A semi-submersible rig is buoyant and is fixed to the seabed for the drilling operation using a series of anchors (see Figure 8). Buoyancy is maintained with vertical columns and underwater pontoon hulls containing tanks for ballast, fuel and freshwater. By varying the buoyancy, the rig can be partly submerged to maximise stability for drilling.

As well as the drilling operation the rig also provides accommodation, kitchen facilities, heating and power, sewage facilities, storage areas, medical and emergency response facilities and secondary operations such as welding, painting, machining etc. The proposed crewing schedule for the operation is given below:

| Approximate | Stage of operations | | | | |
|---|---|---|---|---|---|
| **No. personnel** | **Mobilisation** | **Well 1** | **Well 2** | **Well3** | **Demobilisation** |
| Shore based[3] | 17-24 | 23-24 | 23-24 | 23-24 | 17-24 |
| Rig based | 50-78 | 61-74 | 65-78 | 65-78 | 50-78 |
| Maritime (vessels) | 30-40 | 30 | 30 | 30 | 30-40 |
| **Total** | **97-142** | **114-128** | **118-132** | **118-132** | **97-142** |

**Table 7:** Generic drill plan for the drilling campaign in Tranches C & D.

It is likely there would be around eleven crew changes, including mobilisation and demobilisation, ranging from 17 personnel for initial mobilisation of shore-based resources to 52 demobilising at the end of drilling. The average number of personnel for each crew change during operations is expected to be approximately 45, although this will vary.

3 As well as onshore supervisory and contractor personnel, this number includes helicopter pilots and mechanics plus potential personnel requirements for well test operations.

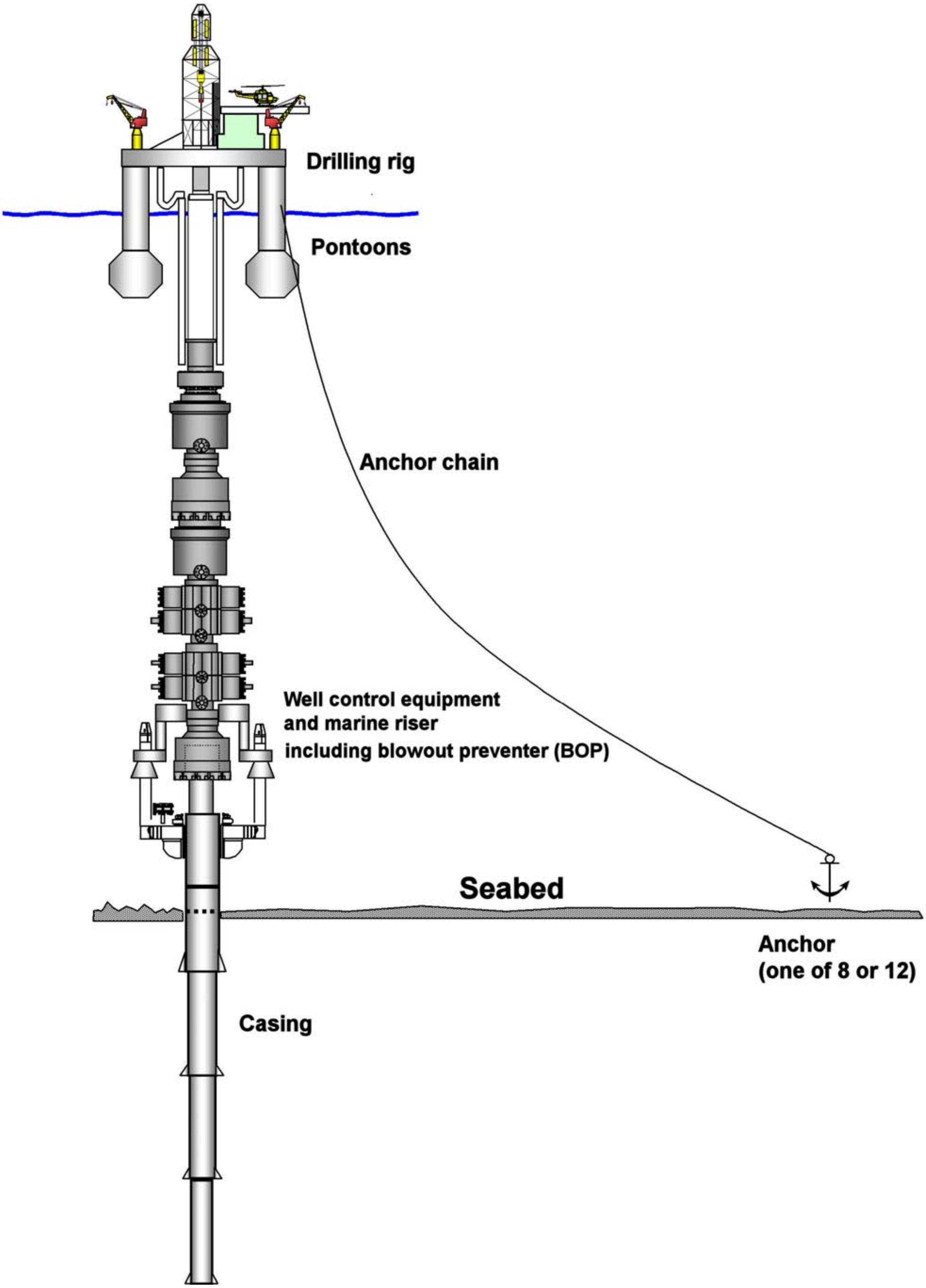
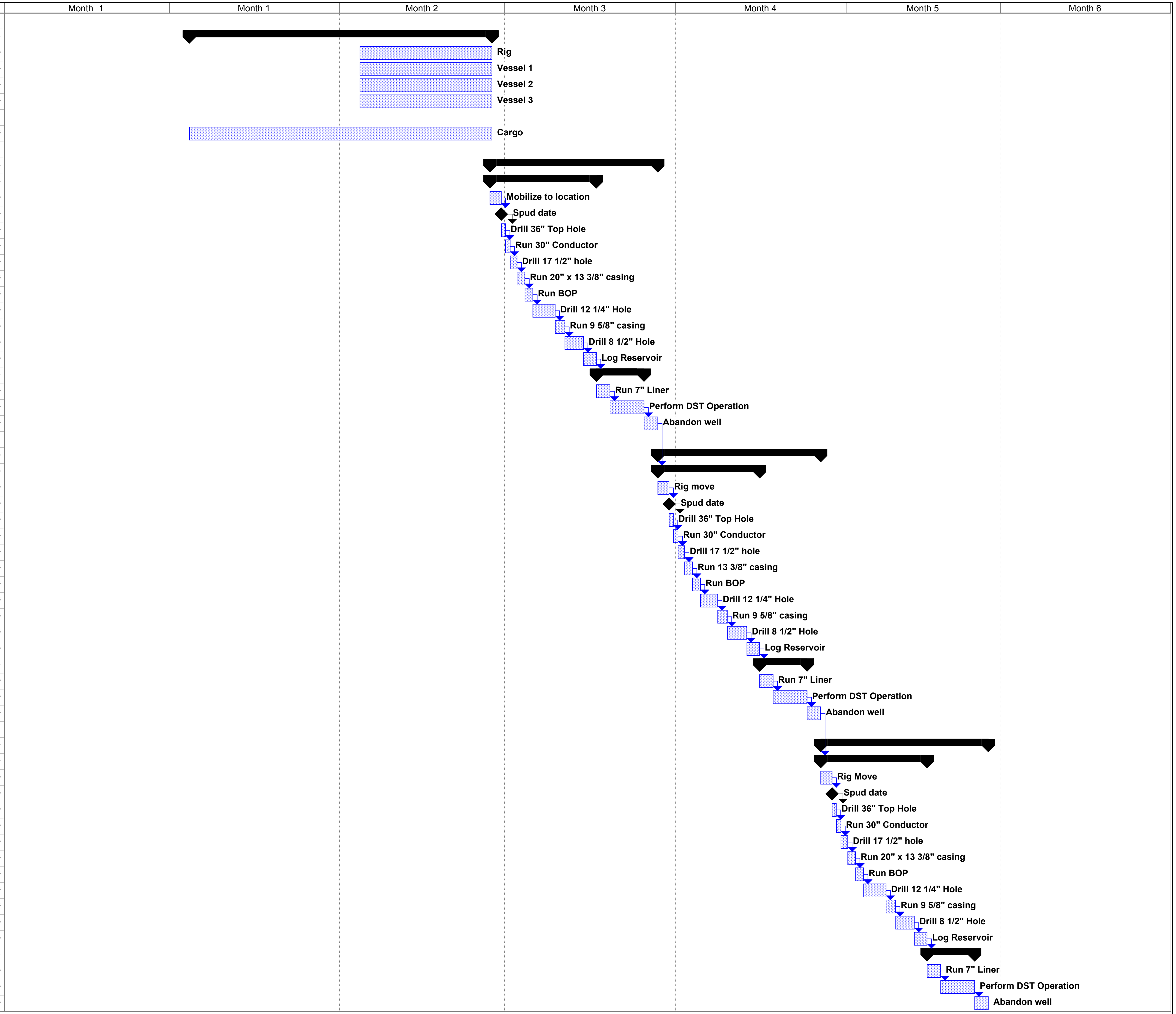



**Figure 8:** Generic diagram of proposed drilling unit (not to scale)

| ID | Task Name | Duration |
|---|---|---|
| 1 | | |
| 2 | **Mobilization** | **55 days** |
| 3 | Rig | 24 days |
| 4 | Vessel 1 | 24 days |
| 5 | Vessel 2 | 24 days |
| 6 | Vessel 3 | 24 days |
| 7 | | |
| 8 | Cargo | 55 days |
| 9 | | |
| 10 | **Well 1** | **30.49 days** |
| 11 | **Drilling** | **19.34 days** |
| 12 | Mobilize to location | 2.07 days |
| 13 | Spud date | 0 days |
| 14 | Drill 36" Top Hole | 0.76 days |
| 15 | Run 30" Conductor | 0.85 days |
| 16 | Drill 17 1/2" hole | 1.24 days |
| 17 | Run 20" x 13 3/8" casing | 1.43 days |
| 18 | Run BOP | 1.45 days |
| 19 | Drill 12 1/4" Hole | 4.06 days |
| 20 | Run 9 5/8" casing | 1.75 days |
| 21 | Drill 8 1/2" Hole | 3.4 days |
| 22 | Log Reservoir | 2.33 days |
| 23 | **Testing (Contingency)** | **8.65 days** |
| 24 | Run 7" Liner | 2.47 days |
| 25 | Perform DST Operation | 6.18 days |
| 26 | Abandon well | 2.5 days |
| 27 | | |
| 28 | **Well 2** | **29.61 days** |
| 29 | **Drilling** | **18.51 days** |
| 30 | Rig move | 2.07 days |
| 31 | Spud date | 0 days |
| 32 | Drill 36" Top Hole | 0.77 days |
| 33 | Run 30" Conductor | 0.85 days |
| 34 | Drill 17 1/2" hole | 1.19 days |
| 35 | Run 13 3/8" casing | 1.44 days |
| 36 | Run BOP | 1.44 days |
| 37 | Drill 12 1/4" Hole | 3.13 days |
| 38 | Run 9 5/8" casing | 1.76 days |
| 39 | Drill 8 1/2" Hole | 3.53 days |
| 40 | Log Reservoir | 2.33 days |
| 41 | **Testing (Contingency)** | **8.63 days** |
| 42 | Run 7" Liner | 2.45 days |
| 43 | Perform DST Operation | 6.18 days |
| 44 | Abandon well | 2.47 days |
| 45 | | |
| 46 | **Well 3** | **30.45 days** |
| 47 | **Drilling** | **19.34 days** |
| 48 | Rig Move | 2.07 days |
| 49 | Spud date | 0 days |
| 50 | Drill 36" Top Hole | 0.76 days |
| 51 | Run 30" Conductor | 0.85 days |
| 52 | Drill 17 1/2" hole | 1.24 days |
| 53 | Run 20" x 13 3/8" casing | 1.43 days |
| 54 | Run BOP | 1.45 days |
| 55 | Drill 12 1/4" Hole | 4.06 days |
| 56 | Run 9 5/8" casing | 1.75 days |
| 57 | Drill 8 1/2" Hole | 3.4 days |
| 58 | Log Reservoir | 2.33 days |
| 59 | **Testing (Contingency)** | **8.63 days** |
| 60 | Run 7" Liner | 2.45 days |
| 61 | Perform DST Operation | 6.18 days |
| 62 | Abandon well | 2.48 days |



The rig will also provide dedicated storage for a variety of process chemicals and secondary materials. This is likely to include:

- Fuel oil
- Fresh (potable) water
- Ballast (seawater)
- Drilling water
- Bulk mud and cement
- Liquid mud
- Dry process materials
- Piperack storage

**MOBILISATION**

It is expected that the rig will be towed from its previous commitments accompanied by a towing vessel capable of supply vessel and standby duties and equipped with oil spill response capability, plus a large support/supply vessel carrying spare materials and equipment. An additional anchor handling vessel (also capable of supply boat and standby duties and equipped with oil spill response capability) will be scheduled to arrive in Stanley prior to the rig and will be used to load additional anchors and materials in preparation for the rig tow.

Prior to rig mobilisation, a cargo vessel is planned to leave Aberdeen carrying all the tangible, consumable and rental equipment required for the campaign. The equipment would be offloaded in Stanley and stored until the arrival of rig. On arrival of the rig, heavy equipment (conductor, wellhead, surface casing etc) will be loaded, with the remainder of the spud equipment loaded onto the supply vessel. It is expected the rig would then be towed to the first drilling location and anchored up. Equipment will be loaded from the support vessel, which will then be released, leaving two vessels to support the remainder of the drilling operation.

On arriving at the required position, the first anchor would normally be dropped short of the planned well location and the anchor chain or cable paid out to allow the rig to move to the desired position. Should the rig need further anchoring, piggy-back anchors can be deployed as required. It is intended that piggy-back anchors and additional mooring tackle will be made available on the attendant vessels.

The potential area of seabed disturbance will vary with the number of anchors used and the proportion of anchor chain that lies on the seabed. The environmental assessment of previous drilling operations in similar water depths (BP, 2002) has estimated a 5m wide by 200m disturbance for each (10 tonne) anchor, plus a 2m wide by up to 300m long disturbance from each section of anchor chain. Either 8 or 12 anchors would probably be used to secure the rig.

Accurate 3D seabed mapping has been carried out to provide a 3D picture of the seabed and subsurface (Figure 22). This 3D picture of the seafloor topography will be used in selecting the optimum position for anchoring the rig. It is also intended to employ ROV (Remotely Operated Vehicle) surveys of the seafloor during positioning and anchoring, which will allow any significant topographic features or seabed obstacles to be avoided.

**DRILLING**

It is planned to drill three wells to approximately 3,000m depths. The drilling process uses drilling bits of different sizes to drill a series of concentric holes from the seabed to the planned well total depth. A drilling fluid (drilling mud) is circulated through the inside of the drill string to the bit. The primary function of the drilling mud system is the removal of cuttings from the well and the control of formation pressures. Other functions of the mud system include:

- Sealing permeable formations
- Maintaining wellbore stability
- Cooling, lubricating and supporting the drill bit and assembly
- Transmitting hydraulic energy to tools and bit

The drilling fluid is prepared by mixing mud additives and chemicals on site to the desired concentrations in fresh water or sea water. Drilling can be carried out using oil based, synthetic or water based muds. **Only water based muds will be used for the drilling campaign**. A generic well plan for each well is shown in Table 8 below:

| Hole Size | Average depth (m) | Proposed mud system |
|---|---|---|
| 36" | Seabed to +/- 500m | Sea water with Bentonite sweeps |
| 26"/17½ | 500 to 1000 | Sea water with Bentonite sweeps |
| 12¼ | 1000 to 2200 | Water based Mud (WBM) |
| 8½ | 2200 to 3057 | Water based Mud (WBM) |

**Table 8:** Generic drill plan for the drilling campaign in Tranches C & D.

Each well is spudded (started) with a 36" surface hole drilled using seawater, which is pumped at a high rate down the drill string to force drill cuttings up the annulus and out onto the seabed. Natural clay and chemical sweeps will be used to enhance the efficiency of the seawater to remove cuttings, with the frequency of sweeps depending on the hole conditions.

Once drilled, a 30" conductor will be cemented into place to ensure the structural integrity of the well. The subsequent hole section will be drilled in a similar manner before cementing in place a further casing string. This will allow installation of a wellhead and the necessary equipment to allow a marine riser to be installed connecting the well to the rig. This allows the subsequent well sections to be drilled with circulating (water based) drilling mud and the cuttings returned to the rig for separation of the mud prior to discharge.

As each section is drilled, casing would be run and cemented into place ready for drilling the next smaller diameter section. Drill cuttings will be returned to the rig with the circulating mud and passed through a solids control package for separation of the mud from the cuttings. During cementing of the top well sections there may be some displacement of cement to the seabed adjacent to the well.

The solids control system typically employs a combination of stages which will include vibrating screens ('Shale Shakers'), centrifuges and degassers to separate various sizes of solid material from the drilling mud, which is then re-circulated downhole. The treated cuttings are then discharged to sea via the cuttings caisson (discharge pipe), positioned below the sea surface to minimise cuttings release into the near-surface layer.

All well sections will be drilled using low toxicity water based muds, approved under the UK Offshore Chemical Notification Scheme (OCNS). Various drilling chemicals also need to be added to the mud as it is mixed on the rig, in order to provide specific properties for drilling at different depths and through various rock types. Only low toxicity chemicals will be used as approved under the OCNS and in accordance with UK standards. The density of the drilling mud will be monitored and adjusted to match the downhole conditions. The drilling mud is stored in dedicated tanks within the drilling unit.

The steel casing used to case the hole is cemented into place. The cement used to anchor the casing within the hole is pumped down the casing or conductor using a high pressure cementing pump. The casing consists of steel tubing that lines the hole. Casing the hole not only allows drilling muds and cuttings to be recirculated to the rig, it also seals off the weaker shallow formations and prevents hole collapse, as well as preventing contamination of potential aquifers by hydrocarbons and drilling materials. In addition the uppermost section of casing provides a firm base for the blowout preventer (BOP).

It is intended for the BOP to be deployed after successfully setting the 13 3/8" casing string. A fully documented pressure test will be required in line with the Drilling Contractors procedures.

A remotely operated vehicle (ROV) carrying a camera will be used to monitor returns to the seafloor and limit cement losses to the seabed. Releases from the cement programme are unlikely except for the surface hole casing. Chemical additives used in the cementing programme may include setting retarders and accelerators, surfactants, stabilisers and defoamers. As with drilling chemicals, all chemical use will be reported to FIG and it is intended to use only the least hazardous category of chemicals (Gold and E) for these operations (see below).

## CHEMICAL USE

Offshore chemical use in the UK is controlled through the UK Offshore Chemical Notification Scheme (OCNS). Drilling in the Falkland Islands will follow the same model of chemical use and reporting as is required in the UK under this scheme. The OCNS groups substances according to their environmental effects. Under the latest revision to the scheme chemicals are classified according to an environmental data set (i.e. toxicity, persistence and bioaccumulation potential) and evaluated with a decision-support tool called CHARM (Chemical Hazard Assessment and Risk Management) to determine the chemical's Hazard Quotient (HQ).

CHARM is not applicable to all chemicals and some remain classified under the previous OCNS model, which classifies them into Groups A (most harmful) to E (least harmful), depending upon biodegradation and bioavailability.

The two sets of categories provide an indication of the environmental risk associated with the use of different chemicals offshore. Whereas the previous system was voluntary and specified tonnage triggers as notification limits, recent legislation in the UK now requires mandatory permitting and reporting for chemical use and discharge offshore. Based on the Hazard Quotient value, offshore chemical use in the UK requires pre-notification and permitting through the PON system (Petroleum Operations Notice) as well as usage reporting through EEMS (Environmental Emissions Monitoring System).

The proposed drilling campaign will follow both the PON system implemented through Falkland Islands legislation and the EEMS reporting structure, with all emissions reported to the FIG in standard format.

The OCNS scheme is administered by the UK Department of Trade and Industry using scientific and environmental advice from Cefas and the Fisheries Research Services (FRS) Marine Laboratory, Aberdeen (www.cefas.co.uk/ocns, 2005). The scheme aims to control and monitor the use of chemicals by the offshore industry and will provide the FIG with detailed information on the substances likely to be used in the drilling programme.

The OCNS was originally introduced in 1979, then revised in 1993 and further in 1996 to meet the requirements of the OSPAR (Convention for the Protection of the Marine Environment of the North-East Atlantic) Harmonised Offshore Chemical Notification Format (HOCNF). Additional changes took place in June 2000 with the introduction of Decision 2000/2 on a Harmonised Mandatory Control System for the Use and Reduction of the Discharge of Offshore Chemicals. Although the legislation used to administer this system in the UK (the Offshore Chemical Regulations 2002) is not in place in Falkland Island waters, the drilling programme will be carried out in full accordance with the chemical classifications and notification limits under the latest OCNS revisions.

The current Scheme requires offshore chemicals to be ranked according to their calculated Hazard Quotients (the ratio of Predicted Environmental Concentration (PEC) to Predicted No Effect Concentration (PNEC)). Cefas then lists products for use offshore on the approved chemical list, ranked by HQ or by the previous OCNS group where no HQ is available. The current Hazard Quotient Bands are shown in Table 9 below.

It is the intention of the drilling campaign to utilise only the least hazardous category chemicals (category Gold or E). All chemical use will be reported in full to the FIG under the EEMS reporting format.

| Hazard Quotient | | OCNS Category |
|---|---|---|
| Min Value | Max Value | |
| >0 | <1 | Gold |
| >=1 | <30 | Silver |
| >=30 | <100 | White |
| >=100 | <300 | Blue |
| >=300 | <1000 | Orange |
| >=1000 | | Purple |

More hazardous ↓

| Previous OCNS Category |
|---|
| E |
| D |
| C |
| B |
| A |

More hazardous ↓

**Table 9:** HQ Bands and categories plus previous OCNS categories

An example of the types and quantities of chemicals that may be used during the drilling campaign is given below for one well. These tables provide an indication of the potential mud chemical use based on generic drilling models worked up by Peak.

Actual chemical use will depend on the downhole conditions and cannot be specified at this time. Chemical names specific to the supplier are also likely to change, although the functions will remain the same. Sections may also vary, for example missing out the 26" section.

In addition to the chemicals listed below, a range of contingency chemicals are also required to account for unexpected conditions. All proposed contingency chemicals are category Gold or E.

| **Example chemical Use** | | | | |
|---|---|---|---|---|
| **Name** | **Function** | **Est. Use (tonnes)** | **Est. Discharge (tonnes)** | **HQ / OCNS category** |
| **Section:** | **36"** | **Drilling time:** | **1 day** | |
| **Mud name:** | **Spud mud** | **Vol. Discharged:** | **205** | |
| Barite | Weighting Chemical | 33.00 | 33.00 | E |
| Bentonite | Viscosifier | 13.00 | 13.00 | E |
| Caustic Soda | Water based Drilling Fluid Additive | 0.15 | 0.15 | E |
| Soda Ash | Other | 0.15 | 0.15 | E |
| **Section:** | **26"** | **Drilling time:** | **2 days** | |
| **Mud name:** | **Spud mud** | **Vol. Discharged:** | **915** | |
| Barite | Weighting Chemical | 71.00 | 71.00 | E |
| Bentonite | Viscosifier | 37.00 | 37.00 | E |
| Caustic Soda | Water based Drilling Fluid Additive | 0.45 | 0.45 | E |
| Soda Ash | Other | 0.45 | 0.45 | E |
| Polyanionic Cellulose | Viscosifier | 0.33 | 0.33 | E |
| Potassium Chloride | Water based Drilling Fluid Additive | 4.78 | 4.78 | E |
| XC Polymer | Viscosifier | 0.25 | 0.25 | E |
| **Section:** | **17½** | **Drilling time:** | **3** | |
| **Mud name:** | **Inhibited Water Based Mud** | **Vol. Discharged:** | **388** | |
| Caustic Soda | Water based Drilling Fluid Additive | 0.49 | 0.49 | E |
| Drilling Starch | Water based Drilling Fluid Additive | 3.92 | 3.92 | E |
| XC Polymer | Viscosifier | 2.94 | 2.94 | E |
| Glycol Inhibitor | Water based Drilling Fluid Additive | 24.68 | 24.68 | GOLD |
| Barite | Weighting Chemical | 78.34 | 78.34 | E |
| Polyanionic Cellulose | Viscosifier | 4.28 | 4.28 | E |
| Potassium Chloride | Water based Drilling Fluid Additive | 60.59 | 60.59 | E |
| Biocide | Biocide | 0.98 | 0.98 | E |
| Soda Ash | Other | 0.49 | 0.49 | E |

| | | | | |
|---|---|---|---|---|
| **Section:** | **12¼** | **Drilling time:** | **3** | |
| **Mud name:** | **Inhibited Water Based Mud** | **Vol. Discharged:** | **388** | |
| Glycol Inhibitor | Water based Drilling Fluid Additive | 23.39 | 23.39 | GOLD |
| Biocide | Biocide | 0.83 | 0.83 | E |
| Caustic Soda | Water based Drilling Fluid Additive | 0.41 | 0.41 | E |
| Soda Ash | Water based Drilling Fluid Additive | 0.41 | 0.41 | E |
| Drilling Starch | Fluid Loss Control Chemical | 3.32 | 3.32 | E |
| Polyanionic Cellulose | Fluid Loss Control Chemical | 3.32 | 3.32 | E |
| XC Polymer | Viscosifier | 2.49 | 2.49 | GOLD |
| Barite | Weighting Chemical | 154.28 | 154.28 | E |
| **Section:** | **8½** | **Drilling time:** | **3** | |
| **Mud name:** | **Inhibited Water Based Mud** | **Vol. Discharged:** | **388** | |
| Potassium Chloride Brine | Water based Drilling Fluid Additive | 113.99 | 114 | E |
| Glycol Inhibitor | Water based Drilling Fluid Additive | 23.55 | 24 | GOLD |
| Biocide | Biocide | 0.84 | 1 | E |
| Caustic Soda | Water based Drilling Fluid Additive | 0.42 | 0 | E |
| Soda Ash | Water based Drilling Fluid Additive | 0.42 | 0 | E |
| Drilling Starch | Fluid Loss Control Chemical | 3.34 | 3 | E |
| Polyanionic Cellulose | Fluid Loss Control Chemical | 3.34 | 3 | E |
| XC Polymer | Viscosifier | 2.51 | 3 | GOLD |
| Barite | Weighting Chemical | 155 | 155 | E |
| **Total** | | **880.39 tonnes** | **880.39 tonnes** | **GOLD & E category only** |

**Table 10:** Potential mud use and chemical additives for different well sections.

## 3.2. Well Testing

If the results of logging indicate a potential for hydrocarbon bearing formations the well may be tested. As it is currently unknown whether well tests will be undertaken, the potential impacts from this aspect have been included as a precautionary measure. Well testing is carried out in accordance with a Testing Programme prepared by the testing engineer on behalf of Peak and subject to the same approvals as the Drilling Programme.

Technical management of the programme is undertaken by the testing engineer working under Peak supervision, to safely meet the programme objectives.

During well tests formation fluids are brought to the surface where pressure, temperature and flow rate measurements are made to evaluate the characteristics of well performance. Following testing, hydrocarbons will be sent to the burner boom for disposal by flaring as this is the only practical handling option for these hydrocarbons. Flaring may be initiated using diesel or similar fuel to ignite the mixture. It is intended to use a high efficiency burner to flare the oil during well testing and minimise as far as practical the release of unburnt hydrocarbons. This will minimise any oil drop-out to sea. Should a visible surface sheen result from hydrocarbon drop-out during flaring, this will be reported through the PON / EEMS systems to FIG.

Should well testing take place it is estimated that the total testing period would be +/- 9 days per well. During this period it is likely that the burning of hydrocarbons would occur for a maximum of a few days per well.

**Well suspension or abandonment and rig removal**

Well suspension or abandoned operations will be carried out in full accordance with UKOOA Standards (United Kingdom Offshore Operators Association). Once drilling activity at each site has been completed, the wells will either be suspended or abandoned, depending on the results of drilling. In order to abandon the well, any productive zones will be isolated from each other and from the surface. Two mechanical barriers will be placed (and tested) between any productive zones and the surface. Casing and wellhead equipment will be recovered from the well and this equipment will be cut 3m below the seabed.

A site (debris) survey will be undertaken prior to rig departure.

If a well is temporarily suspended, cement and mechanical plugs will be used to isolate any hydrocarbons and overpressured formations. A corrosion cap may also be installed on the sub-sea wellhead following retrieval of the BOP and riser system. The well suspension programme will be deigned to ensure contamination of potential aquifers by hydrocarbons and potential flow of hydrocarbons to the surface is prevented and allow future well re-entry at a later date.

Once the well has been secured and all necessary equipment has been retrieved, the rig will be prepared for moving to the next drill location. This will essentially be a reverse of the installation process. Firstly the rig is deballasted, then each of the anchors will be retrieved and the rig towed to the next location.

## 3.3. Support Operations

In addition to the mobilisation, drilling, completing and testing operations described above, normal operations will include loading and offloading of cargo vessels and mud and chemical transfers. It is expected that equipment, stores and chemicals necessary for the drilling programme will arrive at the rig by supply vessel from Stanley and be transferred from vessel to rig either by pressurised hose (bunkering) or using a crane. A vessel will be kept on standby adjacent to the rig, another vessel will be available on rotation out of Stanley.

It is intended to service drilling operations from a supply base in Stanley established for the duration of the drilling programme. This base will act as the receiving, storage and loading point for bulk materials and other equipment/supplies required onboard the rig. The Falkland Islands will also act as a transit point for the drill rig crew. Crew changes to and from the rig will take place using a dedicated helicopter.

Logistics will be managed primarily from Stanley and will address local issues, co-ordinate material receipt, inspection, supply vessel loading/unloading, quality control and returns. It is envisaged that most equipment will be pre-shipped to the Falkland Islands and offloaded to the laydown area and warehousing facility. Other equipment may be transhipped directly to the drilling unit.

Helicopter services in the Falkland Islands will be provided by a Private Contractor based at Mount Pleasant Airport (MPA), although it is likely that Stanley Airport will be used as the pick-up and drop-off point to minimise security issues at MPA. The Contractor will supply a helicopter (likely to be a Sikorsky S-61) to support the drilling operations. A secondary (emergency) helicopter landing area is located at Cape Dolphin. Peak will organise flights to the drilling unit in conjunction with the helicopter operator. It is envisaged that few flights will be required to satisfy operational requirements and that two scheduled flights per week will be sufficient. Additional flights will be supplied depending on operational issues. The same helicopter service will be used for emergency response duties if required.

Management of passenger lists, flight frequency, fuel requirements etc will be the responsibility of the helicopter operator. Additionally, the helicopter operator will be responsible for providing safety equipment and flight briefings prior to each flight.

The Logistics Team will be responsible for calling-off materials and equipment and co-ordinating the movement of vessels to support the drilling operation. The Logistics Team and Materials Controller will co-ordinate availability to minimise delay in vessel loading.

It is intended that most materials will be either pre-slung or containerised prior to shipment to the local shore base, and that the equipment be sent to the rig as delivered. Subsequent slinging and containerisation will be the responsibility of the offshore Logistics. All equipment and materials going offshore, returning to base or transhipped to the supply point must be accompanied by a manifest (and any supporting paperwork).

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# 4. ENVIRONMENTAL MANAGEMENT FRAMEWORK

Environmental management of the Project will be conducted within a comprehensive framework comprising:

- Desire's Health, Safety and Environmental Policy Statement
- Desire's Health, Safety and Environmental Management System (HSE MS)
- Peak Well Management HSE Policy Statement
- Peak Well Management Safety Management System
- Management System Interface Document
- Drilling contractor operational controls and specific environmental procedures within the project Environmental Management Plan (EMP).

This section provides an overview of the current and proposed management framework as it relates to the environmental aspects of the drilling programme.

## 4.1. Desire Petroleum Environmental Management System

Desire has in place a Health, Safety and Environmental (HSE) management system incorporating an HSE Policy Statement (Appendix II). The management system is not certified and, as Desire does not actually carry out any operations themselves, is based on the control and monitoring of contractors.

The HSE Policy Statement and management system sets out Desire's top-level goals and commitments and the framework within which these will be applied. The drilling contractors will also have in place operational controls and management procedures detailing how specific operations will be carried out, for example bunkering of fuel, radio communications, drilling and well testing. Bridging these two levels of control will be a Management System Interface Document. This document outlines the systems and procedures developed to ensure that the well operations carried out by Peak Well Management (Peak) on behalf of Desire are managed safely, with due regard for the environment and in a quality manner. Included within this document are:

- Policy, Standards and Procedures
- Safety Management
- Emergency Response
- Environmental Considerations
- Risk Management
- Quality Assurance
- Organisation
- Document Control

The Management System Interface Document will be put in place once the contractor is finalised and the exact nature of their existing systems is know. Additional tiers of management control are shown in Figure 10 below:

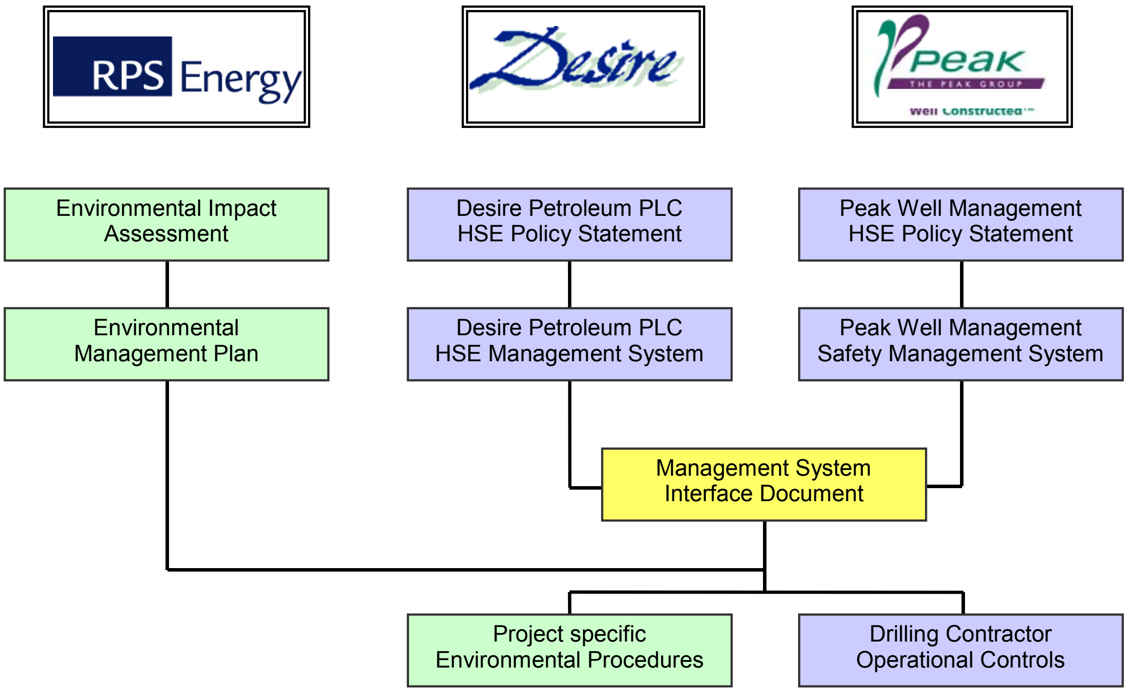



**Figure 10:** Tiers of management control for the drilling programme

## 4.2. Operational Controls and Procedures

A project Environmental Management Plan (EMP) will be compiled as part of the operations specific update to the EIA. This will take place once the drilling rig, vessels and contractors have been selected as the EMP should tie in with existing operational controls and will need to be specific to the rig and personnel to be used.

The drilling contractor will operate in accordance with all applicable laws, standards and conditions while in Falkland Island waters. All crew members, including support vessel crew, will be made aware of the standards and controls applicable to the conduct of this operation before drilling commences. It is also the intention to carry out training of key personnel in oil spill response procedures prior to drilling.

All equipment on board (including engines, compressors, generators, sewage treatment plant, oily water separators, mud and chemical systems, solids treatment package) should be regularly checked and maintained in accordance with manufacturer's guidelines in order to maximise efficiency and minimise malfunctions and unnecessary discharges to the environment.

Wastes must be appropriately segregated and stored onboard prior to disposal via previously agreed and approved disposal routes, either to the Falkland Islands or via transfer to a different location.

Clear lines of communication and operational procedures will be established between the drilling rig, onshore support facilities, support vessels and helicopter facilities before the start of drilling.

Organograms showing the management structure and lines of reporting for both the operational phase and the project initiation and definition phases are given in Figure 11 and Figure 12.

## Operational Phase

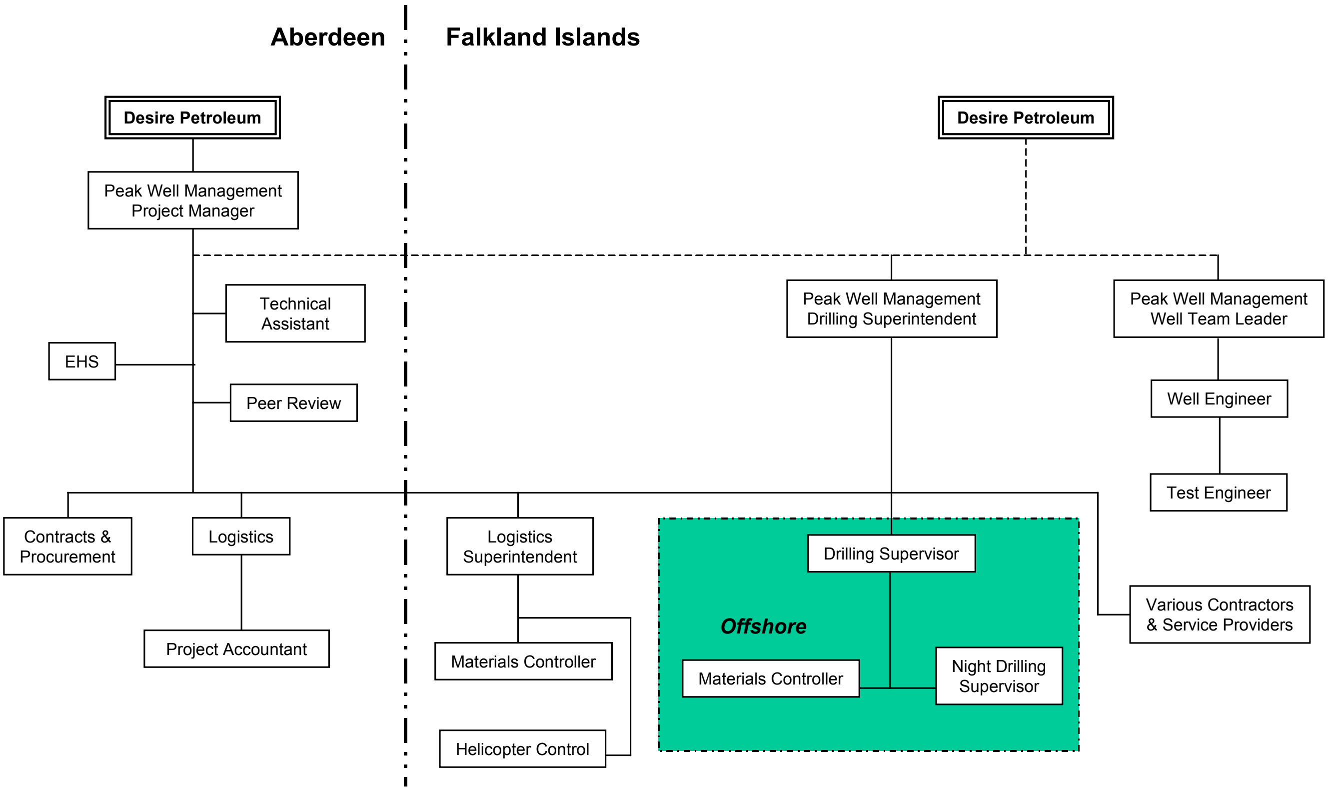



**Figure 11:** Management structure and reporting lines for operational phase.

## Initiation & Definition Phases

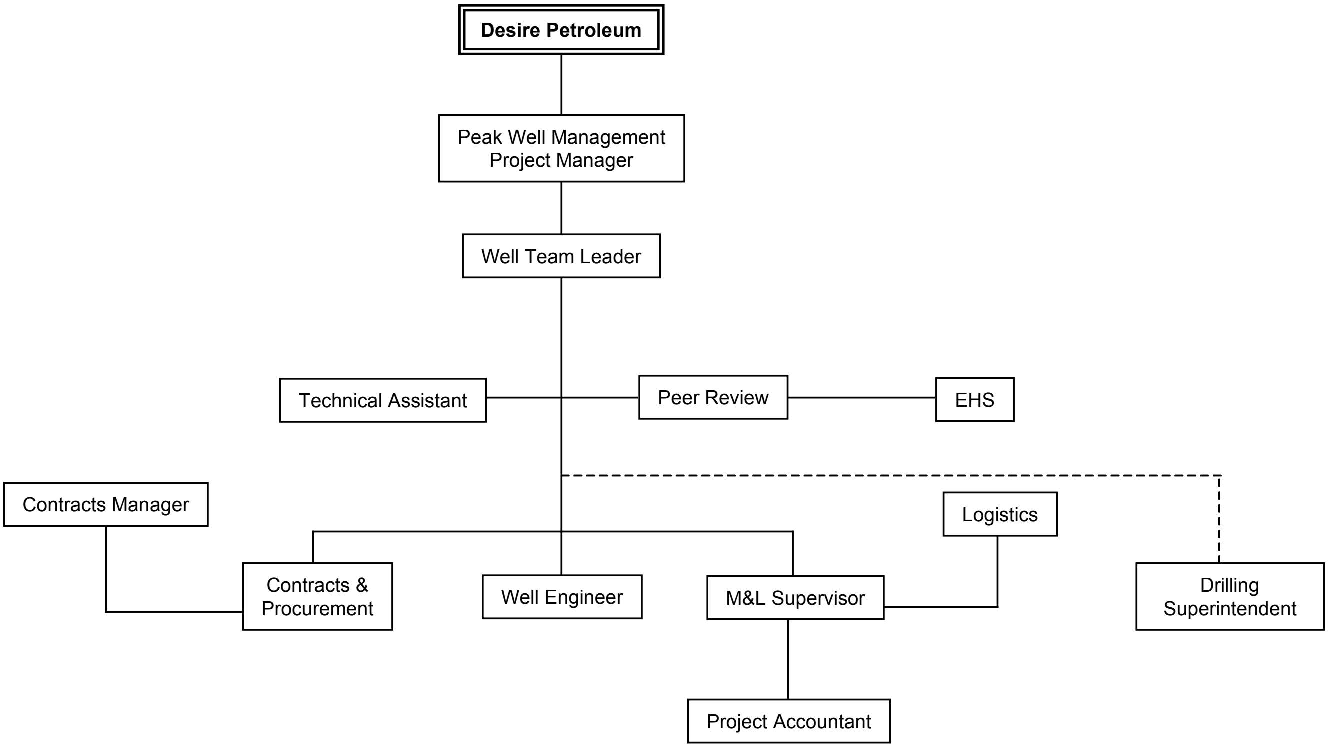



**Figure 12:** Management structure and reporting lines for initiation and definition phases.

## 4.3. Monitoring

### 4.3.1. Emissions and Consumption

The standard EEMS reporting format will be used for monitoring the consumption of resources and emissions to air and water. Shipping manifests will be completed for all shipments to and from the rig and will be logged and reported in line with documented management procedures.

Monitoring of emissions to air and water, waste production and resource consumption will be undertaken in accordance with established procedures for similar operations in the UK based around the EEMS and PON systems. This relies on a multiple tier approach based on varying degrees of uncertainty. The different levels of certainty and accuracy in emissions reporting are shown in Figure 13 below:

| Types of Approaches | Hierarchy |
|---|---|
| Published emission factors | **Improved accuracy**<br>**Additional data requirements**<br>**Higher cost** |
| Equipment manufacturer emission factors | |
| Engineering calculations | |
| Monitoring over a range of conditions and deriving emission factors | |
| Periodic monitoring of emissions or parameters for calculating emissions | |
| Continuous emissions* or parameters monitoring | |

*Continuous emissions monitoring applies broadly to most types of air emissions, but may not be directly applicable nor highly reliable for greenhouse gas emissions.

**Figure 13:** Emission estimation approaches

## 4.4. Reporting

During well operations, an Operational team will be established in Stanley, Falkland Islands. Daily regular reports will be sent from the rig to the Peak Team Leader.

Typically, the reports below shall be forwarded to the Desire representative in the Falkland Islands and (via the Peak Project Manager in Aberdeen) to the Desire representative in the United Kingdom:

- Daily Drilling/ Testing Report.
- Daily Geological Report
- Mud logging report
- Six day look ahead
- POB (persons on board) list
- Vessel and Helicopter Movements
- All accident or incident reports.

A weekly operational report and summary will be prepared by the Peak Well Team Leader and forwarded to the relevant Service companies (by way of an Operational update) to ensure that operational support is available.

At the end of operations Peak will compile an End of Well report including operational and financial sections. The Operational Report will include:

- Daily activities
- Time/depth curve
- Casing running and cementing report
- Materials usage report
- Bit record
- Mud logging report
- Formation evaluation report.
- Directional drilling report
- Testing report
- Abandonment/suspension/completion status report
- Down time Analysis/Lessons Learnt

In addition EEMS reports (Environmental Emissions Monitoring System) and PONs (Petroleum operators Notice) will be completed in accordance with (as a minimum) production licence and regulatory requirements and submitted to the FIG. Relevant EEMS reports encompass the following datasets:

- Form EEMS/005 - Oil/Base Fluid on Cuttings Summary
- Form EEMS/007 - Chemical Term Permits
- Form EEMS/014 - Waste Report
- EEMSATMO - atmospheric emissions inventory - Form 2002

In the UKCS the EEMS data submission timetable for drilling activity is as follows:

| Activity | EEMS/001 | EEMS/004 | EEMS/005 | EEMS/006 | EEMS/007 | EEMS/008 | ATMOS | EEMS/014 |
|---|---|---|---|---|---|---|---|---|
| **Drilling** | N/A | N/A | One month from completion | N/A | One month from completion | N/A | One month from completion | Annually by 1st Mar |

**Table 11:** EEMS Data Submission Matrix
(adapted from: www.eems-database.co.uk)

## 4.5. Oil Spill Contingency Plan

A dedicated oil spill contingency plan (OSCP) has been developed in support of the proposed drilling campaign in the North Falkland Basin. The OSCP provides for a multi-tier response depending on the scale and type of spill involved. At the most extreme end of the scale (Tier 3), the OSCP relies on mobilising specialist aircraft and personnel from Oil Spill Response Limited (OSRL) in the UK to provide aerial dispersant spraying capability.

The draft OSCP is provided in Appendix III. This cannot be finalised until the drilling rig, vessels and relevant personnel have been established and all necessary details within the OSCP can be completed. A revised OSCP will therefore be produced once operational details have been finalised and well in advance of any drilling. Training of key personnel by OSRL in spill response and the use of the OSCP is also recommended.

As the proposed drilling is taking place in the same location as previous drilling, the existing models for spill dispersion have been used for devising the OSCP. Further definition of the risks and results of a potential oil spill from drilling are given in Section 5.2.3.

# 5. OPERATIONAL ASPECTS

Based on the known details of the drilling programme and the likely methods used to carry out the operations, the probable environmental aspects are described below. An environmental aspect is defined under the environmental management standard (ISO14001) as an "element of an organisation's activities, products or services that can interact with the environment." (ISO 14001:2004).

Aspects of the proposed operations likely to interact with the environment have been broadly categorised into those likely to result in:

- Emissions to Air
- Emissions to water
- Waste production
- Resource use

A detailed assessment of the environmental impacts (positive and negative, direct and indirect) likely to result from these aspects is provided in Section 7. The impact assessment process makes a qualitative assessment based on the nature, scope, persistence, intensity, probability and importance of each environmental impact.

Flow diagrams have been used wherever possible to provide a simple visual summary of how different operational aspects are likely to interact with the environment.

## 5.1. Emissions to Air

Emissions to air from the proposed operations will arise from both primary (direct) and secondary (indirect) emission sources:

**Primary emission sources:**

- Rig power generation
- Vessel propulsion and power generation
- Fugitive emissions from the rig and vessels
- Flaring during well testing (if undertaken)

**Secondary emission sources:**

- Transport emissions (increased flights and vehicle traffic)
- Manufacturing emissions (necessary muds, chemicals, machinery etc.)

The principal atmospheric emissions from these sources will include carbon dioxide ($CO_2$), methane (CH4), oxides of nitrogen ($NO_X$), sulphur dioxide ($SO_2$), carbon monoxide (CO) and volatile organic compounds (VOCs). $CO_2$ and $CH_4$ are two of the principal greenhouse gasses (GHGs). Table 12 summarises the environmental impacts of different atmospheric releases:

| Type of emission | Environmental Impact |
|---|---|
| Carbon dioxide ($CO_2$) | A GHG that is believed to contribute to climate change. |
| Methane ($CH_4$) | Enhances low level ozone production, indirectly contributing to climate change. |
| Carbon monoxide (CO) | Enhances low level ozone production, indirectly contributing to climate change. |
| Oxides of nitrogen ($NO_X$) | Contributes to acid deposition (e.g. acid rain). May also enhance ground level ozone when mixed with VOCs in sunlight. |
| Sulphur dioxide ($SO_2$) | Contributes to acid deposition (e.g. acid rain). Toxic gas. |
| Volatile organic compounds (VOCs) | A range of potential impacts, for example hydrocarbons may promote formation of photochemical oxidants. May also be known or suspected carcinogens. |

**Table 12:** Environmental impacts of potential atmospheric releases.

All power requirements on the rig will be supplied on-board by means of diesel generators. As well as main power generators there will be an emergency back-up generator to provide essential services. There may also be smaller generators serving specific purposes, for example to provide power for cementing operations. Estimated fuel use for each stage of the drilling programme is given in Section 5.4; Resource Use.

Based on estimated fuel consumption, emissions of $CO_2$ can be estimated using "Tier C Methodology", which utilises emissions models to predict potential emissions based on fuel use. This is the least accurate tier of emissions modelling, but does not depend on equipment specifications, fuel analysis or monitoring (none of which are available at this time).

Guidance on emission factors is published by the offshore industry in "Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions". This guidance is produced on behalf of IPIECA (International Petroleum Industry Environmental Conservation Association), OGP (International Association of Oil and Gas Producers) and API (American Petroleum Institute), (Battelle 2003). Emission factors are taken from "The Compendium of Greenhouse Gas Emissions Methodologies for The Oil and Gas Industry" (API 2004).

| Area of use: | Fuel | Fuel consumption ($m^3$) | Carbon emission factor from original source document[1] | | Estimated $CO_2$ emission (tonnes) |
|---|---|---|---|---|---|
| | | | Emission Factors | Source | |
| **Rig** | Diesel / Gas Oil | 1800 | $3.82 \times 10^{10}$ J/$m^3$ | IPCC 1996 | 4840.70 |
| **Supply Vessels** | | 6196 | 70.4 tonnes $CO_2$ / J | | 16,662.78 |

**Table 13:** Potential $CO_2$ emissions from fuel consumption.
[1] Based on 100% oxidisation of carbon content.

As there is no other information regarding fuel composition, generator efficiency, number of generators, flare composition or efficiency, it is not feasible to provide a more detailed breakdown of potential GHG emissions from the drilling operation. All emissions will be reported to the FIG in accordance with the EEMS reporting format employed in the UK.

Flaring emission from possible well test operations are likely to produce the greatest levels of non-methane VOCs, as well as smaller levels of $CH_4$, $SO_X$, $NO_X$ and CO. The hydrocarbons burned during potential well tests are likely to result in a significant contribution to atmospheric emissions from the operations, although each well test event would be relatively short-lived. Further details on well test emissions cannot be provided without information on flare tip design and fuel type.

Fugitive emissions are likely to arise from loading and unloading, chemical use, spills, leaks from seals and flanges, poor housekeeping practices (for example containers left unsealed) and from small-scale engineering and maintenance operations such as welding.

These emissions will be of small volumes and cannot be accurately quantified. They can be minimised by good maintenance practices, by following operational controls for the loading and unloading of materials and by maintaining good housekeeping on the rig.

Secondary emissions from transport of personnel and equipment and indirect production are referenced here, however no attempt is made to quantify the possible emissions from these sources. Extensive pre-planning has been undertaken to ensure the required equipment, materials and personnel are available at the right location and at the correct time. Part of this planning process is ensuring sufficient materials are made available but that unnecessary waste is minimised, both in terms of consumption and logistics. Accurate planning and project implementation will help minimise unnecessary emissions from secondary sources.

In addition to atmospheric emissions, airborne noise will be generated by all phases of the programme including drilling and power generation, vessel movements and helicopter use. Offshore airborne noise may disturb birds and animals in the vicinity of operations, however based on evidence from other drilling and vessel operations this is unlikely to be significant, with numerous bird sightings often recorded by both seismic vessel and rig crews.

## 5.2. Emissions to Water

Aspects of the drilling programme that are likely to discharge into the marine environment are divided between controlled emissions, for example rig drainage and cuttings discharge, and uncontrolled releases including oil spills and flare drop-out.

### 5.2.1. Controlled

Controlled discharges from the rig drainage system may arise from various areas and processes, as summarised in Figure 14 below.

Run-off from 'clean' areas of the rig will normally discharge straight to sea. It is important to ensure that all areas which can discharge directly overboard are well maintained, not used for storage of chemicals or soluble materials, suitably separated from process and storage areas and subject to good operational controls.

The drilling process will also require cooling water. Seawater will be drawn up using pumps and used to cool the drilling equipment in a sealed system. The heated seawater will then be discharged back into the sea via a subsurface caisson. It is not intended to add any antifoulant chemicals to the seawater.

Both bilge water and drainage from machining and engineering areas are likely to be contaminated with hydrocarbons and/or chemicals. Waters from these areas are therefore separated from clean water drainage and will be routed to the oily water treatment system.

Overboard discharge from the oily water treatment system will be monitored by an oil-in-water monitor. It is intended that the overboard pump will automatically shut down if the concentration of oil in discharged water exceeds 15 parts per million (15 ppm) oil in water. Oily residues will be retained onboard for disposal at appropriate waste reception facilities. Under the FIG Petroleum Operations Notices (PONs), PON 8 requires any visible oil sheen to be reported to the FIG, where it does not result directly from the produced water stream.

The contaminated drainage system deals with discharges that have arisen as a direct result of drilling and is likely to include the drill floor and solids control areas. These will feed into a collection tank and subsequently be routed into the solids control system.

Sanitary wastes include all black (sewerage) and grey water (showers and washing facilities). As well as human waste, grey and black water will contain detergents and cleaning agents from toilets and showers. Treatment and disposal of sanitary wastes varies between rigs, however it is likely the waste streams will be combined and processed in a system that, as a minimum, will macerate any solid material prior to discharge. Aeration processes may also be employed to control the BOD (Biological Oxygen Demand), suspended solids and bacterial content of the waste. Although chemical treatment of sanitary wastes is possible, this is also likely to increase the chlorine content of the discharge stream.

An assumed figure of 0.22m$^3$/day of grey water and 0.10m$^3$/day of black water will be generated by each person on board the rig and vessels (based on previous modelling and assumptions for offshore drilling operations (bp 2002)). Estimated discharge levels for grey and black water throughout the programme would therefore be:

| | Stage of operations | | | | |
|---|---|---|---|---|---|
| | **Mobilisation** | **Well 1** | **Well 2** | **Well3** | **Demob** |
| Ave. No. rig based personnel | 53 | 67 | 72 | 72 | 64 |
| Ave. No. vessel personnel | 35 | 30 | 30 | 30 | 35 |
| **Grey water produced (m$^3$)** | **19.36** | **21.34** | **22.44** | **22.44** | **21.78** |
| **Black water produced (m$^3$)** | **8.8** | **9.7** | **10.2** | **10.2** | **9.9** |

**Table 14:** Estimated daily quantities of grey and black water discharge.

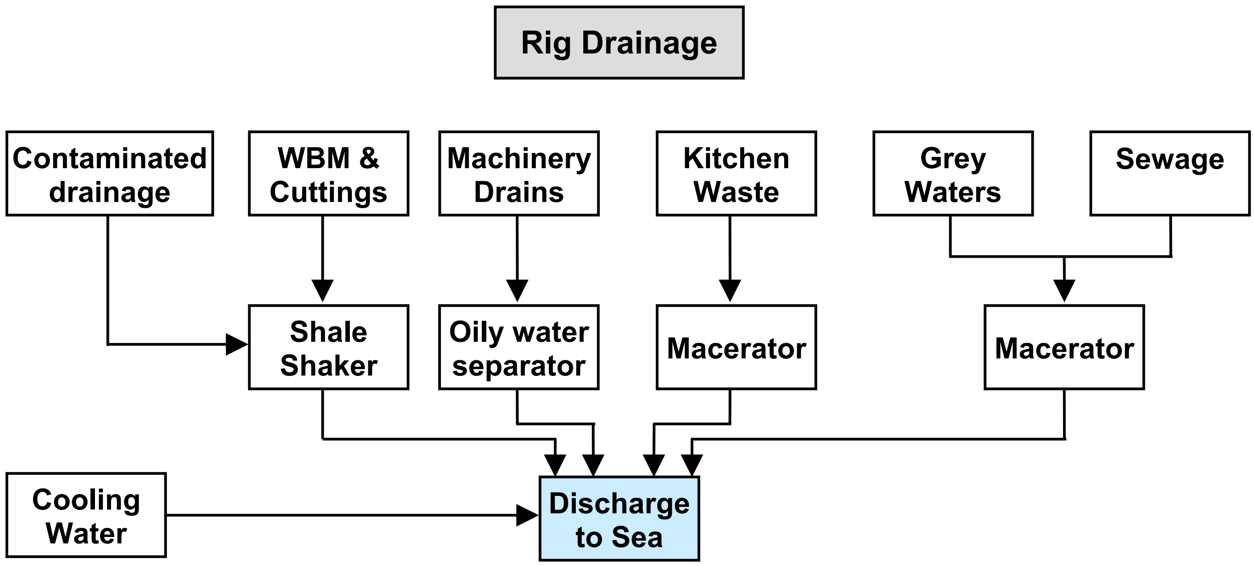



**Figure 14:** Flow diagram of controlled drainage from the drilling rig

### 5.2.2. Cuttings

Following the 36" surface hole, which is drilled using seawater with cuttings discharged to the seabed, subsequent sections of the well will be cased allowing cuttings to be returned to the rig for treatment prior to discharge to sea through the cuttings caisson. Discharged cuttings will contain trace amounts of (water based) drilling muds and any chemical additives used in the drilling process. Due to the use of water based drilling muds and the intention to use only low toxicity chemicals (OCNS category Gold or E) the main impact of cuttings will be due to seafloor smothering rather than toxicity.

An approximation of the likely quantity of cuttings that would be generated by the three well drilling programme, based on three of the targeted hydrocarbon plays and target depths is given in Table 15 and Table 16 below:

| **Well 1** | | | | |
|---|---|---|---|---|
| **Hole Size (in)** | 36" | 17½" | 12¼" | 8½" |
| **Depth from (m)** | 388 | 468 | 1000 | 2400 |
| **Depth to (m)** | 468 | 1000 | 2400 | 3045 |
| **Cuttings Volume ($m^3$)** | 52.54 | 82.56 | 106.45 | 23.61 |
| **Total Volume Discharged ($m^3$)** | **78.80** | **103.19** | **133.07** | **25.97** |
| **Discharged:** | To seabed | To seabed | to sea | to sea |
| **Well 2** | | | | |
| **Hole Size (in)** | 36" | 17½" | 12¼" | 8½" |
| **Depth from (m)** | 437 | 517 | 1000 | 2000 |
| **Depth to (m)** | 517 | 1000 | 2000 | 3106 |
| **Cuttings Volume ($m^3$)** | 52.54 | 74.95 | 76.04 | 40.49 |
| **Total Volume Discharged ($m^3$)** | **78.80** | **93.69** | **95.05** | **44.54** |
| **Discharged:** | To seabed | To seabed | to sea | to sea |
| **Well 3** | | | | |
| **Hole Size (in)** | 36" | 17½" | 12¼" | 8½" |
| **Depth from (m)** | 348 | 464 | 1000 | 1950 |
| **Depth to (m)** | 464 | 1000 | 1950 | 3021 |
| **Cuttings Volume ($m^3$)** | 76.18 | 83.18 | 72.24 | 39.21 |
| **Total Volume Discharged ($m^3$)** | **114.26** | **103.97** | **90.29** | **43.13** |
| **Discharged:** | To seabed | To seabed | to sea | to sea |

**Table 15:** Expected discharge quantities of cuttings (3 wells).

| SUMMARY: | 36" Hole | 17 1/2" Hole | 12 1/4" Hole | 8 1/2" Hole |
|---|---|---|---|---|
| **Well 1** | 204.89 MT | 268.30 MT | 345.97 MT | 67.53 MT |
| **Well 2** | 204.89 MT | 243.59 MT | 247.12 MT | 115.80 MT |
| **Well 3** | 297.09 MT | 270.32 MT | 234.77 MT | 112.14 MT |
| **Total** | **706.86 MT** | **782.22 MT** | **827.86 MT** | **295.47 MT** |

**Table 16:** Summary of total expected cuttings discharge (tonnes).

Given that water based drilling muds will be used for all well sections, the Best Practicable Environmental Option (BPEO) for disposal of cuttings is considered to be discharge overboard and discharge to seabed from the surface hole. This is based on several factors:

- Environmental risk
- Health and safety risks
- Compliance with licence and regulatory requirements
- Cost of alternatives
- Available technologies

Both cuttings re-injection and ship-to-shore disposal of cuttings have been discounted based on the low environmental risk of at sea disposal (and full regulatory compliance) versus greater cost, safety and technological implications of these two alternatives. Other factors include:

- Drilling muds for the surface hole and top-hole sections will consist of either water-based muds or seawater systems, formulated to contain minimal toxic components.
- Modelling of cuttings discharge patterns and benthic sampling has been previously carried out. The post-drilling benthic survey conducted by Gardline in this area showed that drilling activity had little, if any, impact on the environment. No evidence was found to suggest that the formation of cuttings piles occurred at the surveyed well location post drilling (Gardline Surveys, 1998 A and H).
- Energy consumption and atmospheric emissions are less for discharge overboard than for the alternatives.
- Handling and safety risks are less for discharge overboard than for the alternatives.
- Cost for overboard discharge of cuttings is considerably less than for the alternative options.

Despite the lack of a significant cuttings pile formation demonstrated by the Gardline post drilling survey, it is probable that there will be localised physical smothering of seabed fauna in the vicinity of the well. As there are no expected toxic effects, recolonisation of benthic fauna can be expected (Kingston 1987 and 1992).

Drill cutting discharge modelling was carried out for previous drilling activity in this area and is summarised in the environmental assessment produced in 1997 by Environment & Resource Technology Ltd (ERT). Cutting dispersion modelling looked at several possible scenarios, including dispersion of cuttings from a 3000m well in 160m, 250m and 450m water depths.

Modelling assumed the release of cuttings from a 30cm diameter caisson at a depth of 10m below the surface. Although the physical parameters of the rig are not known, as drilling is proposed to around 3000m in water depths of between 350m and 450m these models have been taken as sufficient for assessment of the likely environmental impacts.

It is recognised that there are inaccuracies in the existing cutting dispersion models due to a lack of consideration for the effects of turbulence in the water column, use of broad current models and limited particle sizes. There is also no attempt to model further dispersion of the cuttings pile through resuspension processes and the results may therefore represent a worst-case scenario (Coggan et al, 1998).

The results of previous modelling showed that the majority of discharges will be restricted to within 200m of the release point and will have a maximum accumulated height of less than 8cm.

A fine cover of less than 2mm thickness is likely to around half a kilometre from the discharge point. The conclusion of previous modelling as a worst-case scenario is reinforced by the results of physical sampling following drilling, which demonstrated minimal seafloor impacts from discharged cuttings.

Benthic environmental baseline surveys of the sediments surrounding a well location were carried out by Gardline Surveys for wells:

- 14/05
- Little Blue-A
- 14/13-B "Minke"
- 14/14-A
- 14/19-A
- 14/23-A
- 14/24 "Braela"

In addition, a "Post-Drill Environmental Survey of the Sediments around the Exploration Well "Little Blue-A" was performed by Gardline and reported in October 1998 (Gardline 1998). Further analysis of the results of benthic and post-drill environmental surveys is provided in Appendix IV.

The main physical impacts on seawater from the discharge of cuttings are associated with a localised increase in water turbidity in the vicinity of the discharge point and minor changes in local water quality, physical smothering of the seabed, nutrient changes in seawater quality and minor toxicity effects from the potential escape of any low toxicity chemicals. Based on the availability of more accurate and comprehensive datasets for the offshore environment, it would be possible to revise and improve the modelling exercise for cuttings dispersion in this area. Given the use of WBMs and low toxicity chemicals, survey evidence of minimal cuttings accumulation and the quantity of cuttings involved, this is not considered necessary for a realistic assessment of the likely environmental impacts.

### 5.2.3. Uncontrolled

#### MAJOR OIL SPILLS

The greatest environmental threat from offshore drilling operations is the risk of a major spill taking place, for example from a blow-out or loss of well control. Although the probability of this happening is extremely small, the impact of a major spill on the natural environment could be extremely damaging and this aspect of the drilling programme needs to be given full consideration. Hydrocarbon spills of varying sizes and types could also result from related operations including the bunkering of fuel oil, the storage and handling of oil drums or faults in the oil/water separator and the rig drainage system.

By far the greatest number of oil spills from offshore oil and gas activity are of a small quantity (<1 tonne) from non-emergency situations. This is demonstrated in Table 17 below, which provides a breakdown of the quantities of oil spilled in UK waters from 1994 to 2004.

| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total Amount Spilled (tonnes)** | 174 | 84(2) | 127 | 866 | 137 | 120 | 524 | 94 | 96 | 113 | 75 |
| **Amt of Spills > 1 tonne** | - | - | - | 26 | 14 | 21 | 18 | 17 | 18 | 10 | 13 |
| **Amt of Spills < 1 tonne** | - | - | - | 323 | 378 | - | 405 | 419 | 463 | 365 | 425 |
| **Total Number of Oil Spill Reports** | 147 | 145 | 300 | 349 | 392 | 372 | 423 | 436 | 481 | 375 | 438 |

**Table 17:** Quantities of oil spilled from offshore installations in UK waters (DTI Oil and Gas Directorate website).

The most probable occurrence of a spill is therefore a small operational spill of fuel oils such as diesel.

In line with previous drilling in this area, Desire will join Oil Spill Response Limited as an associate member to ensure a suitable response is available to any major spill requiring outside assistance. OSRL were also commissioned for previous drilling to examine the risks of hydrocarbon spills, possible spill scenarios and the optimum response.

A description of oil spill risk and spill modelling is included in the previous EIA. As drilling is taking place in the same location remodelling of spill risks and likely spill behaviour has not been undertaken. Existing models have therefore been used for the current campaign and are summarised below.

Should the worst case oil spill scenario occur, the flow rate and duration of the blowout would be dependent on the characteristics of the reservoir. It is worth noting that events of this nature are extremely rare. The oil spill modelling exercise carried out by OSRL looked at risk, trajectory and possible fate of a spill of this type.

The spill scenario was based on a spill of 1,000$m^3$ per hour for 12 hours and used historical meteorological data to model the most realistic conditions. As the proposed drilling will take place in an area encompassed by this modelling, the existing models are considered to be valid and it is not considered necessary to repeat and revise the previous modelling exercise.

Oil spill modelling by OSRL focussed on a release from both a northern (49°20' S, 59°12' W) and a southern (50°00' S, 59°18' W) location within the exploration area. The northern location is situated within Tranche D and is therefore accurate for the proposed drilling programme.

In summary the results of this exercise indicated that the risk of oil beaching from a spill in the northerly location is negligible. Based on these results, the risk to the Falkland Islands' coastline of an oil spill from drilling in Tranches C and D is not considered to be significant. The focus of this assessment and spill response capability is therefore on the risk to offshore marine resources from a potential spill, or the risk to coastal environments from nearshore operations e.g. vessel use and materials transfer (see Operational Spills below).

The computer simulation model OSIS (Oil Spill Information System) was used in conjunction with Patagonian Shelf current models to provide fate and trajectory modelling for potential spill situations. Four oil types were assessed using the models:

| Group | Oil type | S.G. | Pour point (°C) | Viscosity @ 15°C (cSt) | Asphaltene (%) |
|---|---|---|---|---|---|
| 1 | Kerosene | <0.8 | low | 2 | 0 |
| 2 | Argyll | 0.83 | 9 | 11 | 0.95 |
| 3 | Forties | 0.85 | 0 | 8 | 0.24 |
| 4 | Gamba | >0.95 | 30 | high | 0.05 |

**Table 18:** Oil types and characteristics used for OSIS runs (ERT 1997)

Oil weathering and trajectory utilised wind speed and direction data from monthly historical meteorological information provided by the Meteorological Office as well as reference to historical wind persistence data. The results of the oil spill modelling exercise are summarised from the previous EIA (ERT 1997) as follows:

- All Group 1 computer runs indicated total dissipation of the slick within 12 hours.
- Modelling for Groups 2,3 and 4 showed dissipation within 7 to 11 days and also demonstrated rapid emulsification of the slick, shortening the possible window for effective use of dispersants.
- Modelling of wind speed and persistence resulted in a small risk of oil beaching from the southern release point and negligible risk of a beaching incident from the (current) northern release point.

Based on these findings an Oil Spill Contingency Plan has been developed specifically for the drilling operation. This focuses on treatment at source and offshore remedial action for a major spill from drilling activity. The negligible risk of a beaching incident from the drilling location, coupled with the physical attributes of the Falkland Islands make extensive shore based protection both impractical and unwarranted.

**OPERATIONAL SPILLS**

Statistically, there is a far greater probability of a minor spill of hydrocarbons, chemicals or drilling mud than of a blow-out and major spill. Operational spills may arise from bunkering operations (offshore or in port), separator failure or container and equipment leaks.

Smaller scale spills from vessel movements and loading/unloading operations in port pose a far greater risk to the near shore environment than a major spill in Tranches C and D. The use of two standby vessels with spill response capability (both booms and dispersant spraying equipment) rotating between Stanley and the drilling location ensures that a first tier response should be available at both the well site and port area at all times.

It is important that the operational OSCP is fully aligned and dovetails with the national OSCP for any small-scale nearshore hydrocarbon releases that may impact on the sensitive coastal zone. The OSCP has been developed to provide a rapid response to both vessel and rig based spills.

**WELL TESTS**

Following well tests the rig is unable to contain the resultant hydrocarbons and these are necessarily sent to the burner boom for disposal by flaring. Inefficient combustion of hydrocarbons can result in the release of unburnt hydrocarbons, which 'drop-out' onto the sea surface and may form a visible slick of oil. Hydrocarbon drop-out can be minimised by the use of a high efficiency burner for flaring and through accurate control of the mix of hydrocarbons and air going to flare.

Any visible sheen resulting from hydrocarbon drop-out during flaring will be reported to the FIG using the established forms (e.g. PON 8) and reporting channels.

## 5.3. Waste Management

The various waste streams likely to originate on the rig are summarised in the table below. A further breakdown of the proposed waste management options for the various waste types is shown in Figure 15 on the following page. The expected waste types are based on previous experience and operational planning by Peak and on waste manifests from similar operations in the UK.

Solid and liquid wastes generated on board the drilling rig and vessels will be segregated and stored in appropriate containers on board. Hazardous and non-hazardous wastes will be stored separately and in accordance with on board operational controls. Waste from the rig can be broadly divided into the following broad classifications:

- Non-hazardous combustible solid waste such as paper, wood and cardboard
- Non-hazardous, non-combustible waste such as scrap metal
- Hazardous solid waste such as paint cans and empty chemical containers
- Hazardous liquid wastes such as oily wastes, paint and solvent residues

Skips will be transferred from the rig to a support vessel for transport to shore for disposal, sorting, storage, treatment and/or transfer to another location (e.g. the UK).

| Likely waste types | | Details |
|---|---|---|
| Empty Chemical Drums | | May contain residues |
| Fluorescent Tubes | | Special waste in large numbers |
| Oil Contaminated Solids | | Oily rags, filters, soak ups etc |
| Batteries | | Nicad, Lead Acid, Lithium, Household |
| Waste oil | | |
| Helifuel | | |
| Waste Paint | | Solvent based, Water Based |
| Thinners | | |
| Flammable Liquids | | |
| Flammable Solids | | |
| Chlorinated Solvents | | |
| Water Based Mud Slops | | |
| Corrosion Inhibitors | | |
| Aerosols | | |
| Gas Cylinders | | |
| Brines | | |
| Low Hazard Solids | | Cement, Barites etc |
| **From Well Test Operations (if undertaken)** | MEG | (Mono ethylene glycol) |
| | TEG | (Triethylene glycol) |
| | Mercury | |

**Table 19:** Breakdown of likely waste materials from the drilling campaign

Wastes including cuttings, sanitary waste and food waste will be treated and discharged to sea and have been discussed previously. It is intended to make use of waste compactors on the rig in order to minimise the volume of waste produced and the required waste transfers to shore.

Due to the lack of appropriate waste treatment and disposal facilities in the Falkland Islands, waste minimisation and good waste management will be key to successfully dealing with the unavoidable waste streams that arise from drilling. A number of waste management options exist for the different waste types and all realistic alternatives have been included here to allow for changes in the legal framework, in-country facilities, operational specifications and politics.

Including the two supply vessels, quantities of waste likely to be produced ***on a well by well basis*** is estimated below (based on waste manifests from similar UK wells):

- General Waste (timber, old pallets, dunnage etc): 40 MT
- Compacted waste (office debris/kitchen waste etc): 5 MT
- Empty drums (possibly hazardous): 10 MT
- Waste oil: 4000 litres
- Scrap Iron / cut casing etc: difficult to estimate
- Old slings / shackles / lifting gear: difficult to estimate
- Hazardous waste (batteries/chemicals etc): difficult to estimate

Waste will be segregated into individual waste streams and skips. Accounting for the provision of compactors, it is estimated by Peak that 4-6 skips would be shipped to shore from the rig via a weekly boat transfer.

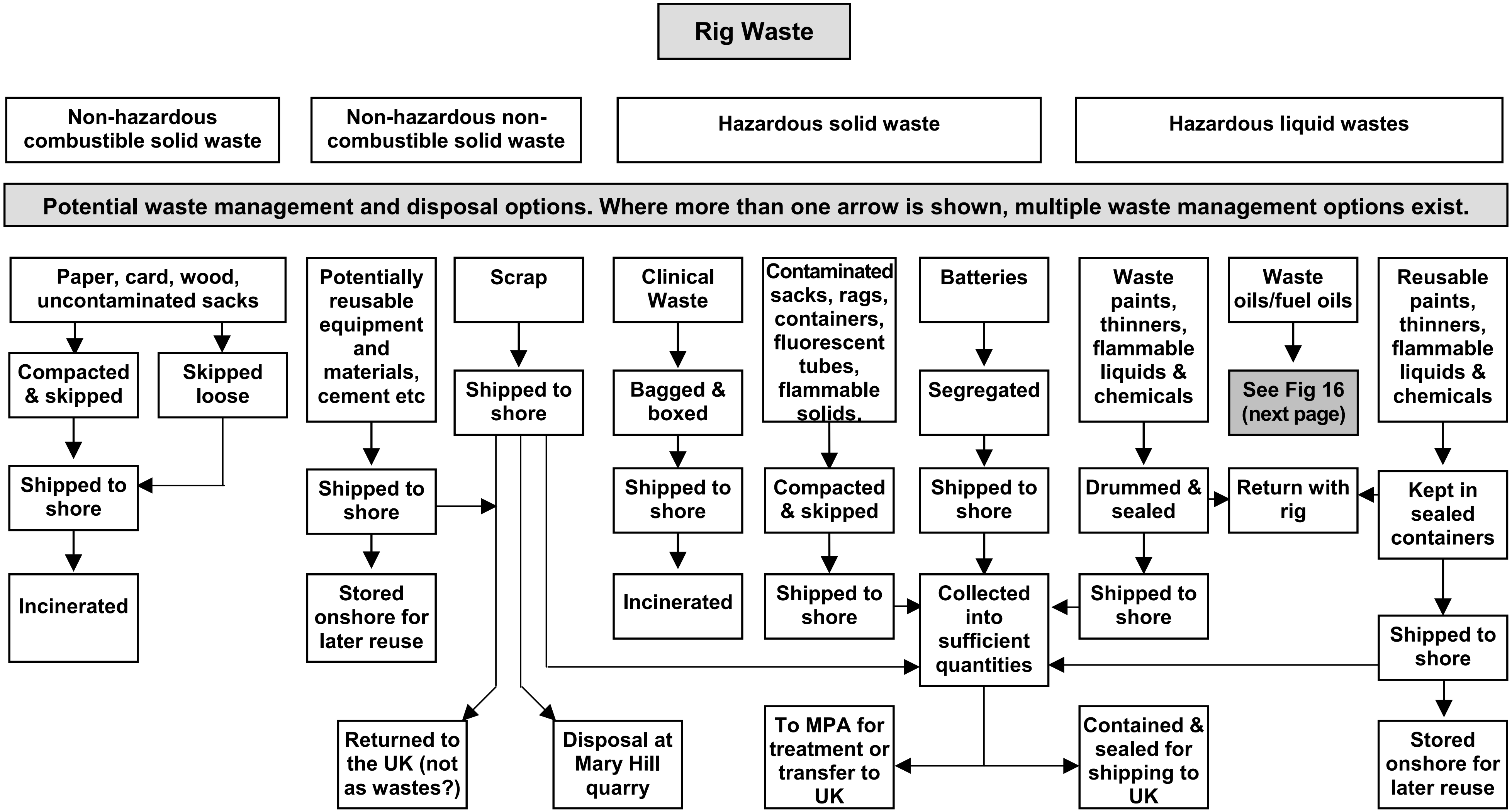



**Figure 15:** Flow diagram showing management options for drilling waste streams.

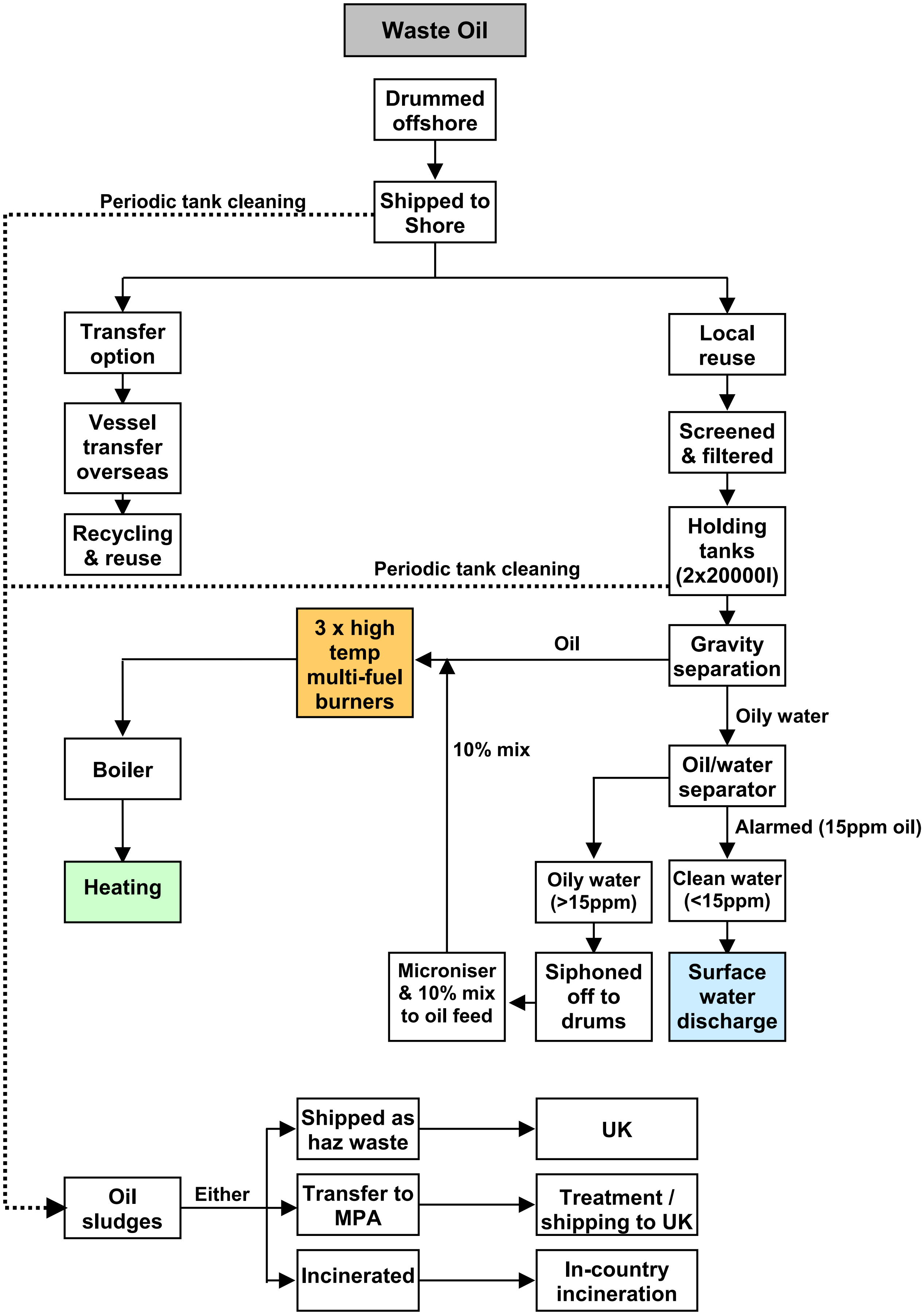



**Figure 16:** Process flow diagram showing disposal routes for waste oil.

All waste transfers from the rig will be fully documented in line with Peak and relevant international Regulatory monitoring and reporting procedures. Operational controls will be used to ensure the transfer of waste skips follows best practice (fugitive releases are minimised by covering skips, any necessary health and safety documentation accompanies hazardous wastes, wastes are kept segregated throughout transfer etc).

The regulatory system for controlling waste storage, handling and disposal in the Falkland Islands requires further clarification, as does the position of the Islands as regards the Transfrontier shipment of hazardous waste. Enquiries are outstanding both with the Scottish Environmental Protection Agency (SEPA) and with the FIG regarding the legal connotations of transfrontier shipment between the Falklands and the UK. Other issues relevant to the disposal route for waste materials, particularly hazardous wastes are:

- The **Basel Convention** controls the international movement of hazardous wastes (i.e. explosive, flammable, oxidizing, poisonous, corrosives, toxic etc) as well as non-hazardous wastes from specific industries/processes (e.g. waste mineral oils unfit for originally intended use, waste oils/water, hydrocarbons/water mixtures, emulsions). The UK has ratified this Convention (including, by extension, the Falkland Islands).
- The Basel Convention is implemented in Europe through Council Regulation (EEC) No 259/93 on the supervision and control of shipments of waste within, into and out of the European Community (The Waste Shipment Regulation). At a national level, the Convention is implemented in the UK through The Transfrontier Shipment of Waste Regulations 1994 (TFS Regs).
- The UK Government's policy is that waste should not be imported for disposal in the UK. Exemptions include countries outside the EU without the capability to adequately dispose of the waste, and who hold a "Duly Motivated Request" with the Environment Agency (EA) or a Bilateral Agreement with the UK Govt. A further exemption covers hazardous waste from small EU countries that do not possess suitable facilities e.g. Ireland & Portugal.
- Imports of waste for recovery from signatory countries of the Basel Convention is permitted to the UK. Exports of hazardous waste to OECD (Organisation for Economic Co-operation and Development) countries for recovery is permitted. Export of hazardous waste to non-OECD countries is prohibited.
- Transfrontier Shipment of permitted wastes under the Basel Convention and TFS Regs requires pre-notification, certification and financial guarantees to be put in place. A period is allowed for any objections to the shipment to be raised.

It is believed that the British military, based at Mount Pleasant Airport (MPA), hold a bilateral agreement with the UK for shipping military hazardous wastes without falling under the TFS Regs. The extension of this agreement to incorporate non-military waste was a recommendation of the Halcrow report[4]; "It must be once more stressed that the bilateral agreement, as it is currently being negotiated, relates only to wastes from the Military. It is important that it is extended to cover wastes arising from civilian sources."

Given that there is currently no suitable disposal route for hazardous waste in the Falkland Islands, the options for disposing of such waste material should be given immediate attention by the FIG. Continued activity by the oil and gas industry will require changes to both policy and amenities if companies are not going to be faced with the option of either unsuitable onshore disposal, or the financial and regulatory implications of falling under the TFS Regs for shipments back to the UK.

[4] Falkland Islands Waste Disposal, Halcrow 1998, independent study carried out on behalf of the FIG.

## 5.4. Resource Use

Based on operational planning of personnel requirements, mobilisation times and drilling schedules, the expected consumption of drilling water, potable water and fuel is estimated in the table below.

| Resource Use ($m^3$) | | Mobilisation (31 days) | Well 1 (32 days) | Well 2 (35 days) | Well 3 (37 days) | Demob (25 days) | TOTAL |
|---|---|---|---|---|---|---|---|
| Rig | Drillwater | 155 | 1408 | 1540 | 1628 | 130 | **4861m³** |
| | Potable Water | 186 | 416 | 455 | 481 | 150 | **1688m³** |
| | Fuel | 248 | 416 | 455 | 481 | 200 | **1800m³** |
| Supply Vessel #1 | Fuel | 1085 | 384 | 420 | 444 | 875 | **3208m³** |
| | Potable Water | 62 | 64 | 70 | 74 | 50 | **320m³** |
| Supply Vessel #2 | Fuel | 372 | 384 | 420 | 444 | 300 | **1920m³** |
| | Potable Water | 62 | 64 | 70 | 74 | 50 | **320m³** |
| Supply Vessel #3 | Fuel | 372 | 12 | - | - | 300 | **684m³** |
| | Potable Water | 62 | 2 | - | - | 50 | **114m³** |
| Standby Vessel | Fuel | 48 | 96 | 105 | 111 | 24 | **384m³** |
| | Potable Water | 32 | 64 | 70 | 74 | 16 | **256m³** |
| **Total Fuel Burn** | | **2125m³** | **1292m³** | **1400m³** | **1480m³** | **1699m³** | **7996m³** |
| **Total Drillwater Requirement** | | **155m³** | **1408m³** | **1540m³** | **1628m³** | **130m³** | **4861m³** |
| **Total Potable Water Requirement** | | **404m³** | **610m³** | **665m³** | **703m³** | **316m³** | **2698m³** |

**Table 20:** Breakdown of expected resource consumption during the drilling campaign

In addition there is estimated to be average Helifuel consumption of approximately 108 litres per day. Primary resource consumption during the drilling campaign will comprise:

- Food and water for crew
- Drilling and cementing materials
- Drilling and cementing chemicals
- Drilling water
- Fuel oil and Helifuel
- Paints and solvents
- Water based muds
- Engineering and maintenance consumables (welding rods, rags etc)

Secondary resource consumption is expected to comprise:

- Flights / transfers
- Helicopter support
- Personnel transfer station
- Emergency response facilities

Estimated figures for likely consumption have been provided for drilling and potable water consumption, fuel use and mud and chemical use. Data on other resource areas cannot be realistically estimated at this stage of planning. Secondary resource consumption and use of food, paints and solvents, contingency chemicals and maintenance consumables are expected to be minor.

# 6. DESCRIPTION OF THE ENVIRONMENT

## 6.1. General

The Falkland Islands are composed of two main islands, East and West Falkland, although there are a further 778 smaller islands forming a total land area in excess of 12,000 sq.km.

There is a wide range of both flora and fauna present in the islands and the deep waters of the South Atlantic are rich in marine life, key to the survival of a wide variety of species breeding on the archipelago. There are few trees, the natural vegetation being grassland with some species of heath and dwarf shrubs.

As the timing of the drilling programme has not been finalised, this baseline environmental description examines the distribution and sensitivity of flora and fauna throughout the year. In order to simplify the EIA and the large amount of environmental data now available, maps and diagrams have been used wherever possible to demonstrate graphically the baseline environment. The focus of this baseline description is the offshore environment of the North Falkland Basin as it relates to the drilling campaign and terrestrial habitats have therefore not been included, other than coastal zones that may be directly impacted by a polluting incident offshore.

## 6.2. Metocean data

Fugro Global Environmental and Ocean Sciences (Fugro GEOS) were contracted by Shell (on behalf of FOSA) to undertake a year-long programme of meteorological and oceanographic (metocean) measurements to the north of the Falkland Islands. These measurements, starting in June 1997, included an assessment of current and wave profiles, water column structure and meteorological conditions. Salinity and temperature profiles were also undertaken during a series of site visits.

The main study comprised the collection of current, wave and water temperature profile data at 2 sites to the north of the Falkland Islands and one location to the south. Although none of these sites are located within Tranches C and D, Location A is situated less than 20km to the north of Tranche D and Location B is situated approximately 30km to the west of Tranche C. Locations A and B can therefore be taken as providing a reasonable indication of the metocean conditions which may be found around the proposed drilling location:

- Location A 49° 10’ 00” S, 058° 55’ 00” W, 490m water depth.
- Location B 49° 40’ 00” S, 059° 45' 00” W, 210m water depth.

Measurements were carried out at Location A for 15 months and Location B for 12 months. Measurements were undertaken from paired current meter and wave moorings, from the release of Argos drifting buoys and from meteorological systems located both onshore and offshore, including on the drilling rig the Borgny Dolphin. The tracks of buoys was plotted using the Argos satellite and the results were subsequently made available for oil spill contingency planning.

### 6.2.1. Meteorology

The climate of the Falkland Islands is characterised by a narrow temperature range (–5° C to 24°C), strong winds, fairly low rainfall (averaging 625 mm in Stanley) evenly distributed throughout the year, and a higher number of sunshine hours than most parts of Britain (FCO, 2005). Average monthly temperatures range from around 9°C in summer to about 2°C in winter (Brown & Root 1997). Precipitation decreases away from the coast and averages only 150mm in the northern exploration area with a small seasonal variation. Temperatures over the open sea are also less variable than over land.

Offshore sea surface temperatures range from around 6°C in July/August to 13°C in February. The prevailing wind direction (70% of the time) is from a broad arc spanning the SSW to NNW. For at least 60% of the time the winds are less than Force 5 (17 knots) in intensity. Force 8+ gales (>34 knots) and storms account for only 5% to 8.5% of winds in the nine months September to May, but for 12% of all winds in the June through August winter months.

Weather conditions in the North Falkland Basin are less extreme than further south, with the frequency of both violent storms and squalls increasing south of 50°S (Hydrographer of the Navy, 1993). There is also no pack or floating ice as the area is 850 miles (1365 Km) north of the Antarctic circle. There are rare incidents of ice passing close to the eastern margin of the offshore exploration zone (Richards, 2001), however the risk of icebergs impacting on drilling operations within Tranches C and D is considered to be minimal.

The Marine Business Unit of the UK Met Office in Bracknell was used to provide marine forecasts for previous drilling operations via forecasters at Mount Pleasant Airport. A series of verification reports were then issued by the Met Office (1998) to assess the accuracy of forecasting and summarise meteorological conditions (Forecast Verification reports 1 to 7). The contents of these reports are not discussed in depth, however, when the schedule for the proposed drilling programme has been finalised, the meteorological reports will provide a useful indication of possible offshore weather patterns for that time of year. It has been noted from the reports that communication problems frequently prevented reporting between the rig and the UK, requiring the use of hindcast values as reference for issuing forecasts.

Results from the FUGRO Metocean Survey (FUGRO 1999) demonstrate significant differences in the onshore and offshore wind fields. The Maximum 10 minute mean wind speed on the Islands, derived from MPA data was 42 knots, whereas the corresponding value for the Borgny Dolphin was 46 knots.

Maximum atmospheric pressure onshore was recorded in September 1998 at 1035mbar. The corresponding maximum value measured on the Borgny Dolphin was 1040mbar (also September 1998). There was little variation in atmospheric pressure on a long-term basis over the year, although pressures were slightly higher overall during April and May. Long term variations in atmospheric pressure were similar onshore and offshore, although the absolute atmospheric pressures were generally higher at the 'Borgny Dolphin' than onshore.

Mean air temperatures were similar at all locations, but the daily variation onshore was greater than that offshore. The maximum and minimum offshore temperatures were 14.9ºC in October 1998 and -0.7ºC in September, compared with 21.1ºC and -4.0ºC onshore

At all sites, between 65% and 80% of the measured wind speeds exceeded 10 knots, with predominant wind directions being from the west to north-west. Wind speed remained above 10 knots for 6 days on one occasion and the maximum persistence of wind speed over 20 knots was for 38 hours through the year on the Islands. The estimated 100 year return wind speeds for the region were modelled as between 52.6 knots and 62.5 knots.

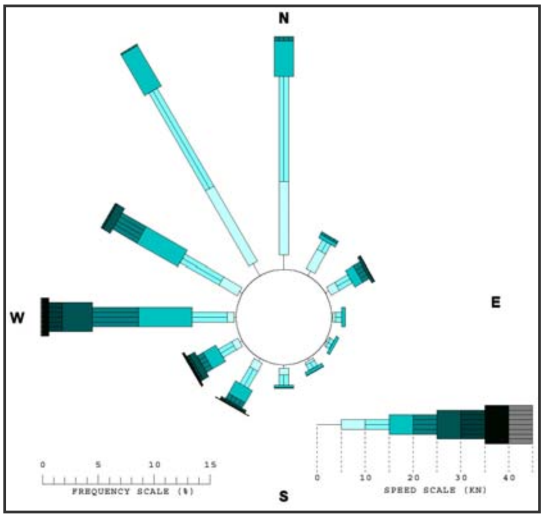


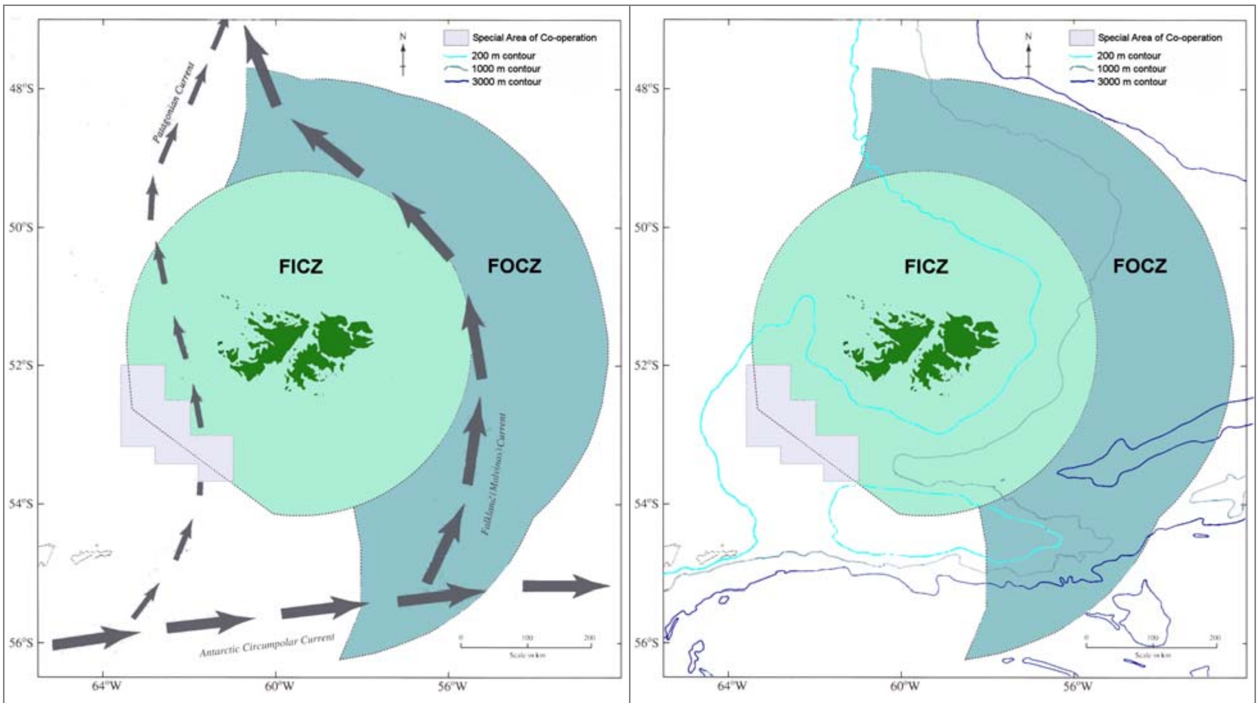

**Figure 17:** Wind Rose (Borgny Dolphin) 12 May 98 to 19 Nov 98.

Adapted from FUGRO (1999)

### 6.2.2. Oceanography

Publications on the oceanography of the South Atlantic show that the current flow regime in the area to the north of the Falkland Islands is complex. The Falklands lie to the north of the Antarctic Polar Front or Antarctic Convergence, where cool surface waters to the south meet warmer surface waters from the north. The Antarctic Polar Front (APF) is of significant ecological importance (Munro, 2004) and occurs between 50°S and 60°S (Laws, 1984), and is therefore to the south of the proposed drilling locations.

As the northern portion of the Antarctic Circumpolar Current flows around Cape Horn it is intensified and then deviates northwards towards the Falkland Islands. As can be seen in Figure 18 below, the Antarctic Circumpolar Current splits to either side of the Falkland Islands as it branches northwards. The 'Patagonian' or 'West Falkland Current' runs roughly northwards along the western side of the Islands, whereas the stronger East Falkland current runs north, then swings west to re-converge with the 'West Falkland Current' and continue northwards in a 100km wide band towards the warm south flowing Brazil Current (Munro, 2004 and Glorioso & Flather, 1995).




| Falkland Islands and major currents | Falkland Islands and water depths |
|---|---|

**Figure 18:** Falkland Islands Conservation Zones, FICZ (est. 1986) and FOCZ (est. 1990), plus major currents and water depths.

The average speeds of the diverging Falklands currents are less than 25 cm/s (0.5 knots) to the west and 25-50 cm/s (0.5-1 knots) to the east (Hydrographer of the Navy, 1993). The licence area lies near to the convergence zone of the Falklands currents, in the vicinity of an area of upwelling and high biological productivity on the continental shelf. It is reported that the general flow of current in this area is from south-north with a mean velocity of 0.5 knots, but that a counter current had been observed showing an east-west flow in winter of 20-30 cm/sec and an ESE-WNW flow in summer of over 30 cm/sec (Zyranov and Zeverov, 1979). Tidal cycles around the Falkland Islands are semi-diurnal (twice daily). Tides range from 0.3 to 3.5 metres above local datum (Brown & Root 1997).

Current patterns and seabed topography are important factors in the circulation of nutrients and level of marine productivity. The area of upwelling on the continental shelf north of the Falklands is reported to have very high biological productivity, which is reflected in the concentrations of birds and marine mammals in this area (see maps in Figures 18 and 20).

In 1997, Proudman Oceanographic Laboratory (POL) published a current model for the Patagonian Shelf area. The model showed that to the north of the Falkland Islands, the Falkland Current is clearly visible at depths below 200m flowing north closely following the shape of the Continental Shelf slope. The model also indicated that in the area of the northern Tranches there is only evidence of a residual flow of 0.1 m/s in a north-west direction off the edge of the Continental Shelf. In the shallower water, closer to the islands, residual current flow is negligible and water movement is dominated by tidal flows.

In order to gain site specific data for the design of potential production facilities and also to verify the model predictions, the FUGRO Metocean Survey (FUGRO 1999) was commissioned to carry out a survey of oceanographic (and meteorological) measurements in the area to the north of the Islands. The summary below focuses on Locations A and B from this survey, as described in the preceding subsection.

Two large scale water masses affect the area; the first being the Brazil Current, the second being the Falklands Current. The two water masses meet at a confluence region situated off the Argentine and Uruguayan coasts, extending between 30° and 50°S, and as far out as 45°W (dependent upon annual variability).

From the all-year current rose plots it is apparent that flows in the south-west to north-west sector dominate the regime at Location A, although occasional relatively high strength events flowed towards the northerly sector. Dominant current directions at Location B varied little through the year, flowing predominantly along a south-west/north-east axis.

Current speeds were generally higher and more tidally driven further up the slope at Location B compared with Location A. Current speeds at both these locations were relatively low, with all year maximum near-surface current speeds not exceeding 0.7m/s at A and 0.8m/s at B.

Current speeds at Location A were highest during the Spring and Summer months, with a tendency for the maximum to occur during the summer months, near surface. Maximum current speeds at Location B were highest in the Autumn, with Summer and Spring current speeds being similar and Winter currents almost 30% lower than those during the Autumn. The tidal current was a more important component of total flow at Location B than Location A.

Wave conditions measured at Locations A and B were very similar, with maximum wave heights of 8.9m and 7.9m respectively. Seasonality in wave height shows a more energetic wave environment between June and September, corresponding to the Southern Hemisphere winter. At both locations the direction of wave approach was predominantly from the south-west to north-west, although a number of energetic events from the north and east were recorded, with the longest period swells coming from the north-east. 100 year return height values were 12.6m and 10.9m respectively.

Measurements were also taken during the mobilisation and service visits in order to provide detailed temperature and salinity profiles across the Falklands Current. A seasonal thermocline is present at approximately 50m depth. The thermocline was most marked during February, but was still present during October and November. There are a number of seasonal changes in the depth of the thermocline and width of the Falklands Current (FUGRO 1999). Sea surface temperatures were also shown graphically using data obtained from the Miami University web site (Figure 19).

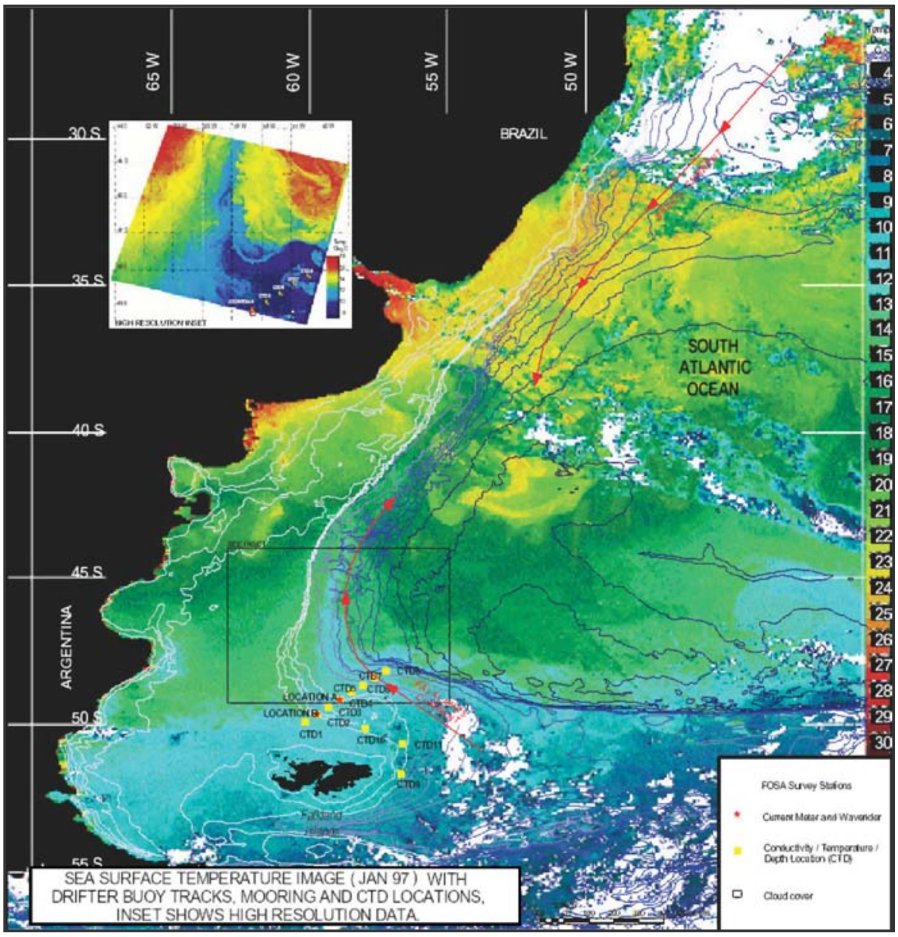



**Figure 19:** Sea surface temperature image (FUGRO 1999).

Current modelling has also been undertaken in the Special Co-operation Area (Pablo Glorioso *et al*, 2000) to the south-west of the islands, including the release of satellite tracked drifting buoys and development of a 3-D hydrodynamic model. Results of the project include models of oceanographic conditions, Ichthyoplankton distribution models and an analysis of the potential risks that may arise from developments in this area. As the focus of this study lies well outside the area of potential drilling, no further analysis of these results has been undertaken here.

### 6.2.3. Bathymetry

The Falkland Islands are situated on an area known as the Falklands Plateau, separated to the north from the Argentine Basin by the Falklands Escarpment. The general bathymetry of the North Falkland Basin indicates a gently sloping gradient with contours oriented along a northwest-southeast direction. Additional observations on general bathymetry from the benthic environmental baseline survey are included in Appendix IV.

Other features of note from the benthic sampling programme include:

- The presence of numerous poorly preserved iceberg keel scars. There was no observed difference between the sediments of the keel scars and the surrounding seabed.
- A number of hard sonar contents were made with no observed relief. These were interpreted as partially buried boulders, although other possibilities include natural features such as gravel aggregations, bioclastic sediment aggregations, carbonates etc.
- A complex seabed topography with several interesting features including depressions (generally with a maximum depth of up to 4m), an east-west trending trough and furrows or channels of unknown origin, commonly up to 1.5km wide and extending up to 210km long.

The likely potential drill sites lie in water depths of approximately 350 to 420m (Figure 20).

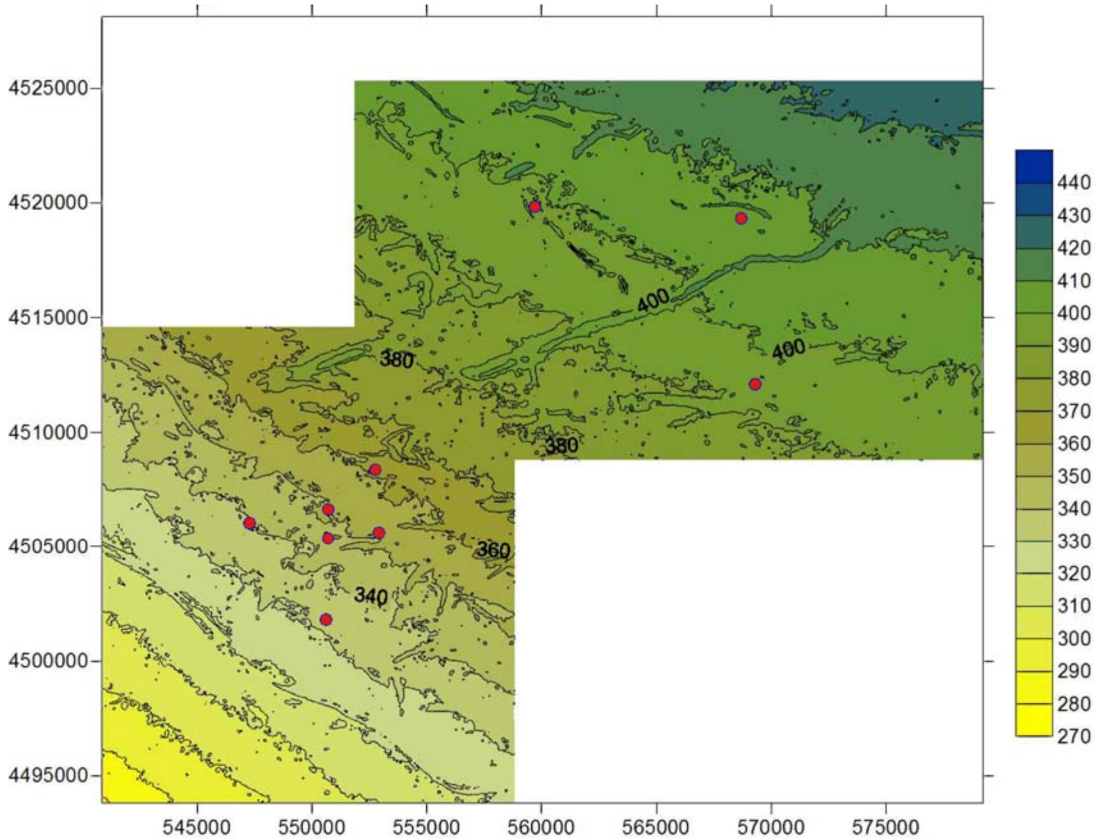



**Figure 20:** Water depths in the prospect area showing potential drilling locations.

The FUGRO survey (FUGRO 1999) demonstrated that the bathymetry at survey Locations A and B is characteristic of a continental margin, with the slope roughly following the line of the Falklands Plateau. At both locations the slope runs north-west before turning northward. The shelf edge slopes relatively gently to the north-east of Location B, with depths increasing from 150m near Location B, to around 2000m 150nm to the north east.

Within the area of study, there are two distinct regions of bathymetry affecting large-scale water mass movements. The first is the Patagonian Shelf, extending over 300km from the South American coastline, with the Falklands situated on an eastward extension at the southern extent of the shelf. The second region is the Falkland Basin, comprising of a steep sided shelf break to the east and south of the Islands, with steep sided troughs, transient mud waves and seabed scouring.

### 6.2.4. Sediments & seafloor topography

The Falklands Plateau is characterised by a layer of fine and medium sand (Bastida et al, 1992), which may be up to 2m thick. Some areas are known to have a high percentage of gravel comprising either small pebbles or bioclasts. The prevalence of hard-bottom areas is not accurately known due to the difficulties in sampling. Although originally reported to be scarce, it is believed these areas may have been under reported (Bastida et al, 1992 and Munro, 2004).

An objective of the benthic sampling programme commissioned by FOSA and undertaken by Gardline over February to June and October 1998 was to; "Provide a current description of the natural sediments surrounding the proposed well locations prior to operations, provide detailed information on the sediment physio-chemical properties, in order to permit the monitoring of physio-chemical impacts due to drilling and other discharges." (Gardline 1998).

A total of 332 samples were obtained during the full environmental cruise, taken at 83 different locations (over Tranches A, B, C, D and F). Sediment characteristics from those sample locations within the current area of interest (Tranches C and D) were summarised as poorly to very poorly sorted medium to coarse silt, with one station recording very fine sand. Seabed sediments were interpreted as comprising superficial silty sand with occasional scattered gravel overlying very soft clay. Depth of silty sand was generally less than 9cm.

Further details of sediment types from the benthic environmental baseline survey are given in Appendix IV.

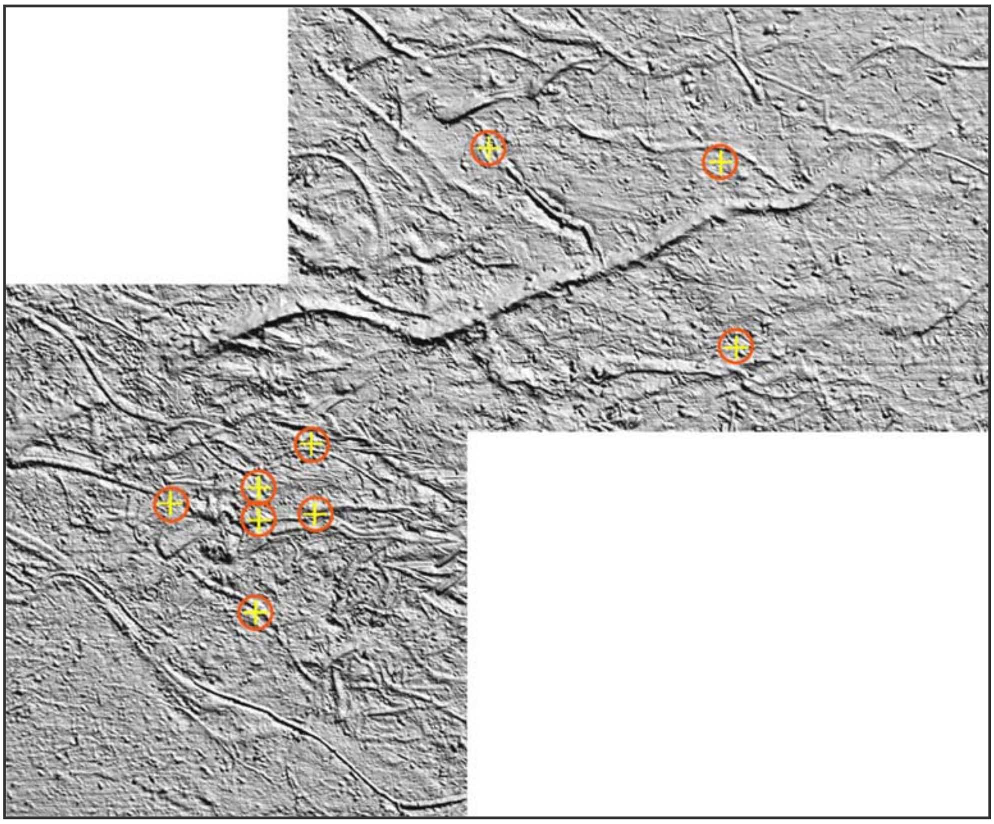


**Figure 21:** Seafloor map of the identified potential well locations
(Vertical scale exaggerated. Illuminated from a bearing of 215º at an elevation of 45º)

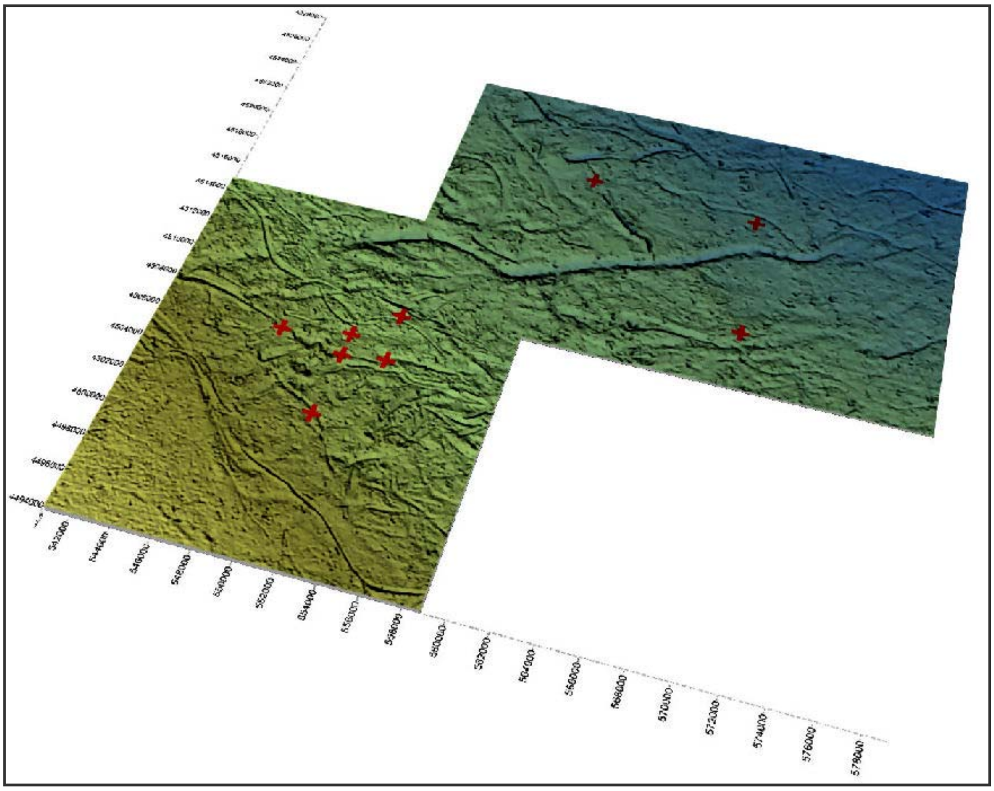


**Figure 22:** 3D Seafloor map showing nine of the potential well locations.
(Vertical scale exaggerated. Illuminated from a bearing of 215º at an elevation of 45º)

Both the 3D imagery and the benthic environmental survey highlight the complex nature of the seabed and the many indentations, troughs and trenches present in this area. The benthic environmental baseline survey highlighted the prevalence of poorly preserved iceberg keel scars, as well as numerous depressions (mostly up to 4m deep but on one occasion up to 11m deep), troughs and furrows or channels of unknown origin, commonly up to 1.5km wide and extending up to 210km long.

Results of the 3D seafloor mapping exercise show that, as well as the large number of historic iceberg keel scars, the seafloor is also heavily pitted in many areas. Interpretation of the results of the side scan sonar images from the benthic survey did not highlight pock marks as an area of concern. There is no evidence from the benthic survey of 'active' pock marks in this area, although the possibility of historic (subsurface) pock marks can be inferred from the shallow seismic sections.

In general the benthic survey revealed a relatively homogeneous macrofauna in a relatively homogenous environment. Further examination of the potential for specific marine habitats within seafloor structures is therefore considered unwarranted at this stage, although both mitigation measures and opportunities for furthering knowledge of this area are expanded below. Once the well locations and rig parameters have been finalised, the operational addendum will examine seafloor topography in more detail, focusing on what information is available for the drill sites and what additional benthic information can be provided during rig positioning, anchoring and post-drill debris surveys.

Anchoring operations would aim to avoid any significant seafloor structures including scars, trenches and indentations. The availability of high definition 3D seafloor mapping and use of a video-equipped ROV during rig positioning will assist the operators in avoiding major seafloor structures. The degree of seabed disturbance that can be expected from anchoring operations is described in the previous section on operations and assessed in Section 7.

Should there be a significant expansion in offshore activities likely to disturb the seabed, for example hydrocarbon drilling and production, offshore structures, seafloor pipelines etc. consideration should be given to further work in this area. Making available any ROV footage from rig operations should help to greatly expand the level of knowledge regarding seafloor structures and whether they have a significant influence on marine (particularly rare or sensitive) habitats.

## 6.3. Physical Environment

### 6.3.1. Geological Setting

The geological setting of the North Falkland Basin as it relates to oil and gas exploration is explained briefly in Section 3.1.2; Prospectivity. Onshore, the coastline around the Islands is deeply indented with rias (submerged coastal valleys) providing a wide array of sheltered inlets and natural harbours. Large sandy beaches are also present on the northern and eastern coasts of the Islands.

The Falkland Islands lie at the western end of the Falkland Plateau. The islands are surrounded by four major sedimentary basins: the Falkland Plateau Basin to the east, the South Falkland Basin to the south, the Malvinas Basin to the west, and the North Falkland Basin to the north (Figure 23).

The North Falkland Basin consists of a complex system of offset depocentres following two dominant structural trends (NW-SE and north-south). Its margins are mostly faulted, and it is surrounded by a structural platform composed probably of Devonian sedimentary rocks. Two major depocentres are separated by a faulted ridge termed the Intra-Graben High, which appears to have been a positive feature influencing sedimentation during much of the basin’s evolution. Eight tectono-stratigraphic units are recognised in the basin.

Good quality source rocks, reservoirs, seals and traps have all been identified in the North Falkland Basin. The main oil-prone source rock intervals are provided by early post-rift lacustrine claystones (Richards and Hillier 2000).

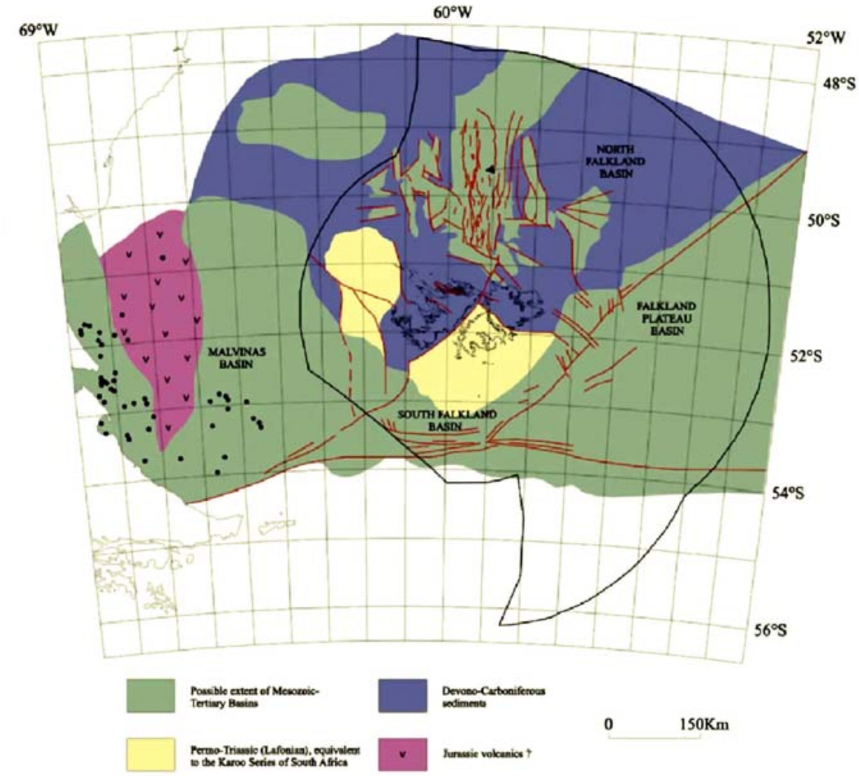



**Figure 23:** Falkland Islands sedimentary basin structure (Richards 2002)

## 6.4. Biological Environment

This section of the report presents a baseline description of the flora and fauna identified to date within the North Falkland Basin. Information presented in this section is based on a wide range of sources, including in-country consultations and websites. Full references are provided in Section 11, however the key documents drawn on here are:

- Seabird and marine mammal dispersion in the waters around the Falkland Islands 1998-1999, White *et al*, 1999.
- The distribution of seabirds and marine mammals in Falkland Islands waters, White *et al*, 2002.
- Vulnerable Concentrations of Seabirds in Falkland Islands Waters, White *et al*, 2000.
- Falkland Islands Environmental Baseline Survey 2004 (DRAF Report), Munro G, 2004.
- Environmental Assessment for the proposed exploration drilling operations offshore the Falkland Islands, ERT, 1997 (97/061).
- Falkland Islands Environmental Baseline Survey Desk Study Report, 1997. Prepared for the FIG by Brown & Root Environmental.

## 6.5. Plankton

Plankton are marine and freshwater organisms with limited swimming capabilities and which therefore drift with the prevailing currents. Generally microscopic, plankton may also include large organisms such as jellyfish. Plankton are divided into phytoplankton (plant organisms, mainly unicellular diatoms and other microscopic algae, which form the base of the food chain in marine systems) and zooplankton (animal plankton). There are two types of zooplankton. Permanent or holoplankton will always be zooplankton. Temporary or meroplankton are made up of the larvae of fish, crustaceans and other marine animals.

Marine plankton productivity is related to the availability of nutrients, which rarely become seasonally depleted in polar and subpolar waters. Phytoplankton productivity is limited by light availability and is therefore greater during the summer period.

Based on research reported in Ingram Hendley (1937) and cited in Munro (2004), the surface waters of the South Atlantic Ocean can be divided into four distinct geographical zones, defined by differences in temperatures and salinity. The Falkland Islands were identified as occurring in the sub-Antarctic Zone, limited to the south by the APF and to the north by the subtropical convergence.

**Phytoplankton**

Little is known about the distribution and abundance of plankton around the Falklands, with most current knowledge based on research on phytoplankton carried out in a Discovery expedition which sampled a line of stations between the Falkland Islands and South America in the 1930s.

This expedition, focusing on diatoms, was reported in Discovery Report Vol. XVI (Ingram Hendley, 1937). At the nearest station to the Falkland Islands, approximately 2-4 km offshore, 10 species of diatom were recorded. South of 44ºS there were relatively few species and a marked increase in diatoms, in comparison to the dominance of dinoflagellates, ciliates and crustaceans further north. This corresponds with known trends, whereby in higher latitudes diatoms comprise a significant component of the plankton population, compared to tropical waters (Barnes and Hughes, 1988).

**Zooplankton**

Surveys of zooplankton of the south-west Atlantic Ocean have shown that the lowest zooplankton concentrations are found in the shelf seas surrounding the Falkland Islands (Rodhouse *et al,* 1992, cited in ERT, 1997).

One of the most important organisms of the zooplankton in this area is krill. Pelagic crustaceans of the genus *Euphausia* are often collectively known as krill, although this term my also be used to describe other pelagic crustaceans. Krill are shrimp-like marine invertebrate animals. In the relatively warm waters of the Falkland Islands, lobster krill (*Munida gregaria*) is probably the most important species.

Other species found in Falkland waters include *Euphasia lucens*, *E. valentini*, and *Thysanoessa gregaria*. The amphipod *Thermisto gaudichaudi (*and other *Thermisto* sp.*)*. also occur in Falkland waters (cited in Munro G, 2004). Lobster krill provides the main food source for the cetaceans, fur seals, penguins and many seabirds in the Falklands, particularly the black-browed albatross and penguins. Lobster krill also represent an important food source for many of the commercial fisheries species, including squid. There is reported to be a noticeable increase in the populations of krill in the latter half of summer and in autumn when large swarms are visible in the surface waters.

## 6.6. Benthic fauna

Benthic fauna are animals that live on or within the seabed. Specific data on the benthic ecology of the Falkland Islands are scarce and according to Munro (2004), no specific research on benthic communities in coastal waters of the Falklands was identified until the baseline survey data commissioned by the Falkland Islands Government.

In order to increase the knowledge on benthic habitats in the vicinity of the Tranches north of the Islands, FOSA commissioned benthic survey work to be carried out by Gardline Environmental Surveys between February and June, 1998. An additional benthic survey was completed in October 1998 in order to re-examine the benthic habitats around well Little Blue A just north of Tranche C following drilling. The initial scope of work covered the collection of samples and subsequent analysis for a number of well sites, each with 12 sample stations, plus sampling from in-field control stations. The vessels used for benthic sampling were the MV L'Espoir and MV Dorada.

Initial benthic sampling indicated natural uncontaminated sediments with typical or low background concentrations of metals and hydrocarbons, respectively. Macrofaunal analysis at each site indicated a relatively high biological diversity. In general the survey revealed a relatively homogeneous macrofauna in a relatively homogenous environment. There were no significant correlations between the seabed fauna and tested environmental variables (e.g. sedimentary parameters, metals and hydrocarbons).

Post-drill benthic sampling concluded that there is no faunistic evidence to suggest that the area was polluted. All physio-chemical sediment parameters had increased slightly since the baseline survey, but remained indicative of uncontaminated sediments with relatively low background concentrations of both heavy metals and hydrocarbons. Given the uniform habitat, it would be expected that any changes in macrofaunal communities as a result of environmental variables (i.e. from drilling) would be easily identifiable. The report summarises that drilling activity has had little if any impact on the fauna to date. Further description and analysis of the benthic sampling programme is provided in Appendix IV.

This data supports the cuttings dispersion modelling carried our for the initial Environmental Impact Assessment (ERT 1997) and the conclusions drawn as to the probable impacts of water based muds and drill cuttings on the benthic environment. Given the work carried out to date on cuttings dispersion modelling and pre/post drill benthic sampling, additional benthic sampling prior to drilling using water based muds and low toxicity chemicals is not considered necessary at this time. It is recognised that knowledge of the benthic environment offshore the Falkland Islands is undeveloped and that dispersion modelling carried out to-date is relatively unsophisticated. Further work in understanding seafloor habitats in this area would be useful, however this should be considered with due regard to the limited potential environmental impacts associated with routine drilling operations using WBMs.

Bastida *et al* (1992) conducted a survey of benthic macro-invertebrate assemblages on the wider continental shelf, including but not specific to the seas around the Falklands. Results confirmed the traditional biogeographic division and suggested the possibility of sub-dividing the Magellanic Sector into two districts: Patagonian and Malvinean, under the influence of the Patagonian and the Falkland Current, respectively.

The study also indicated that the area around the Falklands and between the Falkland Islands and Tierra del Fuego is directly affected by the cold and highly productive waters of the Falkland Current. An indication of the benthic community composition was determined from an analysis of bioclasts in the superficial sediments. A total of 152 benthic species (restricted to molluscs, bryozoans, and echinoderms) were recorded in the Malvinean area influenced by this current in comparison to 112 species in the Patagonian area influenced by the sub Antarctic Patagonian Current.

Sediment samples in the sector from 49ºS to 55ºS were found to be quite variable (Bastida *et al*., 1992). Between southern Patagonia and the Falkland Islands, sediments were found to have a high percentage of bioclasts and in general a small percentage of carbonates. Whilst large-scale regional differences have been demonstrated (Bastida *et al*, 1992), patterns of benthic fauna distribution are not well known.

Polychaetes (segmented worms) are an important component of Antarctic benthic communities and are usually the dominant species. The polychaete fauna around the Antarctic coast is relatively homogenous. In comparison with other cold water areas the area is reported to be extremely diverse with 548 species of polychaetes described and possibly 800 species overall.

Qualitative data on larger epifauna are available from six stations sampled in the area of the shelf break (203-232m) south-east of Tranche F. These stations were sampled by a Rockhopper trawl during a research cruise conducted in November 1994 by the Falkland Islands Fisheries Department. These suggest a degree of spatial heterogeneity of sediment and community type in this area, a result which differs markedly from the largely homogenous findings of the Gardline survey in deeper waters. Two of the stations yielded catches of the scallop *Chlamys patagonia,* associated with soft seabeds, while another was characterised by the presence of sea urchins and large sponges, indicating hardier (rockier) ground (Conor

Nolan, pers comm. cited in Munro 2004). Other invertebrate species caught included the crab *Peltarian Spinulosum* and prawn *Thymops birsteini*. This would seem to indicate a greater diversity in the benthic habitat in these shallower waters to the south of the proposed drilling locations (Tranches C and D).

Intensive sampling of the benthos all over the Argentine continental shelf, from Brazil down to the Falklands and from coastal areas down to the beginning of the continental slope, was carried out by benthic trawl during cruises of the German FFS *Walther Herwig* conducted in 1966, 1968, 1971 and 1978. The animal material collected is housed at the Hamburg Zoological Museum, and has given rise to numerous publications on different animal groups encountered, including ascidians, corals, polychaetes and molluscs.

Antarctic fauna, including the area up to and around the Falkland Islands, has also been studied based on collections taken by cruises of the USNS *Eltanin* (1962-66). The work confirmed a high diversity and abundance of polychaetes at all depths, and indicated that they are important in turning over the sediments and in supporting larger animals (Hartman, 1967). Several new genera and species were found only in the Falkland Islands, including the scaleworm *Dilepidonotus falklandicus* and orbiniid polychaete *Falklandiella annulata* (both found at depths of between 646 and 845 m) (ERT 1997).

## 6.7. Fish, Squid and Shellfish

The fishing industry provides substantial income to the Falkland Islands and for this reason knowledge of fish species is closely related to commercial factors. Much of the information here references the work of the Falkland Islands Government Fisheries Department (FIFD). The summarised information in the draft Falkland Islands Environmental Baseline Survey (Munro 2004) has also been drawn on to provide a concise baseline description of fish species in this area.

In addition to the harvest of commercial fisheries, fish stocks are a major component of the diet of many seabirds and marine mammals. Any impact on fish stocks is therefore likely to have consequent impacts for numerous other species. At least 80 species of fish have been recorded in Falklands waters ranging from small fish such as the rock cod to larger fish such as tuna and sharks (Strange, 1992). Commercial fishing is described from a socio-economic perspective in Section 6.13.2.

The Falklands Interim Conservation and Management Zone (FICZ) was introduced in February 1987 in an effort to reduce uncontrolled fishing. Continuing conservation problems led to the declaration of the Falkland Islands Outer Conservation Zone (FOCZ) in December 1990, 200 nautical miles from coastal baselines.

The main fisheries resources are the squid species, *Illex argentinus* and *Loligo gahi*. A finfish fishery also exists targeting predominantly hake, hoki, red cod and blue whiting. Blue whiting provides the highest finfish catches with 80% of the catch targeted seasonally by large surimi trawlers. A specialised small ray fishery also exists. In addition a small longline fishery operates targeting Patagonian toothfish. The main commercially fished species are predominantly demersal and include:

- Argentine shortfin squid (*Illex argentinus*)
- Patagonian squid (*Loligo gahi*)
- Southern blue whiting (Micromesistius australis australis)
- Hoki (Macruronus magellanicus)
- Patagonian toothfish (Dissostichus eleginoides)
- Patagonian hake (Merluccius australis)
- Common hake (Merluccius hubsii)
- Red cod (Salilota australis)
- Skates & rays (*Rajidae*)

Shellfish are not an important component of the commercial fishery although several species of crab are found around the Falkland Islands including the false king crab (*Paralomis granulosa*) and the larger southern king crab (*Lithodes antarcticus*). Additionally, a small-scale scallop (*Zygochlamys patagonica*) fishery is being developed (Munro 2004).

### 6.7.1. Cephalopods

Cephalopods include species from the squid and octopus families. Squid provide economic benefits through commercial exploitation and are also a food source for a variety of marine vertebrate predators (Munro 2004). Adult squid are active predators occupying a position near the top of the food chain, consuming fish, crustaceans and other cephalopods (Hatfield, 1990). The stock of squid varies from year to year, influenced by the success of the spawning season based on favourable environmental conditions. Octopus, found in kelp beds and crevices in rocks, are common prey for sealions.

The distribution of cephalopods is related to temperature preference and the influence of currents. Larval phases concentrate on the Patagonian shelf and shelf break area and the adult phases exploit the currents for migration between feeding and spawning grounds (Rodhouse *et al*., 1992).

Cephalopod paralarvae and juveniles were sampled in the south-west Atlantic Ocean by BAS (Rodhouse *et al*., 1992). The sub-Antarctic surface waters of the Falkland Current are reported to contain the richest assemblage of species, characterised by the sub-tropical/sub-Antarctic *Histioteuthis atlantica*, the sub-Antarctic *Batoteuthis* skolops, H.*eltaninae*, H.*macrohista* and the sub-Antarctic/Antarctic *Gonatus antarcticus*. In comparison, with the exception of some small *Gonatus antarcticus*, the polar frontal zone water of the Falklands Current was relatively poor in species (Rodhouse *et al*., 1992). Cephalopod species recorded on the Falkland Islands shelf included *Loligo gahi, Gonatus antarcticus, Martialia hyadesi, Moroteuthis* knipovitchi, *Batoteuthis skolops*, *Semirossia patagonica* and an *Octopus sp*. (Rodhouse et al, 1992).

An evaluation of the distribution of *Loligo gahi* paralarvae found greatest concentrations around East Falkland (Rodhouse *et al*., 1992). *Gonatus antarcticus* was found in greatest concentrations at the offshore stations sampled, particularly to the south of East Falkland. Octopus sp. was reported to be the most widely distributed.

**Argentine shortfin squid (*Illex argentinus*)**

*Illex argentinus* is one of the most abundant cephalopods in the Southwest Atlantic. *Illex argentinus* is distributed in the southwest Atlantic from approximately 30ºS to 54ºS over the Patagonian shelf, slope and around the Falkland Islands. *I.argentinus* is a demersal and schooling species.

*Illex argentinus* are caught in the FICZ between late February and June, between 80m-800m depth (FIFD, 2001; Rodhouse and Hatfield, 1990). Numbers caught peak between April and May. Principal catch areas are to the north and northwest of the Falklands although the most important areas vary from year to year.

The migration and dispersal of *Illex argentinus* is highly dependant upon the major oceanic currents and resultant water temperature and abundance in the Falklands is highly variable. The species is predominantly a warmer water species and variations in current strength and flow that modify sea temperatures and temperature gradients can cause severe changes in migration and aggregation of the species (FIFD, 2001).

**Patagonian Squid (*Loligo gahi*)**

*Loligo gahi* is a demersal, schooling species found in shallower water around the coast to a depth of about 400m (Boyle, 1983). They have two main spawning periods; the spring (September-October) spawning group which is larger than the autumn (March-April) group.

The fishing industry is focused to the south of East Falkland, mainly around Beauchene Island from February to June and later moving northwards to an area north-east of East Falkland around August-October. The trawling fleet targets *Loligo gahi* during its feeding phase, in depths of 120-250m, corresponding to the optimum commercial size

Recently squid eggs have been recorded in shallow marine areas (less than 30m depth) during dive surveys carried out in 1996 (FIG, 1996a) and by the Falkland Islands Fisheries Department (FIFD, 2000). Eggs were found in inshore waters of all islands sampled, except the offshore islands to the south. In 1999 (FIFD, 2000) egg masses were encountered around the entire coast of East Falkland with the exception of the central part of Falkland Sound. All egg masses were found associated with and attached to kelp, although there was considerable local variation in egg mass density.

A third squid species, red squid (*Martialia hyadesi*) occurs in large numbers but is not widely fished. It is larger in size than *Illex argentinus* or *Loligo gahi* and is thought to be numerous in the waters of the Antarctic Convergence Zone, near South Georgia. This species forms at least 90% of the squid intake of the grey-headed albatross population during the chick rearing period resulting in approximately 1400 tonnes of squid consumed each breeding season (Brunetti and Ivanovic, 1992).

### 6.7.2. Finfish

Some 11 species of finfish are taken in significant quantities. Southern blue whiting catch is caught both to the south-west of the islands and to the north-east of the Islands. Hoki, rays, red cod and Patagonian toothfish are caught widely around the Falklands in the FICZ, with the exception of the southeast. Within the FOCZ all are caught to the north of the Islands. Patagonian toothfish and rays are also caught to the southeast within the FOCZ (Munro 2004).

The distribution of migratory species such as hake may be affected by fluctuations in spawning success and external environmental affects. Many of the commercially caught demersal species are likely to spawn in deep water and have planktonic eggs and larvae. Immature stages of some species may occur inshore; however, there is little information on specific nursery areas.

**Hake (Merluccius sp.)**

Hake are widespread throughout the FICZ and two species are caught commercially; Patagonian hake (*Merluccius hubbsi*) and common hake (*Merluccius australis*), which are similar species and often regarded together in catch statistics. The common hake is distributed mainly in the offshore waters to the north of the Falklands as opposed to the Patagonian hake, which is found to the south of the islands. Fishing effort concentrates in the far west of the FICZ where the highest abundance of hake are found, and also to the north (Tingley *et al*., 1995), and around Beauchene Island to the south (Lisovenko *et al*., 1982: Tingley *et al., 1995).*

*Merluccius hubbsi* is thought to spawn in September/October, and *M.australis* in June/August. In general hake are known to migrate diurnally, being found near the seabed during the day and migrating further up the water column to feed at night.

**Southern Blue Whiting (*Micromesistius australis*)**

Southern blue whiting are a food source for the Patagonian hake and as such the two species show a similar distribution. Southern blue whiting migrate to the Falkland outer shelf and aggregate in dense schools to spawn. Specialised surimi vessels target feeding concentrations of southern blue whiting until the following March. Acoustic surveys of the southern blue whiting stock are conducted annually through a joint Argentine/Falkland project.

The Falkland sub-species is found at depths between 180m to 780m and appears to be most abundant at depths of 200m around the Falklands (Inada and Nakamura, 1975). Spawning occurs in August-September around the south of the Islands and both eggs and larvae are pelagic. Prespawning fish congregate south of West Falkland during July (Patterson, 1986) and subsequent to spawning migrate into deeper water dispersing south and west where they are thinly distributed over the Patagonian Shelf.

**Whiptail Hake / Hoki (*Macruronus magellanicus*)**

Whiptail hake or hoki is the second most important commercial species in terms of annual catch. A pelagic and near-bottom fish, the species is present in Falkland waters year round and is generally associated with warmer waters up to 200m deep in the north and west of the FICZ (Middleton *et al*, 2001). Falkland waters are primarily a feeding ground. The uniform distribution of *M.magellanicus* as a proportion of daily catch suggests that the species is taken as a part of a mixed finfish fishery rather than specifically targeted.

**Cod (*Notothenia spp.)***

Antarctic cod are one of the most common fish in Antarctic and subantarctic waters, and 16 species have been recorded in Falklands waters. Of these the dominant species are *Notothenia ramsayii* (no common name) and yellow belly (*Notothenia macrocephala*). These species are common in nearshore waters in summer, but migrate to deeper waters during the winter (ERT 1997).

### 6.7.3. Shellfish

Data on shellfish found in the shallow and offshore waters of the Falklands are scarce. Lobster krill is abundant in Falklands waters (see Section 6.5). Crabs found in the shallow inshore waters of the Falklands include red crab (*Paralomis granulosa*) and, to a lesser extent, the king crab (*Lithodes antarcticus*). Trawling to the south of the Falklands has also shown there to be a probable significant population of sub-Antarctic stone crab (*Neolithodes* sp.).

**Red Crab (Paralomis granulosa)**

The red crab fishery utilises a small inshore vessel operating in Choiseul Sound. The operation is licensed by the Department of Fisheries with restrictions on minimum size. *Paralomis granulosa* is typically found in relatively shallow water, of 10-40m depths and within sheltered inshore waters. The highest concentrations of *P.granulosa* are found around the south east of the Falklands. Both juveniles and adults are found at the edges of kelp beds (Hoggarth, 1993).

**Patagonian scallop (Zygochlamys patagonica)**

A small commercial fishery exists for the Patagonian scallop in the northeast of the FICZ at depths of 130-142m. Stock assessment estimates a standing biomass in these beds of 18,000 - 27,000 mt. Distribution is mainly along the northeastern, eastern and southern edge of the Falkland shelf. Distribution is thought to be determined by three main factors: the Falkland Current, bottom morphology and suitable depth. Scallops have not been found on areas of hard rocky bottom, nor in waters greater than 145m deep. In Falkland waters no inshore scallop beds have yet been found (Munro 2004).

## 6.8. Marine Mammals

Both pinipeds (seals) and cetaceans (whales, porpoise and dolphins) are present in Falkland Island waters. The elephant seal, sea lion and fur seal are all known to breed on the Falkland Islands. Although the leopard seal has been spotted in some areas it is not believed to breed there. Various species of cetacean can regularly be spotted from the islands, either from beaches or further out into deeper waters.

The at-sea surveys conducted between 1998 and 2000 by the JNCC and Falklands Conservation have added greatly to the level of knowledge regarding the frequency and distribution of marine mammals, particularly cetaceans, in this area. These surveys were a direct result of hydrocarbon exploration, with initial funding provided by FOSA for the at-sea surveys of seabirds and marine mammals. Additional funding has been provided to Falklands Conservation by FIG in order that the programme of surveys could continue for a further 2 years. The final report (White et al, 2002) therefore summarises 3 years of survey work and updates and expands the distribution atlas published after the first year of the project.

The aim of the report is to; "present the results of the study in a way that will assist the assessment of the likely impact of human use of the marine environment on seabirds and marine mammal populations in the area". It is therefore well suited for this environmental impact assessment and has been used extensively in the following section.

The at-sea surveys encompassed an area defined by a box extending north and east from 56º S 64º W. As the focus of this EIA is the North Falkland Basin, the area shown graphically in the following figures has been cropped just south of the main Islands at 53º S. This allows impacts to the shoreline of the Islands to be taken into account, for example in assessing the effects of offshore oil spills.

#### 6.8.1. Cetaceans

Both Peale's dolphin and Commerson's dolphin are commonly seen from land and are known to breed locally, although nothing is known about the population size of these species. For most other species there is little information available regarding their status in Falkland Islands waters.

The effects of oil pollution on marine mammals is poorly understood (White et al, 2002), with the most likely immediate impact of an oil spill on cetaceans likely to be the risk of inhalation of oil vapours.

The marine mammal sighting maps shown on the following pages are based on the figures presented in White et al (2002), modified for the area of interest and to show the proposed drilling location (Tranches C and D). A total of 6,550 marine mammals of 17 species was recorded during the surveys (5,463 cetaceans, 1,087 pinnipeds). Refer to Figure 24 and Figure 25 for distribution maps of marine mammal sightings over the survey period.

Although the at-sea surveys have greatly expanded the level of knowledge regarding marine mammals in this area, the results are subject to a variety of factors including survey effort and weather conditions. It is recognised in the report that a lack of sightings in some cases may be due to reduced survey effort in certain water depths, rather than any behavioural changes.

On a number of occasions large whales were observed during the survey that could not be specifically identified. A total of 44 unidentified large whales was recorded on 40 occasions, primarily between November and March. A summary of the distribution of identified marine mammals is given below:

**Fin whale** *Balaenoptera physalus*

The majority of fin whales were recorded between November and January, with 57 recorded in total on 27 separate occasions. Sightings were generally in water depths >200m.

**Sei whale** *Balaenoptera borealis*

Most sei whale sightings took place between November and April, with 45 animals recorded on 31 occasions. Most records were from Patagonian Shelf waters around East Falkland, with sightings in other areas generally coming from relatively shallow waters.

**Minke whale** *Balaenoptera acutorostrata*

Minke whale sightings peaked in April and December, with a total of 68 whales recorded on 60 occasions. The majority of records were from Patagonian Shelf waters around East Falkland and in the north-west of the survey area.

**Sperm whale** *Physeter macrocephalus*

A total of 28 sperm whale were recorded on 21 occasions, mainly in July, October and December, but also present throughout most months. All sperm whale sightings occurred in deeper waters (>200m), with records clustered to the south and to the north of the islands.

**Southern bottlenose whale** *Hyperoodon planifrons*

Southern bottlenose whales were recorded between September and February, with a total of 34 records on 18 occasions. All sightings were made in waters >1000m, generally to the north, east and south of the islands.

**Long-finned pilot whale** *Globicephala melas*

A large number of records were made of long-finned pilot whale (872 over 27 occasions), with group sizes of up to 200 animals sighted. Although these whales were recorded in all months except January, they were predominantly recorded between April and September and in waters deeper than 200m.

**Hourglass dolphin** *Lagenorhynchus cruciger*

Hourglass dolphin were also recorded in large numbers, with 866 Sightings over 177 occasions, mainly between September and March and in water depths of greater than 200m.

**Peale's dolphin** *Lagenorhynchus australis*

Peale's dolphin was the most numerous and frequently recorded cetacean with a total of 2,617 animals recorded on 864 occasions. Peale's dolphin was recorded in all months with a maximum of 358 animals recorded in August. They were generally found only in waters less than 200m deep and are therefore unlikely to be seen in the proposed drilling area.

**Commerson's dolphin** *Cephalorhynchus commersonii*

A total of 336 Commerson's dolphin was recorded on 100 occasions, covering all months except May. It is expected that the dip in records over May and June is due to variation in the level of survey effort rather than seasonal variations. No Commerson's dolphin were recorded greater than 25km offshore.

In addition to the sightings described above, several species of marine mammals were recorded on few than 10 occasions and are therefore described as rare in White *et al* (2002):

**Southern right whale** *Eubalaena australis*

Two records, each of two animals, were recorded in 1998, a further record was made in June 2000 and two additional records of single animals in January 2001. Although the majority of sightings were to the north of the Falkland Islands, the low number sightings make geographic or seasonal modelling inaccurate.

**Humpback whale** *Megaptera novaeangliae*

Seven records were made over five occasions, all between October and March in Patagonian Shelf waters. Most records were made to the north-west of the Islands.

**Unidentified beaked whale species** *Mesoplodon spp.*

There were 15 animals sighted in seven occasions, none were specifically identified. All records were in waters deeper than 1000m to the east of the islands.

**Killer whale** *Orcinus orca*

A total of 18 animals were recorded in seven occasions, mainly in coastal and Patagonian Shelf waters. These sightings took place throughout the year in groups of between 1 and 4 animals. Longline fishing vessels have also reported interaction with killer whales in deep waters to the north and east, where they are understood to remove fish from the lines (Munro, 2004).

**Southern rightwhale dolphin** *Orcinus orca*

Southern rightwhale dolphin were recorded on 5 occasions totalling 231 animals, all in deep waters to the east of the Falkland Islands.

Not included in White et al (2002), but described within Munro (2004) as having been recorded in Falkland Islands waters are dusky dolphins (*Lagenorhynchus obscurus*), bottlenose dolphin (*Tursiops truncatus*) and spectacled porpoise (*Phococena dioptica*). The lack of any sighting over the three year survey period indicates that these animals are unlikely to be present in the licence area in significant numbers.

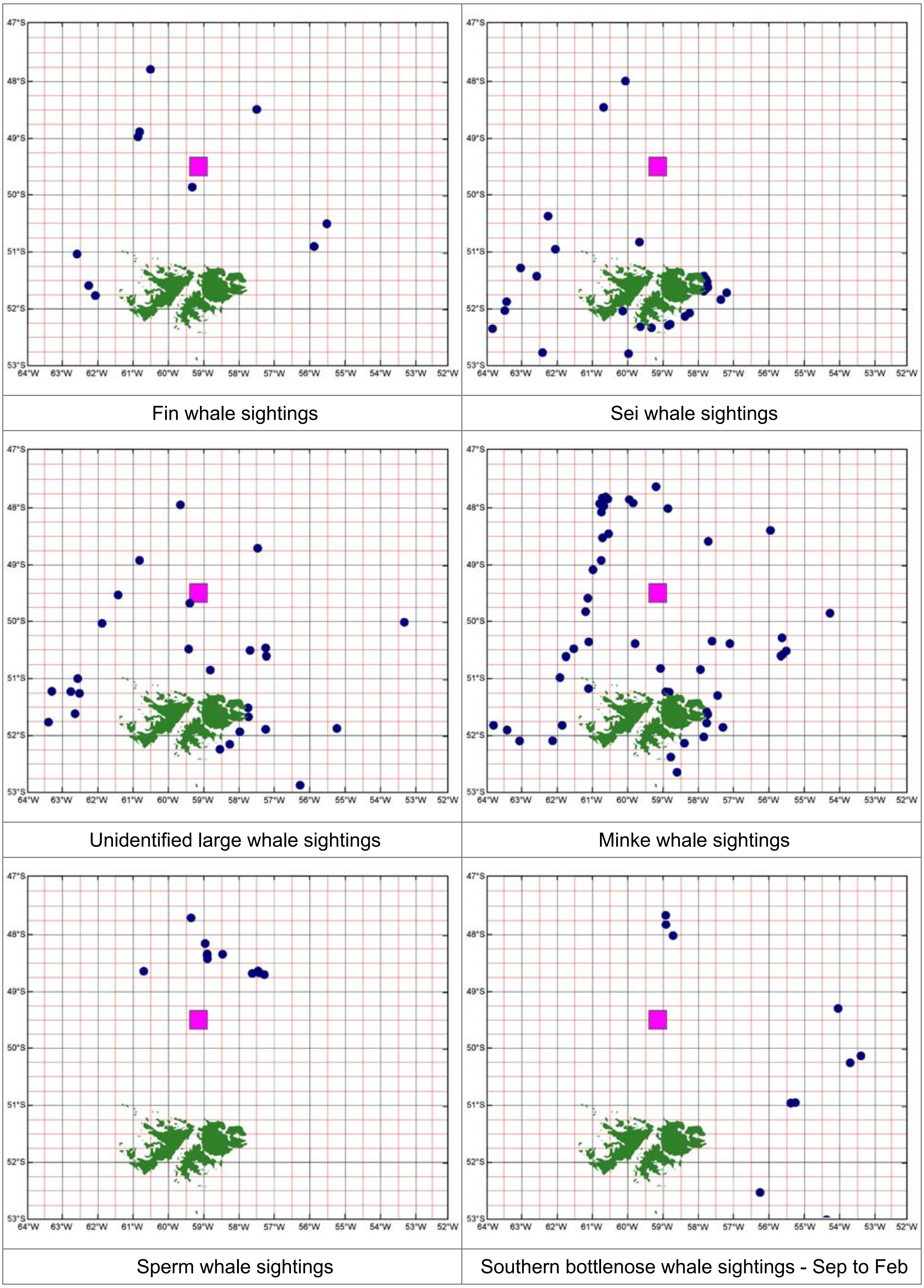
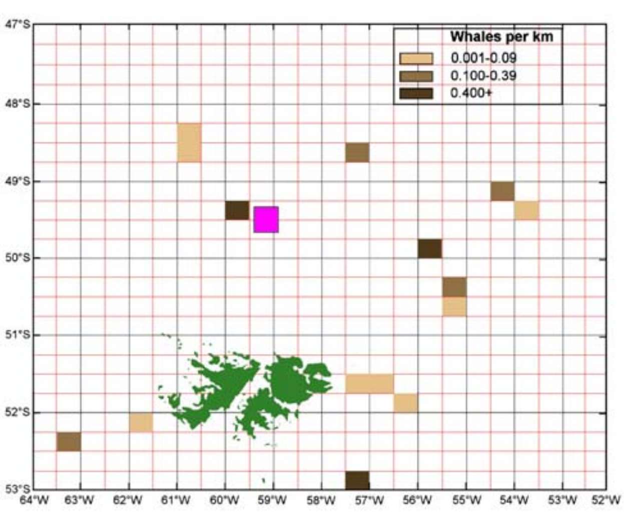
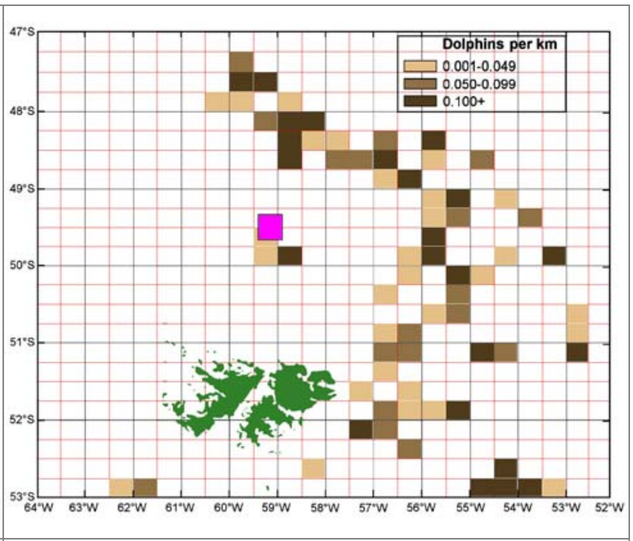


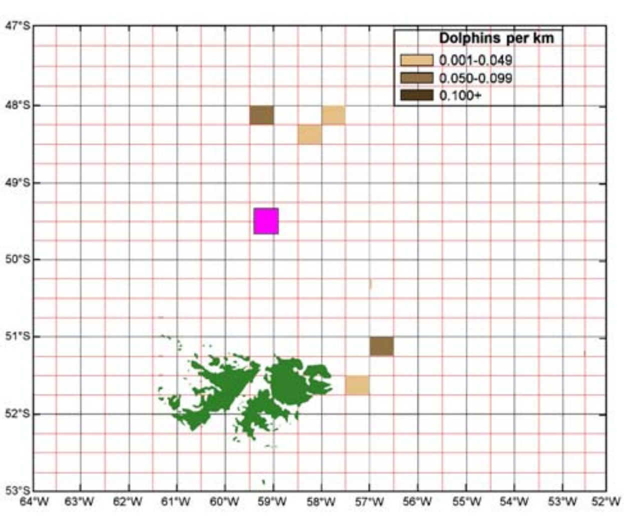

**Figure 24:** Cetacean distribution (based on surveys from February 1998 to January 2001)



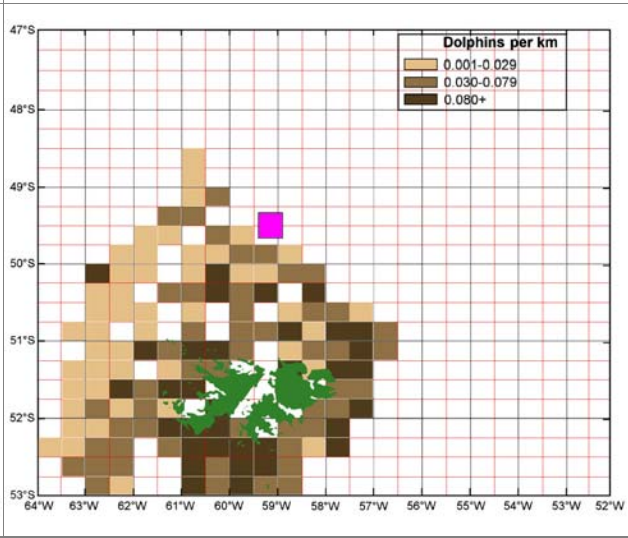

Long-finned pilot whale distribution



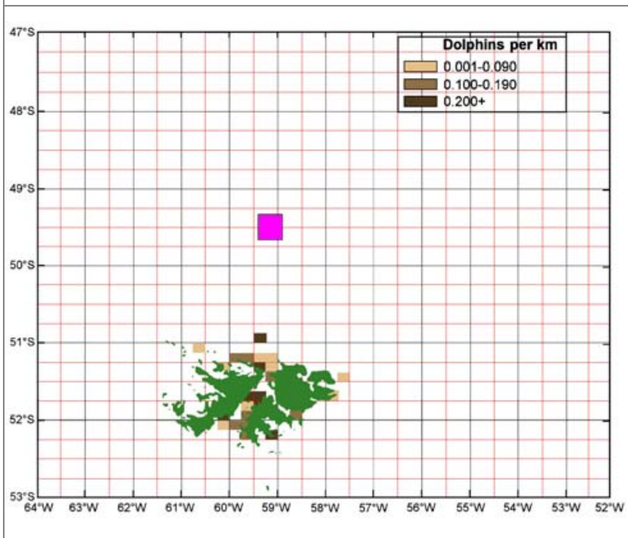

Hourglass dolphin distribution - September to March




Hourglass dolphin distribution - April to August




Peale's dolphin distribution




Commerson's dolphin distribution

**Figure 25:** Cetacean distribution (based on surveys from February 1998 to January 2001)

In conclusion, of the 14 species of cetacean likely to be present in Falkland Islands waters only hourglass dolphins were recorded over the surveying period within Tranches C or D. Based on known habits and nearby records, it is also possible that long-finned pilot whales and fin whales would be present in this area, depending on the time of year at which drilling takes place.

The area for proposed drilling is therefore not considered to be an area of particularly high sensitivity for cetaceans.

### 6.8.2. Pinnipeds

Four seal species are reported as occurring in the Falkland Islands, with three species breeding and one occurring as vagrant. Breeding seals will generally rely on near-shore areas for their food source, whereas non-breeding seals will prey on small fish and the occasional penguin further offshore (Munro 2004).

Only three species of pinniped were recorded in the three year offshore distribution survey (White et al 2002):

**South American sea lion** *Otaria byronia*

The Falkland Islands population of South American sea lions is estimated to be in the region of 3,385 animals (Strange 1990). A total of 81 South American sea lions was recorded on 77 occasions, peaking in October and at it slowest in June. Most records were from coastal or Patagonian Shelf waters and no sightings were made in the licence area.

**South American fur seal** *Arctocephalus australis*

The South American fur seal population in the Falkland Islands is estimated at 18-20,000 animals (Strange 1992). While the majority of records will refer to the South American fur seal, it is expected that some will refer to the Antarctic fur seal, which may also visit Falkland Islands waters during the winter period. A total of 937 fur seals was recorded on 442 occasions, peaking in June, July and November. Fur seals are likely to be encountered in the licence area, particularly between June and October.

There are 15 known breeding sites within the Falklands, with breeding commencing early November. Females may then remain close to the breeding site throughout the year.

**Southern elephant seal** *Mirounga leonina*

A total of 13 southern elephant seals was recorded, with animals recorded throughout the year, although all records north of 50º S occurred between January and May. All recorded animals were in waters to the north of the Falkland Islands, however none was recorded close to the licence area.

The largest breeding site of Elephant Seal is found on Sea Lion Island where there are over 500 pairs. This is located to the south of the islands and is highly unlikely to be impacted in any way by exploration activity in the North Falkland Basin. Southern elephant seals are thought to disperse widely in search of food and it is probable that they feed in deeper oceanic waters off the continental slope to the east of the islands (Munro 2004).

Additional species known to be present in the Falkland Islands (either breeding or as visitors) are described in more detail in Munro (2004):

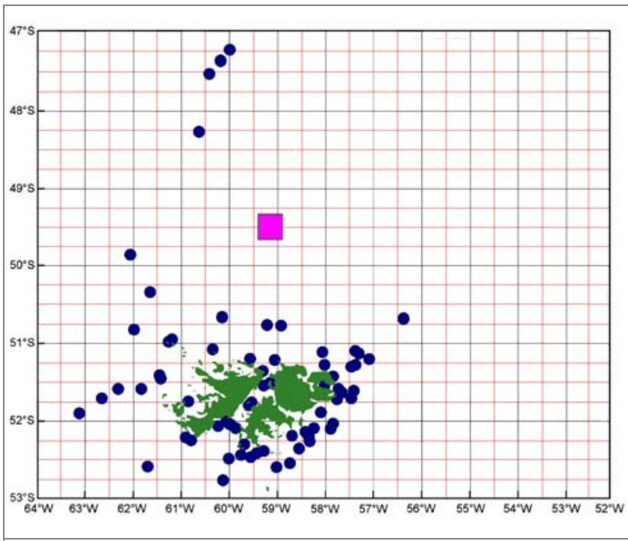
**Southern sea lion** *Otario flavescens*

The Falklands are estimated to hold no more than 5% (approximately 7000) of the world population of southern sea lion, which breed in small colonies at a large number of sites throughout the islands. Census of southern sea lions were conducted in 1995 and 2003 and showed a small decrease in numbers (3.8%). Due to the small size of the Falklands population it should be considered as vulnerable (Munro 2004). Coastal pollution is considered one of the potential risks to population numbers. As sea lions are believed to be shallow benthic feeders, they are unlikely to be impacted on by normal (non emergency) offshore operations.

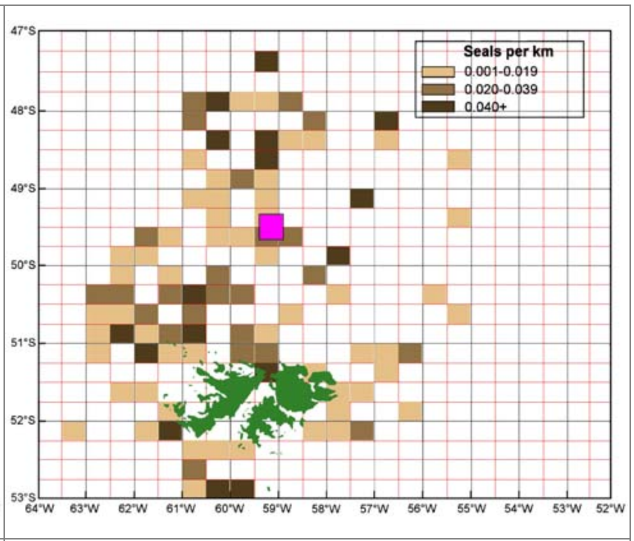
**Leopard Seal** *Hydrurga leptonyx*

The leopard seal is a winter visitor to the Falkland Islands, with only occasional sightings reported to Falklands Conservation. They are known to breed on sub-Antarctic pack ice and are highly unlikely to be impacted by normal offshore drilling operations.

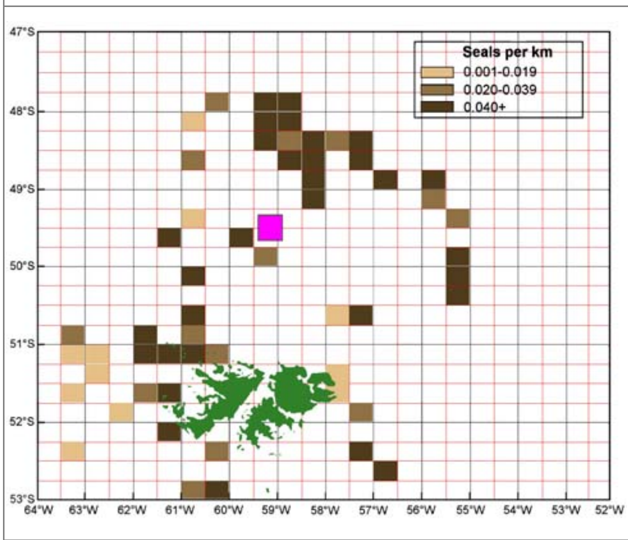
Based on the distribution survey and further descriptions in Munro (2004), there is believed to be a low risk to populations of pinnipeds from offshore oil and gas operations. In the event of a catastrophic event such as well blow-out, modelling suggests that a spill from the North Falkland Basin would not reach the coastline. Risks to breeding populations and haul out locations are therefore also considered to be low.



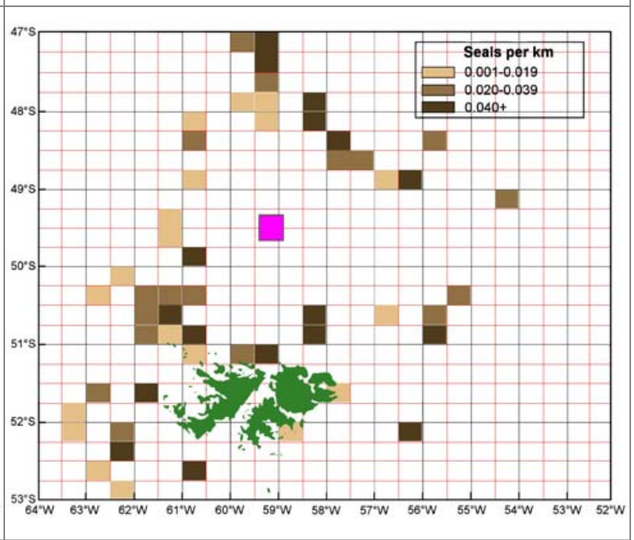

South American sea lion distribution



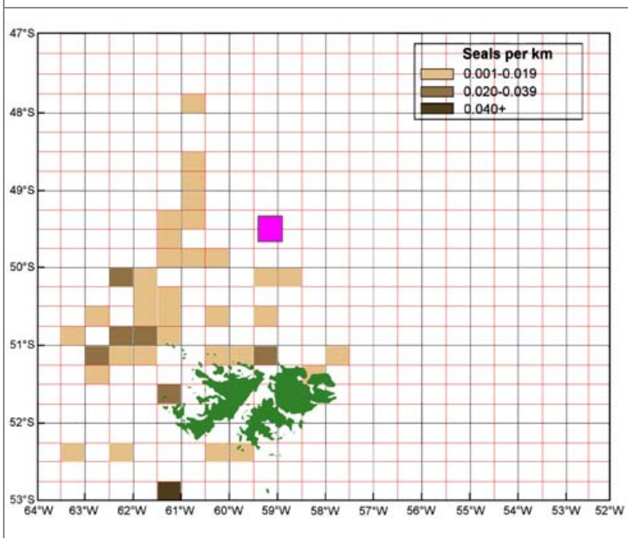

Fur seal distribution, June to October



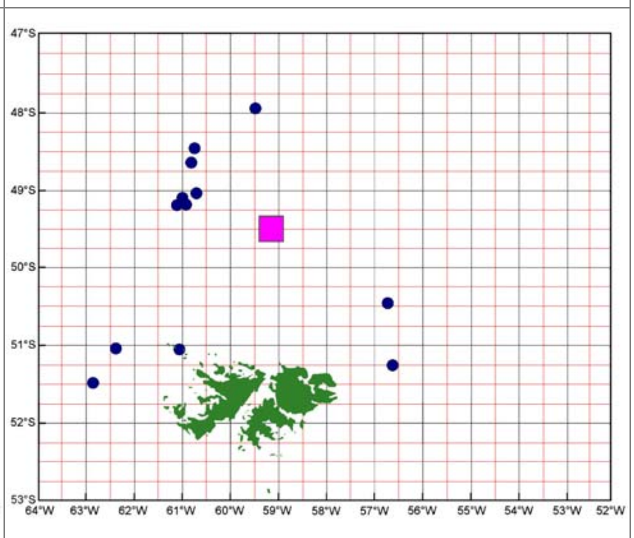

Fur seal distribution, November




Fur seal distribution, December to January




Fur seal distribution, February to May




Southern elephant seal distribution

**Figure 26:** Pinniped distribution (based on surveys from February 1998 to January 2001)

## 6.9. Birds

The avifauna of the Falkland Islands is fairly well documented (Munro, 2004), with 21 resident landbirds, 18 waterbirds, 22 breeding seabirds, 18 annual non-breeding migrants and at least 139 occasional visitors (Woods *et al*, 2004). The Islands are considered to be highly important for birdlife, with seabirds considered to be of particular significance.

Over half the breeding birds on the Islands are largely dependent on the sea for food. There are five different species of breeding penguin in the Falkland Islands (rockhopper, Magellanic, gentoo, king and macaroni). The Islands are the most important world site for the endangered rockhopper penguin and are also home to 80% of the world's breeding population of black-browed albatross. Several rare and threatened species of petrel nest on offshore islands.

There are 9 species of birdlife listed as of global conservation concern (Birdlife, 2004):

- The black-browed albatross is classified as "Endangered".
- The rockhopper penguin, macaroni penguin, southern giant petrel, white-chinned petrel and Cobb's wren are all currently classified as "Vulnerable".
- The gentoo penguin, Magellanic penguin and striated caracara are all classified as "Near Threatened"

Extensive at sea surveys from both patrol vessels and fishing vessels have built up a considerable level of knowledge regarding seabird distribution at sea and seabird foraging ranges (White *et al*, 2002). Over the previous 20 years there have been a number of major survey programmes for specific species and groups of species, including:

- The Falkland Islands Seabird Monitoring Programme (1986-2004)
- 5 yearly penguin census
- 5-yearly black-browed albatross census
- Census and distribution for striated caracara (1999)
- Survey of breeding sites for tussac bird and Cobb's wren

Of particular relevance to this environmental assessment is the "Vulnerable Concentrations of Seabirds in Falkland Islands Waters" (White *et al*, 2001). This report summarises two years of survey work between February 1998 and January 2000 in the form of a vulnerability atlas, highlighting the locations of seabird concentrations most vulnerable to the effects of surface pollution. The survey effort was carried out by the JNCC, under contract to Falklands Conservation and prioritised two core study areas: those areas licensed at the time for hydrocarbon exploration; and those areas earmarked for future hydrocarbon exploration. A summary of the findings of this survey is given below.

"The distribution of seabirds and marine mammals in Falkland Island waters" (White, 2002) has also been used extensively to provide a synopsis of seabird species, numbers, locations and sensitivities. The report summarises three years of survey work undertaken in Falkland Island waters between February 1998 and January 2001.

Full details of the methods used for this survey can be found in Tasker et al (1984) and Webb and Durinck (1992). A description of seabird species found in the Falkland Islands is given in the text below, followed by a discussion of their vulnerabilities to impacts from oil and gas exploration activities. This section is not intended to be a comprehensive description of all avifauna present in the Falkland Islands and focuses on seabirds as those species most vulnerable to the potential impacts of offshore drilling activity.

A full species checklist of mammals, freshwater fish and birds, as produced by Falklands Conservation, is provided in Appendix VI.

### 6.9.1. Penguins Spheniscidae

| Species: | |
|---|---|
| King penguin | *Aptenodytes patagonicus* |
| Gentoo penguin | *Pygoscelis papua* |
| Chinstrap penguin | *P. antarctica* |
| Rockhopper penguin | *Eudyptes chrysocome* |
| Macaroni penguin | *Eudyptes chrysolophus* |
| Magellanic penguin | *Speniscus magellanicus* |

Nine species of penguin have been seen in the Falklands, of which 5 species are known to breed regularly. Six species were recorded during surveys (shown above). The Falkland Islands population of king penguin is almost entirely concentrated at Volunteer Point. The population is healthy and growing at a current rate of approximately 15 chicks per year. As this population makes up only 0.04% of the world population, it is considered to be of local rather than global importance (Munro 2004), however the fact that the population is limited to one site increases its vulnerability, particularly to a polluting event.

By mid-winter birds begin to forage north of the Falklands, in an area used by many bird species as a winter feeding ground (Patagonian continental shelf and slope waters within the Antarctic Polar Frontal Zone). In total 151 king penguins were recorded during the at-sea surveys on 81 occasions, almost entirely between May and November. Birds were recorded throughout the survey area, mainly to the north of the islands.

The gentoo penguin is numerous and widely distributed throughout the Falkland Islands, although most are found around West Falkland and the outer islands. The present population is estimated at 113,000 breeding pairs (Clausen & Huin, 2003) and annual counts have shown that the overall population has either been stable or increasing in recent years. Tracking of foraging gentoo penguins shows that the birds remain in predominantly inshore waters, although in winter foraging trips may be undertaken up to 300km from the coast.

A total of 3,896 gentoo penguins was recorded, covering all months but with an increase between April and September. They are only likely to be found outside coastal waters between April and November, with densities in offshore areas generally low.

Chinstrap penguins do not breed in the Falkland Islands, however a total of 24 individuals were recorded on 10 occasions. All records occurred between August and October in the extreme south-east of the survey area, a considerable distance from the North Falkland Basin.

Rockhopper penguins are found in greatest numbers in the outer islands of West Falkland. There are around 52 breeding sites on the islands, with a population estimated at 272,000 breeding pairs (Clausen & Huin, 2003). As the Falklands hold the world's largest population of rockhopper penguins, the colonies are considered to be of international importance (Munro 2004). This species is now classified as "Threatened" by the IUCN (Birdlife, 2004).

Annual surveys conducted at selected sites suggest that the rockhopper population has stabilised since the early 1990's, although there are still occasional periodic annual declines from which the populations do not fully recover. Tracking of rockhopper penguins has shown that they are likely to be present in the licence area on foraging trips.

While the macaroni penguin is the least common breeding penguin in the Falklands with probably no more than 100 pairs present (Woods, 1997), globally it is the most common with millions of pairs present in the southern Atlantic and Indian Oceans (Munro 2004). The occurrence of vagrant individuals in the Falklands is therefore of only local interest.

A total of 2,980 eudyptod penguins were recorded made up of 1,357 rockhopper penguins, 45 macaroni penguins and 1,578 as either rockhopper or macaroni. Based on the available evidence this last figure was incorporated with the rockhopper results for the purposes of analysis. Most rockhopper penguin records occurred between September and April. Records occurred throughout the conservation zones but were restricted to mainly coastal and Patagonian Shelf waters from December to March.

A total of 45 macaroni penguins were recorded over 13 occasions between June and October, all to the north and east of the islands.

The Magellanic penguin is numerous around the whole Falkland Islands coastline and it is estimated that the population numbers in the region of 200,000 breeding pairs. As this is a significant proportion of the world population, the Falkland Islands are regarded as internationally important for this species. There is a low breeding success rate for Magellanic penguins, making them highly vulnerable to external threats including oil pollution. Penguin tracking has shown that they are likely to travel through the licence area during long foraging trips into deeper waters, although they are likely to be absent from Falklands waters over winter.

In excess of 12,000 Magellanic penguins were recorded during the at-sea surveys, the majority between November and April. Few were recorded between May and August, with the highest densities recorded between December and February, primarily in inshore waters. Some locally high densities were recorded over Patagonian Shelf waters and continental shelf slope waters to the north of the islands.

### 6.9.2. Albatrosses Diomedeidae

| **Species:** | |
|---|---|
| Wandering albatross spp | *Diomedea exulans spp.* |
| Northern royal albatross | *Diomedea sanfordi* |
| Southern royal albatross | *Diomedea epomophora* |
| Black-browed albatross | *Thalassarche melanophris* |
| Shy albatross | *Thalassarche cauta* |
| Grey-headed albatross | *Thalassarche chrysostoma* |
| Light-mantled sooty albatross | *Phoebetricia palpebrata* |

Of the species listed above, only the black-browed albatross breeds in the Falkland Islands. It is estimated that the Falkland Islands population of black-browed albatross (around 382,000 breeding pairs) may represent 70% of the world population. The Falklands are therefore of critical international importance for the conservation of this species (Munro 2004).

Albatross species are in decline globally. Populations in the Falklands are reported to have declined by 28% in the last 20 years, with the rate of decline accelerating over the last 5 years. The black-browed albatross has now been reclassified as "Endangered" by Birdlife International. Outside of the breeding season, adults spend all of their time at sea and birds are likely to forage in and travel through the licence area. The main threats to the albatross and probable reason for the significant decline in numbers has been ascribed to longline and trawl fisheries. One analysis of longline fishing over the continental shelf of Argentina, Uruguay and Brazil showed that longline fishing effort may be responsible for between 4,000 and 16,800 black-browed albatross deaths (Huin 2001).

Other species of albatross that may be seen in Falkland Island waters, together with current threat status according to Birdlife International are the wandering albatross (Vulnerable), northern and southern royal albatross (Vulnerable and Endangered), shy albatross (Near Threatened), grey-headed albatross (Vulnerable), light-mantled sooty albatross (Near Threatened) and sooty albatross (Endangered). All albatross species would be at risk from surface oil pollution.

Wandering albatross were recorded by the at-sea surveys for all months, with a peak in November and highs between January and April. They were locally abundant in all deep waters surveyed, particularly to the east of the islands.

Of the 4,114 royal albatrosses recorded, 3,252 were identified as southern and 447 as northern (with 415 not determined). Highest numbers of southern royal albatross were seen between March and June, particularly to the north-west of the islands. Highest numbers of northern royal albatross were seen between March and July, generally in the same areas as the southern.

Black-browed albatross were recorded in all months, with a total of 84,614 birds recorded, reaching a peak in March. Between November and January the highest densities occurred in inshore waters to the west of the islands. Between February and June high densities occurred throughout Patagonian Shelf waters to the north-west of the islands and between July and October high densities shifted to the south-west of the islands.

Shy albatrosses are non-breeding visitors and a total of 25 were recorded during the survey, all between January and May. The majority of records were from the north and west of the islands.

A total of 1,321 grey-headed albatross was recorded, covering all months with a peak between May and September. Distribution varied throughout the year, with records over the licence area occurring between February and September.

The light-mantled albatross is also a non-breeding visitor. In total 24 were recorded during the survey, mainly between August and November and in waters deeper than 200m to the east of the islands.

### *6.9.3.* Petrels and shearwaters *Procellariidae*

| **Species:** | |
|---|---|
| Northern giant petrel | *Macronectes halli* |
| southern giant petrel | *giganteus* |
| Antarctic petrel | *Thalassoica antarctica* |
| Cape petrel | *Daption capense* |
| Antarctic fulmar | *Fulmarus glacialoides* |
| Blue petrel | *Halobaena caerulea* |
| Kerguelen petrel | *Pterodroma brevirostris* |
| Soft-plumaged petrel | *Pterodroma mollis* |
| Atlantic petrel | *Pterodroma incerta* |
| Prion spp | *Pachyptila spp* |
| Grey petrel | *Procellaria cinerea* |
| White-chinned petrel | *Procellaria aequinoctialis* |
| Great shearwater | *Puffins gravis* |
| Sooty shearwater | *Puffins griseus* |
| Little shearwater | *Puffins assimilis* |
| Wilson’s storm-petrel | *Oceanites oceanicus* |
| Grey backed storm-petrel | *Garrodia nereis* |
| Black-bellied storm-petrel | *Fregetta tropica* |
| White-bellied storm-petrel | *Fregetta grallaria* |
| Common diving petrel | *Pelecanoides urinatrix* |
| Magellan diving-petrel | *Pelecanoides magellani* |

Petrels and shearwaters form the largest group of oceanic birds, with the most common species being the southern giant petrel. This species is widespread and common locally throughout the islands. At sea they take a variety of food from the surface. The Falklands hold a significant percentage of the world population and surveys have shown at-sea distribution to be concentrated mainly over Patagonian Shelf waters. Fishing related mortality is estimated to be around 100 birds per annum in Falklands waters and world populations are declining. The species is classified as "Vulnerable" (Birdlife 2000).

Giant petrels are divided between the northern and the southern, with only the southern giant petrel breeding regularly in the Falklands (population estimated at between 5000 and 10000 pairs, Woods and Woods 1997). In total 6,672 giant petrels were recorded in the at-sea survey, accounting for 3,535 southern and 751 northern giant petrel, with 2,386 recorded as unidentified giant petrel. Southern giant petrels were recorded in all months, peaking in June and with highest densities between March and June over Patagonian Shelf waters to the west and south of the islands.

Northern giant petrels were recorded throughout the year. Between March and August densities were highest to the north and west of the islands. From September to February sightings were less concentrated and more widely scattered. Northern giant petrels were less likely to be recorded in coastal or inshore waters.

A total of 56 Antarctic petrel were recorded, all between July and September in waters to the south and east of the islands. Antarctic petrels are winter visitors to the Falkland Islands.

Cape petrels were recorded in every month, with a total of 15,199 records made over the survey. Highest numbers were recorded between May and September. Cape petrels were only recorded in abundance to the north of the islands over this period, lessening off between October and November with very few records in this area throughout the rest of the year.

A total of 18,061 Antarctic fulmars were recorded, all between April and December. Highest densities were recorded in the North Falkland Basin between April and June, dropping between July and October with only occasional sightings for the rest of the year.

Blue petrels are another non-breeding visitor to the Falkland Islands, with all records coming in the period May to October. A total of 573 blue petrels were recorded, the majority in deep waters to the east and south-east of the islands. Records in the North Falkland Basin were rare.

A total of 152 Kerguelen petrel were recorded, almost wholly between May and November and mainly in the deep waters to the east of the islands. Peak numbers were recorded in August.

Soft-plumaged petrels are non-breeding late summer visitors to the islands, with records occurring between November to April, peaking in January. In total, 861 soft-plumaged petrels were recorded, mainly in deep waters to the north-east of the Falkland Islands. Low numbers were also recorded in the North Falkland Basin.

A total of 252 Atlantic petrels were recorded, primarily between October and March but with records in all months. Most sightings were to the north-east and south-east of the islands in deep waters.

Due to the difficulty in identifying prions to species level at sea, most records from the survey were for "prion species". A total of 119,610 records makes prions the most numerous seabirds encountered during the survey, with the highest numbers recorded between September and January. Highest densities were recorded to the west, north and south of the islands, with numerous sightings in the North Falkland Basin.

The fairy prion was identifiable at sea and has been recorded separately. In total 228 fairy prions were recorded, in all months except February, with peaks in April, August and October. This species was recorded primarily in continental shelf slope and oceanic waters, with very few records to the north of the islands.

Grey petrels were recorded mainly between December and March, with peak numbers n February. A total of 45 grey petrels were recorded, all in deep waters to the north and east of the islands.

The white-chinned petrel breeds in the Falkland Islands with a breeding population estimated at 1000 to 5000 pairs (Woods and Woods 1997). A total of 8,044 white-chinned petrel were recorded from the survey, encompassing all months but with the highest numbers between January and May. Most records were to the north and west of the islands.

Great shearwaters were recorded primarily between December and April, with almost none recorded between June and October. Total number of records was 6,468, mainly over shelf slope and oceanic waters to the east and north of the islands.

Sooty shearwaters breed on the Falkland Islands, with a population estimated at 10,000 to 20,000 pairs (Woods and Woods 1997). A total of 37,109 sooty shearwaters were recorded, mainly between September and March, with a peak in October. Most records occurred throughout inshore waters of the islands and shelf to the east and south-east.

A total of 24 little shearwaters was recorded, all between December and April with a peak in March. All records came from waters to the north and east of the islands.

Of the six species of storm petrels previously recorded within Falkland Island waters, four species were recorded during at-sea surveys. Wilson's storm-petrel breeds on the islands with an estimated population in excess of 5000 pairs (Woods and Woods 1997). A total of 21,019 Wilson's storm-petrels was recorded, mainly between October and June. Most records were to the west and north-west of the islands, although high densities also occurred to the north-east between November and February.

The Falkland Islands support between 1,000 and 5,000 breeding pairs of grey-backed storm-petrels (Woods and Woods 1997). A total of 2,758 grey-backed storm-petrels was recorded, mainly between September and March. Records occurred on all sides of the islands, with high densities recorded to the north of the islands from November to March.

Black bellied and white bellied storm-petrels were both recorded, primarily between December and February and in the deep waters to the north-east of the islands. There were 205 records of black bellied storm-petrels and 23 of white bellied storm-petrels. Numbers of both species peaked in January.

A total of 6,078 diving petrels were recorded, incorporating both the Magellan (133 confirmed) and common (753 confirmed) diving-petrel. The remainder were not specifically identified, but have been combined with common diving-petrel numbers for the purposes of the report. Most diving petrels were recorded between September and February, with greatest densities to the west and south of the islands.

### 6.9.4. Shags Phalacrocoracidae

| **Species:** | |
|---|---|
| Imperial shag | *Phalacrocorax atriceps* |
| Rock shag | *Phalacrocorax magellanicus* |

Three species of shags have been recorded in Falkland Island waters (Woods 1988). Two are resident breeding species (rock shag and imperial shag), the other (red-legged shag) is a vagrant that was not recorded during surveys.

The population of rock shags is estimated at between 32,000 and 59,000 pairs (Woods and Woods 1997). They are only found in the Falkland Islands and South America. A total of 796 rock shags were recorded, peaking in July and predominantly within enclosed or partially enclosed waters. All rock shag records were made within 27km of the coast, with evidence of birds remaining closest to the coast during summer.

The population of imperial shag in the Falkland Islands is estimated at 45,000 to 84,000 breeding pairs (Woods and Woods 1997). A total of 39,264 imperial shags was recorded during surveys, peaking between June and September. The majority of records were from inshore waters with birds moving further offshore during winter months.

### 6.9.5. Ducks Anatidae

| Species: | |
|---|---|
| Falkland steamer duck | *Tachyeres brachydactyla* |

Only one species of duck was recorded during the at-sea surveys off the Falkland Islands; the Falkland Steamer duck. Other species would be expected in coastal areas, including kelp goose and Patagonian crested duck. These species would therefore be more vulnerable to surface pollution in the event of a spill close to shore, but are not expected to be impacted from routine drilling operations in Tranches C and D.

The Falkland steamer duck has an estimated population in the islands of between 9,000 and 16,000 pairs (Woods and Woods 1997). A total of 699 Falkland steamer ducks was recorded during surveys, however all records were made in coastal waters with peak numbers recorded in April, tailing off to none in December.

### 6.9.6. Skuas Stercorariidae

| Species: | |
|---|---|
| Antarctic skua | *Catharacta Antarctica* |
| Arctic skua | *Stercorarius parasiticus* |
| Long-tailed skua | *Stercorarius longicaudus* |

Although five species of skua have previously been recorded in the waters of the Falkland Islands, only one species breeds in the islands and four species were recorded during the at-sea surveys.

The Falkland Islands support a population of between 5,000 and 9,000 pairs of Antarctic skua, the majority of the world population of this subspecies. Of the 737 *Catharacta* skuas recorded, 573 were recorded as Antarctic skuas, four as Chilean skuas and the remainder could not be accurately identified and were counted as Antarctic skuas for the purposes of the distribution atlas. Almost all records occurred between November and April, primarily in inshore waters. Between May and October few birds were recorded and these records were from further offshore to the north of the Falkland Islands.

Arctic skuas are summer visitors to the Falkland Islands and only 35 were recorded over the surveys, all between January and April. Distribution is divided between inshore waters and deeper waters to the north of the islands.

Long-tailed skuas were recorded in the waters off the Falkland Islands between November and April. A total of 239 long-tailed skuas was recorded, mainly in deep waters to the north and east of the islands. It is likely they would be found in the licence area, particularly between December and March when numbers are greatest.

### 6.9.7. Gulls Laridae

| Species: | |
|---|---|
| Dolphin gull | *Larus scoresbii* |
| Kelp gull | *Larus dominicanus* |
| Brown-hooded gull | *Larus maculipennis* |

Although seven species of duck have been recorded in the Falkland Islands, only the three species known to breed in the islands (listed above) were recorded during the at-sea surveys.

The Falkland Islands population of dolphin gulls is estimated at between 3,000 and 6,000 pairs (Woods and Woods 1997). This is possibly as much as 85% of the world population and makes the Falkland Islands population of global importance. A total of 114 dolphin gulls was recorded on 60 occasions, peaking in July and covering all months except March. Distribution was concentrated in coastal waters, with no gulls recorded more than 20km from the coast.

The Falkland Islands population of kelp gull is estimated at between 24,000 and 44,000 pairs (Woods and Woods 1997). A total of 2,288 were recorded during the surveys, covering all months with highest numbers between June and September. Records between November and April were primarily close to shore, whereas records from May to October were more widespread over Patagonian Shelf and continental shelf slope waters.

The Falkland Islands population of brown-hooded gull is estimated at between 1,400 and 2,600 pairs (Woods and Woods 1997), as compared to a world population of around 50,000 pairs. A total of 134 brown-hooded gulls was recorded during the survey over 69 occasions, covering all months with the highest recorded number in January. The majority of records were made within 10km of the coast, with a recorded maximum of 53km from the coast. Given the concentration of gulls primarily in coastal waters, impacts from routine drilling operations are unlikely, although these species may be impacted by near-shore operations or coastal spills.

### 6.9.8. Terns Sternidae

| **Species:** | |
|---|---|
| South American tern | *Sterna hirundinacea* |
| Arctic tern | *Sterna paradisea* |
| Unidentified sterna tern | *Sterna spp.* |

Three species of tern were recorded during the surveys (shown above), although six species have been previously recorded in Falkland Island waters (Woods 1988) and one species is known to breed in the islands.

A total of 1,894 South American terns was recorded during the surveys, covering all months but with highest numbers in March and April. The South American tern is the only species known to breed in the Falkland Islands. Distribution throughout all months was mainly in coastal waters.

Arctic terns are a summer visitor to the islands. A total of 21 Arctic terns was recorded during the surveys, all between October and March. Records occurred throughout the survey area, mostly in offshore areas. A number of unidentified sterna terns was also recorded. Of the 160 unidentified terns recorded in offshore waters, the majority was between April and November.

### 6.9.9. Rare seabirds

During the Seabirds at Sea Team surveys, fewer than ten records of the following species were made. Due to the low numbers of records made, modelling of spatial or monthly distribution is not considered meaningful.

- Sooty Albatross *Phoebetria fusca*
- Broad-billed prion *Pachyptila vittata*
- White-headed petrel *Pterodroma lessonii*
- Great-winged petrel *Pterodroma macroptera*
- Spectacled petrel *Procellaria conspicillata*
- Cory's shearwater *Calonectris diomedea*
- Manx shearwater *Puffinus puffinus*
- Grey phalarope *Phalaropus fulicarius*
- Chilean skua *Catharacta chilensis*
- Ceyenne tern Sterna *Sterna (sandvicensis) eurygnatha*

### 6.9.10. Seabird Vulnerabilities

The following figures are adapted from 'Vulnerable Concentrations of Seabirds in Falkland Islands Waters' (1998-2000). This report has been produced by the JNCC under contract to Falklands Conservation, with the assistance of funds from the FIG. Unshaded areas of these maps are unsurveyed. The grid pattern used for surveying is based on ICES Rectangles (International Council for the Exploration of the Sea), measuring 15' latitude by 30' longitude. ICES rectangles differ from the Block and Quadrant system used in offshore petroleum licensing.

The vulnerability of seabirds was assessed with regard to species-specific aspects of their feeding, breeding and population ecology. The methods used for development of the vulnerability atlas are complex and well documented (White *et al*, 2001) and are not expanded upon further here.

Vulnerability of seabirds to surface pollution is depicted in four shades ranging from pale (lowest vulnerability) to dark (highest vulnerability). Tranches C & D, the focus of the current drilling campaign, are shown as a pink square on the maps. A summary of the results of the seabird vulnerability survey for each month of the year, focusing on the proposed drilling area is given in the following paragraphs.

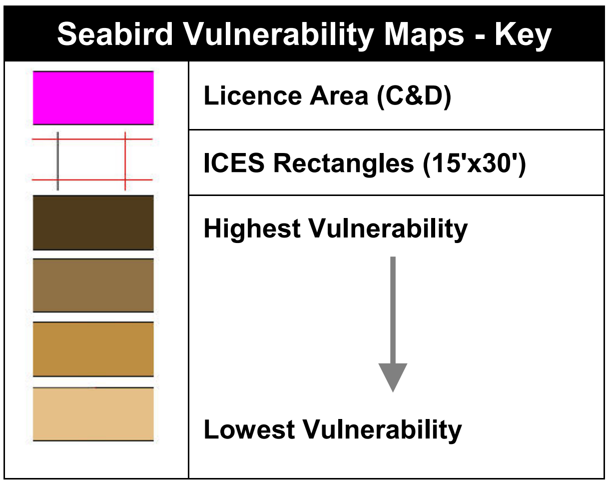
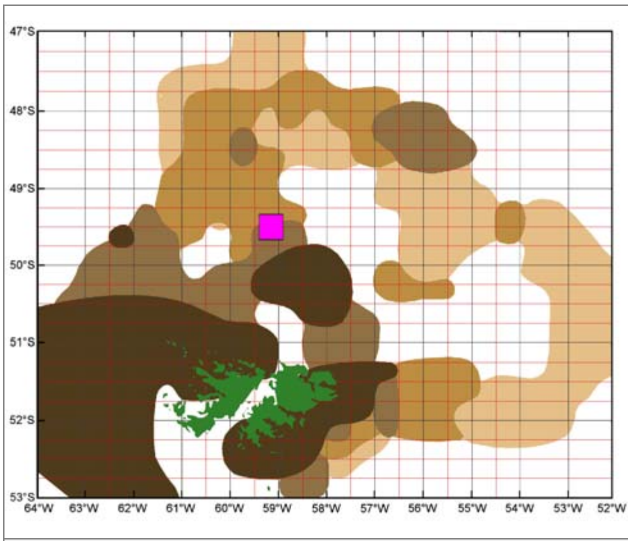
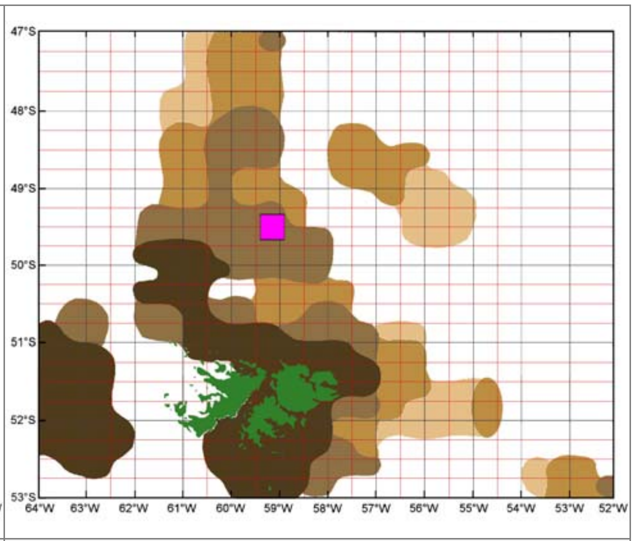


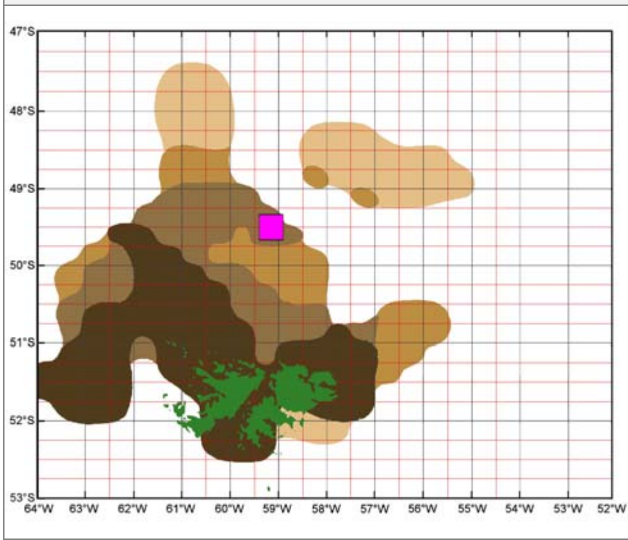

**Figure 27:** Key to the maps in Figures 28 and 29 showing vulnerability of seabird concentrations.



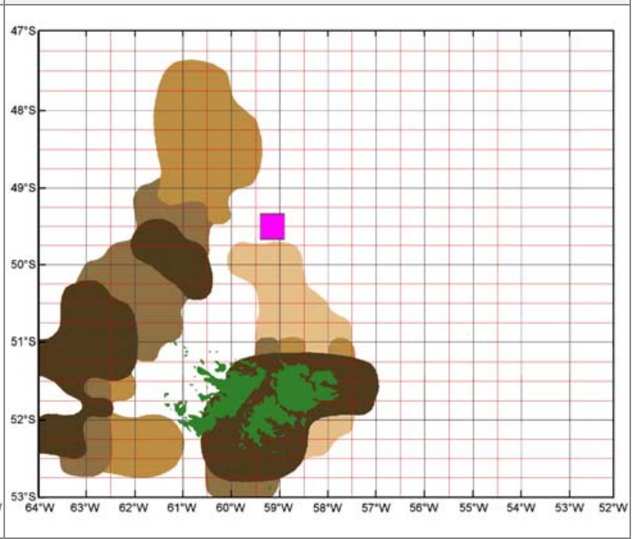

Vulnerability of seabird concentrations - January



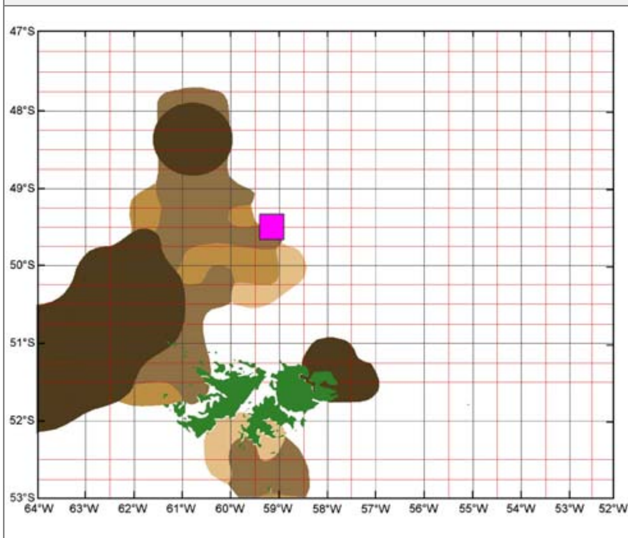

Vulnerability of seabird concentrations - February



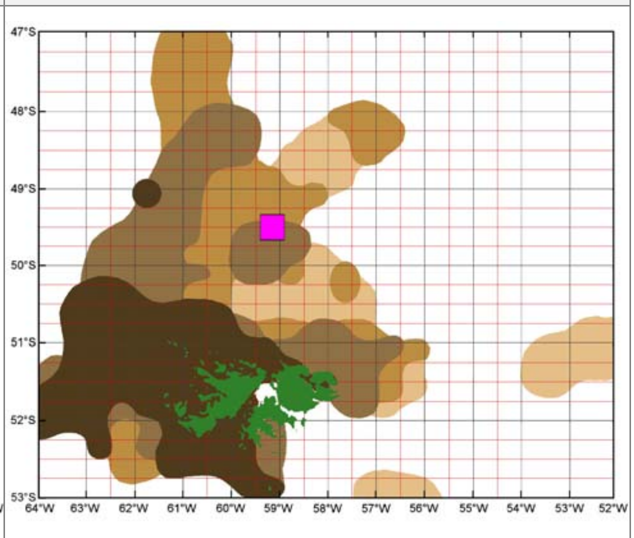

Vulnerability of seabird concentrations - March




Vulnerability of seabird concentrations - April

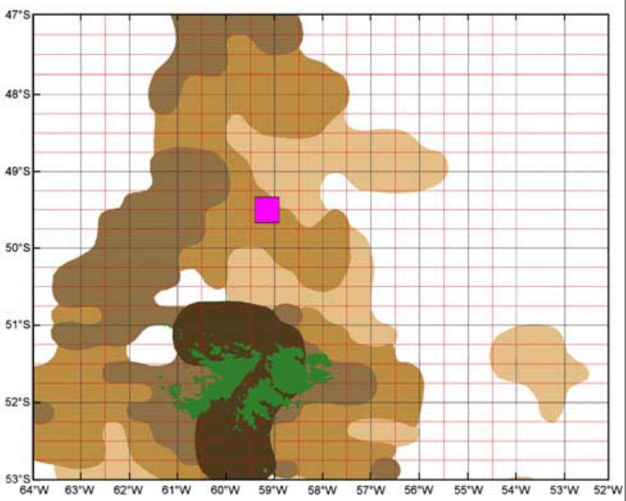



Vulnerability of seabird concentrations - May

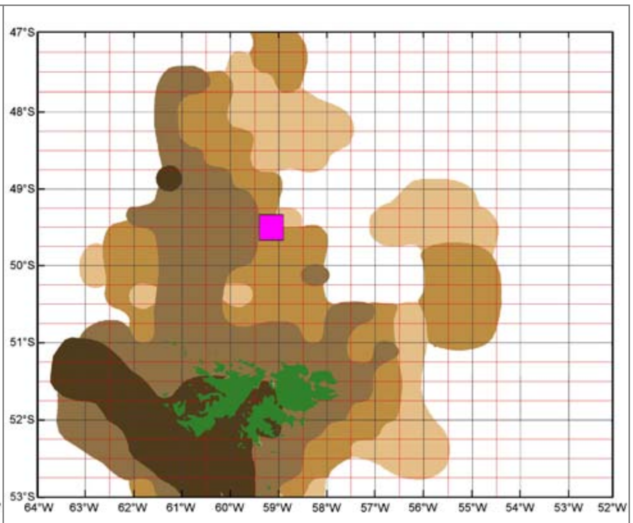



Vulnerability of seabird concentrations - June

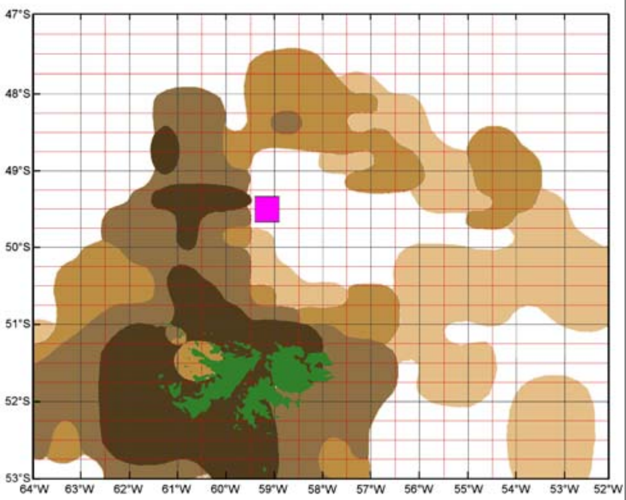
**Figure 28:** Monthly vulnerability of seabird concentrations to surface pollution January to June (based on surveys from February 1998 to January 2000)



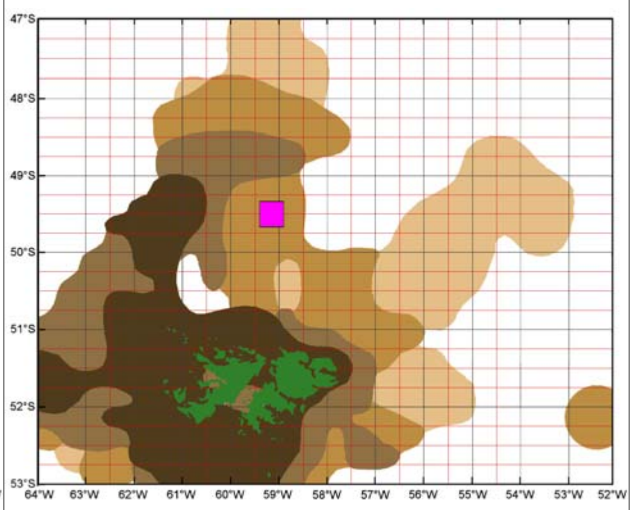

Vulnerability of seabird concentrations - July



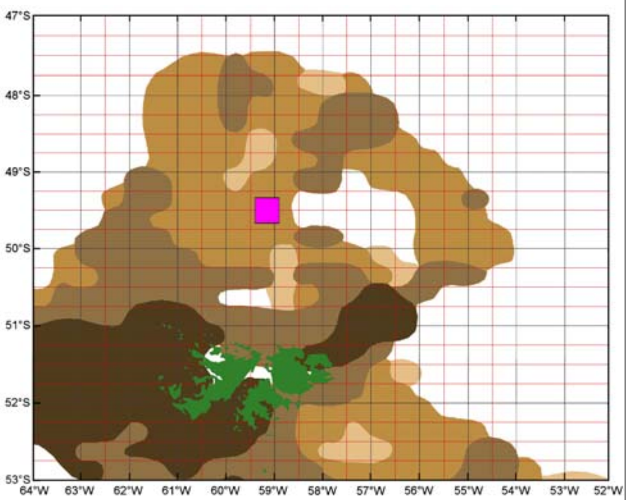

Vulnerability of seabird concentrations - August



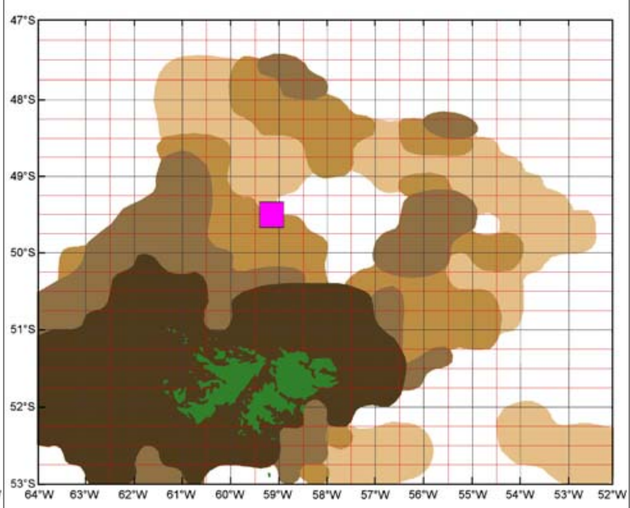

Vulnerability of seabird concentrations - September




Vulnerability of seabird concentrations - October




Vulnerability of seabird concentrations - November




Vulnerability of seabird concentrations - December

**Figure 29:** Monthly vulnerability of seabird concentrations to surface pollution July to December (based on surveys from February 1998 to January 2000)

Seabird vulnerability in January is highest in coastal and Patagonian Shelf waters, although there is also an area of high vulnerability north of the Islands, several kilometres south of the Tranche area. The main bird type in this area are the small petrels (prions, storm-petrels, diving-petrels and shearwaters).

Vulnerability in February is moderate to high, with a wide range of species present including prions, Wilson's storm-petrels, white-chinned petrels and black-browed albatrosses, plus grey-backed storm-petrels and great shearwaters towards the north. As with February, seabird vulnerability in March is highest in the inshore and Patagonian Shelf waters. Vulnerability in the licence area is similar to the previous month, with black-browed albatrosses, Magellanic penguins and great shearwaters supported in high densities.

April shows the licence area to be largely unsurveyed, although in general the northern licence blocks supported fewer seabirds at this time and so had low vulnerability. May shows a decrease in the vulnerability of nearshore areas and moderate vulnerability over the licence blocks, although survey coverage is again patchy. The area around Tranches C and D supported low or moderate concentrations of Cape petrels and black-browed albatrosses, with low numbers of grey-headed albatrosses, Antarctic fulmars and prions.

Seabird vulnerability for the drilling area in June is again low to moderate, with patchy distribution of prions, Antarctic fulmars and black-browed albatrosses. Vulnerability for July is similar to June with similar species found within the licence area. In August areas of high vulnerability are concentrated to the south and west of the Islands, although there is also an increase in vulnerability around the licence blocks, with black-browed albatrosses, diving petrels, prions and Cape petrels recorded in this area.

Survey coverage of the licence area in September was limited, but does show a probable increase in vulnerability for this area, particularly to the west of Tranches C and D. Likely species includes both albatrosses and small petrels (prions, storm-petrels, diving-petrels and shearwaters). Vulnerability in October again shows as low to moderate, with black-browed albatrosses, diving petrels, prions and Cape petrels record, but in low densities.

Extensive survey coverage was achieved in November, with the results showing low to moderate vulnerability with both petrels and albatrosses present. December demonstrates high levels of seabird vulnerability around the coast, but low to moderate levels for the licence area. Species present include black-browed albatrosses, Magallenic and rockhopper penguins, prions and Wilson's storm-petrels.

Based on the findings of this survey effort and the conclusions presented in the publication (White *et al*, 2001), the month with the highest overall vulnerability is February, while the month with the lowest vulnerability is July. Highest vulnerability broadly coincides with the breeding season for most seabird species in the islands. Concentrations of seabirds in coastal waters are more highly vulnerable to the effects of surface pollution than in all other areas. The deeper waters to the north of the licence area are generally of lower vulnerability than the shallower waters to the south. The licence area in general shows higher vulnerability between January and March, although at no time of the year do Tranches C and D fall under the category of highest vulnerability.

Although this summary has concentrated on the proposed drilling location, the Falkland Islands' coastline has been included on the adapted maps of seabird vulnerability to take account of the potential for migration of oil spills towards the coastline, particularly smaller spills from nearshore activity.

The vulnerability atlases have shown inshore waters to be particularly important over all months of the year, largely due to the presence of resident species with a predominantly coastal distribution such as the endemic Falklands steamer duck, imperial shag and gentoo penguin.

Other areas of importance to seabirds are the Patagonian Shelf waters to the north and west of the islands, which support high densities of black-browed albatrosses and royal albatrosses year-round. The low densities of seabirds encountered in deep water areas results in these areas being of generally low to moderate vulnerability for seabirds in all months (White *et al*, 2002).

Oiled seabirds were recorded in all three years of the survey, peaking between March and October, which coincides with the period of highest shipping activity. It is also important to account for the fact that many seabirds range throughout the Patagonian Shelf waters, so surface pollution in other areas may also have an impact on Falkland Island populations. An estimated 40,000 penguins die from oil pollution on the coast of Argentina each year, due primarily to chronic oil pollution such as the discharge of oily waste from ballast tanks.

It is noted in White et al (2002) that hydrocarbon exploration is just one of the threats facing seabird populations at sea and there is a growing awareness to the problems faced by albatross and petrel populations as a result of interactions with fisheries in the Southern Oceans.

## 6.10. Marine & Coastal Flora

In the Falkland Islands, the only major habitats believed to have suffered major declines are coastal tussac grass and scrub habitats dominated by native box and fachine (FIG Natural DRAFT Priorities 2005). The decline of tussac grass has been slowly halted. There is little or no data on changes in the extent of scrub habitats.

Tussac Grass is confined to coastal areas generally below 200m altitude and less than 300m from the coast. The pedestal of the tussac grass provides an important nesting habitat for a variety of bird species, with the leaves also providing valuable nesting cover.

Sand dunes in coastal areas may contain a variety of flora including sea cabbage (*Senecio candicans*), native rush (*Juncus scheuchzerioides*), shore meadow-grass (*Poa robusta*) and marram (*Ammophilia arenaria*) (Munro, 2004).

Seaweeds play a crucial role in the marine environment providing both habitat and forage for a variety of marine organisms (including the early life stages of commercially important squid species) as well as stabilising shorelines. The seaweeds of the Falkland Islands are however relatively poorly studied (Munro, 2004).

Coastal environments form several different zones. The intertidal area supports smaller marine algae, which are exposed during each tidal cycle. A zone of kelp exists between the extreme low water mark and up to 3-4m depth, with deeper waters supporting both giant kelp and tree kelp.

Giant kelp (*Macrocystis pyrifera*) is a common species in the southern hemisphere and ubiquitous around the shores of the Falklands. It is typically found in intertidal areas to a depth of between 3 and 6m and may also be found up to 1km from the shore. Many marine invertebrates live amongst or on kelp, providing an abundant food source for a variety of birds, mammals and invertebrates (Munro, 2004). In less extreme conditions kelp acts as a buffer to the shore, breaking the force of waves and strong westerly winds.

Tree kelps (*Lessonia sp.*) are found on most open coasts, with three species having been identified; *L.flavicans*, *L.frutescens* and *L. nigrescens*. *Lessonia* plants are usually found either entwined with the giant kelp canopy in depths of 3 to 20m or in depths further offshore, or in the sub-tidal inshore zones (Searles, 1978 cited in Munro, 2004).

The distribution of free-floating kelp patches in Falkland Islands waters was reported from the at-sea surveys carried out between February 1998 and January 2001 (White et al 2002). These areas are important for a wide range of bird species, with 22 species of seabird recorded as associating with free-floating patches of kelp.

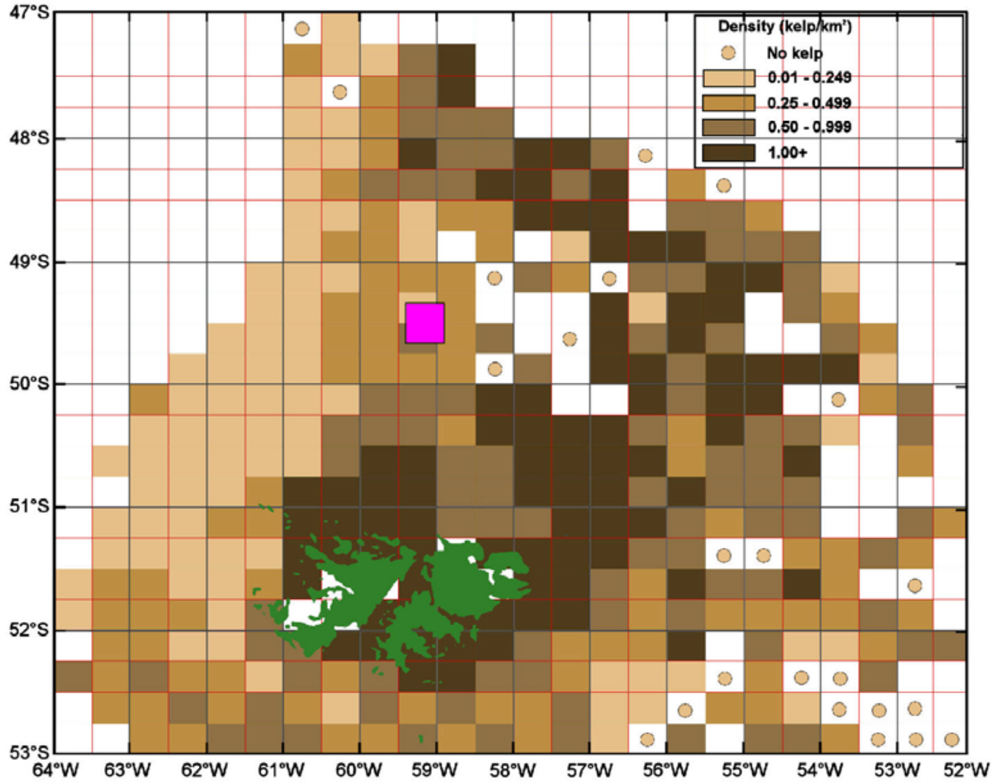



**Figure 30:** Distribution and abundance of kelp patches over all months (White *et al* 2002)

## 6.11. Protected and Vulnerable Species

The IUCN Red List 2004 includes a number of Falkland Island species, characterised as endangered, threatened or vulnerable to extinction. In some cases vulnerability arises from small population size (e.g. *Suaeda argentinensis*), whereas in others vulnerability arises from known rates of decline (e.g. black-browed albatross) (FIG DRAFT Natural Priorities 2005).

Individual protected species are described within the descriptions of flora and fauna. The list of species identified as under threat by IUCN is given in Appendix I.

## 6.12. Habitats and Protected Areas

There are three types of formal designation which operate in the Falkland Islands:

- National Nature Reserves (NNRs - designated under the Conservation of Wildlife & Nature Ordinance (1999);
- National Parks (under the National Parks Ordinance); and
- Ramsar sites (which require designation as NNRs for their protection & management).

Although the FIG have the power and ability to designate marine reserves, as yet no marine National Nature Reserves have been created in Falkland Island waters. Existing Nature Reserves previously designated under the Nature Reserves Ordinance 1964 and Sanctuaries designated under the Wild Animals and Birds Protection Ordinance 1964 have both been redesignated as National Nature Reserves.

| | Date | Order | Designated Area |
|---|---|---|---|
| Nature Reserve Orders | 1964 | Nature Reserves (Kidney & Cochon Islands) Order 1964 (1/64) | Cochon Island 51º 36'S 57º 47'W<br>Kidney Island 51º 38'S 57º 45'W |
| | 1966 | Nature Reserves (Flat Jason Island) Order 1966 (2/66) | Flat Jason 51º 06'S 60º 53'W |
| | 1969 | Nature Reserves (Bird Island) Order 1969 (4/69) | Bird Island 52º 10'S 60º 54'W |
| | 1973 | Nature Reserves (Crown Jason Islands) Order 1973 (10/73) | Elephant Jason 51º 09'S 60º 51'W<br>South Jason 51º 12'S 60º 53'W<br>North Fur Is. 51º 08'S 60º 44'W<br>South Fur Is. 51º 15'S 60º 51'W<br>Jason East Cay 51º 00'S 61º 18'W<br>Jason West Cay 50º 58'S 61º 25'W<br>The Fridays 51º 03'S 60º 58'W<br>White Rock 51º 17'S 60º 53'W<br>Seal Rocks 51º 07'S 60º 48'W |
| | 1978 | Nature Reserves (Sea Dog & Arch Islands) Order 1978 (2/78) | Sea Dog Island 52 00'S 61 06'W<br>Arch Islands 52 13'S 60 27'W<br>(Inc. Arch Island East, Natural Arch, Clump Island, Tussac Island, Pyramid Rock, Last Rock & Albemarle Rock) |
| Sanctuary Orders | 1964 | Wild Animals & Birds Protection (Sanctuaries)(The Twins) Order 1964 (2/64) | The Twins,<br>51º 15'S 60º 38'W<br>Adjacent to Carcass Island, West Falkland |
| | 1964 | Wild Animals & Birds Protection (Sanctuaries) (Low Island) Order 1964 (3/64) | Low Island,<br>51º 19'S 60º 27'W<br>Adjacent to Carcass Island, West Falkland |
| | 1964 | Wild Animals & Birds Protection (Sanctuaries) (Beauchene Island) Order 1964 (4/64) | Beauchene Island,<br>52º 54'S 59º 11'W |
| | 1966 | Wild Animals and Birds Protection (Sanctuaries) (Middle Island) Order 1966 (4/66) | Middle Island,<br>51º 38'S 60º 20'W<br>King George Bay, West Falkland |
| | 1968 | Wild Animals and Birds Protection (Volunteer & Cow Bay Sanctuary) Order 1968 (11/68) | Volunteer Point and Inside Volunteer, Cow Bay area of Carysford Camp.<br>51º 29'S 57º 50'W |
| | 1968 | Wild Animals and Birds Protection (Cape Dolphin Sanctuary) Order 1968 (12/68) | Extreme end of Cape Dolphin.<br>51º 15'S 58º 51'W |
| | 1970 | Wild Animals & Birds Protection (Bleaker Island Sanctuary) Order 1970 (3/70) | Bleaker Island north of Long Gulch.<br>52º 18'S 58º 51'W |
| | 1973 | Wild Animals & Birds Protection (Stanley Common and Cape Pembroke Peninsula Sanctaury) Order 1973 (1/73) | Stanley Common & Cape Pembroke.<br>51º 43'S 57º 49'W |
| | 1993 | New island South Sanctuary Order 1993 (14/93) | New Island South<br>51º 43'S 61º 18'W |
| | 1996 | Moss Side Sanctuary Order 1996 (26/96) | Pond and sand-grass flats behind Elephant Beach (Top Sandgrass Camp & Sorrel Pond Camp).<br>51º 23'S 58º 49'W |
| | 1998 | Narrows Sanctuary Order 1998 (53/98) | Narrows Farm, West Falkland.<br>51º 41'S 60º 19'W |
| | 1998 | East Bay Sanctuary Order 1998 (54/98) | East Bay Farm, West Falkland<br>51º 48'S 60º 13'W |

**Table 21:** National Nature Reserves incorporating existing Reserves and Sanctuaries

Important Bird Areas (IBAs) have also been defined and are an initiative of Birdlife International, a global partnership of conservation organisations. IBAs are identified according to a standard set of criteria applied consistently throughout the world, with Falklands Conservation responsible for the cataloguing and description of IBA's within the Falklands. IBAs do not form any part of an international agreement or convention. The Important Bird Areas program was created to address the increasing global threat to birds from habitat loss and fragmentation.

Through the programme, 21 sites of international conservation importance have been identified in the Falkland Islands, with a further 9 sites classified as potential IBA's. Of the 21 identified sites seventeen consist of islands and island groups and four are situated on the main islands of East or West Falkland. As yet no extension of IBA's has occurred to marine areas. The 21 IBA sites are;

| | | | |
|---|---|---|---|
| Beauchene Island | Jason Group | Pebble Island Group | Hope Harbour |
| Beaver Island | Keppel Island | Saunders Island | Seal Bay (East Falkland) |
| Bird Island | Kidney Island Group | Sea Lion Island Group | Volunteer Point. |
| Bleaker Island | Lively Island Group | Speedwell Island Group | |
| Elephant Cays Group | New Island Group | West Point Island Group | |
| Hummock Island Group | Passage Island | Bull Point | **(Munro, 2004)** |

Both Sea Lion Island and Bertha's Beach have each fulfilled stringent criteria to be designated to the Ramsar 'List of Wetlands of International Importance'. Further details on these sires are provided in Section 2.1.

## 6.13. Socio-Economic Environment

### 6.13.1. General Characteristics

Figures from the 2001 census show a permanent population of 2,913. An additional 1,700 military and civilian personnel are located at the Mount Pleasant Complex (MPC). Gross Domestic Product (GDP) was estimated at £70 million (2001), with the major industries being fisheries, tourism and agriculture (FCO 2005).

Since 1982 the economy has grown rapidly, initially as a result of UK aid but more recently from the development of fisheries. The Islands have received no aid from Britain since 1992 and are now self-sufficient in all areas except defence.

Tourism is of growing importance, with over 30,000 passengers landing in Stanley each year from cruise ships, many attracted to the Islands by the unique environment and wildlife of the area. Agriculture remains important as the largest source of employment. The FIG has built a modern abattoir designed to meet EU standards and hopes to capitalise on the Falklands' certification as an organic country (FCO 2005).

### 6.13.2. Fisheries and Aquaculture

The seas around the Falklands are an important area for fisheries, predominantly for squid and demersal fish. Since 1987 the fishing industry in the Falklands has been the most important economic sector in terms of income, derived primarily from the sale of fishing licences. A multinational fishing fleet has been operating in Falkland Islands waters since the 1970's, although prior to 1986 it was unregulated by the Falkland Islands Government.

Since 1 February 1987 all fishing within 150 nautical miles of the Falklands has been subject to licensing by the FIG, with the limit of this zone extended to 200 nautical miles in 1990. The fishery now generates over £20 million per annum in licence fees, roughly half of government revenue. Since 1990 Britain and Argentina have worked together to conserve fish stocks under the auspices of a UK/Argentine South Atlantic Fisheries Commission (FCO 2005). Approximately £6m of fisheries income is spent each year on catch and conservation monitoring, research and administration.

The Falkland Islands fishery is very closely monitored and managed by the FIG Fisheries Department (FIFD) with external assistance from Imperial College, London. Information on fish stocks is collected and collated by:

- Routine monitoring of commercial landings.
- Regular surveys, stock assessments and research on the populations, breeding habitats and biology of commercially important species.
- At sea observers reporting biological parameters of commercial species in real time.

Since the establishment of the managed fisheries a large number of papers on squid and fish ecology in the Falkland Islands waters has been published and the FIFD has an active programme of scientific research (Munro 2004).

The most significant fishery has been for *Illex* squid, although this has been in decline since 2002. This seasonal jigging fishery takes place between February and June and is concentrated over the Patagonian Shelf to the north and west of the islands. The trawl fishery for *Loligo* squid operates between February and May and also between August and November off the east coast of the Falklands. *Loligo* squid are fished mainly by trawlers registered in the Falklands and owned jointly by Falklands and European companies. *Loligo* is the most important species for the development of a local fishing industry with all 15 stern trawlers involved in the fishery operated through joint venture arrangements. Due to the location and extent of the *Loligo* squid fishery, it is considered less significant for the purposes of this assessment.

A number of trawlers are also licensed to fish in Falkland Islands waters for a variety of target species, primarily finfish. Each year some 250,000-300,000 tonnes of fish are caught in these waters, of which approximately 75% is squid. Finfish include blue whiting, hake, hoki and toothfish (refer to **Section 6.7**). The deeper waters of the FOCZ support a longline fishery for Patagonian toothfish, which consists of two vessels (White *et al*, 2002). To protect against poachers, the waters are patrolled by Falkland Islands Government aircraft and fishery protection vessels, one of which is armed.

The average fish catch per year, based on Falkland Islands Fisheries department catch records from 1992-2001 is shown in the figure below. A full report on fishery statistics is produced by the Falkland Islands Government Fisheries Department (FIGFD 2004) entitled " Falkland Islands Government Fisheries Department Fishery Statistics Volume 9 (1995 - 2004)". Catch data for 2004 is given in Table 22 below.

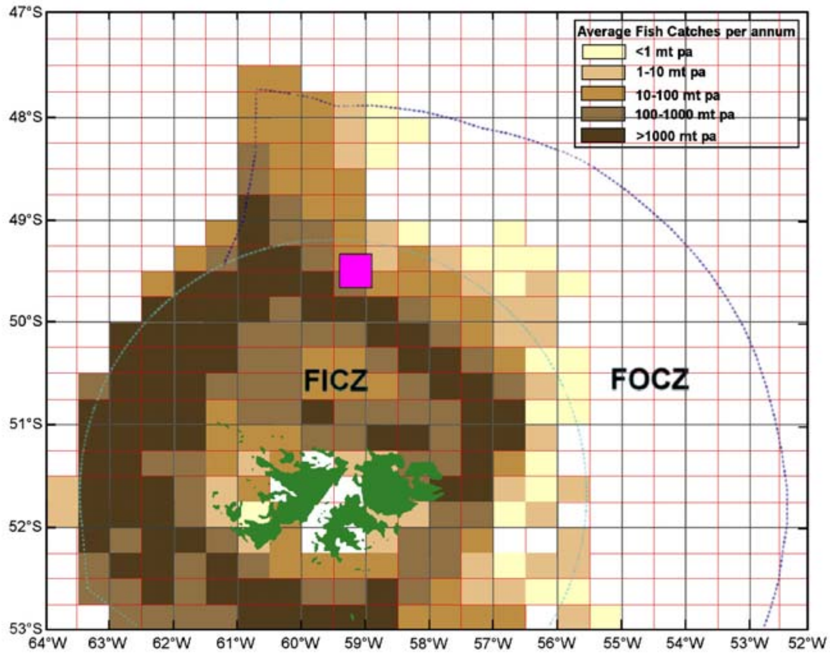



**Figure 31:** Average Fish Catches per annum, FIGFD catch records 1992-2001 (adapted from FIG Department of Mineral Resources).

| Catches by species and months in 2004 (tonnes) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | **Total** |
| Red cod *Salilota australis* | 80 | 362 | 188 | 350 | 271 | 13 | 94 | 258 | 436 | 583 | 134 | 11 | **2780** |
| Southern blue whiting *Micromesistius australis* | 234 | 3155 | 3652 | 1785 | 109 | . | 7 | 598 | 2192 | 6388 | 6624 | 3813 | **28557** |
| Illex squid *Illex argentinus* | . | 24 | 1417 | 265 | 3 | . | . | . | . | . | . | . | **1709** |
| Kingclip *Genypterus blacodes* | 54 | 192 | 114 | 289 | 172 | 19 | 95 | 263 | 143 | 351 | 132 | 12 | **1836** |
| Patagonian squid *Loligo gahi* | 0 | 586 | 4431 | 2522 | 869 | 201 | 5852 | 8045 | 4301 | 29 | 1 | 0 | **26837** |
| Martialia squid *Martialia hyadesi* | . | 4 | 20 | . | . | . | . | . | . | . | . | . | **.** |
| Hake *Merluccius* spp. | 14 | 196 | 141 | 269 | 222 | 86 | 144 | 441 | 260 | 131 | 23 | 1 | **1928** |
| Skates and rays *Rajidae* | 1257 | 159 | 95 | 113 | 148 | 142 | 93 | 1589 | 1022 | 351 | 59 | 155 | **5183** |
| Toothfish *Dissostichus eleginoides* | 167 | 188 | 167 | 113 | 150 | 97 | 157 | 269 | 142 | 218 | 223 | 110 | **2001** |
| Hoki *Macruronus magellanicus* | 506 | 3516 | 3821 | 4866 | 2490 | 111 | 55 | 2223 | 1452 | 4883 | 925 | 1023 | **25871** |
| Others | 588 | 1010 | 1027 | 719 | 487 | 59 | 273 | 658 | 622 | 585 | 284 | 20 | **6332** |
| **Total** | **2900** | **9392** | **15073** | **11291** | **4921** | **728** | **6770** | **14344** | **10570** | **13519** | **8405** | **5145** | **103058** |

**Table 22:** Fisheries catch by species and month over 2004 (from FIFD website).

**Squid Fisheries**

Since the establishment of the FICZ in 1987, the catch of squid has been regulated within the zone through licensing restrictions to ensure sustainable management of the squid stocks. The two main commercial species are the *Illex* and *Loligo* as described previously. The Falkland Islands Government is undertaking detailed research on the biology of commercial squid species in the southwest Atlantic. Studies are focused on recruitment processes and factors influencing the variability of recruitment strength in the *Loligo gahi* stock.

Both species are short-lived and fast growing, living for about a year and spawning once within that time (Rodhouse, 1988). Typically, species with this sort of lifecycle are susceptible to changes in environmental conditions. This can create a high level of variability in stocks on a year-to-year basis.

For example, both 2004 and 2005 were considered unsuccessful years in the Falkland's squid fisheries. The *Illex* squid was the most important commercial species in the Falkland Islands fishery until 2002, when unusually cold sea temperatures inhibited feeding migrations of squid. After the partial recovery of *Illex* catches in the Falklands Zones in 2003, the stock collapsed almost completely in 2004 (FIFD 2004). In 2004 the *Illex* stock comprised just 1.6% of the total catch. The *Loligo* catch was at its third lowest level (26%). Southern blue whiting constituted the largest catch within the FICZ/ FOCZ in 2004 (27.7%), with hoki being in third position (25.1%).

**Aquaculture**

Aquaculture in the Falkland Islands is currently limited to a single shellfish farm located in Choiseul Sound at Darwin. Any pollution of seawater in this area, particularly by hydrocarbons, could have a significant impact on farmed shellfish. Given the scale and location of this operation, however, potential impacts as a consequence of drilling activity are considered highly unlikely.

### 6.13.3. Marine Archaeology

There are numerous wrecks in the waters of the Falklands. There are 17 registered shipwrecks, including six from WWI Battle of the Falkland Islands (December 8, 1914), as well as other designated war graves that cannot be disturbed.

Within Stanley harbour lie the wrecks of a number of wooden ships constructed in the 19th century. These include the Lady Elizabeth and the Jhelum, both of which are considered important examples of ship construction during this period.

There are no identified wrecks or significant marine artefacts specified within the proposed drilling locations, although there are three listed wrecks in nearby areas. These wrecks are of unknown identity and have not been awarded special designations (e.g. war grave status) or restrictions. The Hydrographic Office identification number, co-ordinates and depths of the wrecks are given below (ERT 1997).

- Wreck No 129700356, location 49°55' 06"S 58°02' 30"W, depth 300 m;
- Wreck No 140502865, location 50°17' 12"5 60°11 ' 00"W, depth 160 m;
- Wreck No 140503079, location 50°57' 18"5 58°52' 18"W, depth 140 m.

The use of 3D seabed mapping and ROV surveys will help prevent any potential seafloor obstacles from being impacted by the rig anchoring or drilling operations.

### 6.13.4. Communications

There are no recorded pipelines or cables in the vicinity of the Tranches C and D.

### 6.13.5. Navigation and Maritime Transport

Freight is transported to the Islands from the UK and Chile by both air and sea. The primary port is located in Stanley Harbour and locally known as FIPASS (Falklands Interim Port and Storage System). FIPASS is a floating system installed by the military after 1982, and purchased by the Falkland Islands Government in 1988. It is currently operated by Byron McKay Port Services Ltd. In addition, there is a commercial wharf in Stanley harbour. Located in close proximity to most retail and commercial operations, this commercial jetty offers a four metre draft with limited warehousing, storage areas, water and fuel supplies.

The FIG is reviewing options for port development. A feasibility study has identified a suitable site to construct a new port. Freight is transported locally by road or by sea. Island Shipping Ltd. provide a coastal shipping service. A recently introduced container feeder service is provided by South Atlantic America Shipping Ltd., which provides a service to the ports of Montevideo (Uruguay) and Punta Arenas (Chile). The MOD provide a 35-day sailing from the UK, which offers freight facility to the FIC (Falkland Islands Company Ltd.) and through it to the local civilian community.

### 6.13.6. Tourism and Marine Leisure Activities

Tourism is becoming an important source of revenue to the Falkland Islands and has grown considerably in recent years, particularly in the cruise ship sector. The Falkland Islands Tourist Board (FITB) was established in 1985, and along with the FIG and the Falkland Islands Development Corporation (FIDC), has put considerable effort into developing the industry.

Since 1997 passenger numbers on cruises taking in the Falklands have increased significantly. In 2003/04 a record 84 cruise ship visits occurred carrying 34,927 cruise ship passengers to the Falkland Islands. This represents an increase of almost 900% in cruise ship tourism in less than 10 years.

Growth is predicted to continue and the FITB aims to increase both the number of cruise-ship day visitors and longer-staying tourists. This will be achieved mainly through environmentally sympathetic development of the Islands' infrastructure, building transport links and developing added value products to target low volume, high spend, special interest and 'lifestyle' travellers from the USA and Europe. Central to the strategy is sustainable development.

The Islands' main tourist lodges are located at Port Howard, Darwin, Pebble Island, Sea Lion Island and Weddell Island. Self-catering accommodation can be found at a selection of holiday cottages on island farms, and several locations in East and West Falkland. In Stanley, there are two principal hotels (the Malvina House and Upland Goose) and a choice of guest house and bed & breakfast accommodation.

Cruise ships from various points of origin travel to the Falkland Islands and there is likely to be some movement of cruise liners through the North Falkland Basin. The recent growth in cruise ship movements increases the significance of this aspect and emphasis the need for early notification, ongoing communication and the use of standby vessels to support drilling operations. Liners arriving and departing Port William in the Falkland Islands by way of Puerto Madryn in Argentina will be most relevant to the proposed drilling programme. This route passes through the North Falkland Basin and cruise ships are likely to travel through, or near to, Desire's acreage in this area.

Impacts to cruise ships from the drilling campaign will be limited by the location, scope and duration of the drilling programme. The main impact of oil and gas exploration on the tourist industry is likely to be through secondary impacts such as a potential lack of accommodation at key times of the year and, depending on route, seat take-up on air transfers to and from the islands.

### 6.13.7. Military

Since 1982 the Falkland Islands have had a relatively large British military presence, with approximately 2000 personnel living at the Mount Pleasant air base complex. As well as military personnel, this number includes civilian employees of the MOD or contractors responsible for the provision and maintenance of services at the base.

Discussions with the military authorities regarding cooperation over waste management and waste shipments are ongoing. The various options for management of different waste streams have been described previously and the impacts of these options are assessed in the following chapter.

The military base at Mount Pleasant is highly self-sufficient and it is unlikely that drilling operations would have a negative impact on military operations. There are a number of areas where cooperation between the military and the oil industry would prove financially or environmentally beneficial. These include:

- Waste treatment and disposal options
- Hazardous waste shipments back to the UK
- Possible utilisation of unused drilling materials or equipment
- Transfer of drilling personnel from the UK
- Additional oil spill emergency support

The Royal Navy operates out of the East Cove Navy Port, six miles from Mount Pleasant Airport, home of the Falklands Islands Patrol Vessel (FIPV). Her primary aim is to act as a visible deterrent by actively patrolling the Falkland Islands and surrounding waters, as well as being available for immediate tasking as required by CBFSAI (Commander of the British Forces South Atlantic Islands). The vessel is capable of providing a platform for helicopter operations.

In addition the Atlantic Patrol Ship (South) provides a strengthened naval presence in the form of a Frigate or Destroyer. At times a Nuclear Attack Submarine supplements the force.

The main land deterrent is currently provided by a company-strength force. Air defence is provided by Tornado F3s, supported by VC-10 tankers, Hercules C-130s, Chinook and Sea King helicopters.

### 6.13.8. Oil industry infrastructure

There is currently no offshore oil industry infrastructure in place that would be affected by the proposed drilling programme. Shore based resources and infrastructure used for the previous campaign, such as FIPASS and helicopter links are also likely to be utilised for the proposed drilling programme. Details of all shore-based resources required for drilling have yet to be finalised and will be updated in the Operations Addendum to be published prior to drilling.

## 6.14. Consultation

Consultations were undertaken with representatives from the following bodies:

- Department of Mineral Resources, Falkland Islands Government
- Environmental Planning Office, Falkland Islands Government
- Public Works Department, Falkland Islands Government
- Attorney General's Office, Falkland Islands Government
- Fisheries Department, Falkland Islands Government
- Falklands Conservation
- Peak Well Management
- Desire Petroleum plc
- Byron Group
- Stanley Growers Limited
- UK Foreign and Commonwealth Office

The Ministry of Defence was not met with during the information gathering and consultation exercise in the Falkland Islands (28/09/05 to 05/10/05) due to military exercises and a lack of available MoD personnel. It is important that the Military are consulted in full once operational details have been established. As well as preventing any conflict of interest, this consultation should also examine the risks of seabed explosives in the survey area.

In addition to the above consultations, Dr Ian Duncan, Chief Executive Officer for Desire Petroleum plc was interviewed for both Penguin News and the Falkland Island News Network (FINN). The interview was published by both organisations during October 2005 and was used to provide the Falkland Islands' population with an update of the proposed drilling campaign, the environmental impact assessment process and key environmental issues of the proposed operations.

# 7. IMPACT ASSESSMENT

## 7.1. Introduction

This section identifies and makes qualitative assessments of those aspects of the drilling programme that may have an environmental or socio-economic impact. The potential for positive impacts from drilling (primarily socio-economic) should be recognised together with negative impacts. For both positive and negative impacts this is restricted to the proposed campaign and does not include future petroleum development.

The following factors are assessed in Sections 7.2 to 7.4 below, together with suggested mitigation measures:

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

The results of the impact assessment are presented in matrix form in Table 24**.** A summary of the criteria used in the impact matrix is presented in Table 23.

## 7.2. Emissions to Air

Emissions to air are generated primarily by the burning of fuel to power the engines, compressors and generators on the drilling unit and vessels. Based on operational modelling, it is estimated that approximately 8000m$^3$ of fuel will be consumed during the three well programme.

It is generally accepted that such emissions will be rapidly dispersed. Therefore, there is likely to be negligible contamination of the local environment due to dispersal and dilution by wind. Gases such as carbon dioxide and nitrogen oxides emitted during the course of the survey contribute to global warming although the contributions are extremely small when considered on a continental scale.

Impacts to air from engine and generator emissions were assessed to be of medium importance due to their local to continental scope, medium to long-term effect, low intensity, high probability and capacity for direct and cumulative effects.

Fugitive emissions from unsealed containers, maintenance operations, testing of fire fighting systems and poor housekeeping practices were assessed to be of low importance. Despite the local to continental scope and the potential for direct and cumulative effects to both people and the environment, the impacts from fugitive air emissions are likely to have a short to medium term persistence, low to medium intensity and only medium probability of occurrence.

Impacts to air from flaring are considered to be of medium importance due to their local to continental scope, medium to long-term effect, medium to high intensity, medium probability and capacity for direct and cumulative effects.

Despite the high probability of occurrence and potential for disturbance to wildlife and impacts to human health, noise emissions from operations, vessel and helicopter use were assessed to be of low importance due to the local scope, short to long term persistence and low to medium intensity.

Mitigation of air emission impacts is possible through:

- Use of high efficiency flare tip design.
- Accurate management of the mix to flare during well tests.
- Regular maintenance of engines, compressors and generators.
- Routine maintenance of vehicles, helicopters and vessels.
- Good operational controls and a high level of housekeeping.
- Structured monitoring in accordance with EEMS.

## 7.3. Emissions to Water

### 7.3.1. Controlled discharges

The following emissions to water are expected to take place from the drilling unit and vessels as part of normal operations:

- Sanitary waste water (grey and black waters)
- Run-off and rig/vessel wash water
- Cooling water
- Oily water separator discharge
- Solids control discharges (residual WBMs and cuttings, contaminated drainage)

Any oily or contaminated drainage from the drilling unit and vessels should pass through an oily water separator before being discharged. Concentration of oil in water discharged should be restricted to less than 15 ppm in accordance with the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78) Annex 1 requirements for disposal of oil or oily mixtures at sea. Oily water separators should be equipped with sensors and an alarm to ensure that the discharge limit is not exceeded. Volumes and rates of water discharge are not known, however due to the limited size of the drilling programme the treated water discharge will be highly dispersed and no adverse impact on water quality and wildlife is expected.

The discharge of sewage, drainage waters, cooling water and run-off / wash waters were all assessed to be of low importance. Despite the medium to long term persistence of these impacts (due to the length of the drilling programme) and high probability of occurrence, the impacts from these discharge streams is considered to be localised in scope and of low intensity.

Direct impacts from these emissions will include localised nutrient enrichment, saprogenic effects, temperature increase and low level pollution from trace oils and chemicals, which will be rapidly dispersed. Indirectly these localised impacts may lead to increased pollution of the ecosystem with a cumulative impact on biodiversity.

Mitigation of impacts from routine emissions to water is possible through:

- Treatment / maceration of sewage prior to discharge.
- Use of well maintained and alarmed oil water separator.
- Operational controls covering materials storage, wash-downs and drainage systems.
- Maintaining a high level of housekeeping on board.
- Use of only low toxicity chemicals on board.

### 7.3.2. Cuttings

The discharge of cuttings from top-hole sections to the seafloor (drilled using seawater) and from lower hole sections to the water column (following separation of WBMs) are assessed to be of medium to high importance. Benthic sampling has shown the seafloor impacts of cuttings to be highly localised with minimal evidence of any contamination, however persistence of this impact is rated as medium to long term and both intensity and probability are rated as high.

The quantity of cuttings likely to be discharged over the three well programme is estimated at approximately 1000$m^3$ (based on well modelling). Due to the use of water based drilling muds and the intention to use only low toxicity chemicals (OCNS category Gold / E) the main impact of cuttings will be due to seafloor smothering rather than toxicity.

Direct impacts will be the localised smothering of the seabed around the well site, localised increase in turbidity and the depletion of oxygen in surface sediments. Modelling has demonstrated that the majority of discharges will be restricted to within 200m of the release point and will have a maximum accumulated height of less than 8cm.

The importance of cement release to the seafloor and chemical discharge from well completion were assessed to be of low importance due to the localised scope, short to long term persistence, medium intensity and high probability. The quantities of cement able to escape to the seabed will be small and contain only low toxicity chemicals. The release of well completion chemicals such as corrosion inhibitor, biocides and oxygen scavengers will be on a very small scale, limited to approved low toxicity chemicals which will disperse rapidly in the water column.

Mitigation of impacts from cuttings, cement and chemical discharge is possible through:

- Use of only WBMs.
- Use of only OCNS category Gold / E chemicals and additives.
- Use and regular maintenance of solids control package.
- Discharge of cuttings from lower holes via the cuttings caisson several metres below the sea surface to aid dispersion.

### 7.3.3. Noise

The emission of underwater noise from drilling and vessel activity is not considered to be of sufficient amplitude to cause direct harm to marine life (unlike the noise that may be generated by seismic surveys for example). There is therefore no requirement for marine observers or acoustic monitoring for standard drilling and vessel operations. Underwater noise from drilling and vessel activity may induce localised behavioural changes in some marine species, however there is no evidence of significant behavioural changes due to drilling that may impact on the wider ecosystem.

The cumulative impact of increased background noise levels in the marine environment is an ongoing and widespread issue of some concern. The secondary and cumulative impacts in this case are considered negligible when compared to operations such as marine seismic surveys, use of active sonar, pile-driving and offshore construction or even high intensity fisheries and vessel traffic.

Impacts due to underwater noise are therefore considered to be of low importance due to the local to regional scope, medium to long term duration, low intensity and high probability of occurrence.

### 7.3.4. Non-routine Discharges

Non-routine discharges include oil and chemicals spills, flare drop-out, ballast water discharge and the accidental lose of non-liquid materials at sea.

The loss of non-liquid materials from loading / unloading and transfer is assessed to be of low importance due to the local scope, medium to long term persistence, low to medium intensity and low probability. The loss of powders, plastics, wood, metal, items of equipment or packaging material at sea will cause localised pollution and may cause physical harm to marine animals including snaring and ingestion. It will also contribute to the wider pollution of the ecosystem and impact on biodiversity.

The discharge of ballast water from vessels coming into the area may lead to the introduction of exotic species contained in the ballast water and displacement of native species. Discharge of ballast water from the drilling unit and vessels while in the area of operations may lead to the release of low levels of oils and chemicals into the marine environment. Although the probability of ballast water being discharged during the campaign is considered to be high, the scope of impact will be local, persistence will be short to medium and intensity will be low to medium. The impact is therefore considered to be of low importance. Any discharge of ballast water should also follow established International maritime guidance and legal requirements.

The fall-out of unburned hydrocarbons from well test flaring may create localised surface oil pollution and lead to a visible sheen on the sea surface. The importance of hydrocarbon drop-out is considered to be low to medium importance based on local scope, medium persistence (based on likely length of possible well tests), medium intensity and medium probability (well tests may or may not be carried out).

Chemical spills are assessed to be of medium importance due to the local scope of impact, short to medium term persistence, high intensity and low probability. The impact of any chemical spills will be direct toxicity effects on marine biota, which would be limited by the use of only UK OCNS approved low toxicity chemicals throughout operations. Any spill of chemicals could also have impacts to human health and safety and lead to increasing pollution of the ecosystem.

Mitigation of impacts from chemicals spills, flare drop-out, ballast water discharge and the accidental lose of non-liquid materials at sea is possible through:

- Use of a high efficiency flare tip.
- Careful control of the mix going to flare during well tests.
- Minimisation of chemical transfers and loading operations.
- Operational controls for loading, unloading and movement of materials.
- Double-checking containment of all materials for transfer to/from the rig.
- Storage of chemicals within bunded areas and away from any discharge point from the rig, vessel or onshore storage location.
- Strict adherence to the rules governing discharge of ballast waters at sea.
- Emergency response procedures in the event of a chemical spill.
- Availability of Materials Safety data Sheets (MSDS) and Personal Protective Equipment (PPE) for all chemicals in use.

**Hydrocarbon spill**

Surface pollutants, particularly mineral oils, are one of the most widely acknowledged threats to seabirds, although the reported incidence of oiled seabirds in the Falkland Islands is low, helped by the low levels of shipping in this area (Smith *et al*, 2000).

Despite the very low probability, the impact of oil and fuel spills on water from both near-shore and offshore operations was assessed to be of high importance due to the local to regional scope, medium to long term effect and high intensity. Any release of liquid hydrocarbons has potential for direct, indirect and cumulative effects including physical oiling and toxicity impacts to wildlife, localised mortality to krill, eggs and larvae, habitat loss, impacts to fishing and tourism, political problems from transboundary movements and accumulation of oil in the food chain and in sediments.

Mitigation is possible through contingency planning, comprehensive and well-implemented operational controls, training of personnel, effective communications and observation.

At the drilling locations offshore a loss of well control or blow-out could lead to a large (>10,000 litre) spill. Storage failure (e.g. from collision), accidents during bunkering or mechanical failure could also lead to small or medium sized spills of hydrocarbons, most likely of fuel oils. The risk of an offshore spill beaching is considered negligible based on meteorological and current modelling and the impacts of such a spill will therefore be focussed on the offshore environment.

Oil spilled in the marine environment will have an immediate detrimental effect on water quality. Oil is most toxic in the first few days after the spill and as it begins to weather it loses some of its toxic properties and begins to emulsify. Once the oil emulsifies the effectiveness of dispersants is also greatly reduced. The window of opportunity for dispersant use will depend on the type of oil and the metocean conditions at the time of the spill, however it is unlikely to exceed several days in the proposed drilling area.

Spills that occur on the surface of deep waters are unlikely to have an immediate effect on the seabed. Oil in sediments as a result of accidental spillage or oil contaminated drill cuttings can result in physical smothering or chronic pollution of the benthos, although this will be mitigated by the use of water based muds for drilling, which is demonstrated by the results of post-drill benthic sampling.

Research in the North Sea has identified potential toxic effects of oil on plankton (particularly copepods), fish eggs and larvae, however, the effects of petroleum-derived hydrocarbons in seawater are to a large extent unknown (Munro 2004). In general, if pollution is severe, plankton will be killed, whereas fish can generally avoid the polluted area.

The atlas of monthly vulnerability of seabird concentrations to surface pollution shows generally low to medium vulnerability levels for the drilling location. The atlas includes penguin species, as well as the various species of albatross, petrel and shags likely to be found in this area. The licence area generally shows higher vulnerability between January and March, although at no time of the year do Tranches C and D fall under the category of highest vulnerability. The offshore impacts to seabirds from an oil spill are still considered highly significant and this would be taken into account in the spill response operation and possible use of dispersants.

Diving sea birds that spend most of their time on the surface of the water are particularly likely to encounter floating oil. Small oil slicks drifting through concentrations of birds resting on the sea may inflict heavy casualties disproportionate to the quantity of oil. The direct impacts of oil to seabirds are considered below.

The effects of oil pollution on marine mammals is poorly understood (White et al, 2001), with the most likely immediate impact of an oil spill on cetaceans being the risk of inhalation of oil vapours. The relatively low level of marine mammal sightings in the area of proposed drilling and high mobility of these species makes it unlikely that there would be significant direct impacts to marine mammals offshore.

Small to medium sized spills of oil could occur due to vessel movements in the coastal zone or storage, loading and handling operations in the harbour. The volume of released oil would be less than from a loss of well control offshore and the oil type would also most likely be either fuel or lube oils rather than crude. Evaporation of lighter fuel oil fractions would be far quicker than for a crude spill, removing a proportion of the volatile content of the spill to atmosphere (depending on fuel composition and metocean conditions). Handling errors, poor communications, mechanical failure, vehicular accidents or extreme weather could all lead to a release of hydrocarbons to the environment. In this instance the impacts of a spill will be to the near-shore environment and coastal habitats.

Despite the lower likely quantities and greater evaporation, the environmental consequences of a nearshore spill are potentially far greater. Chronic and acute oil pollution is recognised as a significant threat to both pelagic and inshore seabird species, ducks, wildfowl and waders. The majority of deaths attributable to oil pollution amongst seabirds are due to the physical properties of the oil and damage to the water repellent properties of the birds' plumage. This allows water to penetrate, decreasing buoyancy and leading to sinking and drowning. Additionally, thermal insulation capacity is reduced requiring greater use of energy to combat cold. Oil is also ingested as the birds preen in an attempt to clear oil from plumage and may furthermore be ingested over the medium to long term as it enters the food chain (Munro 2004).

Any stranded oil from near-shore operations would be quickly removed from high-energy beaches by wave action and water movement, but would not be readily removed from low energy sedimentary beaches and may become incorporated into the sediment.

Sensitive shorelines have been categorised in order of increasing vulnerability to oil spill damage by the Gundlach and Hayes Index (Gundlach and Hayes, 1978). The most sensitive habitats are likely to be sheltered rocky coasts and tidal flats, with exposed rocky shores being the least sensitive.

The atlas of vulnerable concentrations of seabirds to surface pollution (White *et al* 2001) further defines areas of high vulnerability to surface pollutants, particularly oil from offshore hydrocarbon development.

The atlas uses an Oil Vulnerability Index (OVI) to calculate vulnerabilities of different species to surface pollution. The OVI includes 4 factors within its calculation:

- The proportion of the time spent on the surface of the sea by that species;
- The size of the biogeographical population of that species
- The potential rate of recovery of the species after a reduction in numbers; and
- The reliance on the marine environment by that species.

Nearshore areas will be particularly vulnerable to surface pollution and adequate preventative and response measures will need to be in place to address the risk of near-shore pollution. Figures of coastal vulnerability are given previously in Section 6.9.10. Recommended mitigation measures are described below.

**Impacts on marine mammals:**

Marine mammals may be seriously affected by oil pollution through coating, inhalation and ingestion of oil. However, they would normally be expected to actively avoid spilled oil. This problem is likely to more pronounced if coastal pollution occurs during the breeding season when animals are associated with breeding colonies and lactating pups and cannot disperse.

Many species are also reliant on shallow benthic prey species or closely associated with kelp beds both of which may be affected by oil pollution and this may have a secondary effect on these marine mammals (Munro 2004). The presence of Commerson's and Peale's dolphins in nearshore areas may make them particularly vulnerable to disturbance and or pollution effects.

**Impacts on humans:**

Petroleum hydrocarbons are potentially carcinogenic and can cause severe dermatitis. Human health could be affected through contaminated seafoods if acute hydrocarbon pollution occurs as a result of oil spills, although there is little evidence that petroleum hydrocarbons accumulate in marine organisms (Munro 2004).

Mitigation of impacts from nearshore and offshore oil spills is possible through:

- Managing potential drilling hazards, such as shallow gas, and following established drilling safety standards to minimise the risk of control loss.
- Establishing comprehensive Oil Spill Response Planning.
- Training of key personnel in oil spill response.
- Consultation with the Fisheries Department and ongoing communications with all concerned parties regarding spill response.
- Collaboration with the national OSCP and availability of nearshore defences (i.e. booms), as well as trained personnel, spill surveillance services etc.
- Availability of dispersants and spill response kits on the rig and vessels for initial spill response.
- Membership of OSRL to provide external oil spill response capability.
- Operational controls covering materials loading, transfer and storage
- Supervision of all loading / bunkering operations.
- Loading / bunkering during suitable weather conditions and light levels only.
- All oil stored in tanks or drums on board the vessel in accordance with maritime safety requirements.
- Comprehensive operational planning and risk assessment and provision of suitable specification equipment for drilling (BOP etc).

## 7.4. Waste Materials

Impact from the discharge of food waste was assessed to be of low importance due to the local scope, medium to long term persistence (length of drilling), low intensity and high probability. Food waste should be macerated and discharged overboard in accordance with MARPOL 73/78 Annex V requirements. The discharge of macerated food waste can cause localised organic enrichment, however there are not expected to be any adverse impacts due to the discharge of food waste in this area.

The potential transfer of viruses from discharged poultry waste to local bird populations has also been raised as a potential issue. The likelihood of macerated food waste transferring viruses (e.g. Asian bird flu) to scavenging seabirds is believed to be extremely small, however there is no way of quantifying what this risk may be. It is recommended that poultry is sourced from a reputable and traceable supply, for example from the UK. Alternatively, should the situation change due to any evidence of viral transfer in this way, all poultry waste could be segregated for disposal by incineration.

The segregation, compaction, storage and transfer of waste materials from the drilling operations were all considered to be of low importance due to the local scope, short to long term persistence and low intensity. The probability of impacts due to waste material escaping during transfer was also assessed to be low. The disposal of any garbage at sea is prohibited by legislation. Waste will therefore be transferred from the rig and vessels back to shore for storage, disposal and/or transfer depending on the waste type and the options available (see Section 5.3).

All wastes should be sorted, compacted where practical and stored according to type and disposal route for subsequent transfer to shore. Hazardous or special waste should be stored in appropriate containers separately from non-hazardous wastes.

Vessels are required by MARPOL 73/78 Annex V regulations to have a garbage management plan and a garbage record book where garbage volumes, types and disposal routes are recorded.

In summary, impacts from the storage and handling of waste material on the rig are assessed to be low and can be minimised through responsible waste management procedures and supervision. Once transferred from the rig and vessels, the issue of appropriate waste management and disposal also needs to be considered for the unique setting of the Falkland Islands.

**On-shore waste management**

Should suitable incineration facilities exist or be imported to the Falkland Islands, impact from incineration of waste material is assessed to have medium importance for emissions to air and disposal of ash.

Emissions to air from a correctly specified and operated incinerator will have local to continental scope, medium to long term persistence, low intensity and high probability. The disposal of incinerator ash to landfill would have local scope, long to permanent persistence, low intensity and medium probability (it may be disposed of elsewhere). The impact is assessed as being of medium importance due to the lack of suitable landfill sites in the Falkland Islands. Should waste facilities be improved or the ash exported with other wastes, this impact would be low or negligible.

Landfilling of waste onshore is also considered to be of high importance with potential direct impacts including contamination of soil and groundwater, amenity impacts (litter, odour) and emission of polluting releases to air. Indirect impacts of landfilling include potential impacts to human health, the take-up of land and damage to flora and fauna. The importance of landfilling is considered to be high due to the lack of suitable landfill sites in the Falkland Islands. Should waste facilities be improved the impacts of landfilling would decrease.

The storage, reuse and shipment of waste back to the UK is assessed as being of medium importance. Any materials that can be safely and securely stored for future use will minimise both waste disposal and future use of resources. Materials that are not considered suitable for either re-use or disposal via incineration or landfilling (particularly hazardous materials) would need to be transferred to a suitable location for treatment and disposal.

For political and logistical reasons the most likely destination for such wastes is the UK. This may be either through a third party waste contractor who managers the whole waste management process for drilling operations, via the existing military shipments of hazardous materials or via regular cargo shipments back to the UK (suitably segregated and sealed). The impact of waste storage, re-use and transfer will have a local to continental scope, medium to long term persistence, medium intensity and medium probability (analysis of the various options is ongoing).

The reuse of oily waste for local heating purposes is shown graphically in Figure 16. This is considered to have a positive impact of medium importance due to the local scope, long term persistence, medium intensity and medium probability. The use of oily waste for this purpose will see a consequent reduction in waste disposal by other means and the encouragement of efficient local heating. Indirectly it will cut down on potential waste shipments and on a cumulative basis will provide financial assistance to local businesses.

Mitigation of impacts from waste materials is possible through:

- Reduction of waste at source and recycling of waste on board wherever possible.
- Maceration of food waste prior to disposal in accordance with MARPOL 73/78 Annex V and sourcing of poultry from a reliable supplier.
- Sighting of incinerator (if used) to minimise impacts to the public.
- Use of correctly specified incinerator for the types of waste being generated and suitable operation of incinerator.
- Incinerator residues should be disposed of to a suitable location or shipped to the UK.

- Re-use of waste oil for local heating (see Figure 16).
- Possibility of hazardous waste shipment via the military Memorandum of Understanding with the UK.
- Appropriate sealed and segregated storage of all waste material both onshore and offshore.
- Sealing of skips and containers for transfer from rig to shore.
- Eliza Cove tip is not a contained site and would currently be unsuitable for disposal of liquid, hazardous or easily dispersed materials.
- Mary Hill quarry is suitable for some inert waste items only.
- Storage and re-use of excess materials and equipment at a later date is encouraged where this can be done safely and without environmental impacts.

## 7.5. Physical Presence

The impact to fishing and shipping operations caused by mobilisation of the rig was assessed to be of low importance due to the regional to continental scope, medium persistence, low intensity and low probability. Direct impacts include hazards and disruption of fisheries and vessel traffic along the mobilisation route (currently unknown) with indirect financial impacts to industry.

The impact to fishing and shipping operations caused by the presence of the rig in Falkland Island waters was assessed to be of medium importance due to the local scope, medium to long term persistence, medium intensity and medium probability. The direct effect will be the exclusion of fisheries and vessel traffic around the drilling area, with indirect impacts including economic costs and risk of collision. The use of support vessels will help prevent other vessels encroaching too close to the drilling operation. Impacts to fisheries and vessels will also be minimised due to the short duration of the campaign.

The impact due to interference with other sea users by support vessels was assessed to be of low importance due to the local to regional scope, medium to long term persistence, low intensity and low probability. It is expected that one vessel will remain on hand at the rig to enforce the exclusion zone and act as support, while a second vessel remains on standby in Stanley. Interference to other sea users from these vessels will therefore be minimal.

Disturbance of the seabed from anchoring operations was considered to be of medium importance due to the local scope, medium persistence, medium intensity and high probability. High definition 3D seafloor mapping has now been carried out for the proposed drilling locations and will be used to aid rig positioning to avoid seafloor hazards and significant topographic features. The direct effects will include damage to marine biota and to seafloor habitats. There is also likely to be an indirect increase in turbidity. A benthic survey programme has been carried out and revealed a relatively homogeneous macrofauna in a relatively homogenous environment. There is no evidence to indicate active pock marks or other seafloor habitats that may be particularly rich or unique environments. ROV video footage will assist with rig positioning and should also help to ensure anchoring avoids significant seafloor features.

Damage to potential seabed artefacts from anchoring operations was considered to be of low importance due to the local scope, permanent persistence, medium intensity and low probability. There are no known wrecks or significant artefacts at the drilling locations. ROV video footage will assist rig positioning and should help to ensure the area is free of obstacles and seabed artefacts.

Any items left on the seabed following demobilisation of the drilling rig will be a potential hazard to trawl fishing in the area. Lost anchors, protruding casing and well apparatus proud of the seafloor could snag nets and damage equipment, with indirect financial costs to fisheries and cumulative impacts to the local economy. There is likely to be a limited, local positive environmental impact from any area of the seafloor excluded to trawl fishing due to seafloor hazards. This impact is assessed to be of low importance due to the local scope, long term to permanent persistence, medium intensity and low probability.

The aesthetic/visual impacts of the drilling operation are not considered to be significant due to the considerable distance from any land mass.

Mitigation of impacts from physical presence is possible through:

- Programme of consultation and notification with Fisheries Department and vessel operators.
- Use of support vessels throughout operations to maintain exclusion zone.
- Use of previous 3D seafloor mapping and accurate rig positioning with GPS.
- Use of ROV video footage for rig positioning.
- Subsequent availability of seafloor footage to environmental and research bodies.
- Location of the well sites away from the main fisheries areas.
- Ongoing communications with key stakeholders (fisheries, shipping etc) throughout operations to prevent conflicts.
- Follow established procedures for suspending / abandoning well and removing seafloor hazards.
- Demobilisation survey with ROV to look for any remaining seafloor hazards.

## 7.6. Use of Resources

The consumption of resources through the acquisition of drilling consumables and equipment (casing, cement, mud, chemicals etc) is assessed to be of low importance due to the regional to continental scope, medium to long term persistence, low intensity and high probability. Given the location of drilling, sufficient materials, equipment, spares and contingency supplies need to be ordered well in advance and shipped in prior to rig mobilisation. Reordering and shipping replacement parts or additional materials once the campaign is underway would be financially and logistically impractical and the level of resource use is therefore dictated by operational requirements and the remoteness of the drilling location.

Fuel use during mobilisation, transfer and drilling is considered to be of low to medium importance due to the local to continental scope, medium to long term persistence, low to medium intensity and high probability. The consumption of helifuel, aviation fuel for flights, diesel and marine fuel oil is an operational necessity, although fuel consumption can be minimised by a regular programme of maintenance and servicing. Advanced planning has been undertaken and should help to ensure flights and transfers are kept to a minimum, however regular crew changes are a necessity both for operational and health and safety reasons.

The use of seawater for drilling is assessed to be of low importance due to the local scope, medium to long term persistence, low intensity and high probability. The use of potable water is assessed to be of low to medium importance due to the local scope, medium to long term persistence, medium intensity and high probability. There is the possibility of a drop in the town's water pressure while potable water is being loaded and operations should be scheduled to avoid peak periods of water use. The cumulative effect of potable water consumption will be reduced availability.

Mitigation of impacts from resource use is possible through:

- Loading potable water outside peak times to prevent drop in towns pressure.
- Regular maintenance and servicing of engines, generators and compressors.
- Monitoring and reporting figures for resource consumption in accordance with established protocols.
- Advanced operational planning to ensure sufficient materials and equipment is available for the campaign but that waste is minimised.

## 7.7. Socio-economic Impacts

Socio-economic impacts due to the need for accommodation and office space during mobilisation are assessed as being of low importance due to the local scope, long term to permanent persistence, low intensity and high probability. The mobilisation of personnel to the Falkland Islands is likely to generate local income for individuals and businesses and provide a short term boost to the economy. Indirectly there may be increased competition for available accommodation.

The socio-economic impact of flying personnel to the Falkland Islands is assessed to be of low to medium importance due to the regional to continental scope, medium to long term persistence, medium intensity and high probability. Whether or not the mobilisation of personnel impacts on routine flights and seat availability depends on the point of origin and route taken. No details on this aspect of operations are currently available and this will be updated once point of origin and transfer route is known.

There is also likely to be a direct boost to jobs and the economy from the drilling campaign, although this is assessed to be of medium importance due to the limited duration. The scope of this impact is assessed as local to regional, with long term persistence, medium intensity and high probability. Indirect impacts may lead to a change in the focus of the local economy towards servicing drilling activity, with the cumulative effect of local services providers adapting to the exploration industry.

> Mitigation of socio-economic impacts is possible through:
>
> - Awareness of drilling personnel to the unique nature of the Falkland Islands
> - Utilising local goods and service providers wherever feasible
> - Advanced planning for mobilisation of personnel and notification in the Falkland Islands where this may impact on the local population

## 7.8. Qualitative Impact Assessment

The following tables summarise the impact assessment process.

| Heading | Content | Detail |
|---|---|---|
| **Activity** | | |
| Brief description of the type of activity | | |
| **Aspect** | | |
| Description of potential results of the activity that may cause impact | | |
| **Impact** | | |
| Scope | Geographical area affected | Local, regional, continental (L, R, C) |
| Persistence | Duration of impact | Short (minutes–hours), medium (days–weeks), long (months–years), permanent, unknown (S, M, L, P, U) |
| Intensity | Severity of impact | Low, medium, high (L, M, H) |
| Probability | Likelihood of impact occurring | Low (<25%), medium (25–75%), high (>75%) (L, M, H) |
| Importance | Importance of impact | Low, medium, high (L, M, H) |
| **Effects** | | |
| Direct | Qualitative description of what is directly, indirectly and cumulatively impacted by the Activity/Output. | |
| Indirect | | |
| Cumulative | | |

**Table 23**: Criteria for assessment of likely impacts.

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| Activity | Aspect | Impacts | | | | | Impact Description | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Scope L R C | Persis. S M L P | Intens. L M H | Proba. L M H | Import. L M H | Direct Effects | Indirect Effects | Cumulative Effects |
| **Emissions to Air** | | | | | | | | | |
| Rig mobilisation | Rig engine emissions | L-C | M-L | L | H | M | Air pollution, emission of GHGs and particulates | Pollution of ecosystems; impacts to human health | Contribution to regional and continental air pollution |
| Drilling | Generator emissions | L-C | M-L | L | H | M | | | |
| Vessel use | Engine emissions | L-C | M-L | L | H | M | | | |
| Helicopter operations | Engine emissions | L-C | M-L | L | H | M | | | |
| Well testing | Flare emissions | L-C | M-L | M-H | M | M | | | |
| Drilling | Fugitive emissions | L-C | S-M | L | M | L | Air pollution, emission of VOCs and GHGs | Human health effects | Contribution to regional and continental air pollution |
| Fire control | Fugitive testing emissions | L-C | S | M | M | L | Emission of ozone depleting substances | Damage to the ozone layer, human health effects | Increasing UV levels |
| Drilling / vessels | Noise | L | M-L | L | H | L | Disturbance to wildlife | Human health and safety effects | Loss of biodiversity |
| Helicopter operations | Noise | L | S | M | H | L | | | |
| **Emissions to Water** | | | | | | | | | |
| Drilling | Sewage discharge | L | M-L | L | H | L | Nutrient enrichment. Saprogenic effects. | Changes to localised ecosystem | Organic enrichment |
| Drilling | Rig drainage discharge | L | M-L | L | H | L | Low levels of oil and chemicals released. | Pollution of ecosystems. | Loss of biodiversity. |
| Drilling | Cooling water discharge | L | M-L | L | H | L | Limited localised temperature increase | Localised behavioural changes in marine life. | Negligible |
| Drilling | Run-off / wash water discharge | L | M-L | L | H | L | Low levels of oil and chemicals released in the marine environment | Pollution of ecosystems. | Loss of biodiversity. |

| Activity | Aspect | Impacts | | | | | Impact Description | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Scope L R C | Persis. S M L P | Intens. L M H | Proba. L M H | Import. L M H | Direct Effects | Indirect Effects | Cumulative Effects |
| Top hole drilling | Cuttings discharge | L | M-L | H | H | M-H | Localised smothering of the seabed around the well site. Localised turbidity. Depletion of oxygen in surface sediments. | Pollution of ecosystems, loss of seafloor habitat. | Loss of biodiversity. |
| Drilling lower hole sections | Cuttings discharge | L | M-L | H | H | M-H | | | |
| Top hole drilling | Cement release | L | M-L | M | H | L | | | |
| Well completion | Chemical discharge | L | S-M | M | H | L | Low level toxicity impacts to marine biota. | Pollution of ecosystems. | Loss of biodiversity. |
| Well testing | Hydrocarbon drop-out | L | M | M | M | L-M | Physical oiling and toxicity impacts to wildlife. | Pollution of ecosystems. | Loss of biodiversity. |
| Supply / re-supply of rig. | Loss of materials to sea. | L | M-L | L-M | L | L | Localised pollution, physical harm / snaring from lost materials. | Pollution of ecosystems. | Loss of biodiversity. |
| Rig / vessel ballast water | Ballast water discharge | L | S-M | M | L-M | L | Localised pollution. Introduction of exotic species | Displacement of native species | Loss of biodiversity. |
| Drilling / offshore bunkering | Large (>10,000 litre) fuel / oil spill | L-C | L | H | L | H | Physical oiling and toxicity impacts to wildlife, localised mortality to krill, eggs and larvae | Decreased food resource from krill mortality, impacts to fishing and tourism, political problems from transboundary issues (large spill only). Issue of waste disposal. | Accumulation of oil in the food chain and in sediments. Loss of biodiversity and revenue. |
| Drilling / offshore bunkering | Small-med (<10,000 litre) fuel / oil spill | L-R | M-L | H | L | H | | | |
| Near-shore loading / unloading | Small-med (<10,000 litre) fuel / oil spill | L | M-L | H | L | H | Physical oiling and toxicity impacts to wildlife, contamination of coastal habitats | Habitat loss, impacts to tourism and nearshore fisheries. Human health and disposal issues from cleanup. | Accumulation of oil in the food chain and in sediments. Loss of biodiversity and revenue. |
| Drilling | Chemical spill | L | S-M | H | L | M | Toxicity effects on marine biota. | Pollution of ecosystems. Human health and safety. | Bioaccumulation of toxic substances. |
| Drilling | Underwater noise | L-R | M-L | L | H | L | Disturbance of animals in close proximity to the rig and vessels | Potential behavioural effects in marine mammals. | Increase in background marine noise levels. |

| Activity | Aspect | Impacts | | | | | Impact Description | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Scope L R C | Persis. S M L P | Intens. L M H | Proba. L M H | Import. L M H | Direct Effects | Indirect Effects | Cumulative Effects |
| **Waste Materials - Offshore Aspects** | | | | | | | | | |
| Drilling | Food waste discharge | L | M-L | L | H | L | Organic enrichment, food source for marine fauna. | Changes to localised ecosystem | Organic enrichment |
| Waste transfer | Escape of waste material | L | M-L | L | L | L | Localised pollution, physical harm / snaring from waste items | Pollution of ecosystems. | Loss of biodiversity. |
| Waste Management | Segregation & compaction | L | S-M | L | H | L | Positive effect: improved waste management option. Reduced volume of waste material | See On-shore waste management below. | Reduced landfill take-up. |
| **On-shore waste management** | | | | | | | | | |
| Incineration | Air emissions | L-C | M-L | L | H | M | Air pollution | Pollution of ecosystems | Contribution to regional and continental air pollution |
| Incineration | Landfill of ash | L | L-P | L | M | M | Visual impact, soil and groundwater pollution | Human health & safety effects, amenity impacts, damage to flora and fauna | Reduced landfill availability.<br>Increasing footprint of operations. |
| Disposal on shore | landfilling | L | L-P | M | H | H | Contamination of soil and groundwater. Amenity impacts. Polluting emissions to air | Human health & safety effects, land take-up, damage to flora and fauna | Increasing footprint of operations. |
| Transfer to UK | Trans-frontier shipment | C | M | M | M | M | Impacts from long distance shipping of waste material (air emissions, fuel use, risk of spills etc). | Impacts from treatment / disposal of waste in the UK | Increasing footprint of operations. |
| Waste Management | Storage & reuse | L | M-L | M | M | M | Positive effect - reduced incineration / landfilling | Potential for releases from waste storage | Reduce waste disposal.<br>Reduce raw material consumption |
| Disposal of oily wastes | Re-use for heating | L | L | M | M | M | Positive impacts: reduction in waste, local heating | No trans-frontier shipment of oily waste required | Boost to local business. |

| Activity | Aspect | Impacts | | | | | Impact Description | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Scope L R C | Persis. S M L P | Intens. L M H | Proba. L M H | Import. L M H | Direct Effects | Indirect Effects | Cumulative Effects |
| **Physical Presence** | | | | | | | | | |
| Rig mobilisation | Interference with other sea users | R-C | M | L | L | L | Hazard to fisheries and shipping on route. | Economic costs to shipping and fisheries. | Negligible |
| Rig presence | Interference with other sea users | L | M-L | M | M | M | Exclusion of fisheries and shipping from drilling areas | Economic costs to shipping and fisheries. Collision risk. | Impacts to local economy. |
| Anchoring | Seabed disturbance | L | M-L | M | H | M | Harm to marine biota. Damage to seafloor habitats | Increased turbidity in the water column. | Loss of biodiversity. |
| Anchoring | Damage to seabed artefacts | L | P | M | L | L | Damage to any unlisted artefacts or archaeological remains in the area | Potential emergency situation should explosives be impacted | Loss of items of historic value. |
| Support vessels | Interference with other sea users | L-R | M-L | L | L | L | Disruption to fisheries, shipping, harbour operations. | Potential emergency situation from vessel collision | Impacts to local economy. |
| Well suspension / abandonment | Residual seabed hazards | L | L-P | M | L | L | Any items or extruding equipment will be a potential trawl fishing hazard | Impacts to local fisheries. Some positive environmental effect from seabed exclusion. | Impacts to local economy. |
| **Use of Resources** | | | | | | | | | |
| Pre-mobilisation | Purchase of drilling consumables | R-C | M-L | L | H | L | Consumption of resources - steel, mud, cement, chemicals etc | Effects of mining, processing and manufacturing. | Loss of natural resources. Pollution of the environment |
| Mobilisation & transfers | Fuel use | R-C | M-L | M | H | L-M | Consumption of helifuel, aviation fuel, diesel etc | Effects of extraction and processing, price of fuel | Loss of natural resources. Pollution of the environment |
| Drilling | Fuel use | L | M-L | L | H | L-M | Consumption diesel | Effects of extraction and processing, price of fuel | Loss of natural resources. Pollution of the environment |
| Drilling | Use of seawater | L | M-L | L | H | L | Extraction and use of seawater | None | Negligible |
| Drilling | Use of potable water | L | M-L | M | H | L-M | Consumption of water from the town supply. | Drop in towns' pressure while loading into vessels | Reduced resource availability |

| Activity | Aspect | Impacts | | | | | Impact Description | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Scope L R C | Persis. S M L P | Intens. L M H | Proba. L M H | Import. L M H | Direct Effects | Indirect Effects | Cumulative Effects |
| **Socio-Economic Impacts** | | | | | | | | | |
| Mobilisation / demobilisation | Accommodation & offices | L | L-P | L | H | L | Financial income for local people / businesses. | Increased competition for available accommodation. | Pressure on local resources.<br>Localised economic growth |
| Mobilisation / demobilisation | Flights | R-C | M-L | M | H | L-M | Potential increased pressure on available airline seats | Development of new travel options / routes in the long term? | Negligible |
| Drilling | Direct / indirect economic flow-on | L-R | L | M | H | M | Increase in jobs and income. | Change in focus of local economy towards servicing the drilling operations. | Adaptation of local service providers to exploration industry |

**Table 24:** Matrix of Likely Environmental Impacts.

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# 8. ENVIRONMENTAL MITIGATION AND MANAGEMENT

A specific Environmental Management Plan (EMP) for the drilling operations will be produced once the choice of drilling contractor and drilling unit have not been finalised. It is important that the EMP is tailored to the specific drilling unit, crew, well locations and operational parameters. The drilling contractor will also have their own environmental management procedures, which must be accounted for to avoid duplication and ensure the final plan is both relevant and usable.

The list below provides a summary of the principal mitigation measures highlighted earlier:

- Prior consultation and ongoing liaison with key government departments and stakeholders.
- Consultation meetings with the public and promoting open information exchange
- Monitoring and reporting of emissions under the UK standard EEMS protocol.
- Maximise efficiency of flaring (if well testing is carried out) through flare tip design and control of air/fuel mix to flare.
- Maintenance and servicing programme for engines, generators and compressors
- Maintaining a high level of housekeeping on board, particularly regarding materials storage, rig washing, routine maintenance operations and paint and solvent storage.
- Using water based drilling muds for all wells.
- Only using low toxicity chemicals as approved under the UK OCNS
- Use and regular maintenance of solids control package
- Treatment / maceration of sewage prior to discharge
- Maintain oily water separator and discharges below 15 ppm oil in water.
- Supervision of all loading, unloading and bunkering operations and controls regarding the containment of materials and preventing escapes.
- Bunkering of diesel during daylight hours only.
- Controls for the segregation, storage, compaction and transfer of waste to shore.
- Implementation of an Oil Spill Response Plan
- Training of key personnel in oil spill response procedures
- Associate membership of OSRL in the UK for Tier 3 oil spill response.
- Training of all personnel in basic environmental awareness
- Incineration of combustible material onshore where suitable facilities exist.
- Re-use of waste oil for local heating
- Sealed and segregated storage of all waste material onshore and offshore
- Eliza Cove tip is not a contained site and would currently be unsuitable for disposal of liquid, hazardous or easily dispersed materials
- Mary Hill quarry is suitable for some inert waste items only
- Storage and re-use of excess materials and equipment at a later date is encouraged where this can be done safely and without environmental impacts
- Use of 3D seafloor mapping and ROV video survey for rig positioning
- Provision of seafloor footage to environmental and research bodies
- Follow established procedures for suspending / abandoning well and removing seafloor hazards
- Demobilisation survey with ROV to look for any remaining seafloor hazards
- Schedule loading/unloading operations (including potable water) to minimise disruption to the local population
- Monitoring and reporting figures for resource consumption

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# 9. ALTERNATIVES TO PROPOSED ACTIVITY

A necessary part of the EIA process is the consideration of alternatives to the proposed activity.

The many complex factors controlling the situation of oil wells (geology, topography, communications) usually means that there are few viable alternatives that can be genuinely considered from an environmental viewpoint. The two alternatives may simply be proceeding or not proceeding. The potential impacts of the project proceeding are described in preceding chapters. Potential operational mitigation measures (as opposed to alternatives) are discussed in Section 8.

Processed and interpreted seismic data are used to indicate areas where hydrocarbons could be trapped in oil or gas-filled geological structures. Without exploratory drilling, however, seismic data is unable to show for definite whether oil and gas are present, the quantities involved, whether the hydrocarbons could be commercially extracted or even the actual rock types. Exploratory drilling is a necessary step in the development of commercial hydrocarbons and is a requirement under the terms of the production licence awarded to Desire Petroleum.

The potential direct benefits to the region and the country from the exploitation of natural resources are financial income and local business opportunities. Secondary indirect benefits are a potentially increased standard of living and better education, social services and amenities (for example improved waste disposal). All of which can potentially help raise awareness of the importance of environmental protection in the area.

The implications of no operation proceeding also need to be considered. In this case the impacts from the drilling operations on the environment described in this report will not occur. The environment will not necessarily maintain its current baseline condition however, as impacts from fishing and vessel activity, waste materials, sedimentation, fall-out of atmospheric pollutants, discharge of ballast waters etc will still take place.

Should no development proceed the potential financial and social benefits of oil and gas production will not be realised. Ultimately, 'No Development' in this case would effectively preclude development of offshore hydrocarbon resources in this instance, with the consequent impacts to businesses and future revenue.

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# 10. SUMMARY / CONCLUSIONS

Sufficient baseline data now exists for this part of the North Falkland Basin to carry out a comprehensive environmental impact assessment of the proposed operations. Despite this, the area remains relatively unstudied and any additional environmental data gathered during these operations will be extremely worthwhile. Areas of interest include benthic habitats and seafloor topography, seabird and marine mammal distributions, oceanographic and meteorological data.

Impacts assessed to be of high importance are the discharge of drill cuttings, the risk of offshore and near-shore spills and the onshore disposal of waste material. Mitigation measures exist for these aspects of the operations and it should be possible for operations to proceed without any significant long lasting impacts to the marine or coastal environment of the Falkland Islands. A number of pro-active measures have already been instigated by Desire and Peak in planning these operations, which should be commended.

In order to ensure mitigation is successful and impacts are minimised, the focus should now be on ensuring operations follow the established procedures, training of key personnel in oil spill response is carried out and joint exercises are run with the Falkland Islands OSRP, all personnel receive basic environmental awareness training and contingency plans are in place to deal swiftly with any potentially polluting incidents. The production of an operations-specific addendum to this EIA will further define the environmental management, operational controls and employee training necessary to keep impacts to ALARP levels (As Low As Reasonably Practicable)[5].

Finalising the drilling unit and crew is not expected to cause a significant deviation from the operational aspects identified in this report. Should there be any operational changes likely to cause a significant change to the assessment of impacts, this will be incorporated within the operational addendum. At this stage it is thought most likely that potential changes will be minor and that these will not significantly alter the impact assessment.

This assessment has focussed on the impacts associated with the current drilling campaign, however there are also wider issues connected with ongoing oil industry operations, which it is recommended are discussed openly within the islands:

- Waste facilities onshore are an area of continuing concern. Options for waste management from the proposed campaign should allow impacts to the Falkland Islands to be prevented or mitigated. This is not considered to be a long-term solution, however, and waste management in the islands (storage, handling, treatment, disposal and legal framework) requires a long-term plan of action by the FIG.
- A broader look at the interaction of the national oil spill response strategy with project specific OSRPs would be beneficial. Given the importance of this aspect, both in regard to hydrocarbon exploration and fisheries and shipping activity, a framework of responsibilities, boundaries and overlaps between the various plans would prove useful. The issue of dispersant use and storage on the islands should also be considered in a wider context than just the current campaign.
- Socio-economic aspects of oil and gas exploration have been deliberately limited within this EIA at the request of the FIG to avoid overlaps with existing studies. These issues are not discussed further.

In conclusion, despite the high sensitivity and international importance of Falkland Islands' waters, there is obvious dedication to carrying out these operations to a high environmental standard. Given the current operational commitments and proposed mitigation measures, it is considered that the proposed operations can be undertaken without significant impacts to the Falkland Islands' environment.

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[5] For examples of ALARP regarding offshore health and safety risks see www.hse.gov.uk/offshore

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# 11. REFERENCES

www.falklands.gov.fk

www.falklands-oil.com

API 2004; Compendium of Greenhouse Gas Emissions Methodologies for The Oil and Gas Industry. American Petroleum Institute February 2004, 489pp.

Bastida, R., Roux, A., & Martinez, D.E. (1992) Benthic Communities of the Argentine Continental Shelf. *Oceanologica Acta*, 15 (6), 687-698.

Battelle 2003, Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions, IPIECA, OGP & API.

Barnes, R.S.K. and Hughes, R.N. (1988) An introduction to marine ecology. 2nd. Ed., Blackwell Scientific Publications, Oxford.

Birdlife International (2004) Threatened birds of the world 2004. CD ROM Cambridge, UK: Birdlife International.

Boyle, P.R. (1983) (Ed.) Cephalopod life-cycles Vol 1 Species Accounts. Academic Press Inc. (London) Ltd.

Broughton, D.A. & McAdam, J.H. (2002) A red data list for the Falkland Islands vascular flora. Oryx 36 (3): 279-287.

Brown & Root Environmental (1997), Falkland Islands Environmental Baseline Survey Desk Study report.

2001 Falkland Island Census, UK Foreign and Commonwealth Office Country Profiles: The Falkland Islands (www.fco.gov.uk)

bp (2002); Azeri, Chirag & Gunashli Full Field Development Phase 1 Environmental & Socio-economic Impact Assessment, Section 5a.

Clausen, A. & Huin, N (2003) Status and numerical trends of king, gentoo and rockhopper penguins breeding in the Falklands. *Waterbirds* **26**(4): 389-402.

E&P Forum report No. 2.59/197, 1994, 'Methods for Estimating Atmospheric Emissions from E&P Operations', Table 4.11 Tier Three Estimation: Draft Emission Factors for Transportation Fuel Combustion (tonnes emission/tonne fuel), Sea Transport emission factors.

Falkland Islands Government Fisheries Department (FIGFD 2000) Fisheries Statistics Volume 9 (1995-2004): 70 pp Stanley, FIG Fisheries Department

Falkland Islands Fisheries Department (FIGFD 2004) Scientific Report Fisheries Research Cruise ZDLH1-11-1999

Falkland Islands Government (FIG) (1996a) The first shallow marine survey around the Falkland Islands. Falkland Islands Environmental Baseline Survey, Brown and Root Environmental/ICON.

FCO 2005; Foreign and Commonwealth Office Country Profiles - Falkland Islands; www.fco.gov.uk

FUGRO GEOS (1999) North Falklands Metocean Survey Final Report - Volume 1 19-June-97 to 30-Sep-98. C10317/1762.

Gardline 1998(A). Benthic Environmental Baseline Survey of the Sediments around the exploration "Little Blue-A" Well (February 1998), Gardline Surveys Limited.

Gardline 1998(B). Benthic Environmental Baseline Survey of the Sediments around the exploration "B1" Well (February 1998), Gardline Surveys Limited.

Gardline 1998(C). Benthic Environmental Baseline Survey of the Sediments around the exploration "14/14-A" Well (February 1998), Gardline Surveys Limited.

Gardline 1998(D). Benthic Environmental Baseline Survey of the Sediments around the exploration " Well 14/23-A (February 1998), Gardline Surveys Limited.

Gardline 1998(E). Benthic Environmental Baseline Survey of the Sediments around the exploration "FI 14/19-A" Well (March 1998), Gardline Surveys Limited.

Gardline 1998(F). Benthic Environmental Baseline Survey of the Sediments around the exploration FI 14/24 "Braela" Well (March 1998), Gardline Surveys Limited.

Gardline 1998(G). Benthic Environmental Baseline Survey of the Sediments around the exploration "Minke" 14/13-B Well (June 1998), Gardline Surveys Limited.

Gardline 1998(H). Post-Drill Environmental Survey of the Sediments around the Exploration Well "Little Blue-A" - Final report October 1998. Gardline Surveys Limited.

Gundlach, E.R. & Hayes, M.O. (1978) Vulnerability of coastal environment to oil spill impacts. *Marine Tech. Soc. Jour*. **12**, 18-27.

Hatfield, E.M.C. (1990) The squid of the Falkland Islands Fishery; A profile. *Falkland Islands Newsletter*, **10**, 2-5.

Hatfield, E.M.C. (1991) Post-recruit growth of the Patagonian squid *Loligo gahi* (D'Orbigny, 1835) A review of current knowledge. *Journal of Cephalopod Biology,* **2**(1), 41-49.

Hoggarth, D.D. (1993) The life history of the Lithoid crab, *Paralomis granulosa*, in the Falkland Islands. *ICES J Mar Sci*., **50**, 405-424.

Huin, N. (2003) Falkland Island Seabird Monitoring Programme Annual Report 2002/2003. Falkland Islands Seabird Monitoring Program SMP 11, Falklands Conservation, Falkland Islands.

Huin, N. (2002) Year round use of the Southern Oceans by the black-browed albatross breeding in the Falkland Islands. Falklands Conservation, Falkland Islands.

Huin, N. (2001) Census of the black-browed albatross population of the Falkland Islands 2000/2001. Falklands Conservation.

Hydrographer of the Navy (1993). *South American Pilot Volume II.* (*16th ed*)*.* Southern coasts of South America from Cabo Tres Puntas to Cabo Raper and the Falkland Islands. Hydrographic Office, Ministry of Defence, Taunton. 457pp.

Inada, T., & Nakamura, I. (1975) A comparitive study of two populations of the Gadoid fish, *Micromesistius australis* from the New Zealand and Patagonian-Falkland regions. *Bulletin of Far Seas Fish Resource Laboratory*, **13**, November 1975.

Ingram Hendley, N., (1937) The plankton diatoms of the Southern Seas. *Discovery Reports* Vol XVI, 151-364, Plates VI-XIII.

Kingston, P F (1987). Field effects of platform discharges on benthic macrofauna. Philosophical Transactions of the Royal Society of London.

Lisovenko, L.A., Barabanov, A.V., Yefremenko, V.N. (1982) New data on the reproduction of the "Southern Putassu", *Micromesistius australis* (Gadidae), from the Falkland-Patagonian Zoogeographic Region. *Journal of Ichthyology*, **22**, 55-67.

Met Office Marine Consultancy (1998). North Falklands Forecast Verification Report No 7, Prepared for IPC Falklands Limited.

Met Office Marine Consultancy (1998). North Falklands Forecast Verification Report No 6, Prepared for IPC Falklands Limited.

Met Office Marine Consultancy (1998). North Falklands Forecast Verification Report No 5, Prepared for IPC Falklands Limited.

Met Office Marine Consultancy (1998). North Falklands Forecast Verification Report No 4, Prepared for IPC Falklands Limited.

Met Office Marine Consultancy (1998). North Falklands Forecast Verification Report No 3, Prepared for IPC Falklands Limited.

Met Office Marine Consultancy (1998). North Falklands Forecast Verification Report No 2, Prepared for IPC Falklands Limited.

Met Office Marine Consultancy (1998). North Falklands Forecast Verification Report No 1, Prepared for IPC Falklands Limited.

Middleton, D.A.J., Arkhipkin, D.I., Grzebielec, R. (2001). The biology and fishery of *Macruronus magellanicus* in Falkland Islands waters. *Workshop on hoki and southern blue whiting, Chile, 3-7th July 2001.*

Patterson, K.R. (1986) The Polish fishery for Southern Blue Whiting in the FICZ from July to October 1985. Source; Falkland Islands Fisheries Department.

Richards, P BGS (December 2001), Falkland Islands: past exploration strategies and remaining potential in underexplored deepwater basins.

Richards, P (2002), Overview of petroleum geology, oil exploration and associated environmental protection around the Falkland Islands. Paper published in Journal of Aquatic Research 2002 Special Publication on the Falklands Environment.

Richards, P. C. and Hillier B. V. (July 2000) Post-Drilling Analysis of the North Falkland Basin - Part 1 - Stratigraphic Framework. Manuscript of paper published in Journal of Petroleum Geology, vol 23(3), July 2000, pp 253-272.

Richardson, W. J., C. R. Green Jr., C. I. Malme and D. H. Thomson (1995). Marine Mammals and Noise. Academic Press, San Diego, USA.

Rodhouse, P G, Symon, C and Hatfield, E M C (1992). Early life cycle of aphalopods in relation to the Major Oceanographic features of the southwest Atlantic Ocean. Marine Ecology Progress Series 89, p183-195.

Rodhouse, P.G., Barton, J., Hatfield, E.M.C., & Symon, G. (1995*) Illex argentinus*: life cycle, population structure and fishery. *ICES Marine Science Symposium*, **199**, 425-432.

Searles, R.B. (1978) The genus *Lessonia* (Phaeophyta, Laminariales) in Southern Chile and Argentina. *Br. Phycol. J.*, **13**, 361-381.

Shah, A. and Pope, P (editors) 1994. *Methods for estimating atmospheric emissions from E&P operations*. E&P Forum, London. Report No. 2.59/197.

Strange, I J (1990) Sea Lion Survey in the Falkland Islands. Falkland Islands Foundation, Stanley.

Strange, I J (1992) A field guide to the wildlife of the Falkland Islands and South Georgia, HarperCollins, London.

Tasker, M L, Jones, P H, Dixon, T J and Blake, B F (1984) Counting seabirds at sea from ships: a review of methods employed and a suggestion for a standardized approach. Auk, 101, 567-577.

Tingley, G.A., Purchase, L.V., Bravington, M.V., & Holden, S.J. (1995) Biology and fisheries of hakes (*M.hubsii* and *M.australis*) around the Falkland Islands. Ch 10. In Alheit, J., Pitcher, T., (Eds) Hake: Biology, Fisheries & Markets, Chapman & Hall, London.

Turnpenny, A.W.H. and Nedwell, J.R. 1994. The Effects on Marine Fish, Diving Mammals and Birds of Underwater Sound Generated by Seismic Surveys. Fawley Aquatic Research Laboratories.

Urick, R.J. 1983. Principles of Underwater Sound. McGraw-Hill, New York.

Webb, A and Durinck, J (1992) Counting birds from ship. IWRB Special Publication No. 19, Slimbridge.

White, R.W., Gillon, K.W., Black, A.D. & Reid, J.B. (2002) The distribution of seabirds and marine mammals in Falkland Island waters. JNCC, Peterborough

White, R.W., Gillon, K.W., Black, A.D. & Reid, J.B. (2001) Vulnerable concentrations of seabirds in Falkland Islands waters. JNCC, Peterborough.

White, R.W., Reid, J.B., Black, A.D. & Gillon, K.W. (1999) Seabirds and marine mammal dispersion in the waters around the Falkland Islands 1998-1999. JNCC, Peterborough.

Woods, R., Stevenson, J., Ingham, R., Huin, N., Clausen, A., & Brown, A. (2004) Important Bird Areas in the Falkland Islands. A Falklands Conservation Report to Birdlife International.

Woods, R.W. & Woods, A. (1997) Atlas of Breeding Birds of the Falkland Islands. Anthony Nelson, Owestry, Shropshire, England.

World Bank Financing to Albania, the World Bank Tirana Office, March 2005.

World Conservation Monitoring Centre (WCMC). 1999. WCMC home page. www.wcmc.org.co.uk.

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# APPENDIX I

# Species Identified as under threat by the IUCN

## Species identified as at threat by IUCN

| Scientific Name: | English Name: | IUCN Category: |
|---|---|---|
| | **Whales** | |
| *Balaenoptera borealis* | Sei whale | *Endangered* |
| *Balaenoptera musculus* | Blue whale | *Endangered* |
| *Berardius arnuxii* | Arnoux's beaked whale | *Least Concern** |
| *Caperea marginata* | Pygmy right whale | *Least Concern* |
| *Cephalorhynchus commersonii* | Commersons dolphin | *Data Deficient* |
| *Eubalaena australis* | Southern right whale | *Least Concern* |
| *Globicephala melas* | Long-finned pilot whale | *Least Concern* |
| *Hyperoodon planifrons* | Southern bottlenose whale | *Least Concern* |
| *Lagenorhynchus australis* | Peale's dolphin | *Data Deficient* |
| *Lagenorhynchus cruciqer* | Hourglass dolphin | *Least Concern* |
| *Lagenorhynchus obscurus* | Dusky dolphin | *Data Deficient* |
| *Lissodelphis peronii* | Southern right whale | *Data Deficient* |
| *Megaptera novaeangliae* | Humpback whale | Vulnerable |
| *Mesoplodon grayi* | Gray's beaked whale | *Data Deficient* |
| *Mesoplodon hectori* | Hector's beaked whale | *Data Deficient* |
| *Mesoplodon layardi* | Layard's beaked whale | *Data Deficient* |
| *Orcinus orca* | Killer whale | *Least Concern* |
| *Phocoena dioptrica* | Spectacled porpoise | *Data Deficient* |
| *Physeter macrocephalus* | Sperm whale | *Vulnerable* |
| *Ziphius cavirostris* | Cuvier's beaked whale | *Data Deficient* |
| | **Seals** | |
| *Arctocephalus australis* | South American fur seal | *Least Concern* |
| *Hydrurga leptonyx* | Leopard seal | *Least Concern* |
| *Leptonychotes weddellii* | Weddell seal | *Least Concern* |
| *Lobodon carcinophagus* | Crabeater seal | *Least Concern* |
| *Mirounga leonina* | South Atlantic elephant seal | *Least Concern* |
| *Otaria flavescens* | South American sea lion | *Least Concern* |
| | **Birds** | |
| *Eudyptes chrysocome* | Rockhopper penguin | *Vulnerable* |
| *Eudyptes chrysolophus* | Macaroni penguin | *Vulnerable* |
| *Gallinago stricklandii* | Fuegian snipe | *Least Concern* |
| *Macronectes giganteus* | Southern giant petrel | *Vulnerable* |
| *Phalcoboenus australis* | Striated caracara | *Least Concern* |
| *Procellaria aequinoctialis* | White-chinned petrel | *Vulnerable* |
| *Pygoscelis papua* | Gentoo penguin | *Least Concern* |
| *Spheniscus magellanicus* | Magellanic penguin | *Least Concern* |
| *Thalassarche melanophrys* | Black-browed albatross | *Endangered* |

| | | |
|---|---|---|
| *Troglodytes cobbi* | Cobb's wren | *Vulnerable* |
| **Vascular Plants** | | |
| *Chevreulia lycopodioides* | Clubmoss cudweed | *Least Concern* |
| *Erigeron incertus* | Hairy daisy | *Vulnerable* |
| *Gamochaeta antarctica* | Antarctic cudweed | *Endangered* |
| *Hamadryas argentea* | Silvery buttercup | *Least Concern* |
| *Leucheria suaveolens* | Vanilla daisy | *Least Concern* |
| *Nassauvia gaudichaudii* | Coastal nassauvia | *Least Concern* |
| *Nassauvia serpens* | Snake-plant | *Least Concern* |
| *Nastanthus falklandicus* | False-plantain | *Vulnerable* |
| *Phlebolobium maclovianum* | Rock-cress | *Vulnerable* |
| *Plantago moorei* | Moore's plantain | *Vulnerable* |
| *Senecio littoralis* | Woolly ragwort | *Least Concern* |
| *Senecio vaginatus* | Smooth ragwort | *Least Concern* |
| **Fish** | | |
| *Cetorhinus maximus* | Basking shark | *Vulnerable* |
| *Squalus acanthias* | Spiny dogfish | *Least Concern* |

Source, www.iucn.org and www.redlist.org.

- Although a number of Falkland Island species are still assessed and listed under 1994 categories and would be classified as *Lower Risk* (LR), the new equivalent category of *Least Concern* (LC) has been used for consistency.

# APPENDIX II

# Desire Petroleum HSE Policy Statement

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Desire PETROLEUM PLC

# HSE Policy

Desire Petroleum plc is committed to high standards of Health, Safety and Environmental (HSE) protection. We achieve this through:

- Strong leadership and clearly defined responsibilities and accountabilities for HSE at all levels of the organization;
- Selection of competent staff to manage the business;
- Compliance with regulatory requirements, or where regulations do not exist, application of sensible standards;
- Identifying, assessing and managing HSE risks to people and the environment as an integral part of the business;
- Developing plans to identify, assign responsibilities, schedule and track HSE activities within each project;
- Preparing and testing response plans to ensure that any emergency can be quickly and efficiently controlled;
- Reporting and investigating incidents to ensure the company learns from these;
- Monitoring HSE performance through regular reporting and periodic audits;
- Periodic management reviews to identify and implement improvements to our HSE systems.

We recognize the key role contractors play in our business, and select competent companies that meet our HSE standards. We monitor our contractors' performance and manage this as an integral part of our business.

This policy is implemented through our HSE Management System and is used to guide all our activities. It will not be compromised by other business priorities.

| | |
|---|---|
| Dr Ian Duncan<br>Chief Executive Officer | Date: |

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# APPENDIX III

# Oil Spill Contingency Plan (DRAFT)

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# THIS PLAN SETS OUT RESPONSE PROCEDURES IN THE EVENT OF AN OIL SPILL DURING OFFSHORE OPERATIONS

The plan contains the following sections:

**SECTION 1:** Spill response procedures

**SECTION 2:** Background and strategy

**SECTION 3:** Organisation and communication

APPENDIX A: List of contacts
APPENDIX B: Spill assessment form
APPENDIX C: Spill response log sheet
APPENDIX D-E: Spill response kit inventories

**All Desire Petroleum personnel & contractors shall familiarise themselves with Section 1, which is posted on notice boards and with spill kits.**

## *Amendment Record*

*Any future changes made to the Plan document will be noted below:*

| Amendment number and description | Date | Inserted by (print and sign) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

## *Distribution List*

Copy 1(Master Copy): Desire Petroleum

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## TABLE OF CONTENTS

# SECTION 1: SPILL RESPONSE PROCEDURES

**PERSONNEL SAFETY SHOULD BE ENSURED AT ALL TIMES!**

## PRIORITY 1: INITIAL ASSESSMENT & FIRST RESPONSE

- Identify source, type and extent of spill.
- Assess hazards from the spill and ensure safety of all persons.
- Notify Spill Response Commander (SRC) of spill source/volume, fire risk, casualties etc.
- Stop flow at source of spill if possible.
- Attempt to limit immediate spread of spill: prevent off-board migration by surface runoff.
- Extinguish all ignition sources in the area: isolate live equipment and enforce no smoking!

## PRIORITY 2: MONITOR & DECIDE RESPONSE STRATEGY

- SRC to monitor and evaluate situation.
- Decide spill response strategy and assess whether spill is within Desire Petroleum spill response capability (complete Spill Assessment Form, Appendix B).
- Notify Desire Project Manager, provide all information relating to the spill and request external spill response assistance if required.
- Desire Project Manager to ensure that necessary external notifications are made depending on extent of spill: Fisheries Department, OSRL, Desire Petroleum senior staff, Falklands Conservation.

## PRIORITY 3: SPILL RESPONSE

- Tier 1/2/3: dependent on size and location of spill and weather conditions.
- If spill and sea and weather conditions allow, containment significantly reduces the effort required to control and clean up the spill.
- Coastal spills may require booming of inlets.
- Response to offshore spills may consist of monitoring and evaluation **OR** may justify the use of dispersants.
- Complete the Spill Response Log Sheet (Appendix C).

## PRIORITY 4: DEMOBILISATION

- Clean and decontaminate response equipment.
- Medical screening of personnel involved.
- Separate liquid and solid wastes.
- Dispose of in accordance with current waste disposal procedures for special wastes.

## PRIORITY 5: POST-SPILL EVALUATION

- Evaluate cause of spill and implement corrective action.
- Make amendments to Oil Spill Response Plan (if required).
- Conduct environmental monitoring if needed, liasing and coordinating with Falkland Islands Fisheries Department and other bodies.

## Action Card in event of Oil Spill from Rig or Vessel

**STOP WHAT YOU ARE DOING AND DEAL WITH THE SPILL!**

1. **IDENTIFY SOURCE, TYPE AND EXTENT OF SPILL**
2. **ASSESS HAZARDS & ENSURE SAFETY OF ALL PERSONNEL**
3. **NOTIFY SPILL RESPONSE COMMANDER (VESSEL MASTER OR TOOLPUSHER)**
4. **STOP FLOW AT SOURCE**
5. **ISOLATE DRAINAGE SYSTEM**
6. **EXTINGUISH IGNITION SOURCES - ISOLATE LIVE EQUIPMENT - NO SMOKING**
7. **WAIT FOR FURTHER DIRECTIONS FROM SPILL RESPONSE COMMANDER**

**REMEMBER — SAFETY IS OF PARAMOUNT CONCERN DO NOT PUT YOURSELF OR OTHERS AT UNNECESSARY RISK!**

# SECTION 2: BACKGROUND AND STRATEGY

## 2.1 INTRODUCTION

This document outlines Desire Petroleum's response plan for oil spilled during their proposed drilling operations off the Falkland Islands.

This plan refers to the Falklands Islands Government (FIG) National Oil Spill Contingency Plan (2005) and the Falkland Operators Sharing Agreement (FOSA) Oil Spill Contingency Plan (1998).

## 2.2 STRATEGY

The main objectives of the Desire Petroleum Spill Response Strategy are as follows:

- Minimise the adverse impacts on the environment by monitoring and evaluating the spread of spilled oil.
- Use a variety of techniques to contain, recover or disperse as much of the spilled oil as possible.
- To limit the effects of any adverse publicity and potential damage to Desire Petroleum's corporate profile with regulatory bodies and the general public.

This Spill Response Plan has been prepared in order to fulfil these objectives and describes the actions and resources (plant, equipment and personnel) necessary to contain and recover spills.

## 2.3 SPILL CLASSIFICATION AND TIERED RESPONSE

There are three levels of response depending on the size and nature of the spill:

- Tier 1: Local response (by the spiller) to small spills.
- Tier 2: A regional response to larger spills — Desire will be assisted by other FI bodies in this e.g. Fisheries Department.
- Tier 3: Response to large or difficult spills which requires the input of external assistance based outside the Falkland Islands.

All spills fall into one of the three classifications defined below. The classification is based upon the volume of the spill and the resources necessary to achieve appropriate containment and clean up. Specific spill response actions will be based on this classification of spills as indicated in Table 1.

**TABLE 1. SPILL CLASSIFICATION AND RESPONSE CAPABILITY**

| Spill Classification | Type | Volume (Litres) | Response |
|---|---|---|---|
| Level 1 | 'Small' | ≤ 1000 | Tier 1 (dealt with by Desire spill response resources onboard vessel or rig) |
| Level 2 | 'Medium' | 1000 — 10,000 | Tier 2 (response by Desire assisted by other FI resources, e.g. Fisheries Department, other operators in area) |
| Level 3 | 'Major' | >10,000 | Tier 3 (Requires resources of OSRL or similar contractor for adequate response). |

To clearly assess the level of spill, it is essential that the nature and location of the following is known:

- All oil sources on board vessels and the rig.
- The potential pathways and drainage systems whereby the oil may reach the sea surface.

This information must be clearly communicated to spill response personnel and any external spill response contractors that may be involved in a Tier 3 spill.

## 2.4 RESPONSE CHOICE

- It is the responsibility of the Spill Response Commander to determine the most appropriate level of response dependent on the spill volume and the sea/weather conditions.
- Level 2 spills that migrate may be outside the response capability of the Spill Response Team. In such cases, these spills should be treated as Level 3 spills.
- It is easier to downgrade a Tier 3 response to Tier 2 than to up-grade the response once the spill has impacted a wide area.

## 2.5 SPILL DISPERSANTS

Spill dispersants are chemicals that can be applied to floating oil to enable the formation of tiny oil droplets in the top part of the water column. In offshore settings, this can encourage biodegradation, inhibit the formation of oil-in-water emulsions and prevent subsequent oil stranding.

The FOSA Oil Spill Contingency Plan suggests dispersants may be used in responding to a spill, **however no dispersant should be used without the prior approval of the Falkland Islands Government**.

The FIG Oil Spill Contingency Plan states that dispersants may only be used in the following areas:

1. Sea areas with > 30m charted water depth
2. Sea areas > 1 mile from kelp beds
3. Sea areas > 1 mile from any inland coastline

It is advised that Desire utilise a Tier 1 package of 54m$^3$ of Corexit® 9500 dispersant which can be applied by boats equipped with spray booms — this allows for 18m$^3$ of dispersant to be applied per day for a period of 3 days, enough time for a Tier 3 response to be mounted.

The effective method of application from a workboat is to use a low-volume, low-pressure pump so the chemical can be applied undiluted. Natural wave or boat wake action usually provides adequate mixing energy to disperse the oil. Early treatment with Corexit®, even at reduced treatment rates, can also counter the "mousse" forming tendencies of spilled oil. A dispersant to oil ratio of 1:50 to 1:10 is recommended. This rate varies depending on the type of oil, degree of weathering, temperature, and thickness of the slick.

The most effective and rapid application of dispersants to an oil spill is via aircraft and a variety of aircraft are available in the FI for spraying. In a Tier 3 incident, OSRL has its 'ADDS Pack' for applying aerial dispersant, which is to be used with its Hercules L-382 aircraft. This can apply 68 tonnes of Corexit® 9500 dispersant per day.

## 2.6 TIER 1 RESPONSE

The deployment of spill response equipment onboard the rig and support vessels provides a targeted spill risk control investment by Desire Petroleum which will enable small (Level 1) and medium (Level 2) spills to be controlled, contained and cleaned up.

**The location of spill kits on the rig and vessels should be clearly identified.**

Specific inventories of the contents of the various spill response kits are presented in Appendix D. The spill kits are designed to meet the following general requirements:

- Containment and recovery of oil spillage onboard a vessel for a spill of up to 600 litres.
- 'First Aid' control for a spill of up to 1000 litres onto water until external assistance arrives.
- Application of 18m$^3$ per day of Corexit® 9500 for a period of 3 days (54m$^3$).

The supply and standby vessels will each carry 5 m$^3$ of dispersant in bulk tanks and drums. The remaining supply of Corexit® will be stored in the Falklands available for loading onto supply vessels for transport out to the spill site.

## 2.7 TIER 2 RESPONSE — FI RESOURCES

In a Tier 2 incident, Desire will notify the FI Fisheries Department and request their assistance in mobilising extra resources, such as aircraft, vessels and personnel. Dependent on spill trajectory, this may involve defensive actions in coastal areas of the FI such as booming of inlets. The Fisheries Department is the lead FI agency for national oil spill planning and response and has a stockpile of response gear (see Appendix E).

## 2.8 TIER 3 RESPONSE — OSRL

Desire is an Associate Member of Oil Spill Response Limited (OSRL), based in Southampton, UK. This enables Desire to call on OSRL to respond to Tier 3 spill incidents and coordinate the necessary response.

OSRL maintain bases in Southampton and Singapore and have their own C-130 aircraft permanently on standby 24 hours a day, 365 days a year in Southampton along with a full team of managers and response technicians to deploy to oil spill incidents world-wide. Equipment packages are pre-loaded to enable rapid transportation to airports, to be loaded onto freight aircraft.

In a Tier 3 incident OSRL would liase with the Fisheries Department in the coordination of the response effort, supplying additional specialised equipment, supervisory and spill management assistance. Technical support from Southampton would also be available including computer prediction of the spill trajectory concerned.

A Tier 3 incident would require aerial surveillance capability and a FIG Air Service (FIGAS) Islander could be used for this. Offshore recovery operations would require a supply vessel and tanker for storage of recovered oil/water. Recovery operations are ineffective above Beaufort Force 5 conditions, which are approximately 30% of the time in the offshore Falklands environment. There are appropriate reception facilities in South America (e.g. Punta Arenas).

## 2.9 SPILL RESPONSE OPERATIONS

A comprehensive spill response operation will consist of all or most of the prioritised tasks and sub-tasks shown in Table 2.

### TABLE 2. SPILL RESPONSE OPERATIONS

| Task | Sub-tasks |
|---|---|
| **1. INITIAL ASSESSMENT** | • Ensure personnel safety<br>• Assess size and nature of spill<br>• Report spill to Spill Commander<br>• Stop flow of material<br>• Isolate vessel drainage system |
| **2. STRATEGY CHOICE** | • Monitor and evaluate spill<br>• Decide on spill response required |
| **3. SPILL RESPONSE** | • Contain spill onboard if possible (using absorbents, plugs etc.)<br>• Clean up contaminated surfaces (using sorbent materials)<br>• Recover off-board spilled material using booms and skimmers if conditions allow<br>• Coastal spills may require booming of inlets<br>• Deploy aerial dispersant if offshore spill and conditions allow |
| **4. DEMOBILISATION** | • Cleaning and decontamination of response team personnel<br>• Medical screening of response team personnel<br>• Clean equipment and replace consumable items from spill response kit |
| **5. WASTE DISPOSAL** | • Separate liquid and solid wastes<br>• Dispose of in accordance with Desire Petroleum waste disposal procedures for special (oily) wastes |
| **6. POST-SPILL EVALUATION** | • Spill incident reporting (use log sheet, see Appendix C)<br>• Evaluate cause of spill and implement corrective action<br>• Make amendments to Spill Plan (if required)<br>• Conduct environmental monitoring (if required) |

## 2.10 ENVIRONMENTAL MONITORING

As part of the post-spill evaluation, a programme of environmental monitoring may be necessary. The objectives of monitoring are to determine:

- Movement and fate of spills
- Short-term and long-term environmental effects
- Health effects
- Evidence for any legal proceedings that may follow

Monitoring may take several forms:

1. Visual examination supported by photographic and video records.
2. Oil sampling to determine chemical characterisation and level of deterioration.
3. Sampling of water and where appropriate sediment. flora and fauna.

Desire should liase closely with the FI Fisheries Department to share resources for aspects of the sampling programme.

## 2.11 SPILL TRAINING

All relevant Desire personnel (Project Managers, Vessel Masters, Toolpushers) will undertake a course of oil spill training specific to the planned operations off the Falkland Islands run by OSRL.

This will include study of the behaviour and fate of spilled oil; overall response objectives and managing response strategies; roles and responsibilities; communications; Tier 3 response planning; environmental monitoring; case studies and both desktop and practical exercises.

# SECTION 3: ORGANISATION AND COMMUNICATION

## 2.12 ROLES AND RESPONSIBILITIES

The organisational structure and chain of communication during a spill is presented in Figure 1. Communication between those individuals involved in a spill incident will be via telephone/radio. Contact telephone numbers are presented in Appendix A.

The Desire EHS Manager will regularly update a 24-hour telephone list for on-site spill response team members. This list will be kept in a designated location to enable the Spill Response Commander to mobilise an on-site spill response team at any time.

The following site personnel will be involved in spill response:

## 2.13 FIRST PERSON TO SIGHT SPILL (FIRST RESPONDER)

- All personnel have the responsibility to immediately report any spill at Desire Petroleum to the Vessel Master or Toolpusher who will adopt the responsibility of Spill Response Commander (SRC).
- Available information including source of spill, volume of spill, fire risk, casualties etc. should be reported to the SRC.
- The First Responder should assess the source, type and extent of the spill and if safe to do so shut down at the source and attempt to limit immediate spread of the spill.
- All hazards from the spill and safety of all personnel should be assessed and all ignition sources in the vicinity of the spill eliminated as necessary.

## 2.14 SPILL RESPONSE COMMANDER (VESSEL MASTER OR TOOLPUSHER)

- The Vessel Master or Toolpusher will adopt the responsibility of Spill Response Commander (SRC) depending on the timing and location of the spill.
- The Spill Response Commander is responsible for initiating and co-ordinating appropriate spill response actions in accordance with this plan. This will include, as necessary:
    - ensuring complete shut-down,
    - isolation of the source of the spill,
    - limiting spread if possible,
    - monitoring the spill and
    - deciding on the appropriate level of response required.
- The SRC is also responsible for ensuring the safety of all persons involved in the spill incident.
- The SRC may also need to contact the FI Fisheries Department and emergency services. Immediate spill response actions should be initiated with the On-Site Spill Response Team.
- The SRC should determine the source, type and extent of spill and assess whether the spill is within the response capability of Desire's on-site Spill Response Team using the Spill Assessment Form (Appendix B).

- The SRC is responsible for ensuring that the Desire Project Manager is given all information relating to the spill and notified if OSRL or other outside contractors are required for the spill response.
- **In the event of a Tier 1/2 spill** — the SRC will be responsible for monitoring the spill response, liasing with the FI Fisheries Department (if necessary) ensuring that sufficient resources are allocated to achieve the appropriate response to the spill. They will also ensure that sufficient information has been passed on to the Desire Project Manager as appropriate.
- **In the event of a Tier 3 spill**, the Spill Response Commander will be responsible for fully liasing with OSRL and the Fisheries Department to enable a successful coordination of resources to respond to the spill.

## 2.15 ON-SITE SPILL RESPONSE TEAM (SRT)

- The Spill Response Commander will be responsible for appointing a Spill Response Team (SRT) from the rig or vessels to monitor the spill, deploy spill equipment and contain, retrieve or disperse the spilled oil.
- Upon mobilisation, the SRT will confirm complete operational shut-down, attempt to ensure that flow at the source of spill has been stopped, confirm initial assessment of spill volume and conditions and notify if external assistance is necessary.
- The SRT are responsible for containing off-site migration of internal spills by surface runoff, and protect rig/vessel drainage to ensure that the spill does not worsen.
- The SRT are responsible for deploying booms, skimmers, absorbent materials and holding tanks to contain and retrieve spilled oil.
- The SRT are responsible for ensuring proper holding and disposal of any retrieved oil.
- The SRT are responsible for spill clean-up operations and should complete the Spill Response Log Sheet (Appendix C) and submit to the Spill Response Commander.

## 2.16 DESIRE PROJECT MANAGER

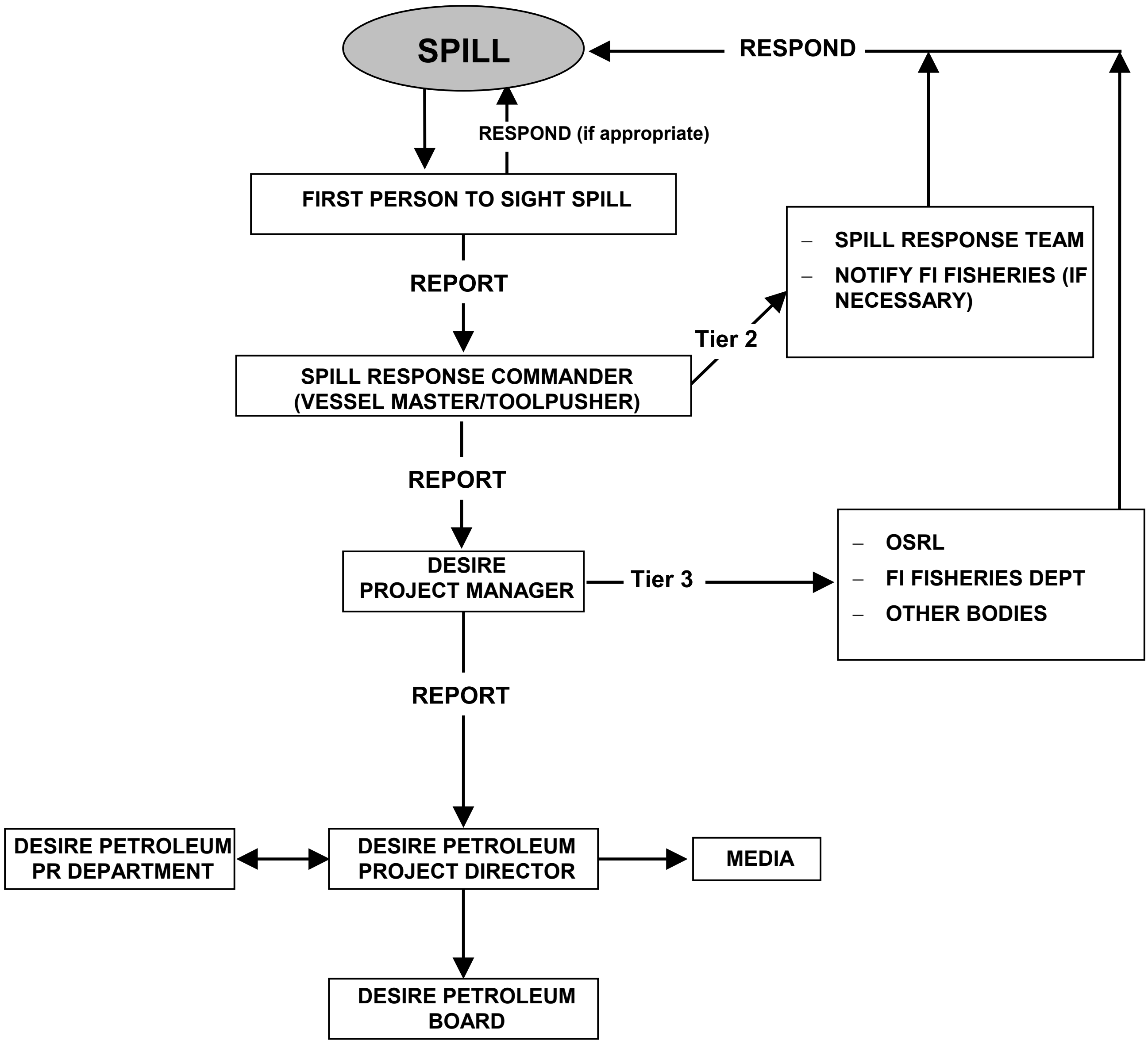
- The Project Manager is the spill contact for Desire Petroleum and is responsible for off-site communications while spill response is in action, and for ensuring sufficient allocation of resources to achieve clean-up of the spill (e.g. contacting outside spill response contractors).
- The Project Manager must maintain communications with the Spill Response Commander and keep informed of all developments relating to spill.
- The Project Manager is responsible for notifying the Fisheries Department of all spills.
- The Project Manager is responsible for notifying the Desire Project Director.

## 2.17 DESIRE PROJECT DIRECTOR

- In the event of a large spill (Tier 2 or Tier 3), the Project Director will monitor the spill response and ensure that the Project Manager and Spill Response Commander obtain sufficient resources to achieve an appropriate response to the spill.
- The Project Director will also ensure that the necessary external notifications have been made and act as representative and spokesperson in communications with press and media, local community groups, general public, etc. Under certain circumstances, these responsibilities may be delegated to the Project Manager.

## 3.1 CHAIN OF COMMUNICATIONS

**Figure 1. Spill Response Organisational Structure**



## 3.2 EXTERNAL REPORTING

All Tier 2 and 3 spills occurring during the operation of Desire Petroleum's operations must be reported to the Fisheries Department.

The following reporting procedure should be followed for all Tier 3 spills:

1. Notify the Fisheries Department immediately (Tel Number: XXXXX);
2. Preliminary details must be sent by telephone or fax to the Fisheries Department, containing the following minimum information:
    a. Location and extent of spill;
    b. Type and amount of oil spilled;
    c. Date and time of incident;
    d. Weather and sea conditions at time of spill (wind speed & direction, sea state, current direction);
    e. Any immediate environmental impacts noted (whether photos taken, water samples taken);
    f. Response action and remediation measures implemented (and whether OSRL need to be called in);
    g. In the case of accident, number of persons affected and extent of injuries;
    h. Source of and cause of spillage;
    i. Further actions necessary.
3. Details should be confirmed or amended in writing as soon as possible after preliminary reporting has taken place

## APPENDIX A — CONTACTS

| Organisation | Contact | Position | Location | 24-Hour Contact Number |
|---|---|---|---|---|
| **Vessels** | | | | |
| | | | | |
| | | | | |
| | | | | |
| **Rig** | | | | |
| | | Toolpusher | | |
| | | HSE Manager | | |
| **Desire Petroleum** | | | | |
| | | Project Manager | | |
| | | Project Director | | |
| | | | | |
| **Falkland Islands Government Lead Agency** | | | | |
| Fisheries Department | | | | 27260/27266 |
| **Other Support Agencies** | | | | |
| Falklands Conservation | | | | 22247 |
| Police | | | | 27222 |
| FIGAS | | | | 27219 |
| **Oil Spill Response Limited** | | | | |
| OSRL | Duty Manager | | Southampton, UK | Telephone: +(44) 23 8033 1551<br>Pager*: +(44) 8700 555500 or +(44) 7623 523523 |
| * Ask for pager "OIL 39" and provide telephone number as well as the message to be displayed. If calling from the Falkland Islands ensure that the +500 country code precedes the telephone number. | | | | |

## APPENDIX B — SPILL ASSESSMENT FORM

This form is to be used by the Spill Response Commander in recording details relating to the spill. **If a shaded box is ticked, external assistance should be requested immediately** - refer to Contacts List in Appendix A).

| | | |
|---|---|---|
| • All personnel safe and uninjured? (Desire Petroleum, contractors, public ) | Yes ☐ | No ☐ (shaded) |
| • Assess volume of spill: | < 250 litres ☐ | >250 litres ☐ (shaded) |
| • Can/was spill be adequately contained and cleaned up by on-site spill response team? | Yes ☐ | No/Don't Know ☐ (shaded) |
| • Fire hazard present? | Yes/Don't Know ☐ (shaded) | No ☐ |
| • Flow of oil stopped at source? | Yes ☐ | No ☐ (shaded) |
| • Is spill likely to drain off-vessel? | Yes ☐ (shaded) | No ☐ |

**Spill Conditions Description:**

1. Date and time of spill incident:

2. Source and type of spilled oil:

3. Location and volume of spill:

4. Cause of spill incident:

5. Personnel on-board at time of spill (Desire Petroleum, contractors, others):

6. Other comments:

## APPENDIX C. SPILL RESPONSE LOG SHEET

| DATE AND TIME | DESCRIPTION OF ACTION / EVENT | NOTES |
|---|---|---|
| | Discover oil spill | |
| | Spill Response Commander notified; | |
| | Spill assessment completed | |
| | Type of response decided | |
| | Spill response kit deployed | |
| | Leakage stopped | |
| | Spill contained | |
| | Spill cleaned up | |
| | Spill dispersed | |
| | Desire Project Manager contacted | |
| | Fisheries Department contacted (if necessary) | |
| | OSRL notified (if Tier 3) | |
| | OSRL arrives at site (Tier 3) | |
| | Demobilisation | |
| | Other events: | |

## APPENDIX D. DESIRE PETROLEUM VESSEL SPILL RESPONSE KIT

| Item | Total absorbency (litres) | Quantity |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

*Insert details when known as part of Operational Addendum*

## APPENDIX E. FIG SPILL RESPONSE KIT INVENTORY

# OIL SPILL EQUIPMENT INVENTORY

**CONTAINER No. 1** -1ST CONTAINER ON LEFT

## SEA BOOMS ONLY

HARBOUR FLOW 750 INFLATABLE BOOM

20 x 10M SECTIONS (200M)
12 x 20M SECTIONS (240M)
(FITTED WITH ASTM CONNECTORS)

FLOW SEAL 550 SHORE SEALING BOOM

3 x 20M SECTIONS SHORE BOOM (60M)
4 x 10M SECTIONS SHORE BOOM (40M)
(FITTED ASTM CONNECTORS)

? x COILS OF 12MM ROPE WITH BUOYS ATTACHED

## CONTAINER No.2

PROSHIELD 2 SUITS
50 x LARGE 50 x X-LARGE 50 x XX-Large (150 SUITS)

TITEX CHEMICAL SUITS
25 x LARGE 25 x X-LARGE (50 SUITS)

BOILERSUITS
15 x SIZE 42 15 x SIZE 44 15 x SIZE 46 15 x SIZE 48 (60 SUITS)

TYVEK PROTECH C- SUITS
25 x LARGE 25 x X-LARGE (50 SUITS)

STEEL TOED WELLINGTONS
8 PRS x SIZE 8
15 PRS x SIZE 9
15 PRS x SIZE 10
7 PRS x SIZE 11 (TOTAL 45 PAIRS)

15 PRS x TUBE SOCKS
15 x BALACLA V AS
45 x FURNITURE GLOVES
15 x PVC GLOVES 16 INCH
40 x GOGGLES 600 RANGE
40 x RQ 7000 GEMINI HALF FACE MASK
40 x SINGLE FILTERS FOR HALF FACE MASK
8 x BOATHOOKS
10 x SHOVELS
10 x SQUEEGES WITH HANDLES (MODEL SQ6500)

**CONTAINER No.3**

1x INSTEE SE TANK

3x 30KG BRUCE ANCHORS

1000 x HEAVY DUTY PLASTIC BAGS

COWEN FLOWLINE MIDI SKIMMER, STAINLESS STEEL, ADJUST ABLE WEIR TYPE

4x 10 METRE OIL/WATER HOSES WITH CAM LOCK CONNECTORS FOR USE WITH SKIMMER AND PERISTALTIC WATER PUMP

2x TYPE A AIRBLOWERS

1x WATERPUMP (DIESEL -LOMBARDINI) -HANDSTART 3x

5M AIRHOSES & CONNECTORS

3x 5M WATERHOSES & CONNECTORS

16x SORBENT BOOM 5M X 13 CM)

SKIRTED SORBENT BOOM IN SIZE 20 X 3M (20CM DIAMETER) 8X5M
19 x 3M (57M)
8 x 5M (40M)

1000 x SORBENT PADS (10 PACKS 100)

10 x RAKES

10 x SPADES

3 x PLASTIC DUSTBINS AND LIDS

? x DECONTAMINATION TRAYS

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# APPENDIX IV

## Summary of the results of Benthic and Post-drill environmental surveys

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FOSA commissioned Falklands Islands benthic survey work to be carried out by Gardline Environmental Surveys. The scope of work covered the collection of samples and subsequent analysis for a number of well sites, each with 12 sample stations, plus sampling from in-field control stations. The vessels used for benthic sampling were the MV L'Espoir and MV Dorada.


**Figure 32:** MV Dorada used alongside the MV L'Espoir for the benthic survey.

In addition a shallow water marine survey was conducted around the Falkland Islands between the 12 January 1996 and 21 March 1996 by a survey team from IC Consultants Ltd (ICON) in conjunction with Brown & Root Environmental (undertaking the baseline environmental survey), Tingley, G et al (1996). As this survey focussed on the shallow marine environment away from the licence area, no further discussion of these results is presented here.

The following Gardline survey reports have been reviewed. The following section is a summary of the survey description and environmental results of these reports.

- Benthic Environmental Baseline Survey of the Sediments around the exploration "Little Blue-A" Well (February 1998), Gardline Surveys Limited.
- Post-Drill Environmental Survey of the Sediments around the Exploration Well "Little Blue-A" (October 1998), Gardline Surveys Limited.
- Benthic Environmental Baseline Survey of the Sediments around the exploration "B1" Well (February 1998), Gardline Surveys Limited.
- Benthic Environmental Baseline Survey of the Sediments around the exploration "14/14-A" Well (February 1998), Gardline Surveys Limited.
- Benthic Environmental Baseline Survey of the Sediments around the exploration " Well 14/23-A (February 1998), Gardline Surveys Limited.
- Benthic Environmental Baseline Survey of the Sediments around the exploration "FI 14/19-A" Well (March 1998), Gardline Surveys Limited.
- Benthic Environmental Baseline Survey of the Sediments around the exploration FI 14/24 "Braela" Well (March 1998), Gardline Surveys Limited.
- Benthic Environmental Baseline Survey of the Sediments around the exploration "Minke" 14/13-B Well (June 1998), Gardline Surveys Limited.

The object of the benthic environmental sampling programme was to:

- Provide a current description of the natural sediments surrounding the proposed well locations prior to operations, provide detailed information on the sediment physio-chemical properties, in order to permit the monitoring of physio-chemical impacts due to drilling and other discharges.

- To provide sediment samples to be used in the description of the seabed biological community in terms of macrofaunal species distribution and abundance to permit monitoring of the seabed biological impact due to drilling and other discharges.
- To provide an initial investigation into the general status of the seabed surrounding the proposed well locations, including the identification of biological communities of significant scientific interest (e.g. deep water corals such as *Lophelia pertusa*) (Gardline 1998).

Each of the survey sites were sampled four times, the first three samples were sieved through a 500µm mesh for macrofaunal determination, while the fourth was sub-sampled for physio-chemical analysis. A total of 332 samples were obtained during the full environmental cruise, taken at 83 different sites. Physio-chemical tests undertaken included particle size analysis, organic content, total carbonates, heavy and trace metal content and hydrocarbon analysis, split into the concentration of total oils (saturates), paraffin range aliphatics ($nC_{10}$-$nC_{35}$) and polycyclic aromatic hydrocarbons (PAHs).

Samples from the survey were demobilised back to the UK for analysis. Benthic macrofauna was analysed by DRM Associates at the Southampton Oceanographic Centre, particle size analysis was carried out by the Brixham Environmental Laboratory and total organics, carbonates, heavy and trace metals and hydrocarbon analysis was undertaken by Geochem Group Limited.

All parameters indicated natural uncontaminated sediments with typical or low background concentrations of metals and hydrocarbons, respectively. Macrofaunal analysis at each site indicated a relatively high biological diversity. All sites were faunistically very similar with no significant correlations against environmental variables.

It is recognised in the reports that benthic macrofauna of the Falkland Islands is relatively undocumented and that there is a lack of published literature in this area. For this reason macrofaunal samples were sorted into putative species/taxa and analysed to provide a baseline description of the site. Identification of samples to species level using taxonomic experts was not thought to be practical.

The general bathymetry of the North Falkland Basin indicates a gently sloping gradient with contours oriented along a northwest-southeast direction. In general the survey revealed a relatively homogeneous macrofauna in a relatively homogenous environment. There were no significant correlations between the seabed fauna and tested environmental variables (sedimentary parameters, metals and hydrocarbons), other than a potential link between habitat complexity and the presence of coralline bryozoan fragments. In such a uniform habitat it is concluded that there should be little difficulty in relating any changes in macrofaunal communities to environmental changes associated with drilling activity.

Results for the well sites encompassed within the benthic environmental sampling programme, which are located in Tranches C and D, and therefore of most relevance to this environmental assessment are summarised below. Results for Well Little Blue-A are also included as this location was also the subject of post-drill sampling.

**Well 14/19-A**

A total of 52 samples were taken during the survey from 13 stations using a $0.1m^2$ Day grab. Results showed that particle size distribution was consistent around poorly to very poorly sorted medium to coarse silt.

Sidescan sonar results were interpreted as showing poorly preserved iceberg keel scars. Seabed sampling indicated <9cm of silty sand with occasional scattered gravel, overlying very soft clay. Water depth was between 345.5m and 372.3m, with an undulating and complex seabed topography.

Nineteen hard sonar contents were made with no observed relief, which were interpreted as partially buried boulders, although they may also represent items of debris.

Macrofauna was analysed for 26 samples at 13 sites. Analysis indicated that faunal composition over the whole area was fairly homogeneous. A total of 157 taxa were distinguished, of these 61 species were Annelida, 43 were Crustacea, 19 were Mollusca and 15 were Echinodermata. Remaining phyla accounted for 12.0% of the total species.

The top 10 species for the sampling areas were reported as:

| Rank | Species / Taxon | Rank | Species / Taxon |
|---|---|---|---|
| 1 | Phoxocephalidae sp.A | 6 | *Aricidea sp. C* |
| 2 | *Onuphis aff.holobranchiata* | 7 | Sabellidae sp. A |
| 3 | *Urothoe spp* | 8 | Nematoda spp |
| 4 | *Cyclammina sp* | 9 | *Lumbrineris sp. A* |
| 5 | Foraminifera sp.C | 10 | *Amphiura sp* |

**Well 14/14-A**

A total of 56 samples were taken during the survey from 14 stations using a 0.1m$^2$ Day grab. Results showed that particle size distribution was consistent around poorly to very poorly sorted coarse silt, with one station recording very fine sand.

Sidescan sonar results were interpreted as showing poorly preserved iceberg keel scars. Seabed sampling indicated <7cm of silty sand with occasional scattered gravel, overlying very soft clay. There was no observed difference between the sediments of the keel scars and the surrounding seabed. Water depth was between 373.0m and 396.2m, with a complex seabed topography superimposed on a regional slop to the east-northeast. In the southern half of the survey area the seabed had a random undulating character and a depression 11 metres deep (southeast of the proposed well location).

Macrofauna was analysed for 28 samples at 14 sites. Analysis indicated that faunal composition over the whole area was fairly homogeneous. A total of 179 taxa were distinguished, of these 60 species were Annelida, 58 were Crustacea, 26 were Mollusca and 17 were Echinodermata. Remaining phyla accounted for 10.1% of the total species.

The top 10 species for the sampling areas were reported as:

| Rank | Species / Taxon | Rank | Species / Taxon |
|---|---|---|---|
| 1 | Phoxocephalidae sp.A | 6 | Sabellidae sp. A |
| 2 | *Urothoe spp* | 7 | *Aricidea sp. C* |
| 3 | *Onuphis aff.holobranchiata* | 8 | Nematoda spp |
| 4 | Foraminifera sp.C | 9 | *Melythasides sp* |
| 5 | *Cyclammina sp* | 10 | Phoxocephalidae sp B |

**Well 14/13-B**

A total of 52 samples were taken during the survey from 13 stations using a 0.1m$^2$ Day grab. Results showed that particle size distribution was consistent around poorly to very poorly sorted coarse silt.

Sidescan sonar results were interpreted as showing poorly preserved iceberg keel scars. Seabed sampling indicated <9cm of silty sand with occasional gravel overlying very soft clay. Water depth was between 373.6m and 392.6m, with little topographic expression of the seafloor. Small depressions with a maximum depth of 4 metres were noted occasionally throughout the survey area although an east-west trending trough, north of the proposed location was the most clearly defined bathymetric feature.

Macrofauna was analysed for 26 samples at 13 sites. Analysis indicated that faunal composition over the whole area was fairly homogeneous. A total of 171 taxa were distinguished. Of the fauna recorded 68 species were Annelida, 52 species were Crustacea, 15 species were

Mollusca and 17 species were Echinodermata. Remaining phyla accounted for 11.1% of the total species.

The top 10 species for the sampling areas were reported as:

| Rank | Species / Taxon | Rank | Species / Taxon |
|---|---|---|---|
| 1 | *Onuphis aff.holobranchiata* | 6 | *Spiophanes sp* |
| 2 | *Urothoe spp* | 7 | *Lumbrineris sp. A* |
| 3 | Phoxocephalidae sp.A | 8 | Sabellidae sp. A |
| 4 | *Cyclammina sp* | 9 | Nematoda spp |
| 5 | Foraminifera sp.C | 10 | *Aricidea sp. C* |

In addition to the above wells located in the current area of interest (Tranches C and D), a summary of the findings for well "Little Blue-A" is also included below. This well is located just to the north of Tranche C, however it is included here as a post-drill environmental survey was also carried out for this location.

**Well Little Blue-A**

A total of 60 samples were taken during the survey from 15 stations using a $0.1m^2$ Day grab. Results showed that particle size distribution was consistent around poorly, or very poorly, sorted medium to coarse silt. Sediment parameters indicated natural uncontaminated sediments with typical or low background concentrations of metals and hydrocarbons, respectively.

Sidescan sonar results showed an undulating seabed with some exposure of underlying clays. Water depth was reported to be 416.8m at the well location. The sea floor, particularly to the south-east of the site, contained furrows or channels of unknown origin, commonly up to 1.5km wide and extending up to 210km long. Echo sounder data also indicated mounded deposits on the seabed, corresponding to a number of topographic highs in the area. Seabed sediments were interpreted as comprising superficial silty sand with gravel overlying soft clay.

Macrofauna was analysed for 30 samples at 15 sites. The range of taxa was typical of undisturbed/unpolluted offshore muddy environments. A total of 144 taxa were distinguished. Of the fauna recorded 63 species were Annelida, 36 species were Crustacea, 20 species were Mollusca and 7 species each of both Echinodermata and Foraminifera. Remaining phyla accounted for 7.6% of the total species.

The top 10 species for the sampling areas were reported as:

| Rank | Species / Taxon | Rank | Species / Taxon |
|---|---|---|---|
| 1 | *Archaeotanais hirsutus* | 6 | *Edwarsiidae spp.* |
| 2 | *Onuphis aff.holobranchiata* | 7 | *Lumbrineris sp. A* |
| 3 | Foraminifera sp C | 8 | Mediomastus sp. |
| 4 | *Cyclammina sp* | 9 | Aricidea sp B |
| 5 | *Urothoe spp* | 10 | Phoxocephalidae sp.A |

**Well Little Blue-A - Post-Drill environmental survey (October 1998)**

This survey was a repeat of the earlier baseline survey undertaken in February 1998. A total of 56 samples were taken during the survey from 14 stations using a $0.1m^2$ Day grab. Samples were analysed in the same manner as for the previous environmental survey.

Results showed that particle size distribution was consistent around poorly, or very poorly, sorted medium to coarse silt. All physio-chemical sediment parameters had increased slightly since the baseline survey, but remained indicative of uncontaminated sediments with relatively low background concentrations of both heavy metals and hydrocarbons. Increases above baseline levels demonstrating a spatial structure indicating likely association with drilling activity (i.e. point source discharge) include both total oil concentrations (Figure 33) and a subset of Polyaromatic hydrocarbons (PAHs) as shown in Figure 34.

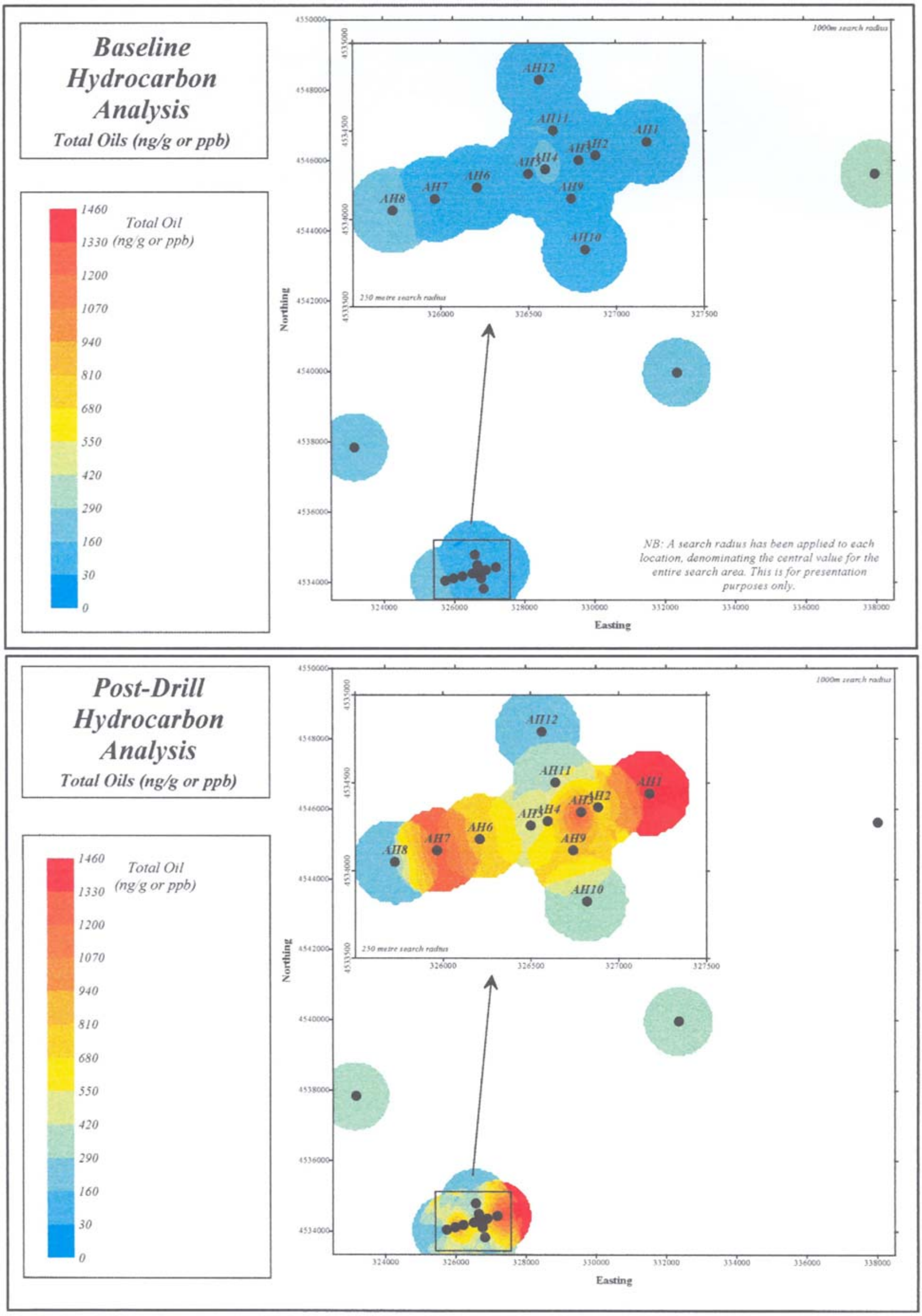


**Figure 33:** Graphical representation of total oil results in sediments around well Little Blue-A, before and after drilling.

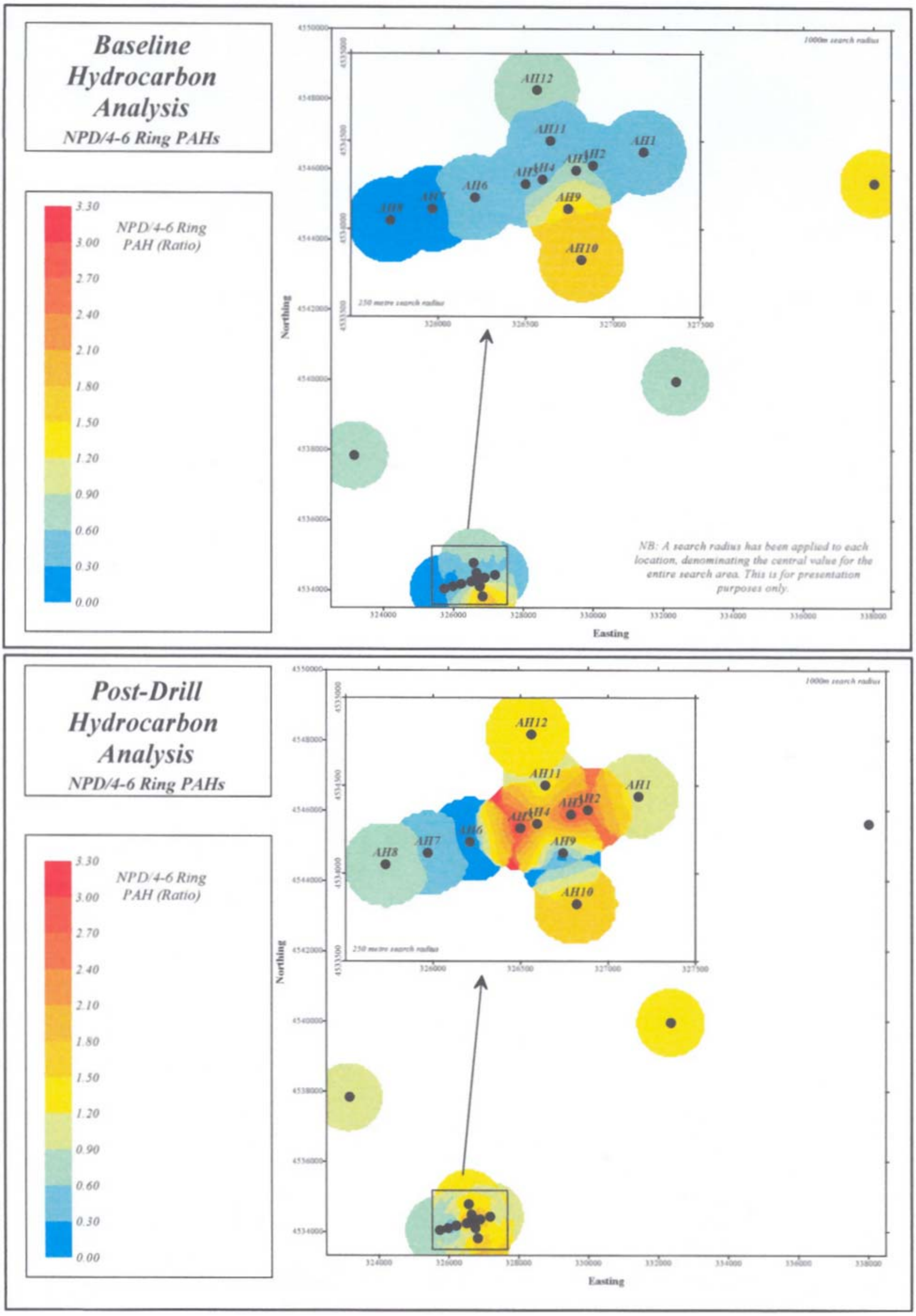


**Figure 34:** Graphical representation of PAH results (NPD/4-6 Ring PAHs) in sediments around well Little Blue-A, before and after drilling.

Total oil concentration was shown to increase at all stations. The greatest increase was seen around the central well location and along the axis of dominant current flow, suggesting a small impact from drilling related deposits over the survey area. Levels were generally low across the survey area and levels at all stations were within the range expected for similar uncontaminated sediments recorded in the northern North Sea.

The total number of taxa had increased slightly from the baseline value. A total of 154 taxa were distinguished. Of the fauna recorded 65 species were Annelida, 42 species were Crustacea, 18 species were Mollusca and 8 species each of both Echinodermata and Foraminifera. Remaining phyla accounted for 8.4% of the total species.

The top 10 species for the sampling areas were reported as:

| Rank | Species / Taxon | Rank | Species / Taxon |
|---|---|---|---|
| 1 | Foraminifera sp C | 6 | *Edwarsiidae spp.* |
| 2 | *Onuphis aff.holobranchiata* | 7 | *Lumbrineris sp. A* |
| 3 | *Archaeotanais hirsutus* | 8 | Sternapsis scutata |
| 4 | *Cyclammina sp* | 9 | Nematoda spp |
| 5 | *Urothoe spp* | 10 | Aricidea sp B |

The dominance pattern is similar between the two surveys. Differences in distribution of taxa are reported to probably be the result of seasonal trends rather than human influence.

It is concluded in the report that there is no faunistic evidence to suggest that the area is currently polluted. Given the uniform habitat, it would be expected that any changes in macrofaunal communities as a result of environmental variables (i.e. from drilling) would be easily identifiable. The report summarises that drilling activity has had little if any impact on the fauna to date.

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# APPENDIX V

# Document Review Matrix from previous drilling round

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| Ref | Area Name | Well names | Title | Comments | Date Published | Contractor Name | Data Type |
|---|---|---|---|---|---|---|---|
| DESD00203 | Tranches C & D | FLK 014/13-01 | Benthic Environmental Baseline Survey of the Sediments Around the Exploration Well 14/13-B "Minke" - Final Report | As DESD00028 but for well 14/13-B. Very similar results / conclusions - no evidence of baseline pollution. | 35947 | Gardline Surveys | Report |
| DESD00071 | Tranches C & D | FLK 014/13-01 FLK 014/14-01 FLK 014/19-01 | Shallow Gas Hazard Appraisal Signature Analysis for Proposed Well Locations 14/13-A, 14/14-A & 14/19-A | High gas risk identified for 14/14-A and 14/19-A, not for 14/13-A. Modelled from seismic data - no environmental considerations. | 01/08/1998 | Hydrosearch | Report |
| DESD00028 | Tranche C | FLK 014/14-01 | Benthic Environmental Baseline Survey of Sediments | Benthic survey of well loc 14/14-A for Lasmo. 56 samples, 14 locations (332 samples over full env cruise over 83 locations). Earlier Britsurvey cruise employed side-scan sonar. Total oil & PAH = uncontaminated sediments with low b/g levels. No mention of Pock Marks (?) | 35827 | Lasmo | Report |
| DESD00204 | Tranches C & D | FLK 014/14-01 | Benthic Environmental Baseline Survey of the Sediments Around the Exploration 14/14-A Well - Final Report | As DESD00028 but for well 14/14-A. Very similar results / conclusions. | 35827 | Gardline Surveys | Report |
| DESD00029 | Tranche C | FLK 014/19-01 | Benthic Environmental Baseline Survey of Sediments | As DESD00028 but for well 14/19(-1?). Very similar results / conclusions. | 35827 | Lasmo | Report |
| DESD00205 | Tranches C & D | FLK 014/19-01 | Benthic Environmental Baseline Survey of the Sediments Around the Exploration 14/19-A Well - Final Report | As DESD00028 but for well 14/19-A. Very similar results / conclusions. | 35827 | Gardline Surveys | Report |
| DESD00209 | Tranches C & D | | Metocean Study Reports and Correspondence File, 1997-1998 | Met office Metocean data. Also includes Lasmo cost / production forecasts (FPSO production option). | | Lasmo | Work File |
| DESD00192 | General | | Assessment of Environmental Sensitivity to Seismic Operations Offshore Falkland Islands - Final Report | Pre-seismic EIA. Lots of duplicated info. Tranche C = most important fishing area, Block A of moderate importance, Blocks B&D of low importance. Good references. | 35462 | Environment & Resource Technology Ltd | Report |
| DESD00158 | General | | Borgny Dolphin Environmental Audit - Reports and Correspondence File, 1997-1999 | Correspondence regarding lost anchor - build in to NC/C&PA plan? Also includes env and other audits & responses for the drilling rig. Copy of Condition report would be useful for reference purposes. | | FOSA | Work File |
| DESD00217 | General | | Deepwater Mooring Deployment Study Borgny Dolphin - Draft Copy | No apparent env considerations. | 35899 | Trident Offshore Ltd | Report |
| DESD00249 | General | | Desire Correspondence File - Environment, Nov 1996 to Aug 1997 | Correspondence between operators, FIG, FC, etc. Lots of interesting communications and background information. Folder also includes METOC proposal for JIP to address env issues | | | Work File |
| DESD00198 | General | | Environmental Audit Borgny Dolphin Drilling Rig | 3 day audit of the drilling rig. Materials handling and storage mixed, some risks. Hoses have Avery Hardell connections, but are not pressure tested, also no records of inspections kept. Waste management audits of end disposal sites recommended. Dumping of muds at end of well? Lack of documented systems. | 35855 March 1998 | RSK Environment Ltd | Report |
| DESD00176 | General | | Environmental Desk Study of the Special Co-operation Area - Final Draft | 1997 Report by the BGS on the current level of environmental information available for the Special Co-operation Area (SAC) west of the Falkland Islands. Describes what is currently known, together with recommendations on future surveys. Tailored to baseline information for future O&G exploration and production activity. | 01/12/1997 | BGS\|Dunstaffnage Marine Laboratory\|Proudman Oceanographic Laboratory | Report |
| DESD00045 | General | | Environmental Workgroup Closeout Report | Provides a summary of the key findings and lessons learnt during the initial drilling campaign. Highlighted consultation as a key step. Areas for improvement include environmental personnel to visit the Islands, better waste management and faster acquisition of dispersants. Also concluded that there was little seafloor impact from cuttings discharge. | 14/05/1999 | FOSA | Report |
| DESD00170 | General | | Falkland Islands Environmental Baseline Survey, Desk Study Report | 1997 report to the FIG covering **Legislation,** Sensitive Areas, Flora & Fauna, Habitats, Marine Mammals, Human Use, Ecosystems, Data requirements. Covers coastal, shallow marine and offshore environments. Describes impacts from non O&G activities (fishing, tourism, recreation), potential effects of oil, difficulty in relating bird mortality to O&G development, domestic sewage and recommendations for future environmental legislation, particularly concerning species and habitat protection. | 01/03/1997 | Brown & Root Environmental | Report |
| DESD00189 | General | | Falkland Islands Environmental Forum Correspondence File, 1997-1999 | FOSA in-country report March 1999. Also, details of seabirds work carried out between Oct 1998 and Mar 1999. Does an Atlas of abundance exist? (JNCC). Minutes of FOSA EWG meeting. Also includes correspondence, minutes etc. | | Lasmo | Work File |
| DESD00190 | General | | Falkland Islands Environmental Workgroup Correspondence File, 1997-1999 | Inc comments on FOSA EWG close out report. Feb 1999 minutes - lube oil arrived in UK / no further seabirds / cetacean survey funding | | Lasmo | Work File |
| DESD00156 | General | | HSE Documentation Falkland Islands Surveys 1997/1998, M.V. L'Espoir | HSE Case for the Svitzer Ltd seismic survey vessel M.V.L'Espoir. "Fishing activity can be high therefore liaison with fishing vessels as advised by FI Fisheries Office." Env issues include waste disposal to port & cetacean watches from the bridge (no mention of JNCC guidelines). | 30/11/1997 | Svitzer Ltd | Report |
| DESD00181 | General | | National Oil Spill Contingency Plan - Signed off Final Copy | Defines Roles & Responsibilities, Policy & Legislation, Actions & operations, Data Directory. Includes forms and proformas. Polluter Pays, therefore full cost of response must be recovered from the spiller. Incident overseen by Incident Commander (Government Marine Officer) & Lead Agency is the Fisheries Department. Attorney general's Chambers provides advice on current legal framework. Annual simulations should be held by Lead Agency (check). Risk of spills from fishing vessel bunkering (marine diesel). FIG has had Environmental sensitivity GIS developed (Check). | 01/04/1998 | Falkland Islands Government | Report |
| DESD00184 | General | | Oil Pollution Emergency Plan for Mobile Offshore Units | DNV Certified Plan, includes responsibilities, plans and diagrams etc. Could be useful for comparison purposes with new rig. | 31/01/1996 | Dolphin Drilling Ltd | Report |
| DESD00183 | General | | Oil Spill Contingency Plan - Revision 01 | FOSA Oil Spill Contingency Plan runs in conjunction with the FIG National Oil Spill Contingency Plan. FOSA Plan provides details of background spill data, likelihood, training needs, communications, reporting, sampling, response etc. Note: Sch 6 of the Production Licenses requires OPERATORS to have an oil spill contingency plan in place. Window of opportunity for dispersant use <2 days. 54 tonnes required to last 3 days vessel spraying (before further help arrives). Check level of outside support available (UK / S America) e.g. OSRL? | 09/04/1998 | FOSA | report |
| DESD00191 | General | | Oil Spill Contingency Plan Correspondence File, 1997-1999 | Indicates that dispersants were returned to Oil Spill Resource Ltd (OSRL) in the UK (1999). 2 Plans: FIG National Plan & FOSA plan. Includes Correspondence and copy of the FIG National Oil Spill Contingency Plan. | | Lasmo | Work File |
| DESD00199 | General | | Report of Environmental Review of Falklands Drilling Operations Undertaken by Representatives from FOSA Environmental Workgroup | Issues: waste lube oil - special waste needing shipment to UK. Dust emissions from FIPASS (onshore) - resite? Decommissioning of onshore facilities? Very poor onshore waste management / disposal. Has the military resolved Haz waste shipment issues? | 01/11/1998 | FOSA | Report |
| DESD00194 | General | | Seabirds/Cetaceans Study Reports and Correspondence File, May 1997 - October 1998 | Proposals, data and correspondence regarding the seabirds & cetacean study. | | Lasmo | Work File |
| DESD00193 | General | | Seabirds/Cetaceans Study Reports and Correspondence File, November 1998 - May 1999 | Ref: Seabirds at Sea database (JNCC). Includes Seabirds, Cetacean and fisheries information. | | Lasmo | Work File |
| DESD00224 | General | | Shallow Gas Procedure Manual | No apparent env considerations. | 01/07/1989 | Shell | Report |
| DESD00182 | General | | Use of OSIS in Support of Oil Spill Contingency Planning for FOSA - Briefing Note | Oil Spill Information System (OSIS) used to model spills. Configured for South Atlantic based on acquired current and tidal data plus met data from Mt Pleasant Airport (met office). Northern (central point Tranches A-D) and Southern (S boundary of Tranche F) release points used, with 4 oil types and 12 wind scenarios (1 for each month). Results: Grp 1 (Kerosene) = total dissipation within 12 hrs. Grp 2-4 = dissipation at sea within 7 to 11 days. Shoreline impact from S release point during Jan & Aug only. This would require continuous northerly wind velocities of 13 knots for 88 hrs (Jan) or 23 knots for 57 hrs (Aug) - chances of this are 1 in 2700 (37 out of 100,740 hrs). | | | Report |
| DESD00185 | General | | Waste Disposal Procedures - Revision 01 | Based on Shell Expro Offshore Disposal Procedures. Good operational procedure on waste handling, storage, transfer and completing relevant forms. Good offshore waste List. | 17/06/1998 | FOSA | Report |
| DESD00188 | General | | Waste Disposal Study Correspondence File, 1997-1998 | Correspondence on waste disposal issues. Includes detailed text on trans-boundary shipments on haz waste and EA contacts. | | Lasmo | Work File |

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# APPENDIX VI

# Checklist of Falkland Islands Wildlife

# (Falklands Conservation)

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# Falklands Conservation

## FALKLAND ISLANDS WILDLIFE

### A Check List of Mammals, Freshwater Fish, Birds

English names are given first followed by any local names in brackets and the scientific name in italics.

## Mammals

The Falkland Islands have no surviving native land mammals. The last Falkland Wolf or Warrah was killed in 1876. Introduced land mammals other than sheep, cattle and horses include Patagonian foxes, rats, mice, rabbits, cats and, on Staats Island, the guanaco.

### Marine Mammals

| | |
|---|---|
| **Right Whales** | **Balaenidae Neobalaenidae** |
| • Southern Right Whale | Eubalaena australis |
| • Pigmy Right Whale | Caperea marginata |
| **Rorquals** | **Balaenopteridae** |
| • Blue Whale | Balaenoptera musculus |
| • Fin Whale | Balaenoptera physalus |
| • Sei Whale | Balaenoptera borealis |
| • Minke Whale | Balaenoptera acutorostrata |
| • Humpback Whale | Megaptera novaeangliae |
| **Sperm Whales** | **Physeteridae** |
| • Sperm Whale | Physeter macrocephalus |
| **Beaked Whales** | **Ziphiidae** |
| • Arnoux's Beaked Whale | Berardius arnouxii |
| • Cuvier's Beaked Whale | Ziphius cavirostris |
| • Southern Bottlenose Whale | Hyperoodon planifrons |
| • Hector's Beaked Whale | Mesoplodon hectori |
| • Gray's Beaked Whale | Mesoplodon grayi |
| • Straptoothed Whale | Mesoplodon layardii |
| **Marine Dolphins** | **Delphinidae** |
| • Killer Whale | Orcinus orca |
| • Longfinned Pilot Whale (Blackfish) | Globicephala melaena |
| • Peale's Dolphin | Lagenorhynchus australis |
| • Hourglass Dolphin | Lagenorhynchus cruciger |
| • Dusky Dolphin | Lagenorhynchus obscurus |
| • Commersons's Dolphin (Puffing Pig) | Cephalorhynchus commersonii |
| • Southern Right Whale Dolphin | Lissodelphis peronii |
| **Porpoises** | **Phocoenidae** |
| • Spectacled Porpoise | Australophocaena dioptrica |

### Pinnipedia

| | |
|---|---|
| • Southern Sea Lion | Otaria flavescens |
| • Falkland Islands Fur Seal | Arctocephalus australis |
| • Leopard Seal | Hydrurga leptonyx |

| | | |
|---|---|---|
| Southern Elephant Seal | Mirounga leonina | |

## FRESHWATER FISH

I = introduced, E = endemic.

| | | |
|---|---|---|
| Sea Trout (migratory Brown Trout) | Salmo trutta | I |
| Brown Trout (non-migratory) | Salmo trutta | I |
| Falkland Trout | Aplochiton zebra | E |
| Falkland Minnow | Galaxias maculatus | |

## BIRDS

This checklist includes all species known to have occurred on the Falklands Islands or within the 200 mile zone of surface water surrounding the archipelago. The sequence of families follows the Checklist of the Birds of South America, 2nd edition (1989) by Allen Altman and Byron Swift. Nomenclature generally follows the Handbook of the Birds of the World (del Hoyo et al, 1992-2004) with some local alternative names in ( ). The Atlas of Breeding Birds of the Falkland Islands (Robin & Anne Woods) gives further information on distribution and breeding status.

Status is shown by the following code letters or symbols:
E Endemic species
B Breeds in the Falkland Islands
L Falkland Islands race, endemic subspecies
N Non-breeding regular visitor
V Irregular vagrant
X Lost breeding species: not recorded recently
M Migrates regularly to and from the Falklands or adjacent waters
? Status in doubt due to lack of information
* Introduced species
U Unsubstantiated or doubtful record

### Order PODICIPEDIFORMES

#### Family Podicipedidae

| | | |
|---|---|---|
| Pied-billed Grebe | Podilymbus podiceps | V |
| White-tufted Grebe (Golden/Rollands Grebe) | Rollandia rolland rolland | B, L |
| Great Grebe | Podiceps major | V |
| Silvery Grebe (White Grebe) | Podiceps occipitalis occipitalis | B |

### Order PROCELLARIIFORMES

#### Family Diomedeidae

| | | |
|---|---|---|
| Wandering Albatross | Diomedea exulans | N |
| Northern Royal Albatross | Diomedea epomophora sanfordi | V |
| Southern Royal Albatross | Diomedea epomophora epomophora | N |
| Black-browed Albatross (Mollymawk) | Thalassarche melanophrys | B, M |
| Buller's Albatross | Thalassarche bulleri | V |
| Shy Albatross | Thalassarche cauta | V |
| Yellow-nosed Albatross | Thalassarche chlororhynchos | V |
| Grey-headed Albatross | Thalassarche chrysostoma | N |
| Sooty Albatross | Phoebetria fusca | V |
| Light-mantled Albatross | Phoebetria palpebrata | N |

#### Family Procellariidae

| | | |
|---|---|---|
| Northern Giant Petrel | Macronectes halli | N, B? |
| Southern Giant Petrel (Stinker) | Macronectes giganteus | B, M |
| Antarctic (Silver-grey) Fulmar | Fulmarus glacialoides | N |
| Antarctic Petrel | Thalassoica antarctica | V |
| | Daption capense | N |

| | | |
|---|---|---|
| Cape Petrel | Pagodroma nivea | V |
| Snow Petrel | Lugensa brevirostris | N |
| Kerguelen Petrel | Pterodroma incerta | N |
| Atlantic Petrel | Pterodroma inexpectata | V |
| Mottled Petrel | Pterodroma lessonii | V |
| White-headed Petrel | Pterodroma macroptera | V |
| Great-winged Petrel | Pterodroma arminjoniana | V |
| Herald Petrel | Pterodroma mollis | V |
| Soft-plumaged Petrel | Halobaena caerulea | N |
| Blue Petrel | Pachyptila desolata | N |
| Dove/Antarctic Prion | Pachyptila vittata | V |
| Broad-billed Prion | Pachyptila belcheri | B, M |
| Thin-billed Prion (Firebird) | Pachyptila turtur | B, M |
| Fairy Prion | Procellaria cinerea | V |
| Grey Petrel | Procellaria aequinoctialis | B, M? |
| White-chinned Petrel (Shoemaker, Cobbler) | Calonectris diomedea | V |
| Cory's Shearwater | Puffinus gravis | B, M |
| Great Shearwater | Puffinus griseus | B, M |
| Sooty Shearwater (Shyer Bird) | Puffinus puffinus | V |
| Manx Shearwater | Puffinus assimilis | V |
| Little Shearwater | | |

### Family Hydrobatidae

| | | |
|---|---|---|
| Wilson 's Storm-Petrel | Oceanites oceanicus | B, M |
| White-faced Storm-Petrel | Pelagodroma marina | V |
| White-bellied Storm-Petrel | Fregretta grallaria | V |
| Black-bellied Storm-Petrel | Fregetta tropica | N/B? |
| Grey-backed Storm-Petrel | Garrodia nereis | B, M |
| British Storm-Petrel | Hydrobates pelagicus | V |
| Leach's Storm-Petrel | Oceanodroma leucorhoa | V |

### Family Pelecanoididae

| | | |
|---|---|---|
| Common Diving Petrel | Pelecanoides urinatrix | B, M? |
| Georgian Diving Petrel | Pelecanoides georgicus | V |
| Magellan Diving Petrel | Pelecanoides magellani | V/B? |

## Order SPHENISCIFORMES

### Family Spheniscidae

| | | |
|---|---|---|
| King Penguin | Aptenodytes patagonicus | B |
| Emperor Penguin | Aptenodytes forsteri | V |
| Gentoo Penguin | Pygoscelis papua papua | B |
| Adelie Penguin | Pygoscelis adeliae | V |
| Chinstrap Penguin | Pygoscelis antarctica | V |
| Rockhopper Penguin (Rocky) | Eudyptes chrysocome chrysocome | B, M |
| Macaroni Penguin | Eudyptes chrysolophus | B, M |
| Royal Penguin | Eudyptes (chrysolophus) schlegeli | B?, U |
| Snares Crested Penguin | Eudyptes robustus | V |
| Erect-crested Penguin | Eudyptes sclateri | V |
| Magellanic Penguin (Jackass) | Spheniscus magellanicus | B, M |

## Order PELECANIFORMES

**Family Sulidae**

| | | |
|---|---|---|
| Peruvian | Sula variegata | V |

**Family Phalacrocoracidae**

| | | |
|---|---|---|
| Rock Shag (Black Shag) | Phalacrocorax magellanicus | B |
| Imperial Shag (King Shag) | Phalacrocorax atriceps albiventer | B |
| Red-legged Shag | Phalacrocorax gaimardi | V |

## Order CICONIIFORMES

**Family Ardeidae**

| | | |
|---|---|---|
| Cocoi Heron | Ardea cocoi | V |
| Great White Egret | Egretta alba | V |
| Snowy Egret | Egretta thula | V |
| Green-backed Heron | Butorides striatus | V |
| Cattle Egret | Bubulcus ibis | N |
| Black-crowned Night Heron (Quark) | Nycticorax nycticorax falklandicus | B, L |

**Family Threskiornithidae**

| | | |
|---|---|---|
| Black-faced Ibis | Theristicus melanopis melanopis | V |
| Roseate Spoonbill | Ajaia ajaja | V |

**Family Ciconiidae**

| | | |
|---|---|---|
| Maguari Stork | Ciconia maguari | V |

## Order PHOENICOPTERIFORMES

**Family Phoenicopteridae**

| | | |
|---|---|---|
| Chilean Flamingo | Phoenicopterus chilensis | V |

## Order ANSERIFORMES

**Family Anatidae**

| | | |
|---|---|---|
| Coscoroba Swan | Coscoroba coscoroba | B |
| Black-necked Swan | Cygnus melancoryphus | B |
| Ashy-headed Goose (Coast/White-breasted Brant) | Chloephaga poliocephala | V/B |
| Ruddy-headed Goose (Brent, Brant) | Chloephaga rubidiceps | B |
| Upland Goose | Chloephaga picta leucoptera | B, L |
| Kelp Goose | Chloephaga hybrida malvinarum | B, L |
| Feral Domestic Goose | Anser anser | B* |
| Crested Duck (Grey Duck) | Anas specularioides specularioides | B |
| Falkland Steamer Duck (Logger) | Tachyeres brachypterus | B, E |
| Flying Steamer Duck (Canvasback) | Tachyeres patachonicus | B |
| Spectacled Duck | Anas specularis | V |
| Speckled Teal (Teal) | Anas flavirostris | B |
| Chiloe Wigeon (Black and White Wigeon) | Anas sibilatrix | B |
| White-cheeked Pintail | Anas bahamensis rubrirostris | V |
| Yellow-billed Pintail (Grey/Coast Teal) | Anas georgica spinicauda | B |
| Silver Teal ( Pampa Teal) | Anas versicolor fretensis | B |
| Cinnamon Teal (Red Teal) | Anas cyanoptera cyanoptera | B |
| Red Shoveler | Anas platalea | V/B? |
| Rosy-billed Pochard | Netta peposaca | V |
| Lake Duck | Oxyura vittata | V |
| Black-headed Duck | Heteronetta atricapilla | V |

## Order CATHARTIFORMES

### Family Cathartidae

| | | |
|---|---|---|
| • Turkey Vulture (Turkey Buzzard, Turkey) | Cathartes aura jota | B |

## Order ACCIPITRIFORMES
### Family Accipitridae

| | | |
|---|---|---|
| • Sharp-shinned Hawk | Accipiter striatus | V |
| • Variable Hawk (Red-backed or Blue Hawk) | Buteo polyosoma polyosoma | B |
| • Cinereous Harrier | Circus cinereus | X, V? |
| • Long-winged Harrier | Circus buffoni | V |

## Order FALCONIFORMES
### Family Falconidae

| | | |
|---|---|---|
| • Chimango Caracara | Milvago chimango | V |
| • Striated Caracara (Johnny/Jack Rook) | Phalcoboenus australis | B |
| • Southern (Crested) Caracara (Carancho) | Caracara plancus | B |
| • Peregrine Falcon (Sparrow Hawk) | Falco peregrinus cassini | B |
| • Aplomado Falcon | Falco femoralis | V |
| • American Kestrel | Falco sparverius cinnamominus | V/B? |

## Order GRUIFORMES
### Family Rallidae

| | | |
|---|---|---|
| • Plumbeous Rail | Pardirallus sanguinolentus | , U |
| • Austral Rail | Rallus antarcticus | V |
| • Speckled Rail | Coturnicops notatus | V, U |
| • American Purple Gallinule | Porphyrio martinica | V |
| • Red-gartered Coot | Fulica armillata | V |
| • White-winged Coot | Fulica leucoptera | V/B |
| • Red-fronted Coot | Fulica rufifrons | V |

## Order CHARADRIIFORMES
### Family Recurvirostridae

| | | |
|---|---|---|
| • South American Stilt | Himantopus himantopus melanurus | V |

### Family Charadriidae

| | | |
|---|---|---|
| • Southern Lapwing | Vanellus chilensis | V |
| • American Golden Plover | Pluvialis dominica | V |
| • Two-banded Plover (Falkland Is. Plover) | Charadrius falklandicus | B |
| • Rufous-chested Dotterel (Dotterel) | Charadrius modestus | B, M? |
| • Tawny-throated Dotterel | Oreophilus ruficollis | V |

### Family Pluvianellidae

| | | |
|---|---|---|
| • Magellanic Plover | Pluvianellus socialis | V |

### Family Haematopodidae

| | | |
|---|---|---|
| • Blackish Oystercatcher (Black Curlew) | Haematopus ater | B |
| • Magellanic Oystercatcher (Pied O., Curlew) | Haematopus leucopodus | B |

### Family Scolopacidae

| | | |
|---|---|---|
| • Hudsonian Godwit | Limosa haemastica | V |
| • Whimbrel | Numenius phaeopus | N |
| | Numenius borealis | V |

| | | |
|---|---|---|
| Eskimo Curlew | Bartramia longicauda | V |
| Upland Sandpiper | Tringa melanoleuca | V |
| Greater Yellowlegs | Tringa flavipes | V |
| Lesser Yellowlegs | Arenaria interpres | V |
| Ruddy Turnstone | Gallinago paraguaiae magellanica | B, M? |
| Magellanic Snipe (Snipe) | Gallinago stricklandii | V/X |
| Fuegian Snipe | Calidris canutus rufa | V, U |
| Red Knot | Aphriza virgata | V |
| Surfbird | Calidris alba rubida | N |
| Sanderling | Calidris pusilla | V |
| Semipalmated Sandpiper | Calidris fuscicollis | N |
| White-rumped Sandpiper | Calidris bairdii | N |
| Baird's Sandpiper | Calidris melanotos | V |
| Pectoral Sandpiper | Calidris himantopus | V |
| Stilt Sandpiper | Phalaropus tricolor | V |
| Wilson's Phalarope | Phalaropus fulicarius | V |
| Red/Grey Phalarope | | |

**Family Thinocoridae**

| | | |
|---|---|---|
| White-bellied Seedsnipe | Attagis malouinus | V |
| Least Seedsnipe | Thinocorus rumicivorus | V/B? |

**Family Chionididae**

| | | |
|---|---|---|
| Pale-faced Sheathbill | Chionis albus | N |

**Family Stercorariidae**

| | | |
|---|---|---|
| South Polar Skua | Catharacta maccormicki | N? |
| Falkland Skua (Sea-hen) | Catharacta antarctica | B, M |
| Chilean Skua | Catharacta chilensis | V/B |
| Long-tailed Skua | Stercorarius longicaudus | V |
| Arctic Skua | Stercorarius parasiticus | V |

**Family Laridae**

| | | |
|---|---|---|
| Dolphin Gull | Leucophaeus scoresbii | B |
| Grey Gull | Larus modestus | V |
| Band-tailed Gull | Larus belcheri | V |
| Grey-headed Gull | Larus cirrocephalus | V |
| Kelp Gull (Big Gull, White Gull) | Larus dominicanus | B |
| Franklin 's Gull | Larus pipixcan | V |
| Brown-hooded Gull (Pink-breasted Gull) | Larus maculipennis | B |

**Family Sternidae**

| | | |
|---|---|---|
| Cayenne/Sandwich Tern | Sterna (sandvicensis) eurygnatha | V |
| South American Tern (Split-tail) | Sterna hirundinacea | N |
| Common Tern | Sterna hirundo | N |
| Arctic Tern | Sterna paradisaea | B, M |
| Antarctic Tern | Sterna vittata | V |
| Trudeau's Tern | Sterna trudeaui | V |
| Sooty Tern | Sterna fuscata fuscata | V |
| Black Noddy | Anous minutus atlanticus | V |

**Order COLUMBIFORMES**

**Family Columbidae**

| | | |
|---|---|---|
| Chilean Pigeon | Columba araucana | V |
| Eared Dove | Zenaida auriculata | V |
| Ruddy Ground Dove | Columbina talpacoti | V |
| Blue Ground Dove | Claravis pretiosa | V |

## Order PSITTACIFORMES

### Family Psittacidae

| | | |
|---|---|---|
| Burrowing Parrot | Cyanoliseus patagonus | V, U |
| Austral Parakeet | Enicognathus ferrugineus | V |

## Order CUCULIFORMES

### Family Cuculidae

| | | |
|---|---|---|
| Yellow-billed Cuckoo | Coccyzus americanus | V |
| Dark-billed Cuckoo | Coccyzus melacoryphus | V |

## Order STRIGIFORMES

### Family Tytonidae

| | | |
|---|---|---|
| Barn Owl (White Owl) | Tyto alba tuidara | B |

### Family Strigidae

| | | |
|---|---|---|
| Magellanic Horned Owl | Bubo magellanicus | V |
| Burrowing Owl | Athene cunicularia | V |
| Short-eared Owl (Owl) | Asio flammeus sanfordi | B, L |

## Order CAPRIMULGIFORMES

### Family Caprimulgidae

| | | |
|---|---|---|
| Band-winged | Caprimulgus longirostris | V |

## Order APODIFORMES

### Family Apodidae

| | | |
|---|---|---|
| White-collared Swift | Streptoprocne zonaris | V |
| Ashy-tailed Swift | Chaetura vauxi andrei | V |

### Family Trochilidae

| | | |
|---|---|---|
| Green-backed Firecrown | Sephanoides sephaniodes | V |

## Order PASSERIFORMES

### Family Furnariidae

| | | |
|---|---|---|
| Bar-winged Cinclodes | Cinclodes fuscus | V |
| Tussac-bird (Black Bird) | Cinclodes antarcticus antarcticus | B, L |

### Family Rhinocryptidae

| | | |
|---|---|---|
| Magellanic Tapaculo | Scytalopus magellanicus | X? |

### Family Tyrannidae

| | | |
|---|---|---|
| White-crested Elaenia | Elaenia albiceps | V |
| Tufted Tit-tyrant | Anairetes parulus | V |
| Black-billed Shrike-tyrant | Agriornis montanus | V |
| White-browed Ground-tyrant | Muscisaxicola albilora | V |
| Dark-faced Ground-tyrant (Blue/News Bird) | Muscisaxicola maclovianus maclovianus | V |
| Fire-eyed Diucon | Xolmis pyrope | B, L |
| Cattle Tyrant | Machetornis rixosa | V |
| Austral Negrito | Lessonia rufa | V |
| Great Kiskadee | Pitangus sulphuratus | V |
| Eastern Kingbird | Tyrannus tyrannus | V |
| Fork-tailed Flycatcher | Tyrannus savana | V |

**Family Phytotomidae**

| | | |
|---|---|---|
| • Rufous-tailed Plantcutter | Phytotoma rara | V |

**Family Hirundinidae**

| | | |
|---|---|---|
| • Brown-chested Martin | Progne tapera fusca | V/B |
| • Southern Martin | Progne elegans | V |
| • Purple Martin | Progne subis | V |
| • Grey-breasted Martin | Progne chalybea | V |
| • White-rumped Swallow | Tachycineta leucorrhoa | V |
| • Chilean Swallow | Tachycineta leucopyga | V |
| • Blue and White Swallow | Pygochelidon cyanoleuca patagonica | V |
| • Rough-winged Swallow | Stelgidopteryx ruficollis | V |
| • Tawny-headed Swallow | Alopochelidon fucata | V |
| • Sand Martin / Bank Swallow | Riparia riparia | V |
| • Cliff Swallow | Petrochelidon pyrrhonota | V |
| • Barn Swallow | Hirundo rustica | V |

**Family Troglodytidae**

| | | |
|---|---|---|
| • Falkland Grass Wren (Tomtit) | Cistothorus platensis falklandicus | B, L |
| • Cobb's Wren (Rock Wren) | Troglodytes cobbi | B, E |

**Family Muscicapidae**

| | | |
|---|---|---|
| • Wood Thrush | Hylocichla mustelina | V, U |
| • Falkland Thrush (Thrush) | Turdus falcklandii falcklandii | B, L |

**Family Mimidae**

| | | |
|---|---|---|
| • Patagonian Mockingbird | Mimus patagonicus | V |

**Family Motacillidae**

| | | |
|---|---|---|
| • Falkland Pipit (Skylark, Lark) | Anthus correndera grayi | B, L |

**Family Emberizidae**

| | | |
|---|---|---|
| • Mourning Sierra-Finch | Phrygilus fruticeti | V |
| • Patagonian Sierra-Finch | Phrygilus patagonicus | B, L |
| • Canary-winged/Black-throated Finch (Sparrow) | Melanodera melanodera melanodera | X?/V |
| • Yellow-bridled Finch | Melanodera xanthogramma barrosi | V |
| • Rufous-collared Sparrow | Zonotrichia capensis | V |
| • Patagonian Yellow Finch | Sicalis lebruni | V |

**Family Icteridae**

| | | |
|---|---|---|
| • Long-tailed Meadowlark (Robin, Military Starling) | Sturnella loyca falklandica | B, L |
| • Shiny Cowbird | Molothrus bonariensis | V |

**Family Fringillidae**

| | | |
|---|---|---|
| • Black-chinned Siskin (Siskin, Canary) | Carduelis barbata | B |

**Family Ploceidae**

| | | |
|---|---|---|
| • House Sparrow (English Sparrow) | Passer domesticus | B* |