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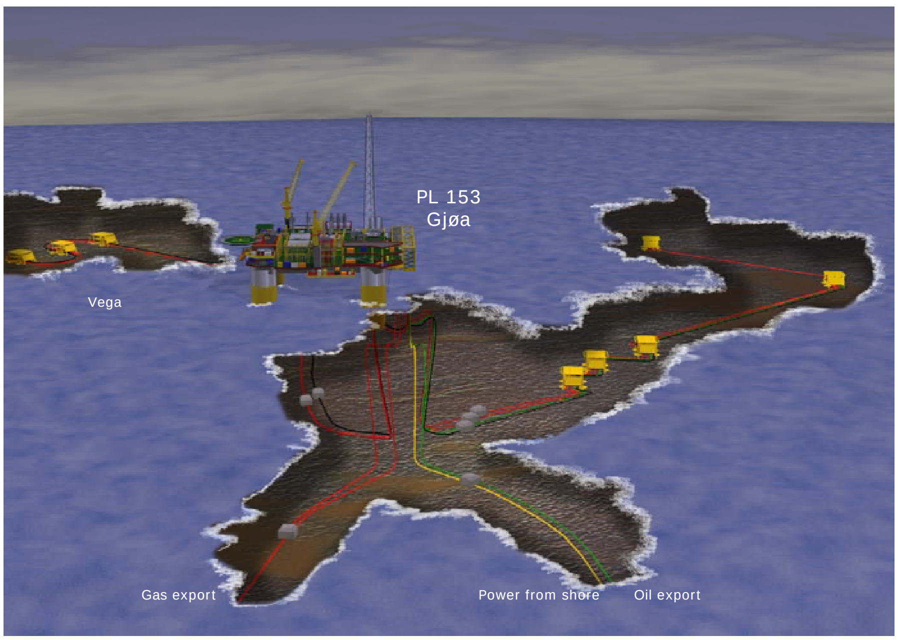
Environmental Statement for the Gjøa to FLAGS pipeline



November 2006

RWE Shell petoro Gaz de France STATOIL

Standard Information Sheet

Project name:	Gjøa to FLAGS Gas Export Pipeline
DTI Project reference:	**D/3325/2006**
Type of project:	Field Development
Undertaker Name:	Statoil ASA
Address:	Statoil ASA N-4035 Stavanger Norway
Licensees/Owners:	RWE Dea Norge AS 8% A/S Norske Shell 12% Statoil ASA 20% Petoro AS 30% Gaz de France Norge AS 30%
Short description:	Statoil are proposing to install a new 28" (ID) gas export pipeline between the Gjøa SEMI and FLAGS, as part of the Gjøa project. The new export pipeline will be connected to a new Gjøa semi-submersible platform via two 12" risers. The pipeline will be connected to FLAGS at the Tampen Link connection, via a new Hot Tap Tee-piece. All connections at Gjøa and at FLAGS will be stabilised using gravel and rock and will be fitted with protective structures.
Dates	
Anticipated commencement of works:	May 2007
Date and reference number of any earlier Statement related to this project:	Not applicable
Significant environmental impacts identified:	Physical Presence of Vessels Anchoring of vessels during pipeline Installation Pipeline installation Physical presence of the pipeline and subsea structures Emissions from anodes Accidental spills of diesel
Statement Prepared By:	Statoil ASA BMT Cordah Limited, Aberdeen

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Abbreviations

Al	Aluminium
ALARP	As Low As Reasonably Practicable
BOD	Biological Oxygen Demand
BSI	British Standards Institute
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CH_4	Methane
CPR	Continuous Plankton Recorder
CO	Carbon monoxide
CO_2	Carbon dioxide
cSAC	Candidate Special Area of Conservation
dB	decibels
DP	Dynamically Positioned
DEFRA	Department of Environment, Food and Rural Affairs
DETR	Department of Environment, Transport and the Regions
dSAC	Draft Special Area of Conservation
DSV	Dive Support Vessel
DTI	Department of Trade and Industry
DWT	Dead weight tonnage
EAC	Environmental Action Concentrations
EC	European Community
EEC	European Economic Community
EIA	Environmental Impact Assessment
EQS	Environmental Quality Standards
ERA	Environmental Risk Assessment
ES	Environmental Statement
EU	European Union
EWD	European Wildlife Division
FDP	Field Development Plan
FLAGS	Far North Liquids and Gas System
FRS	Fisheries Research Services
GPS	Global Positioning System
HAB	Harmful Algal Blooms
HTT	Hot Tap Tee-piece
Hz	hertz
ICES	International Council for the Exploration of the Seas
ISO	International Standard Organisation
JNCC	Joint Nature Conservation Committee
km	kilometre
m	metres
MARPOL	International Convention for the Prevention of Pollution from Ships
MCA	Maritime Coastguard Agency
MDAC	Methane-Derived Authigenic Carbonate
MoD	Ministry of Defence
MPE	Ministry of Petroleum and Energy (Norwegian)
m/s	Metres per Second
NAO	North Atlantic Oscillation
NFFO	National Federation of Fishermen's Organisations
nm	Nautical mile
NO_x	Nitrogen oxides
N_2O	Nitrogen dioxide
NSTF	North Sea Task Force
OD	Overall Diameter

OSIS	Oil Spill Information System
OSPAR	Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic
OVI	Offshore Vulnerability index
PDO	Plan for Development and Operation of a petroleum deposit
PIO	Plan for installation and operation of facilities for transport and utilisation of petroleum
PL	Production licence
PLEM	Pipeline End Manifold
ppm	Parts per million
PWA	Pipeline Work Authorisation
RIA	regional impact assessment
ROV	Remotely Operated Vehicle
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SAST	Seabirds at Sea Team
SCANS	Small Cetacean Abundance in the North Sea (survey)
SEA	Strategic Environmental Assessment
SEERAD	Scottish Executive Environment and Rural Affairs Department
SEPA	Scottish Environmental Protection Agency
SFF	Scottish Fishermen's Federation
SFLL	Statfjord Late Life
SMRU	Sea Mammal Research Unit
SMSS	super martensitic stainless steel
SNH	Scottish Natural Heritage
SOPEP	Shipboard Oil Pollution Emergency Plans
SoS	Secretary of State for Trade and Industry
UKCS	United Kingdom Continental Shelf
UKDMAP	United Kingdom Digital Map
UKOOA	United Kingdom Offshore Operators Association
VOC	Volatile Organic Compounds
WWF	World Wildlife Fund
Zn	Zinc

Contents

Standard Information Sheet ... i

Abbreviations ... iii

Contents ... v

1 Non-Technical Summary ... 1-1

1.1 The Project ... 1-1
1.2 The Existing Environment ... 1-2
1.3 Significant Risks and Mitigation Measures ... 1-4
1.4 Conclusions ... 1-6

2 Introduction ... 2-1

2.1 The Gjøa Field and the Background to the Gjøa to FLAGS Gas Export Pipeline ... 2-1
2.2 Plans for Development and Transport from the Gjøa Field and Treaties between the United Kingdom and Norway ... 2-2
2.3 The Purpose of the Environmental Impact Assessment ... 2-2
2.4 Legislative EIA Requirements ... 2-2
2.4.1 International Legislation 2-2
2.4.2 Norwegian Legislation 2-3
2.4.3 UK Legislation 2-3
2.5 The Relationship between UK and Norwegian Legislation and formal Requirements for EIA/ES Documentation ... 2-3
2.5.1 Environmental Impact Assessment Programme 2-3
2.5.2 Regional and Strategic Impact Assessments 2-4
2.5.3 Contents and Structure of the EIA Documents 2-6
2.6 The Impact Assessment Process for the British and Norwegian Authorities ... 2-6
2.7 Necessary Approvals/Applications, Consents and Information Requirements in Addition to PIO/PWA ... 2-7

3 THE ENVIRONMENTAL IMPACT ASSESSMENT PROGRAMME ... 3-1

3.1 Consultation Process ... 3-1
3.2 Concerns and Issues ... 3-1
3.3 Scope of the Environmental Assessment ... 3-2
3.4 Methodology – Environmental Assessment ... 3-2
3.5 Background Documents ... 3-4

4 PROJECT DESCRIPTION 4-1

4.1 Gjøa gas export solutions 4-1
4.1.1 Gas Production at Gjøa 4-2

4.2 Gjøa to FLAGS gas export pipeline 4-2

4.3 Description for the selected Gjøa to FLAGS gas export pipeline 4-3
4.3.1 Site Survey 4-3
4.3.2 Crossings 4-4
4.3.3 Pipeline Installation 4-5
4.3.4 Corrosion Protection 4-6
4.3.5 Structures, Tie-Ins and Connection Operations 4-7
4.3.6 Leak testing and Dewatering operations 4-9
4.3.7 Emissions during pipeline installation 4-10

4.4 Operational Phase 4-11
4.4.1 Pipeline Maintenance 4-11
4.4.2 Chemicals 4-12

4.5 Project Timetable 4-12

4.6 Decommissioning 4-12

5. DESCRIPTION OF ENVIRONMENTAL SETTING 5-1

5.1 Introduction 5-1

5.2 Meteorology 5-1

5.3 Oceanography 5-2
5.3.1 Seabed topography 5-2
5.3.2 Sediment characteristics 5-2
5.3.3 Water masses 5-2
5.3.4 Currents 5-3
5.3.5 Temperature and salinity 5-3

5.4 Biological Resources 5-3
5.4.1 Plankton 5-4
5.4.2 Benthic communities 5-5
5.4.3 Fish and Shellfish Populations 5-6
5.4.4 Commercial Fisheries 5-11
5.4.5 Seabirds 5-13
5.4.6 Marine Mammals 5-15

5.5 Offshore Conservation Areas 5-18
5.5.1 Annex I Habitats occurring in UK Offshore Waters 5-20
5.5.2 Annex II Species occurring in UK Offshore Waters 5-23

5.6 Other sea users 5-25
5.6.1 Shipping 5-25
5.6.2 Oil and Gas Activity 5-25
5.6.3 Ministry of Defence 5-26
5.6.4 Wrecks 5-26
5.6.5 Submarine cables 5-27

5.7 Summary of Environmental Sensitivities 5-28

6 RISK ASSESSMENT METHODOLOGY 6-1

6.1 Methodology 6-1
6.1.1 Description of the method used 6-1
6.1.2 Discussion of the method 6-4
6.1.3 Final Classification of Results 6-5

6.2 Identification of Significant Environmental Risks 6-5

7 EVALUATION OF SIGNIFICANT ENVIRONMENTAL RISKS 7-1

7.1 Physical Presence of Vessels 7-1
7.1.1 Magnitude and Duration 7-1
7.1.2 Impact on Sensitive Receptors 7-1
7.1.3 Impact on Proposed or Designated Conservation Sites 7-2
7.1.4 Trans-boundary, Cumulative and Global Impacts 7-2
7.1.5 Stakeholder Concerns 7-2
7.1.6 Adequacy of Proposed Mitigation Measures 7-2

7.2 Anchoring of Vessels during Pipelaying Activities 7-2
7.2.1 Magnitude and Duration 7-2
7.2.2 Impact on Sensitive Receptors 7-3
7.2.3 Impact on Proposed or Designated Conservation Sites 7-3
7.2.4 Trans-boundary, Cumulative and Global Impacts 7-4
7.2.5 Stakeholder Concerns 7-4
7.2.6 Adequacy of Proposed Mitigation Measures 7-4

7.3 Pipeline Installation 7-4
7.3.1 Magnitude and Duration 7-4
7.3.2 Impact on Sensitive Receptors 7-4
7.3.3 Impact on Proposed or Designated Conservation Sites 7-5
7.3.4 Trans-boundary, Cumulative and Global Impacts 7-5
7.3.5 Stakeholder Concerns 7-5
7.3.6 Adequacy of Proposed Mitigation Measures 7-5

7.4 Physical Presence of the Pipeline and Subsea Structures 7-6
7.4.1 Magnitude and Duration 7-6
7.4.2 Impact on Sensitive Receptors 7-6
7.4.3 Impact on Proposed or Designated Conservation Sites 7-8
7.4.4 Trans-boundary, Cumulative and Global Impacts 7-8
7.4.5 Stakeholder Concerns 7-8
7.4.6 Adequacy of Proposed Mitigation Measures 7-8

7.5 Emissions from Anodes 7-8
7.5.1 Magnitude and Duration 7-8
7.5.2 Impact on Sensitive Receptors 7-9
7.5.3 Impact on Proposed or Designated Conservation Sites 7-11
7.5.4 Trans-boundary, Cumulative and Global Impacts 7-11
7.5.5 Stakeholder Concerns 7-11
7.5.6 Adequacy of Proposed Mitigation Measures 7-11

7.6 Accidental Diesel Spill ... 7-11
7.6.1 Magnitude and Duration 7-11
7.6.2 Impact on Sensitive Receptors 7-13
7.6.3 Impact on Proposed or Designated Conservation Sites 7-13
7.6.4 Trans-boundary, Cumulative and Global Impacts 7-13
7.6.5 Stakeholder Concerns 7-13
7.6.6 Adequacy of Proposed Mitigation Measures 7-14

8 ENVIRONMENTAL MANAGEMENT ... 8-1
8.1 Company Policy ... 8-1
8.2 Policy Implementation and Environmental Management Systems ... 8-1
8.3 Project Specific Environmental Management ... 8-1

9 CONCLUSIONS ... 9-1

APPENDIX A ENVIRONMENTAL IMPACT ASSESSMENT SUMMARY ... A1

List of Tables

Table 1-1: Licencees of the Gjøa production licence PL 153 1-1

Table 1-2: Seasonal Environmental Sensitivities 1-3

Table 1-3: Significant environmental impacts and planned mitigation measures........ 1-4

Table 1-4: Non-significant environmental impacts and planned mitigation measures 1-6

Table 2-1: Licencees of the Gjøa production licence PL 153 2-1

Table 3-1: Summary of the UK consultation exercise........ 3-1

Table 3-2: Supporting reports for the EIA / ES for the new Gjøa gas export pipeline........ 3-4

Table 4-1: Gas Export Solutions for the Gjøa Field 4-1

Table 4-2: Gas Export Pipeline Design 4-3

Table 4-3: Locations of pipeline crossings for the gas export pipeline 4-4

Table 4-4: Areas of rock-dump in the UKCS........ 4-5

Table 4-5: Proposed pipeline operations........ 4-6

Table 4-6: Sources of potential atmospheric emissions 4-10

Table 4 7: Estimated gaseous emissions from vessels during the installation of the pipeline and subsea structures..... 4-10

Table 4 8: Examples of underwater noise levels produced by different types of vessel or type of activity 4-11

Table 4-9: Proposed schedule for the Gjøa to FLAGS development 4-12

Table 5-1: Spawning and nursery areas/periods of fish which coincide with the proposed pipeline 5-8

Table 5-2: Landings by UK vessels over 10m for ICES rectangle 51F1 by species type between January 2004 and August 2005........ 5-11

Table 5-3: Fishing effort (days by vessels over 10m) by gear type used in ICES rectangle 51F1 between January 2004 and August 2005 5-11

Table 5-4: Monthly vulnerability of seabirds to oil pollution in the area of the proposed development (UKCS Blocks 211/29, 211/30 and surrounding blocks) 5-14

Table 5-5: Sightings of cetaceans in the area of the proposed development in the northern North Sea 5-18

Table 5-6: Annex I habitats and Annex II species occurring in UK offshore waters........ 5-19

Table 5-7: Possible and draft Special Area of Conservation (dSAC) in UK Offshore Waters........ 5-19

Table 5-8: Shipping routes in the vicinity of the proposed pipeline route 5-25

Table 5-6: Seasonal Environmental Sensitivities 5-28

Table 6-1: Probability criteria for defining the likelihood of routine and non-routine activities or events. 6-2

Table 6-2: Consequence criteria for defining the characteristics of environmental effects........ 6-3

Table 6-3: Risk Matrix........ 6-5

Table 6-4: Risk assessment of installation of pipelines, risers and subsea structures 6-6

Table 6-5: Risk assessment of production activities........ 6-7

Table 6-6: Risk assessment of decommissioning activities........ 6-8

Table 6-7: Justification for excluding the causes of risks assessed to be Not significant or Positive from further investigation in the environmental assessment for the installation of pipelines, risers and subsea structures 6-9

Table 6-8: Justification for excluding the causes of risks assessed to be Not Significant or Positive from further investigation in the EA for production activities ... 6-11

Table 6-9: Justification for excluding the causes of risks assessed to be Not Significant or Positive from further investigation in the EA for decommissioning activities ... 6-12

Table 7-1: Potential sources of impact and planned mitigation measures for the presence of pipelay vessels. ... 7-2

Table 7-2: Potential sources of impact and planned mitigation measures for anchoring of vessels. ... 7-4

Table 7-3: Potential sources of impact and planned mitigation measures for pipeline installation. ... 7-5

Table 7-4: Planned mitigation measures for the presence of the pipeline, crossings and structures ... 7-8

Table 7-5: Typical composition of aluminium and zinc anodes ... 7-9

Table 7-6a: Estimated concentrations of elements released to seawater through dissolution of sacrifical anodes on the whole gas export pipeline and comparison with concentrations in North Sea water. ... 7-10

Table 7-6b: Estimated concentrations of elements released to seawater through dissolution of sacrifical anodes on the 8.5km of pipeline in the UKCS and comparison with concentrations in North Sea water ... 7-10

Table 7-7: Planned mitigation measures for the presence of the pipeline, crossings and structures ... 7-11

Table 7-8: Sources of oil spills and planned mitigation measures ... 7-14

Table 8-1: Significant environmental impacts and planned mitigation measures ... 8-2

Table 8-2: Non-significant environmental impacts and planned mitigation measures ... 8-4

List of Figures

Figure 1-1: Location of the Gjøa Field and proposed pipeline 1-1

Figure 1-2: Proposed layout of the new gas export pipeline 1-2

Figure 2-1: Main reservoirs of the Gjøa field 2-1

Figure 2-2: North Sea RIA 2-5

Figure 3-1: Proposed layout of the new gas export pipeline 3-2

Figure 3-2: Principal stages in the environmental assessment process 3-3

Figure 4-1: Gas export pipeline solution from Gjøa to the existing FLAGS pipeline system 4-1

Figure 4-2: Gas production profile for the export of gas into FLAGS from the Gjøa, Camilla, Belinda and Fram B fields 4-2

Figure 4-3: Selected gas export pipeline route 4-3

Figure 4-4: Section through the UK and Norwegian pipeline crossings 4-4

Figure 4-5: Rock dump options for pipelaying 4-5

Figure 4-6: Schematic of the Gjøa to FLAGS gas export pipeline 4-7

Figure 4-7: Hot Tap Tee Piece Structure (including protective cover) 4-8

Figure 4-8: Flooding of gas export pipeline 4-9

Figure 4-9: Dewatering of pipeline system 4-10

Figure 5-1: Annual windrose for the proposed pipeline development 5-1

Figure 5-2: Fishing spawning sites in the vicinity of the proposed development in the northern North Sea 5-9

Figure 5-3: Fish nursery grounds in the vicinity of the proposed development in the northern North Sea 5-10

Figure 5-4: Commercial fishing effort (days) and value (£000) for UK vessels over 10m for ICES rectangle 51F1 between January 2004 and August 2005 5-12

Figure 5-5: The proposed development area in relation to the distribution of pockmarks in the northern North Sea, the Scanner Pockmark (dSAC) and Braemar Pockmark (dSAC) 5-22

Figure 5-6: Shipping route positions within the vicinity of the proposed pipeline 5-26

Figure 5-7: Shipping density in the vicinity of the proposed pipeline 5-26

Figure 7-1: Typical anchor pattern for pipelay barge 7-3

Figure 7-2: Stochastic modelling of 1000m^3 diesel release 7-12

Figure 7-2: Deterministic modelling of 1000m^3 diesel release 7-12

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1 NON-TECHNICAL SUMMARY

1.1 The Project

Statoil Norway (Statoil) are proposing to develop the Gjøa oil and gas field located in Blocks 35/9 and 36/7 in the Norwegian sector of the northern North Sea, approximately 135km east of Shetland and 45km west of Norway (Figure 1-1). The proposed Gjøa development would involve the drilling of 13 wells, the installation of seabed templates connected to a semi-submersible (SEMI) production platform and the installation of oil and gas export pipelines. Table 1.1 lists the current licence holders for the production of the Gjøa field (PL 153) with the respective ownership shares. Statoil are the operators for production licence PL 153 in the engineering and development stage, while Gaz de France Norge will become operator when the Gjøa field begins producing oil and gas.

Table 1-1: Licencees of the Gjøa production licence PL 153

Company	Percentage
RWE Dea Norge AS	8
A/S Norske Shell	12
Statoil ASA	20
Petoro AS	30
Gaz de France Norge AS	30

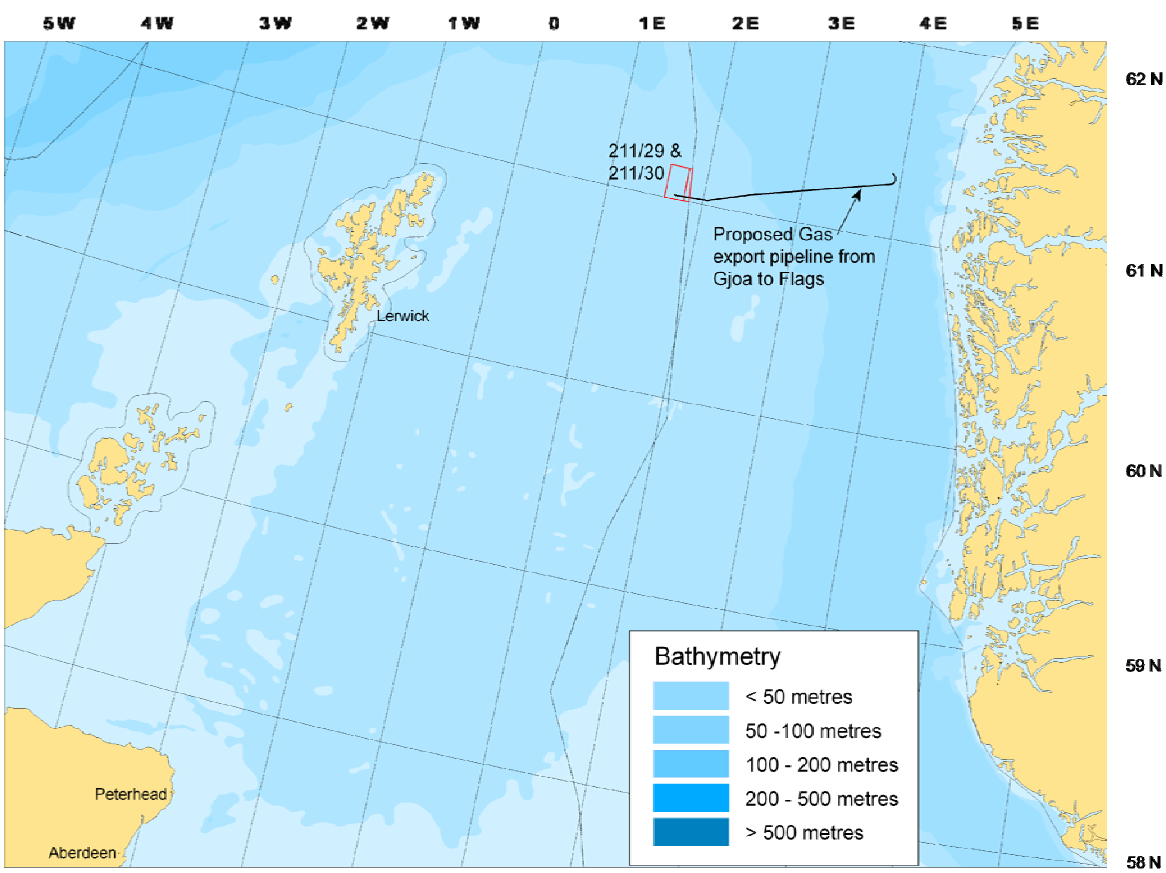

Figure 1-1: Location of the Gjøa Field and proposed pipeline

As part of the Gjøa development, Statoil are proposing to install a new 130km gas export pipeline between the Gøa and the Far North Liquids and Gas System (FLAGS) pipeline, 1.4km south of the Brent Alpha platform (Figure 1-2). The new gas export pipeline will be 130km in length, with approximately 8.5km of the new gas export pipeline to be laid in UKCS Blocks 211/29 and 211/30. Development drilling and installation operations are scheduled to commence in 2009, with first oil and gas from the Gjøa Field expected to occur in October 2010 and production continuing for a further 15 years. Approximately 10 million m^3 of liquid (oil and 40.4 billion m^3 of gas are expected to be recovered from Gjøa over the field lifetime.

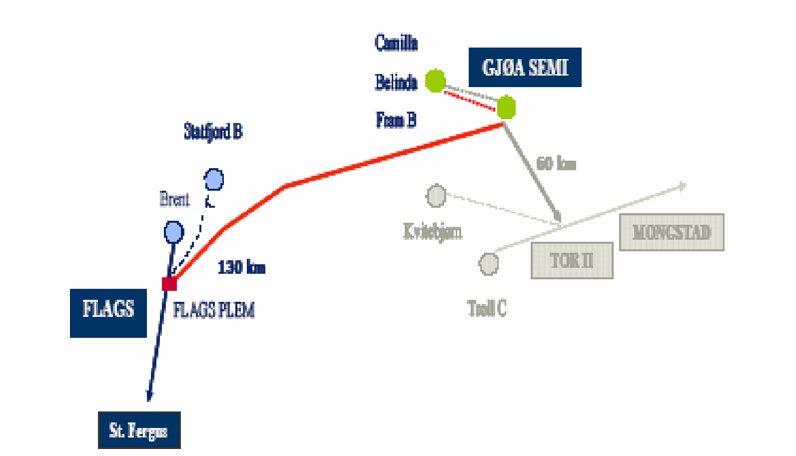

Figure 1-2: Proposed layout of the new gas export pipeline

The new pipeline will be made of carbon steel, with a protective coating of asphalt and a 50mm thick coating of concrete, to prevent corrosion and provide stability. The outside diameter (OD) of the new pipeline will be 30” (internal diameter 28”); and will be laid directly onto surface of the seabed in a conventional manner (i.e. along a more or less direct route between Gjøa and the FLAGS tie-in). In total, approximately 76,750m^3 of rock-dumping would be placed at various locations along the route to stabilise the pipeline, with 12,000m^3 of rock-dump along the UK section of the pipeline. At this stage in the detailed planning of the project, it is not known if the pipe will be laid from a vessel positioned using anchors, or a dynamically positioned (DP) vessel.

The new export pipeline will be connected to the Gjøa SEMI via two 12" risers and to FLAGS via the Tampen Link Hot Tap Tee-piece. All connections at Gjøa and at FLAGS will be stabilised using gravel and rock, and will be fitted with protective structures.

1.2 The Existing Environment

The environmental sensitivities in the area of the proposed pipeline and their seasonal variations are summarised in Table 1-2. The proposed pipeline installation activities are scheduled to take place between May and September 2009, approximately one week in the UKCS between July and August 2009.

Table 1-2: Seasonal Environmental Sensitivities

KEY

- Very high sensitivity
- High sensitivity
- Moderate sensitivity
- Low sensitivity
- Unsurveyed / No data available

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Proposed Project Schedule : May to September 2009												
Plankton	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Benthic Fauna	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Fish Populations	High	High	High	High	Moderate	Moderate	Moderate	Moderate	Low	Low	Low	Low
Fisheries	Low	Low	Low	Low	Low	Low	Low	Low	Low	Moderate	Moderate	Moderate
Seabird populations	Moderate	Moderate	Low	Low	Low	Low	High	Low	Moderate	Moderate	High	Low
Marine mammals	Unsurveyed / No data available	High	Moderate	Moderate	Moderate	Moderate	High	High	Moderate	Unsurveyed / No data available	Unsurveyed / No data available	High
Conservation areas	Low	High	Low	Moderate	Moderate	Moderate	High	Moderate	Moderate	Low	Low	Low

Plankton

Plankton are vulnerable to oil and chemical discharges, but due to their wide distribution there is no direct threat to the viability of the populations. Indirect effects may exist for organisms further up the food chain. Main periods of bloom are in spring and summer. Any impacts from offshore oil and gas operations, including operations to install the pipeline, are likely to be small in comparison with natural variations.

Benthic Fauna

Benthic fauna are an important food resource for fish and shellfish, and are vulnerable to the disturbance of seabed sediments which is likely to occur during pipeline installation operations. However, no rare benthic species are known to occur in this area and the benthic communities in the development area are similar to those found throughout the surrounding area. Therefore, there is no direct threat to the viability of the local benthic community.

Fish Populations

Fish are vulnerable to pollution, particularly during the egg, larval and juvenile stages of their lifecycle. The proposed pipeline is located in spawning grounds for cod, haddock, saithe and Norway pout. With the exception of cod, fish communities in this area are present throughout large areas of the North Sea, therefore there is no direct threat to the viability of the populations. However, this region of the North Sea constitutes an important area for cod spawning activity. The main schedule for the pipeline laying activities will not coincide with peak spawning (February and March) for this species.

Fisheries

The development area is of "high" commercial value, compared to other areas in the North Sea. Fishing occurs throughout the year, with the highest fishing effort (>40 days) in April, May October and December during 2004. Fishing efforts in the area is moderate to low compared to other areas in the North Sea. Both pelagic and demersal species of fish are targeted in the area. Although demersal trawling dominated fishing methods; pelagic species, such as mackerel, dominate the landings in recent years. The value of landings in 2004 was highest in October and December.

Seabird populations

Seabird vulnerability to surface pollution have been described by the JNCC as "low" to "moderate" for most of the year, but is "high" in July and November. Vulnerabilities are related to the position of the proposed development area in relation to the Northern Isles (particularly Shetland) which are of significant importance for large numbers of birds during the breeding season. Important species in this area include fulmar gannet, kittiwake and skua.

Marine mammals

Harbour porpoises are the most commonly recorded cetacean in this area and high numbers have been recorded in July. Other species of cetacean recorded in the area, include killer whales, long-finned pilot whales, minke whales, white-beaked dolphins and white-sided dolphins. Cetaceans have been recorded in the area throughout the year, but numbers are relatively low. Marine mammals are vulnerable to chemical discharges, acoustic disturbance from vessel operations, and injury from collisions with vessels.

Conservation areas

Based on available information there are no reef habitats of conservation value or any other Annex I Habitats in the area of the proposed pipeline. The harbour porpoise is the only Annex II species known to occur regularly in this region of the North Sea. The JNCC and other country agencies are currently analysing distribution data for harbour porpoise in UK waters to determine whether any suitable sites for SAC designation can be found. No conservation designation.

1.3 Significant Risks and Mitigation Measures

A risk assessment was undertaken to identify the range of impacts and risks that could arise as a result of the proposed development. The significant environmental effects and Statoil's planned mitigation measures are detailed in **Section 7** and summarised in Table 1-3, while Table 1-4 summarises the impacts and risks that were assessed to be non-significant (**Section 6**). No impacts were found to be highly significant.

Table 1-3: Significant environmental impacts and planned mitigation measures

Potential source of impact	Potential impact or risk to the environment	Planned mitigation measures
Physical presence of pipelay vessels	▪ Temporary restrictions to sea access ($0.8km^2$ to $12.6km^2$) during the construction period (approximately 4 months) in an area of moderate levels of fishing effort and shipping traffic in the UKCS and Norwegian Continental Shelf. ▪ Noise from a DP pipelaying vessel may disturb low densities of cetaceans in the area.	▪ The pipelaying would be advertised through Notice to Mariners in the UK and Norwegian waters. ▪ The operational area would be monitored during pipelaying to alert shipping and fishing vessels on approach to the area. ▪ Noise would be mitigated by use of well maintained vessels and equipment.
Anchoring of vessels during pipeline installation.	▪ Anchor mounds could form on clay seabed, and potentially become long-term, localised obstructions that could interact with fishing gear.	▪ Exact location of the anchors would be planned. ▪ A remotely operated vehicle (ROV) would be used to ensure anchors placed on the seabed correctly. ▪ A survey of the pipeline route would be undertaken on completion of the activities to identify any seabed discontinuities. ▪ Statoil would ensure any significant mounds formed would be flattened using suitable methods.
Pipeline installation	▪ Installation would disturb the seabed sediments, and the benthic organisms living in or on the sediments, in a small area of seabed beneath the pipeline and rock-dumps. ▪ The pipeline and rock-dumps would create a new area of habitat for benthic organisms that live on hard surfaces, and provide additional habitat for crevice-dwelling fish. ▪ Potential impedance to commercial fishing (see also **Physical presence of pipelines**)	▪ A pipeline route survey of the area would be undertaken in 2007 and would be used to plan the optimum pipeline route. ▪ A survey vessel would be on station during installation to ensure that the pipeline is laid in the correct location. ▪ Rock-dumping would be supervised by the use of sonar, and would be post-dump surveyed by an ROV to ensure that material is placed accurately and in the correct location. ▪ Pipeline Works Authorisation (PWA) applications would be made. ▪ Location and profile of rock-dumps would be made available to fishermen and fishing interests. ▪ Characteristics and profiles of the rock-dumps would be designed to minimise the risk of interference with fishing gear.

Table 1-3 continued: Significant environmental impacts and planned mitigation measures

Potential source of impact	Potential impact or risk to the environment	Planned mitigation measures
Physical presence of the pipeline and subsea structures	▪ Impedance to military exercises is not envisaged as the project area is not utilised for these purposes. ▪ Loss of access to fishing grounds would be insignificant as all subsea structures can be trawled over by demersal trawling gear. ▪ Marginal risk of damage or loss of fishing gear or vessel caused by gear entanglement on the pipeline, subsea structures or rock-dump.	▪ No mitigation planned. ▪ Mariners would be notified of the location, dimensions and heights of all seabed structures. ▪ Locations of all subsea structures, including pipelines, would be recorded on Admiralty charts. ▪ The pipeline and PLEM, their protective structures, and the rock-dumps would be designed to be over-trawlable and do not impede fishing activities. ▪ The seabed will be surveyed after the gas export pipeline has been laid and any significant obstructions will be levelled.
Emissions from anodes during production activities	▪ Release of contaminants (metal ions) into water column and seabed. ▪ Concentrations of metal ions on the anodes are very low and would not cause toxic effects. ▪ Rapid dispersion and dilution in the offshore area.	▪ Industry standard anodes will be used on pipeline. ▪ Pipelines have a design life of 30 years. ▪ Total mass of anodes on pipeline would be small as possible commensurate with ensuring the integrity of the pipeline.
Accidental spill of diesel	▪ Diesel would disperse rapidly. No residual impacts would be expected on the local environment.	Statoil would put in place a number of mitigation measures to reduce the risk of oil spills from the pipelaying vessels. ▪ The pipelaying vessel would monitor the exclusion zone around the pipelaying vessel. ▪ The pipelay vessel would be equipped with all necessary navigation and communication equipment; ▪ All the relevant maritime authorities, and representative fishing organisations, would be notified of the proposed pipelaying activities. ▪ As required under MARPOL 73/92 Amended, the laybarge and other qualifying vessels would have in place Shipboard Oil Pollution Emergency Plans (SOPEPs). ▪ The plans would detail the actions to be taken in the event of a loss of shipboard containment. ▪ Vessels would have sufficient equipment to enable them to respond, contain on board and clean up minor pollution events. ▪ In the unlikely event that a large release occurred, Statoil have in place an agreement with specialist spill response organisations, who can provide an on-scene response, if required. These third party specialists would be brought in under the provisions that vessel operators have with their insurers.

Table 1-4: Non-significant environmental impacts and planned mitigation measures

Potential source of impact	Potential impact or risk to the environment	Planned mitigation measures
Noise from vessels during pipelaying activities	▪ Noise could potentially disturb low densities of marine mammals in the area.	▪ Noise will be minimised through well maintained equipment
Power generation on vessels during pipelaying and decommissioning activities	▪ Short-term, localised air quality deterioration around exhaust outlets.	▪ Emissions will be managed through the use of well maintained equipment. ▪ Compliance with IMO/MARPOL requirements
Discharge of treated bilge from vessels during pipelaying and decommissioning activities	▪ Localised deterioration in seawater quality around discharge point. ▪ Potential for minor oil slick formation, but local environment conditions will rapidly disperse any hydrocarbon discharges.	▪ Bilge treated prior to discharge. ▪ Compliance with IMO/MARPOL requirements. ▪ Vessel audits.
Sewage discharged from vessels during pipelaying and decommissioning activities	▪ Localised increase in biological oxygen demand around point of discharge. ▪ Increase in fish and plankton productivity. ▪ Offshore currents will readily disperse sewage.	▪ Sewage treated prior to disposal or contained and shipped to shore. ▪ Compliance with IMO/MARPOL requirements. ▪ Vessel audits.
Testing and commissioning of pipeline	▪ The permitted discharge to sea of pipeline testing and commissioning chemicals could affect water quality at the discharge site.	▪ Only the range and amounts of chemicals essential to demonstrate the integrity and fitness of the pipeline would be used ▪ The chemicals would be carefully selected so as to minimise potential environmental effects, in accordance with **Offshore Chemical Regulations 2002.**
Dropped objects during production and decommissioning activities	▪ Possible obstruction to fishing. ▪ Creation of artificial substrata to be colonised by organisms.	▪ Adherence to procedures and use of certified equipment. ▪ Retrieval of major items of debris on seabed
Removal of PLEMs, HTTs and other forms of subsea intervention	▪ Temporary disturbance to seabed and benthos.	▪ Post operational seabed surveys to be conducted if judged necessary.

1.4 Conclusions

The environmental assessment undertaken for the UK section of the proposed Gjøa to FLAGS gas export pipeline has established that Statoil have obtained sufficient information on both the environment and the proposed pipeline operations to evaluate the potential environmental consequences of the development.

The proposed pipeline chemicals will be subject to a separate permit under the **Offshore Chemical Regulations 2002**. The regulations require that operators use only approved chemicals, and support their permit application by providing detailed chemical information and environmental risk assessments for each chemical discharged. Statoil will comply in full with these regulations.

The potential environmental impacts of the project can be summed up as follows:

- The Gjøa to FLAGS gas export pipeline will have an impact in a small area of the northern North Sea. In the area in question, both environmental resources and fishing activities are relatively evenly distributed over a large area. The area directly affected by the UK section of the pipeline project is very small ($0.006km^2$). Accordingly, the potential for coming into conflict with environmental or fishery interest is limited.

- The project activity with the greatest impact on the surroundings will be the actual installation of the new pipeline. This phase will be transient and of short duration.

- The area of influence of the pipeline does not include any habitats listed in Annex I of the EU habitats Directive.

- The harbour porpoise is the only Annex II species known to occur regularly in the area. Harbour porpoises may be present in the area throughout the year, with high numbers observed in July.

- Seabirds in this area of the northern North Sea may be particularly vulnerable to surface oil pollution in July and November. Statoil has established procedures to ensure that all necessary measures to prevent accidental spills will be implemented.

- Fishing activities in the area are moderate in comparison to other areas in the North Sea. The most common fishing method is bottom trawling. It is considered that any conflicts with fishery interests in the operating phase of the gas export pipeline will be minimal, since all subsea installations are designed to be over-trawlable. During the actual installation of the pipeline, certain traffic restrictions in the area must be expected, because of the presence of pipelaying vessels, which will possibly deploy anchoring systems. Notification and monitoring procedures will be established, so that any conflict with the fishery interests and other shipping can be avoided as far as possible.

For these reasons, there is little probability that the project will have any significant impacts in the environment or the fisheries.

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2 INTRODUCTION

2.1 The Gjøa Field and the Background to the Gjøa to FLAGS Gas Export Pipeline

The Gjøa field is located in the Norwegian sector of the northern North Sea, approximately 135km east of Shetland, and 45km west of Norway (Figure 1-1).

The field was discovered in 1989 by drilling exploration well 35/9-1. Two segment wells have since been drilled into the reservoir, well 35/9-2 and 36/7-1 in 1991 and 1996 respectively. In 1998, attempts to drill a fourth well (25/9-4s) were abandoned due to problems with water flowing from shallow sand aquifers. The Gjøa field is divided into seven segments, three of which have been discovered by the 3 exploration wells (Figure 2-1).

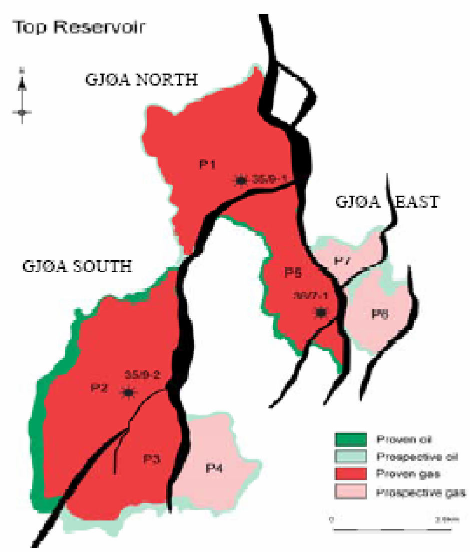

Figure 2-1: Main reservoirs of the Gjøa field

Table 2.1 lists the current licence holders for the production of the Gjøa field (PL 153) with the respective ownership shares.

Table 2-1: Licencees of the Gjøa production licence PL 153

Company	Percentage
RWE Dea Norge AS	8
A/S Norske Shell	12
Statoil ASA	20
Petoro AS	30
Gaz de France Norge AS	30

Statoil are the operators for production licence PL 153 in the engineering and development stage, while Gaz de France Norge will become operator when the Gjøa field begins producing oil and gas.

The proposed Gjøa development would involve the drilling of 13 wells, the installation of seabed templates connected to a semi-submersible production platform and the installation of oil and gas export pipelines.

The Gjøa SEMI will receive, process and export the oil and gas from the field. The Vega gas and condensate field (previously known as the Camilla, Belinda and Fram B fields) located approximately 30 to 50km west of Gjøa, will be tied-back to the semi-submersible production platform. The hydrocarbons from the three fields will be processed along with the Gjøa hydrocarbons.

Produced oil from the Gjøa field and the Vega field will be exported in a new oil pipeline connected to the existing Troll oil pipeline II (TOR 2) and further on to Mongstad. Produced gas from Gjøa and Vega will be exported in a new pipeline that will linked into the existing FLAGS pipeline system in the UKCS.

2.2 Plans for Development and Transport from the Gjøa Field and Treaties between the United Kingdom and Norway

In Norway, operations are required to submit a "Plan for Development and Operation of a petroleum deposit" (PDO). The Norwegian PDO consists of 2 parts; Part 1 (technical/financial part) and Part 2 (environmental impact assessment). In the United Kingdom an equivalent plan is called a "Field Development Plan" (FDP). In the United Kingdom the environmental impact assessment is not a part of the FDP, but is submitted as a basis for the approval of the FDP if the project is required to submit an Environmental Statement (ES). A Norwegian PDO is to be prepared and issued to the Norwegian authorities. An FDP is not to be performed for the Gjøa field development due to the location in the Norwegian continental shelf.

In Norway, operations are required to prepare a "Plan for installation and operation of facilities for transport and utilisation of petroleum" (PIO). In the UK, an equivalent plan for the laying and operation of pipelines is called a "Pipeline Work Authorisation" (PWA). It has been decided, in consultation with the public authorities of both countries to prepare a joint PDO/PIO in Norway, including a joint EIA for the PDO and the PIO, the EIA included a summary of the ES. Further on, it has been decided to prepare a PWA and an ES for the gas export pipeline. The summary of the ES is provided in **Appendix A.**

2.3 The Purpose of the Environmental Impact Assessment

In Norway, the Environmental Impact Assessment (EIA) is an integrated part of the planning of major development projects, and included in the PDO and PIO. The EIA is intended to ensure that factors associated with the environment, society and natural resources are included in the planning work on a par with technical, financial and safety-related factors.

The EIA is intended to contribute to shedding light on matters that are relevant to both the internal and external decision-making processes, and to guarantee the general public information on the projects. The process must be an open one, whereby the various players have the opportunity to express their opinions and influence the design of the project.

The purpose of the Environmental Statement (ES) in the United Kingdom is similar to that of the EIA in Norway; it is meant to ensure consideration by the Secretary of State for Trade and Industry (SoS) of factors associated with the environment and natural resources, before consent to offshore activities is given. The ES is a means of submitting to the regulatory authority, statutory consultees, nongovernment organisations and the wider public the findings of an assessment of the likely effects on the environment of the proposed activity. The size and scope of the environmental assessment will be related to the size and nature of the activity but it should always examine thoroughly all the proposed activities and their consequences.

In the UK, the ES is not part of the FDP or the PWA, but the environmental impact assessment obligation must be met before these plans can be approved. Several other approvals and consents must also be in place before the FDP and PWA can be approved. These are further referred to in **Section 2.7**.

2.4 Legislative EIA Requirements

2.4.1 International Legislation

The requirement for an environmental impact assessment is reflected in the EU regulations that both Norway and the UK have implemented. EU Council

Directive 97/11/EC, which is a Directive amending Council Directive 85/337/EEC, requires an environmental impact assessment for public and private projects that may have significant environmental and/or economic impacts.

Possible transboundary environmental impacts are regulated by the UN "Convention on Environmental Impact Assessment in a Transboundary Context" (ESPOO (EIA) Convention, 1991).

2.4.2 Norwegian Legislation

The planned project, including the planned gas export pipeline to the United Kingdom, is subject to an environmental impact assessment obligation pursuant to the provisions of the Norwegian Petroleum Act Sections 4.2 and 4.3.

The Norwegian Petroleum Act's Regulations Sections 20, 22, 22a, 22b, 22c and 29 regulate the contents of an environmental impact assessment. The Norwegian Pollution Control Act Section 13 also has provisions on notification (assessment programme) and environmental impact assessment in connection with the planning of activities that may cause pollution.

2.4.3 UK Legislation

The requirement for an ES is regulated by the Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations (1999).

Based on the ESPOO Convention, the Department of Trade and Industry (DTI), which is the regulatory authority for oil and gas developments, requires a joint Environmental Statement for Norway and the United Kingdom, as well as an EIA process in the United Kingdom.

2.5 The Relationship between UK and Norwegian Legislation and formal Requirements for EIA/ES Documentation

In a Norwegian EIA, meant for the Norwegian authorities and consultation bodies only, the environmental assessment process and the requirements for documentation are known. The same applies to the ES in relation to the UK authorities and consultation bodies. For this reason the environmental assessment process and requirements for the contents of the EIA/ES documents are not normally discussed in detail. This section describes the requirements for ES/EIA documentation in the UK and Norway, while **Section 2.6** outlines the environmental assessment processes.

2.5.1 Environmental Impact Assessment Programme

Norway has requirements for consultation on an assessment programme prior to preparing the environmental impact assessment. The Norwegian Petroleum Act Regulations Section 22 regulate the requirements for an assessment programme:

> *"The licensee must, in good time before submitting the plan for developing and operating a petroleum deposit, send the consultation bodies a draft assessment programme. The draft must provide a brief description of the development, relevant development solutions and, on the basis of available knowledge, expected effects on other businesses and the environment, including any transboundary environmental effects. Moreover, the draft must clarify the requirements for documentation. If an environmental impact assessment has been prepared for the area in which the development is planned to be implemented, the draft must clarify the requirements for further documentation or updating."*

The purpose of the EIA programme is to give public authorities and other consultation bodies information and notice of what is planned for development and where and how the development is planned. The assessment programme forms the basis for the environmental impact assessment and is adopted by the competent authority (the Ministry of Petroleum and Energy) after prior public consultation.

By commenting on the programme, both public authorities and other consultation bodies are given the opportunity to influence what is to be assessed in the EIA and thus also what is to be used as the basis for the decisions to be taken.

There are no formal requirements in UK legislation for consultation prior to the preparation of an environmental impact assessment. However, the operator is strongly encouraged to engage in informal consultations with the interested parties such as the local authorities, conservation groups, naturalists, special interest groups, users of the sea and where appropriate, the interested public, during the environmental assessment. The relevant environmental authorities should also be involved in this process. Experience of the Regulations has clearly demonstrated that such informal consultation can identify potential difficulties before the ES is prepared and hence reduce or eliminate delay at the formal consultation stage of the process. It is, moreover, confirmed by the guidelines to the Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations (1999) that the preparation of a Scoping Document, summarising the proposed activity, highlighting the sensitivities and proposed mitigating measures has been found to be a very valuable aid in the early, informal consultations and can be considered best practice, particularly for large projects or those in potentially sensitive locations.

Since the UK consultations prior to preparing the ES are informal, there are no formal requirements stipulating how a document in that connection is to be prepared. Norwegian legislation, on the other hand, requires an extensive assessment programme in accordance with certain requirements concerning its contents and the consultation process.

The UK authorities have requested a joint environmental impact assessment that includes measures on both the Norwegian and UK sides and an associated consultation process in the UK. It was therefore deemed expedient to also prepare a joint document in connection with the consultation prior to the impact assessment (the scoping phase) in order to agree on the content of the further assessment process and to ensure that those consulted in both countries have a good overview of the interconnectedness of the project.

The assessment programme which was sent out for consultation in both the United Kingdom and Norway comprised the new Gjøa development and included the new gas export pipeline. The programme and the consultation statements received are described in more detail in **Section 3**.

2.5.2 Regional and Strategic Impact Assessments

2.5.2.1 Regional Impact Assessment for the North Sea

The regional impact assessment for the petroleum activities in the North Sea (the ”North Sea RIA”) was approved by the Norwegian public authorities in 1999. In accordance with the guidelines issued by the Norwegian Ministry of Petroleum and Energy (MPE), the obligation to prepare an environmental impact assessment for new development projects may be met by means of a field-specific environmental impact assessment, a combination of a field-specific assessment and a regional assessment or, in some cases, a regional environmental impact assessment alone.

For the ES, a field-specific environmental impact assessment has been prepared, but with reference to the North Sea RIA for some assessment items.

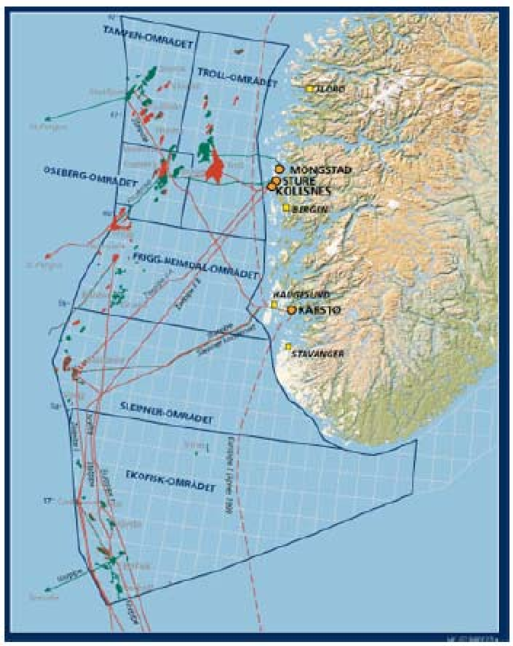

Figure 2-2: North Sea RIA

The North Sea RIA (Figure 2-2) discusses the total impact of the petroleum activities on the Norwegian continental shelf south of 62 °N. The area is divided into six sub-areas:

1. The Tampen area,
2. The Troll area,
3. The Oseberg area,
4. The Frigg-Heimdal area,
5. The Sleipner area and
6. The Ekofisk area.

The Troll area covers the field installation and the oil export pipeline from the Gjøa semi. The Tampen area relates to the UKCS section of the gas export pipeline to FLAGS.

The following sources of discharges and emissions and other environmental impacts are included in the RIA:

1. Developed fields and fields planned for development
2. All transport activity by ship and helicopter
3. Pipelines on and between fields and major export pipelines
4. Planned exploration drilling.

2.5.2.2 Strategic Impact Assessment in the United Kingdom

The UK Sector does not have an equivalent to the Norwegian regional impact assessment. However, strategic environmental impact assessments have been prepared.

The Strategic Environmental Assessment (SEA) is a process for predicting and evaluating the environmental implications of a policy, plan or programme. SEA is conducted at a strategic level - this contrasts with Environmental Impact Assessment (EIA) which is carried out for a specific development or activity.

In 1999 the DTI instituted the practice of carrying out Strategic Environmental Assessments (SEA), as part of the offshore licensing process, as an aid to determining which areas should be offered for licensing for oil & gas development. In doing this, the DTI was anticipating the implementation of the EU directive, the Environmental Assessment of Plans and Programmes Directive, 2001/42/EC which will become mandatory for a very wide range of activities, mostly onshore, in 2004. This now means that environmental assessments carried out for individual projects can take advantage of additional data and information on the regional context of their proposals specific to the E&P industry.

In this environmental impact assessment for the Gjøa to FLAGS gas export pipeline, information from the relevant SEA has been used.

2.5.3 Contents and Structure of the EIA Documents

The content of the EIA documents for field modifications and the Gjøa to FLAGS gas export pipeline is determined by each country's requirements and guidelines, the assessment programme and comments to the programme. Applicable guidelines are: "Guidance Notes on the Offshore Petroleum Production an Pipelines (Assessment of Environmental Effects) Regulations" and in "Guidelines to plan for development and operation of a petroleum deposit (PDO) and in "Guidelines to plan for installation and operation of facilities for transport and utilisation of petroleum (PIO).

The topics assessed and the level of detail may therefore deviate somewhat from the typical UK ES and the typical Norwegian EIA. Socio-economic consequences are, for example, not usually a topic for detailed assessment in the UK ES. On the other hand, environmental impacts may be examined in somewhat greater detail in the UK than in Norway.

The guidelines and requirements for the contents of the EIA/ES in Norway and the UK are considered to be relatively similar and can be summed up as follows:

- Summary ("Non technical summary" in the UK)
- Legislation
- Comments to the environmental assessment programme (the results of informal consultations in the UK)
- Development alternatives
- Substantiation for the selection of the development alternative in terms of technical, financial, safety-related and environmental criteria
- Description of the selected alternative
- Description of:
  - the environment
  - natural resources (for offshore development projects - fisheries)
  - other user interests
  - socio-economic considerations (in Norway only)
- Impacts of the chosen alternative on:
  - the environment
  - natural resources
  - other user interests
  - socio-economics
- Proposed mitigating measures are to be described in the context of an environmental programme, in which the selection of mitigating measures is described on the basis of safety and cost-efficiency.

2.6 The Impact Assessment Process for the British and Norwegian Authorities

The administration of the EIA process and approval of the plans for field modifications (PDO/FDP) and the Gjøa to FLAGS gas export pipeline (PIO/PWA) by the Norwegian and UK authorities, respectively, will be in accordance with the national legislation in each country.

The EIA will be sent for consultation in Norway. A summary of the EIA is given in **Appendix A**.

The ES will be sent for consultation in UK.

2.7 Necessary Approvals/Applications, Consents and Information Requirements in Addition to PIO/PWA

In addition to the approved PIO/PWA, licences and consents must be obtained from both the Norwegian and the UK planning and licensing authorities. Some of these licences will have to be obtained in the planning phase, others are not required before the development phase, and some are only relevant for the abandonment and decommissioning phase.

It has been clarified with the Norwegian and British authorities which licences and consents are required.

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3 THE ENVIRONMENTAL IMPACT ASSESSMENT PROGRAMME

3.1 Consultation Process

The impact assessment programme was sent out for consultation in the beginning of April 2006, to UK government agencies, statutory nature conservation bodies and other interest groups (Table 3-1). The statutory bodies were contacted again in June 2006 regarding the gas export pipeline, however, no comments were received. The purpose was to identify concerns and issues that could have a material bearing on the project, so that these could be addressed within the environmental assessment.

3.2 Concerns and Issues

Table 3-1 lists the UK government agencies, statutory nature conservation bodies and other interest groups that were consulted as part of the Gjøa to FLAGS gas export pipeline project, identifies the main issues raised during the consultation exercise and summarises how Statoil is planning to address these issues. Where appropriate the relevant section of the ES has been highlighted in bold.

Table 3-1: Summary of the UK consultation exercise

Department of Trade and Industry (DTI)	Consultation letter and supporting documentation sent 6 April 2006	No action required as no objections were raised.
Joint Nature Conservation Committee (JNCC),	Consultation letter and supporting documentation sent 6 April 2006	No action required as no objections were raised.
Fisheries Research Services (FRS), Marine Laboratory	Consultation letter and supporting documentation sent 6 April 2006	No action required as no objections were raised.
European Wildlife Division (EWD) of DETR (Department of Environment, Transport and the Regions)	Consultation letter and supporting documentation sent 6 April 2006	No action required as no objections were raised.
Maritime Coastguard Agency (MCA),	Consultation letter and supporting documentation sent 6 April 2006	No action required as no objections were raised.
Scottish Fishermen's Federation (SFF),	Consultation letter and supporting documentation sent 6 April 2006	No action required as no objections were raised.
Royal Society for the Protection of Birds (RSPB),	Consultation letter and supporting documentation sent 6 April 2006	No action required as no objections were raised.
Scottish Environmental Protection Agency (SEPA),	Consultation letter and supporting documentation sent 6 April 2006 No comments.	No action required as no objections were raised.
Scottish Environment Link,	Consultation letter and supporting documentation sent 6 April 2006	No action required as no objections were raised.
Scottish Natural Heritage (SNH),	Consultation letter and supporting documentation sent 6 April 2006	No action required as no objections were raised.
Ministry of Defence Liaison,	Consultation letter and supporting documentation sent 6 April 2006	No action required as no objections were raised.
National Federation of Fishermen's Organisations (NFFO),	Consultation letter and supporting documentation sent 6 April 2006	No action required as no objections were raised.
Defence Estate Safeguarding	No safeguarding objections. Requested an application and EIA if the pipeline starts to encroach into the UK sector.	ES established for the gas export pipeline.

3.3 Scope of the Environmental Assessment

As operator for the production licence PL 153 in the engineering and development phase, Statoil are proposing to install a 130km gas export pipeline between the semi-submersible (SEMI) production platform and a point in the FLAGS pipeline some 1.4km south of the Brent Alpha platform (Figure 3-1).

The new gas export pipeline will have an internal diamerer of 28" and will be approximately 130km long, with 8.5km of the pipeline in the UKCS. The pipeline will have the capacity to transport all the gas produced at Gjøa, and the gas from the Camilla, Belinda and Fram B tie-back fields to the UK.

The new export pipeline will be connected to the Gjøa SEMI via two risers, and will be connected to FLAGS via the Tampen Link Hot Tap Tee-piece. All the connections at Gjøa and at FLAGS will be stabilised using gravel and rock, and will be fitted with protective structures.

The environmental assessment covers all the elements described above and has been carried out in line with the following UK requirements:

- Offshore Petroleum Production and Pipe-Line (Assessment of Environmental Effects) Regulations 1999
- Petroleum Act 1998 (in support of the Field Development Plan)
- Offshore Chemical Regulations 2002
- Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001

3.4 Methodology – Environmental Assessment

The environmental assessment methodology systematically identifies the significant environmental impacts and risks (potential impacts), assesses the requirement for risk-reduction measures and provides an Environmental Management Plan to facilitate the adoption of these measures throughout the project. It aligns with the requirements set out in the Schedule to the Offshore Petroleum Production and Pipe-Lines (Assessment of Environmental Effects) Regulations 1999, and the Department of Trade and Industry Guidance Notes on the Interpretation of the Regulations (DTI, 2000), as well as Norwegian legislative requirements. Figure 3-2 illustrates the principal stages in the environmental assessment process.

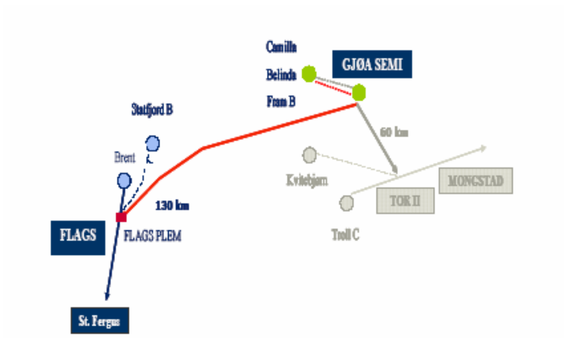


Figure 3-1: Proposed layout of the new gas export pipeline

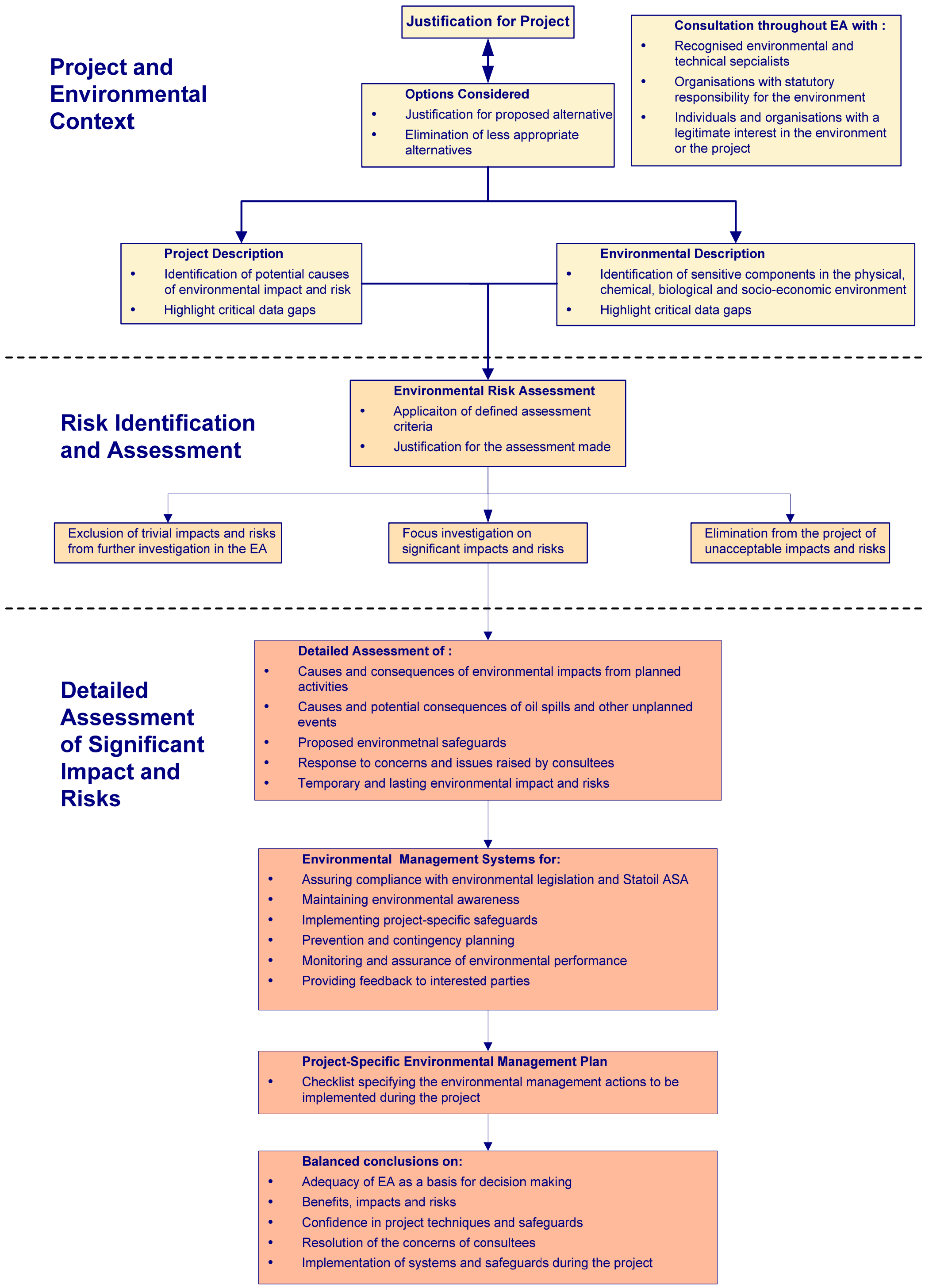


Figure 3-2: Principal stages in the environmental assessment process

3.5 Background Documents

Supporting reports prepared as part of the ES/EIA documentation to describe the impact of the proposed development are shown in Table 3-2.

In the present context, a significant impact or risk can be defined as one requiring management action to be taken to:

- avoid or minimise potentially adverse consequences for the environment, the public or the project;
- resolve the concerns of stakeholders; or
- fulfil the requirements of environmental legislation and Company policy.

Management actions would include:

- controls, i.e. methods of preventing or reducing the likelihood of the events that would lead to environmental impact (e.g. vessel collisions causing oil spills);
- mitigation, i.e. methods of preventing or reducing adverse environmental consequences (e.g. oil spill clean-up and response techniques); and,
- other action (e.g. awareness and training).

The approach has been adapted from the British Standard BS8800 (BSI, 1996a), the UKOOA Guidelines on Risk Assessment (UKOOA 2000), and the international environmental management standard BS EN ISO 14001 (BSI, 1996b).

Table 3-2: Supporting reports for the EIA / ES for the new Gjøa gas export pipeline

Impact of the gas pipeline in the UKCS	BMT Cordah Limited	The main input to the new Gjøa gas export pipeline
Impact of fisheries on the Norwegian Continental Shelf	Acona / Aaserød	
OSIS oil spill model of a diesel spill in the UKCS	BMT Cordah Limited	Oil spill modelling for an accidental diesel spill in the UKCS

4 PROJECT DESCRIPTION

4.1 Gjøa gas export solutions

Prior to the submission for the Norwegian Authories of the Environmental Impact Assessment Programme in April 2006 (Statoil, 2006), the following gas transport solutions were assessed on technical, environment, safety and economic grounds. The selection of the gas export solution was made on the basis of several technical and commercial factors, including:

- Capacity in existing pipelines and processing plants
- Commercial tenders
- Investment costs
- Pressure condition, flexibility
- Third-party access
- Risks
- Environmental considerations

Table 4-1 provides an overview of the gas export solutions that were considered and why they were not selected for the Gjøa development.

The selected gas export solution represents the installation of a 130km, 30" gas export pipeline between the Gjøa platform in the Norwegian sector and the existing FLAGS pipeline system in the UKCS (Figure 4-1). This pipeline would be connected to the Tampen Link and Statfjord B PLEM which is to be installed on the FLAGS pipeline system in 2007, as part of the Tampen Link gas export pipeline project.

For the selected option, it has been documented that FLAGS (with a capacity of 33 million m^3/day) has the capacity to transport all the gas from the Gjøa, Camilla, Belinda and Fram B fields, and that St. Fergus (with a total gas processing capacity of approximately 45 million m^3/day) has sufficient capacity for this gas.

Figure 4-1: Gas export pipeline solution from Gjøa to the existing FLAGS pipeline system

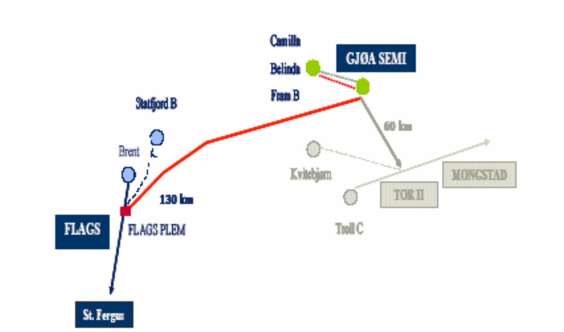


Table 4-1: Gas Export Solutions for the Gjøa Field

Gas Export Solution	Statoil to Provide
1. Gjøa to FLAGS (connected at the Tampen Link and Statfjord B PLEM)	Complicated technical solution, demands for qualification of pressure system. High tariffs in Tampen Link.
2. Gjøa to Statpipe, connected close to the Statfjord B platform	Not sufficient capacity. Financially not good. Kårstå fully used until 2020.
3. Gjøa to Frigg UK Association (FUKA), connected at TP1 in the UKCS	Financially not good.
4. Gjøa rich gas to Kollsnes	No capacity in 2010. Require development of Troll Videreutvikling, development would not to be decided early enough.
5. Gjøa to Huldra/Heimdal via Huldrapipe	Not sufficient capacity. Financially not good. Limited capacity in dry gas system.
6. Gjøa to Heimdal	Financially not good. Limited capacity in dry gas system.
7. Gjøa dry gas to Langelad or Oseberg Gasstransport (GTT)	Financially not good. Limited capacity in dry gas system.
8. Gjøa rich gas to Åsgard Transport	Future volumes from Halten Nordland are prioritized for this pipeline. Financially not good.
9. FUKA connected to TP1 via Oseberg A and Frostpipe	Need for pressure upgrading, increased costs and complexity. Not sufficient capacity for total gas export from Gjøa.

4.1.1 Gas Production at Gjøa

First gas from the Gjøa field is expected to commence in 2010, with production expected to continue for a further

15 years. Gas from the Vega tie-back field will be exported with the produced gas from the Gjøa field to the FLAGS pipeline system. The production and export profile of gas into the FLAGS pipeline system, from the Gjøa field and the third party tie-in field are shown in Figure 4-2.

Gas production from the Gjøa field is expected to start at approximately 4.8 million m^3/day in 2010, with peak production (10 million m^3/day) occurring between 2014 and 2016, before decreasing until end of field life (Figure 4-2).

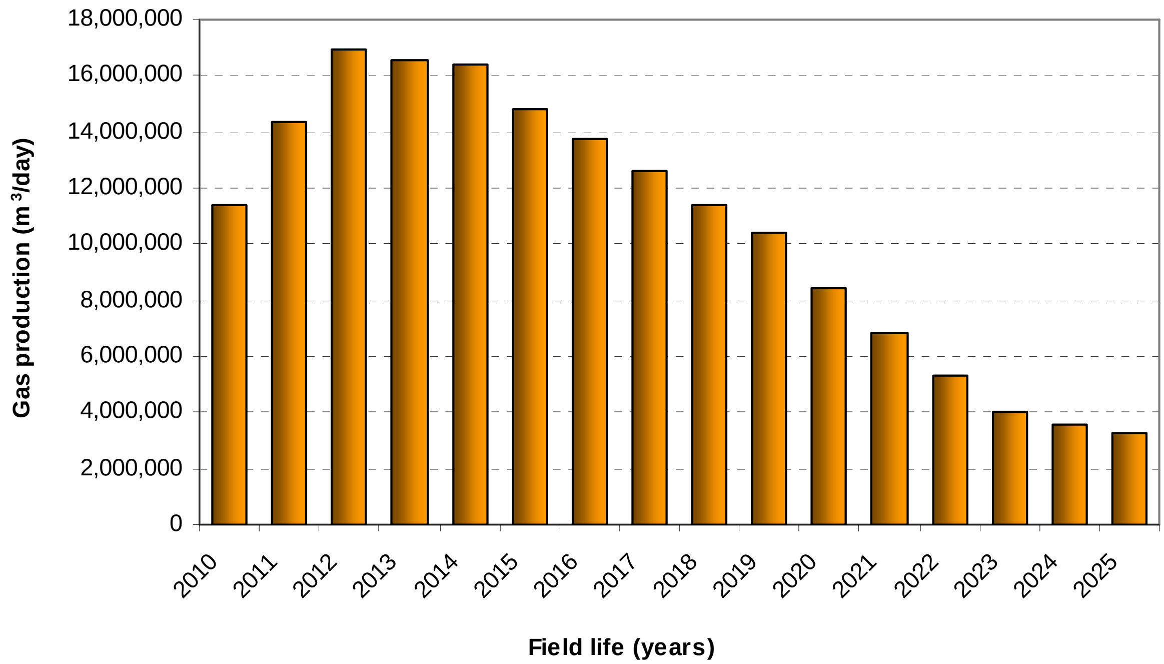


Figure 4-2: Gas production profile for the export of gas into FLAGS from Gjøa and Vega

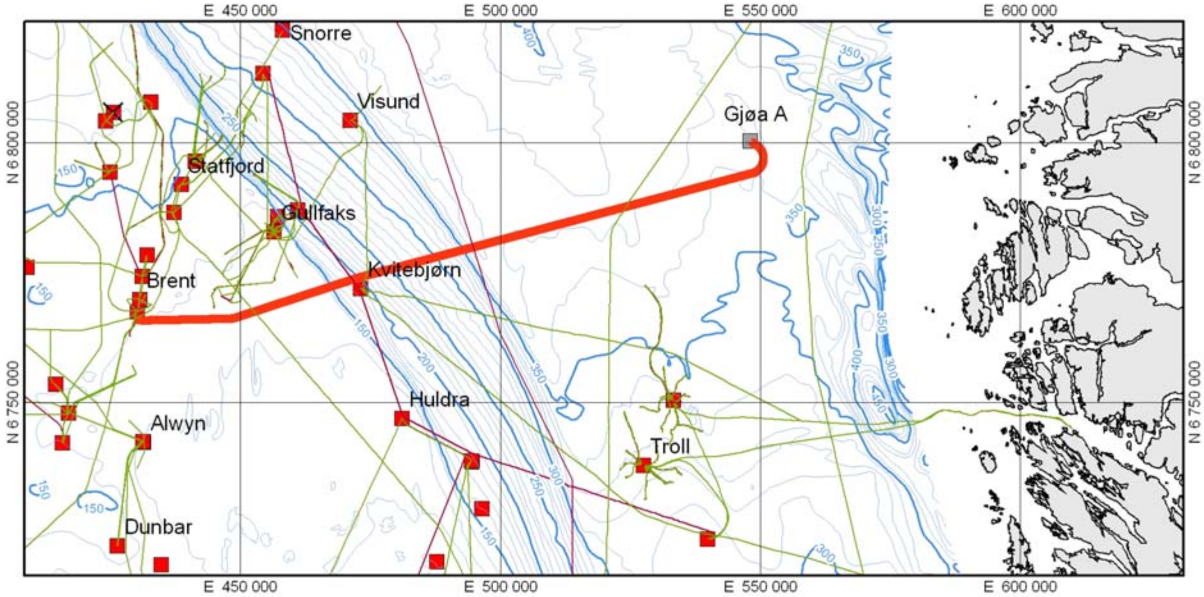
4.2 Gjøa to FLAGS gas export pipeline

The selected option involves exporting all the gas from the Gjøa and Vega fields to the UK, via the existing FLAGS pipeline system. The proposed route for the selected gas export pipeline is shown in Figure 4-3.

The proposed gas export pipeline will be a 130km, 30" (28” internal diameter), pipeline from the Gjøa platform in the Norwegian sector to the Tampen Link tie-in spool on the FLAGS pipeline Hot Tap Tee. Approximately 8.5km of this gas export pipeline will be installed in the UKCS, the remaining 121.5km of the pipeline will be installed in Norwegian water. The pipeline will be made of carbon steel with sufficient wall thickness to satisfy its operational lifetime. The design and flow-rates of the gas export pipeline is shown in Table 4-2.

The gas export pipeline will be tied into the FLAGS pipeline system via a new Hot Tap Tee piece which will be welded onto the existing FLAGS pipeline in 2007 as part of the Tampen Link project. The connection at FLAGS will be fitted with a protective structure and stablised using gravel and rock.

Figure 4-3: Selected gas export pipeline route



The pipeline will tie into the Gjøa platform via two 12" (internal diameter) risers, made of super martensitic stainless steel (SMSS).

Table 4-2: Gas Export Pipeline Design

Total pipeline length	130km
Norwegian section length	121.5km
UK section length	8.5km
Outside nominell diameter	30"
Inside steel diameter	28" / 720mm
Design Life	30 years
Design Pressure	172 barg
Design temperature	55ºC
Material and grade	X65 carbon steel
Sacrificial anode material	Aluminium-Zinc-Indium
No of anodes on pipeline	677 bracelet anodes
Weight of anode	20.2 Kg

4.3 Description for the selected Gjøa to FLAGS gas export pipeline

4.3.1 Site Survey

A series of bathymetric route surveys will be undertaken along the proposed pipeline route in 2007.

The bathymetric survey will provide detailed bathymetric and geological data for the new pipeline route and to identify any significant features/obstacles along the proposed route.

The visual survey will identify crossing locations and the design requirements for crossings over existing pipelines. The visual survey will also provide information about tie-in locations.

4.3.2 Crossings

The installation of the proposed gas export pipeline will require the construction of eight crossings of existing pipelines or cables, as detailed in Table 4-3. In addition to the crossings listed in Table 4-3, the gas export pipeline will have to cross the FLAGS pipeline to allow it to be tied into the Hot Tap Tee.

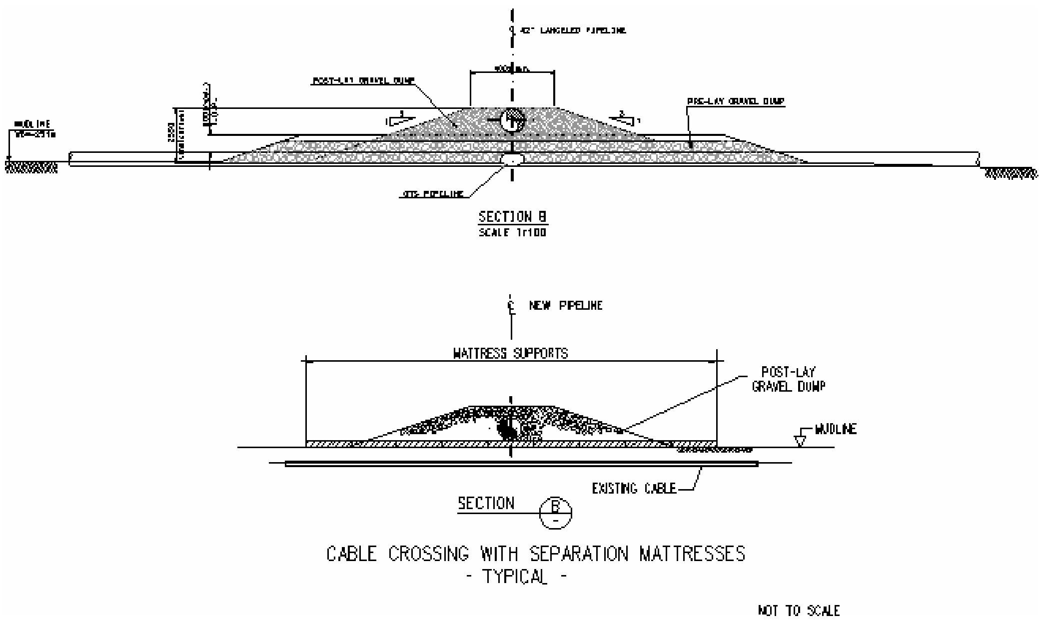


Figure 4-4: Section through the UK and Norwegian pipeline crossings

The location of the crossings may be altered slightly during the detailed design of the pipeline.

Table 4-3: Locations of pipeline crossings for the gas export pipeline

Pipeline	Type	Easting	Northing
Mongstad to Gjøa	Cable	549875	6795111
Langeled Northern Leg	Pipeline	524241	6787721
Belinda Template to Fram B Template	Pipeline	521482	6787000
Cantat 3	Cable	495062	6779993
Visund to Kvitebjorn	Pipeline	474109	6774436
Statpipe S31	Pipeline	452575	6767512
10" Oil Brent South to Brent A (UKCS)	Pipeline	429797	6765988
8" water injection / umbilical Brent A to Brent South (UKCS)	Cable	429760	6765994

It is anticipated that rock-dumping will be undertaken during the construction of all crossings, to protect and stabilise the crossings and the ends of the pipelines. In all cases the material used will be graded crushed rock ranging in diameter from 3.2cm to 12.5cm. The graded rock will be placed onto the seabed in carefully controlled operations by using a dedicated rock-dumping vessel equipped with a dynamically positioned fall pipe. In this technique, the graded rock is fed into the fall pipe at a controlled rate using a hopper system. The length of the fall pipe is adjusted, depending on the water depth at the site, to keep the end of the pipe within 5m of the seabed. This ensures that material is placed accurately at the required location, and the operation will be monitored by an ROV (post dumping) to confirm that the material is deposited in the correct position on the seabed.

It is expected that the crossings will be similar to other crossings in the northern North Sea, which use a pre-lay rock-dumping to support the *crossing* pipeline and protect the *crossed* pipeline. The pipelines will be surrounded and covered by a gently sloped, protective post-lay layer of rock. At each crossing it is planned that the crossed pipeline will remain "live" during installation. The crossing(s) will have a size approximately 60m to 100m by 10m, and a height of approximately 1.5m. The crossings will be generally flat with slopes of 1:2.5 at the edges. Typical details of a pipeline crossing are shown in Figure 4-4.

4.3.3 Pipeline Installation

4.3.3.1 Gas export pipeline

The new pipeline will be laid directly onto the surface of the seabed and may be installed in a conventional straight-lay formation. The pipeline will be surface laid, to accommodate the heat expansion and to allow controlled lateral movements of the pipeline on the seabed. These movements will occur between the locations where the pipeline is fixed to the seabed by rock-dump. Rock-dump will be placed for control and stability at approximately 21 places along the pipeline, with 5 in the UKCS (Table 4-4)

Table 4-4: Areas of rock-dump in the UKCS

Area of rock-dump	Amount of rock-dump (m^2)
2 pipeline crossings in UKCS (Table 4.3)	6,500
Support of pipeline end structures and spools	1,500
Protection of pipeline end structures and spools	2,500
Freespan and seabed roughness mitigation	1,500

The pipeline will require a total of 76,750m^3 of rock-dumping placed intermittently at strategic locations along the route of the gas export pipeline, with 12,000m^3 of intermittent rock-dumping in the UK sector. To increase the friction between the pipeline and the sea bottom, pre-laid rock carpets with a dimension of 100m by 10m and with a height of 0.3m will be constructed at several locations.

Rock-dumps for control and stability will typically have a height of between 1.5 and 2.0m. These rock-dumps will be flat on the top with slopes typically 1:2.5 along the edges. Figure 4-5 illustrates the proposed rock-dumping for conventional and snake –lay options.

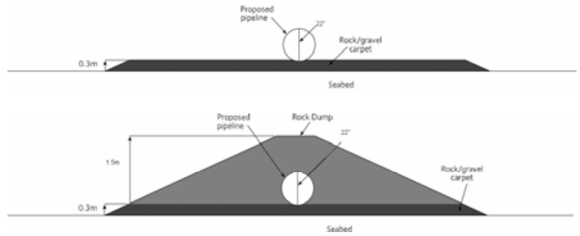


Figure 4-5: Rock dump options for pipelaying

The gas export pipeline will be made of carbon steel, X65, with an asphalt coating to prevent corrosion, and a 40m to 60mm concrete coating which would provide stability and protection against impacts from trawling gear.

At this stage it is not known whether the pipeline will be installed using an anchored lay barge or a dynamically positioned (DP) vessel. If an anchored lay-barge were to be used, it would be moved forward by deploying, tensioning and re-deploying between 10 to 14 anchors, which would be positioned on the seabed in a pre-determined 'anchor pattern'. The anchors will be placed and pulled several times during the laying operation. This type of lay-barge requires up to three anchor-handling vessels to manoeuvre the anchors, and supply vessels to maintain the supply of pipe sections. During installation, pre-fabricated sections of pipeline would be welded together on the lay-barge, and the welded joints would be coated. The line would be deployed into the sea via a 'stinger' (guide frame) and the rate at which pipe would be laid would correspond to the forward speed to the vessel.

The use of DP would avoid the use of anchors and so prevent localised disruption to the seabed caused by the repeated placement and retrieval of anchors, but will result in higher fuel consumption and atmospheric emissions.

A guard vessel (survey vessel will act as guard) may be required to alert fishing vessels about the pipeline and pipe-laying operations.

Whichever method of installation is used, it is likely that at the beginning of the installation process, the end of the pipeline will be fixed to the seabed by means of an anchor or temporary pile; this anchors the line, and allows it to be put under tension as it is progressively laid down. The pipeline will then be laid away from this point, over the various prepared crossing locations, and will terminate at the "lay-down" position where the end of the pipeline would be lowered onto the seabed. Following lay-down, the pipeline will be flooded with inhibited seawater for stability. Positioning of the pipeline and the anchors of the lay-barge will be carefully monitored by the use of GPS and post-lay surveyed and controlled by means of a ROV.

There is no declared exclusion zone around pipe-laying operations. However, the area will be continuously monitored from the pipelay vessel to guard against any operation that could result in snagging of anchors or demersal trawl gear, such as the anchorlines from the pipelaying vessel itself, pipeline crossings or the lay-down heads prior to final protection. The pipe-lay vessel will have a Fisheries Liaison Skipper on board and daily notifications will be issued as required by the conditions of the DTI pipeline works authorisation. The pipe-lay operations will be surveyed post-lay to ensure that the pipe and the rock-dumps are laid in the correct location and that no free spans occur along the pipeline.

Bridging documents between Statoil, and the installation contractors operating the pipeline installation vessel, will describe the management structure and division of responsibilities that will prevail during the operations, the methodology for executing the work programme, and the emergency response procedures.

The main operations that would be undertaken during the pipeline construction phase are shown in Table 4-5.

Table 4-5: Proposed pipeline operations

Type of operation	Type of vessel/method
Surveying of route	Survey vessel
Method for laying the new gas export pipeline	Anchor lay-barge or DP vessel
Method for laying the 12" risers	Reel lay
Hot Tap Tee tie-in operations at FLAGS	Diver
Rock-dumping	Rock-dumping vessel

4.3.3.2 12"gas export risers

The 12" export risers will connect the gas export pipeline to the Gjøa semi-submersible platform that is to be installed as part of the Gjøa project.

4.3.4 Corrosion Protection

The corrosion protection system is designed in accordance with ISO 15589-2 for cathodic protection design. The design life for the corrosion protection system is 20 years.

Protection against corrosion will be provided by coatings (**Section 4.2**) and by proprietary sacrificial aluminium-zinc-indium alloy anodes placed in the form of 677 bracelets around the pipe, with spacing intervals. The anodes will be suitable for long term continuous service in seawater, saline mud or alternating seawater and saline mud environments. All the anodes will be 40mm thick and will be connected via welded steel continuity straps. The number, properties and distribution of the anodes for the pipeline and risers are detailed in Table 4-8. In the 500m long section at each end of the pipeline, the unit mass of anodes will be twice that of the remaining length of the line.

The concrete-coated 30" pipeline will have a 5mm asphalt enamel corrosion coating between the bare steel pipe and the concrete. The two 12" risers at the Gjøa Semi will be comprised of a smoothbore flexible material.

4.3.5 Structures, Tie-Ins and Connection Operations

A schematic of the Gjøa to FLAGS gas export pipeline is presented in Figure 4-6.

The proposed gas export pipeline will connect the Gjøa platform to the existing FLAGS pipeline system. The main structure that will be installed subsea during the pipeline programme is the Pipeline End Manifold (PLEM) which will connect the pipeline to the spare tie-in hub on the existing Hot Tap Tee piece on the existing FLAGS pipeline (Figure 4-6).

4.3.5.1 Pipeline End Manifold (PLEM)

The PLEM structure has been designed to carry out a number of functions (i.e. launching / receiving pigs in connection with pipeline de-watering, drying and product-filling), and will provide an end-line connection point for the tie-in spools.

The structure consists of two main units: a piping skid and a combined protection and foundation structure. The piping is mounted on a skid, so that the whole piping arrangement can be retrieved in the future. The foundation structure is integrated in the over-trawlable protection cover (15m x 15m x 5.5m) and the hatches in the protection cover can be opened for the removal or installation of the piping skid.

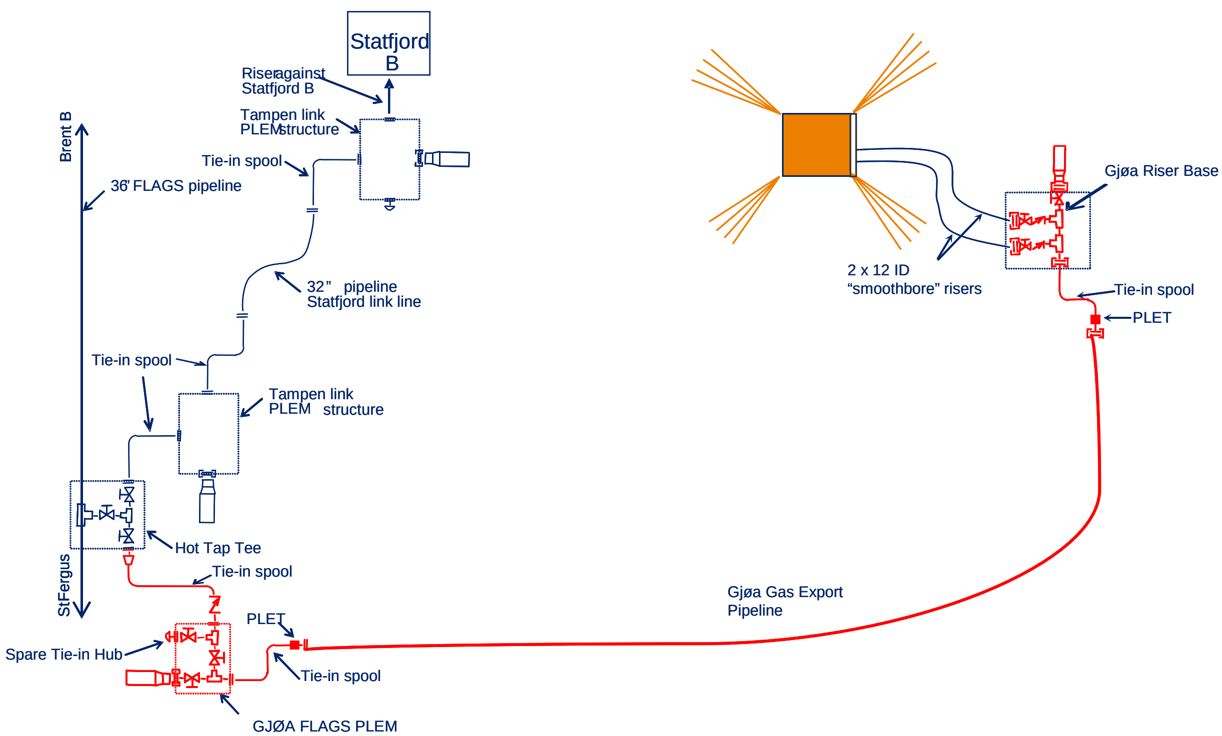


Figure 4-6: Schematic of the Gjøa to FLAGS gas export pipeline

A non-return clapper safety valve is mounted in a retrievable vertical spool bridge, and protects the downstream systems in the event of loss of containment in the upstream system. In the event that repair of the valve is required, its retrieval and reinstallation will be a diver-less operation.

A stand-alone PLEM skid will be installed near to the pipeline end, and the PLEM will be connected to the pipeline by means of a purpose-built spool. Several vessels will be required during the installation programme.

4.3.5.2 Existing FLAGS Hot Tap Tee-piece

The Hot Tap Tee (HTT) piece on the FLAGS pipeline will be installed in 2007 by Shell as part of the Tampen Link project. The Hot Tap Tee piece will provide a connection point for the Tampen Link pipeline and the Gjøa pipeline to the FLAGS pipeline, where no pre-installed tee or connection point is currently present.

Figure 4-7 illustrates the piping and structural provisions for the FLAGS Hot Tap Tee piece. A protective covert will be installed over the Hot Tap Tee piece to provide protection to the Hot Tap Tee piece against dropped objects and trawling loads (Figure 4-7).

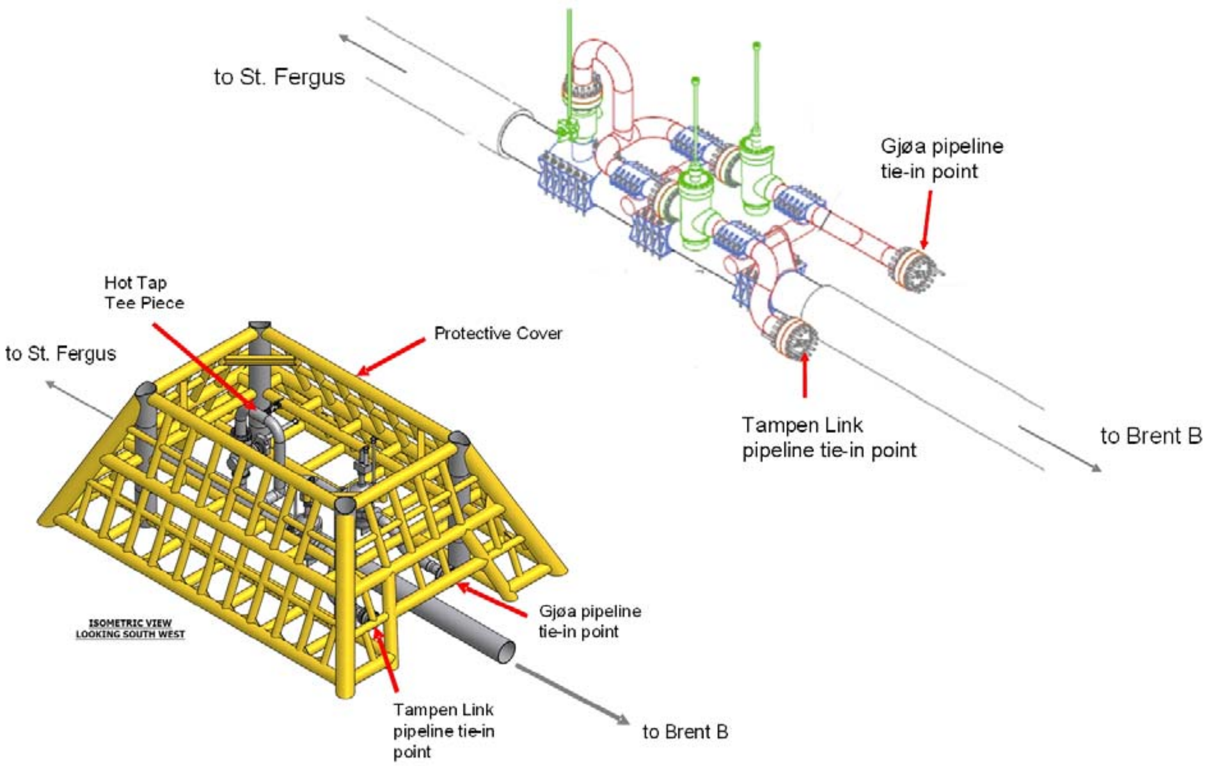


Figure 4-7: Hot Tap Tee Piece Structure (including protective cover)

The Gjøa gas export pipeline will cross over the FLAGS pipeline to be tied into the spare tie-in point of the Hot Tap Tee piece through the protective cover. This tie-in operation will be performed with divers and diver-operated tools.

The diver-assisted hot tapping operation is proven technology, and regarded as a robust and safe installation method; a similar hot tapping operation was undertaken to connect the 16" Gullfaks loop pipeline to the 30" Gassled Area A pipeline to Kårstø in Norway. Hot tapping operations have been developed to minimise production shut-down and allow the production pipeline to remain pressurised.

For the manual welding operation, however, a hyperbaric chamber must be set up over the intervention point.

4.3.6 Leak testing and Dewatering operations

Flooding, gauging, and strength and integrity testing are routine stages of pipeline installation, performed using industry-standard techniques. These operations are necessary in order to:

- ensure that the internal dimensions of the installed pipeline conform to design;
- remove any small quantities of rust and mill-scale that may have remained on the internal walls of the pipeline after fabrication; and
- assure the integrity of the pipeline system by pressuring the pipeline to a pressure higher than the maximum operating pressure.

During the process, it is necessary that the individual components of the pipeline system are flooded with seawater (Figure 4-8). During the flooding operation a gauging pig will be sent through the pipeline with inhibited seawater to check internal dimensions and remove internal debris (rust and mill scale), and integrity tests (hydrotests) will be carried out by pressurising the seawater within the pipeline to a predetermined test pressure which will be held for 24 hours.

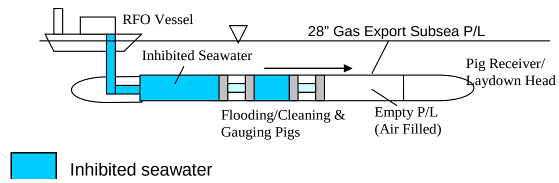


Figure 4-8: Flooding of gas export pipeline

The Gjøa FLAGS PLEM will have valves, pressure monitoring and control instrumentation equipment for launching and receiving the gauging pigs. The Gjøa platform will have pumps and equipment for pressurising and monitoring pressure in the pipeline system, and visual inspection of the tie-in will be conducted by ROV deployed from an installation vessel.

The pipeline system will be dewatered and dried before commissioning. Pre-installed dewatering pigs will be launched from the retrievable and combined subsea pig launcher / receiver on the Gjøa PLEM towards the Gjøa semi, using hydrocarbon gas from the Tampen Link pipeline (Figure 4-9; [a]). The seawater ahead of the dewatering pigs will be discharged to sea from the semi.

During dewatering, seawater will be displaced to sea from the risers by driving slugs of glycol through the lines from bi-directional pigs launched from the Gjøa semi by pumping nitrogen gas or freshwater into the line (Figure 4-9; [b]).

Following the removal of the seawater, the remaining dewatering pigs in the subsea pipeline will be displaced into the pig trap with hydrocarbon gas. The hydrocarbon gas will be routed into the export risers to return the pigs in the risers to the topside pig traps on the Gjøa semi (Figure 4-9; [c]).

The quantities of chemicals to be used and discharged will be determined during the detailed design, and will be subject to a separate permit under the **Offshore Chemical Regulations 2002**. The Regulations require that operators use only approved chemicals, and support their permit application by providing detailed chemical information and environmental risk assessments for each chemical discharged.

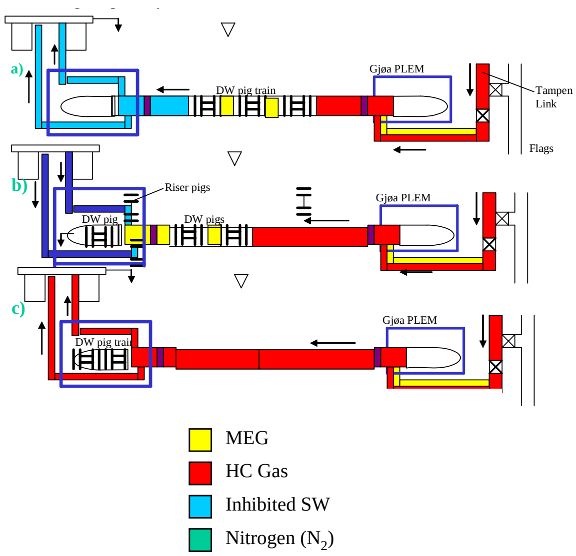


Figure 4-9: Dewatering of pipeline system

4.3.7 Emissions during pipeline installation

4.3.7.1 Source of Emissions

The sources of the atmospheric emissions that may arise during the pipeline installation are given in Table 4-6.

Table 4-6: Sources of potential atmospheric emissions

Source of Emission	Type of Equipment	Gases Released
Combustion	Diesel engines Emergency generators Heaters	CO_2, CO, NO_x, N_2O, SO_2, CH_4, VOC
Fugitive emissions	Coating field joints, refuelling vessels	CH_4, VOC

Refrigerants would only be released if accidental leakage occurred from refrigeration units.

4.3.7.2 Vessel Emissions

The gaseous emissions from the vessel spread during pipeline installation operations can be evaluated on the basis of fuel consumption estimates, energy ratings and the duration of different phases of the operation. The estimated gaseous emissions are shown in Table 4-7. The pipeline operations in the UKCS will account for 6.5% of the total fuel consumption (17.55 tonnes) resultant emissions (Table 4-7). Table 4-7 shows that emissions produced from the pipeline vessel operating in the UKCS for one week, would account for about 0.0003% of the total CO_2 emissions, 0.0017% of the total NO_x and 0.0024% of the total SO_2 emissions produced offshore from UKCS exploration and production activities (based on 2004 values).

Table 4-7: Estimated gaseous emissions from vessels during the installation of the gas export pipeline and subsea structures

Activity	Fuel cons	Emissions		
	tonnes	CO_2	NO_x	SO_2
Marine diesel factors		3.2	0.059	0.004
Fuel consumption from all pipelaying vessels in Norwegian and UK waters (May to August)	2,700	8,640	159.3	10.8
Fuel consumption from pipelaying vessels operating in UKCS for 1 week (**Section 4.5**)	17.55	56.16	1.04	0.07
COMPARISON WITH TOTAL 2004 UKCS EMISSIONS FROM OFFSHORE OIL & GAS ACTIVITIES				
Total 2004 emissions for UKCS offshore Exploration and Production activities		18,521,571	60,144	2,938
Pipeline installation emissions as a % of 2004 UKCS emissions from offshore oil & gas installations		0.047%	0.265%	0.368%
UKCS Pipeline installation emissions as a % of 2004 UKCS emissions from offshore oil & gas installations		0.0003%	0.0017%	0.0024%

4.3.7.3 Noise Emissions

In general terms, sound can be characterised with reference to two features, the frequency at which it is emitted (measured in hertz (Hz)) and its strength or intensity (measured in decibels (dB)). Noise from various sources may combine or cancel to produce a pattern of noise in the marine environment that is characterised by variations in frequency and noise level. Noise levels in the marine environment are attenuated by distance (dispersion in three dimensions), and by absorption by the water. The degree of absorption is roughly in proportion to the square of the frequency.

During the programme to install the new gas export pipeline, the main sources of sound in the marine environment will be the various vessels in the vessel "spread" offshore. The spread may include a DP pipelay vessel, a reel-barge, anchor-handling tugs, a survey vessel, a DSV and two support vessel.

The noise levels that might be received by marine mammals and fish in the water column adjacent to these operations can be calculated using formulae presented in Richardson *et al*., 1995, and a formula for absorption given by Erbe and Farmer (2000). The water depth along the gas export pipeline is approximately 140m, and consequently the calculations have assumed that the underwater noise would spread in a cylindrical rather than a spherical manner. In relatively shallow water, cylindrical spreading results in a larger zone of influence than that produced by the spherical spreading that occurs in deep water.

The formula used is:

$$Lr = Ls - 15 \log H - 5 \log R - 60 \text{ (dB)}$$

Received Level (Lr) = Source Level (Ls) – correction for depth (H, km) – distance (R, km) attenuation – Correction between m and km

The characteristics of the noises produced by different types of vessel are shown in Table 4-8. Using the formulae presented above, the noise levels presented in Table 4-8, and a water depth for the site is approximately 140m, the range of disturbance for a threshold level of 120dB (which is significant in relation to the behaviour of marine mammals) for the cumulative effect of all vessel noise emissions during the proposed activities would be within approximately 0.78km of the pipeline operations (Richardson *et al.,* 1995). **Section 6** demonstrates that the noise emissions during the proposed pipeline operations are not significant.

Table 4-8: Examples of underwater noise levels produced by different types of vessel or type of activity

Source	Source levels of underwater noise (dB re 1µPa at 1m)*
Median Ambient Level	80 to 100
Drilling from semi-submersible	154 (100 to 500Hz)
Tug / Barge	140 to 170
Trenching	159 to 174 (500 Hz)
Supply / Support Vessel	170 to 180 (500Hz)
Pile driver	206
Helicopters (various) & at various altitudes	101 to 109**
Key: dB re1µPa at 1m – unit of Sound Pressure Levels measured at a 1m range from source * Most data taken from 1/3-octave band centre frequencies (50-2000Hz) ** Measured at the water surface	

Source: Richardson *et al*. (1995); Evans and Nice (1996)

4.4 Operational Phase

4.4.1 Pipeline Maintenance

No further planned hydrostatic testing of the pipeline is scheduled during the operational phase. Annual inspections of the pipeline routes will be carried out. The design life of the system exceeds expected field life, therefore no maintenance is planned other than routine inspections such as checking for lack of cover, free spans and evidence of interaction with fishing. Any potential problems such as upheaval buckling and anchor snags will be avoided by correct pipeline design, trenching and careful installation.

The pipeline will be designed to accommodate 'intelligent pigging', whereby a remote sensing 'pig' will be sent through the pipeline to undertake checks on pipeline integrity and condition.

4.4.2 Chemicals

During the operational phase of the gas export pipeline, there will be no discharges of hydraulic fluid or other pipeline chemicals to sea.

4.5 Project Timetable

The pipelaying operations for the Gjøa to FLAGS gas export pipeline are scheduled to commence in May 2009 and will continue until August 2009 with approximately one week in UK waters. Connection of the pipeline to FLAGS will occur between July and August 2009. Production through the new gas export pipeline is expected to commence in 2010. The work programme for the Gjøa to FLAGS development is summarised in Table 4-9.

Table 4-9: Proposed schedule for the Gjøa to FLAGS development

Activity	Period / Date
Route survey for pipeline	2007
Drilling operations	December 2008 to August 2011
Installation of pipelines and flowlines	May to August 2009
Tie-in of pipelines and flowlines	July to August 2009
First oil and gas	2010
Abandonment phase	2025

4.6 Decommissioning

The Gjøa field is expected to continue producing until 2025. At least 2 years prior to cessation of production, an abandonment plan detailing proposed methods for the decommissioning of seabed installations and pipelines will be prepared. Decommissioning of the facilities will be carried out in accordance with the requirements of the UK Government and international guidelines in force at the end of field life.

5. DESCRIPTION OF ENVIRONMENTAL SETTING

5.1 Introduction

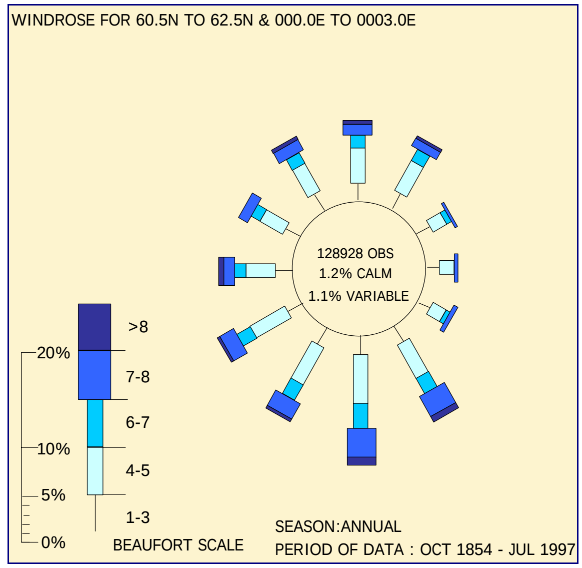
In order to assess the potential environmental impacts of the proposed Gjøa to Flags export pipeline development located UKCS Blocks 211/29 and 211/30, a description of the existing environment, and an assessment of the sensitive key components of the offshore environment (environmental sensitivities) is given below. This assessment was prepared with reference to scientific and technical publications and its purpose is:

- to identify the salient physical, chemical, biological, social and economic components of the environment within the zone of influence of the proposed pipeline; and
- to highlight any particular sensitivities with respect to habitats and organisms, fishing, shipping and other socio-economic activities or uses of the environment.

The Department of Trade and Industry (DTI) has taken a policy decision that Strategic Environmental Assessments (SEAs) will be undertaken prior to future wide scale licensing of the UKCS for oil and gas exploration and production. The Strategic Environmental Assessment of the Mature Areas of the Offshore North Sea (SEA2) coincides with the proposed pipeline area, and where applicable has been used to provide a regional perspective.

5.2 Meteorology

The North Sea is situated in temperate latitudes with a climate that is strongly influenced by an inflow of oceanic water from the Atlantic Ocean, and by the large-scale westerly air circulation which frequently contains low pressure systems (OSPAR, 2000). The extent of this influence is variable over time, and the winter North Atlantic Oscillation (NAO) Index (a pressure gradient between Iceland and the Azores) governs the strength and persistence of westerly winds. The North Sea climate is characterised by large variations in wind direction and speed, significant cloud cover, and relatively high precipitation (OSPAR, 2000).



Source: Meteorological Office (2000)

Figure 5-1: Annual windrose for the proposed pipeline development

Whilst weather patterns in the northern North Sea are highly variable throughout the year, there are clear trends in both wind direction and speed. Figure 5-1 shows annual wind speed, frequency and direction in the area of the proposed pipeline. Winds in this region of the North Sea are most frequently from south to south-westerly directions (Meteorological Office, 2000). Predominant wind speeds throughout the year represent moderate to strong breezes (6-13m/s). Winds greater than Force 7 (28m/s) occur most frequently during the winter months (September to March), and may occur from any direction. Wind speeds during the summer months (May to August) are generally much lower, with dominant wind speeds ranging between Force 4 and Force 6 (5 to 14m/s) and winds originating from north and north-easterly directions are more frequent at this time of year.

SENSITIVITY: The physical presence and installation of the proposed pipeline will have no implications for meteorology.

5.3 Oceanography

5.3.1 Seabed topography

Seabed topography is important in relation to the circulation and vertical mixing of water masses. The rectangular basin of the North Sea is shallow (30-200m), with a shelving topography north to south and a deep trough (ca. 700m depth), the Norwegian Trench, on its northeast margin (NSTF, 1993).

In the northern North Sea, north of 61ºN and in the vicinity of the proposed Development, the seabed is relatively flat (Johnson *et al.,* 1993). The water depth in the area is approximately 140m.

SENSITIVITY: The physical presence and installation of the proposed pipeline will have no implications for gross seabed topography.

5.3.2 Sediment characteristics

The characteristics of the local seabed sediments and the amount of regional sediment transport are important in determining the potential effects of the proposed pipeline installation on the area. The distribution of seabed sediments within this region of the North Sea result from a combination of hydrographic conditions, bathymetry and sediment supply.

Seabed sediments over the majority of the North Sea are sand or mud, or a mixture of the two. Broadscale sediment distribution indicates that the area of the proposed development is dominated by sand (DTI, 2001). Most of the sediment in this area of the northern North Sea is fine and course sands (Kunitzer *et al*., 1992), constituting an approximate silt fraction of 5% and an organic fraction of 3% (Basford *et al*., 1993).

Seabed surveys in the surrounding area, for example along the Tampen Link Gas Export Pipeline (which lies adjacent (0km) from the proposed pipeline in the UK Sector), indicate that sediments comprise fine to medium sand, inter-mixed with varying quantities of coarser material, generally in the size range of pebbles to cobbles, but boulders are also commonplace and shell fragments were present in varying quantities (Stolt Offshore, 2004).

The sub-seabed geology of the surrounding area, e.g. along the Tampen Link pipeline route, is characterised by stiff or very stiff clay (Stolt Offshore, 2004). Similarly a survey of the shallow soils at CNR's Lyell Development (UKCS Block 3/2, approximately 30km from the UK Sector of the proposed pipeline) indicated that surface sediments (0-0.5m) consist of fine clayey sand, sediments between 0.5 and 8m comprise soft to firm sandy clay, and deeper than 8m sediments comprise sandy clay (CNR, 2006).

Pockmarks, i.e. shallow, ovoid seabed depressions, have not been identified in the close vicinity of the proposed development (see **Section 5.5.1.3**).

SENSITIVITY: The pipeline will be installed to avoid the presence of boulders and will have no impact on the sediments other than the area directly covered by and immediately surrounding the subsea structures.

5.3.3 Water masses

Several water mass classifications exist for the North Sea, based on temperature and salinity distributions or on residual current patterns or stratification (NSTF, 1993). The circulation and distribution of these water masses are important in supporting the biological productivity, and the transportation and concentration of plankton and fish larvae, as well as the distribution and circulation of potential contaminants.

The current regime in the northern North Sea is largely affected by an inflow of Atlantic water around the north of Shetland. This current follows the 200m depth contour to the north of the Shetland Isles, before passing southwards along the western edge of the Norwegian

Trench (NSTF, 1993). Occasionally, some of this inflowing water may pass southwards into the northern North Sea close to the eastern coast of the Shetland Islands. In addition, a smaller inflow of water, the Fair Isle Current, follows the 100m contour and enters the northern North Sea between the Shetland Islands and the Orkney Islands. This flow is a mixture of coastal and Atlantic water that crosses the northern North Sea along the 100m contour in a narrow band known as the Dooley Current, before entering the Skagerrak.

The Norwegian Coastal Current, which flows predominantly along the Norwegian coast, constitutes the only outflow from the North Sea and balances the various inputs of water to the North Sea (OSPAR, 2000). Water circulation in the North Sea is anticlockwise, with an eddy forming over the Fladen Ground (DTI, 2001). Circulation in the North Sea is enhanced by south-westerly winds, thus circulation is normally stronger in winter than in summer.

SENSITIVITY: The physical presence and installation of the proposed pipeline will have no implications on the major flow of water in the North Sea.

5.3.4 Currents

Tidal currents over the area of the proposed pipeline in the northern North Sea range from 0.25m/s to 0.4m/s, with seabed currents reaching a maximum speed of 0.5m/s (UKDMAP, 1998).

Sea surface and seabed residual currents flow in a predominately north-easterly/easterly to south-westerly/westerly direction throughout the year. The severe gales and storms that can commonly occur in this area result in variable, wind-driven surface currents and oscillatory currents at the seabed (Johnson *et al.,* 1993).

SENSITIVITY: The physical presence and installation of the proposed pipeline will have no implications on northern North Sea currents.

5.3.5 Temperature and salinity

Most areas of the North Sea are vertically well-mixed and water temperatures remain uniform through the water column during the winter months. During spring, as solar heat input increases, a thermocline (a pronounced vertical temperature gradient) develops, which separates the warmer, lighter surface layers from the colder, heavier, deeper layers of the water column. Thermal expansion of the upper layers of water reduces its density, and self-stabilising stratification develops. The depth at which the thermocline forms is typically 50m in the northern North Sea (OSPAR, 2000). Seasonal surface cooling in autumn, as well as the increased number and severity of storms, promotes vertical mixing of the water column and subsequently breaks down the thermocline.

The sea surface temperature in the area of the proposed development ranges from approximately 7°C in winter to 13.5°C in summer. Temperatures at the seabed are relatively constant throughout the year, between 7 and 9°C (UKDMAP, 1998).

There is a slight seasonal variation in the salinity of the water column in this area (from 34.5 to 35.4 parts per thousand) which is typical of the open and western waters of the North Sea (OSPAR, 2000; UKDMAP, 1998).

SENSITIVITY: The physical presence and installation of the proposed pipeline will have no implications on temperature or salinity values.

5.4 Biological Resources

The operations associated with proposed pipeline installation may impact on the seabed, flora and fauna, including plankton, fish stocks, seabirds and marine mammals that occupy or migrate through the area associated with the development. An outline of susceptible flora and fauna, and their vulnerability to environmental conditions, is given below.

5.4.1 Plankton

The planktonic community is composed of a range of microscopic plants (phytoplankton) and animals (zooplankton) that drift freely on the ocean currents, and together form the basis of the marine food web. The majority of the plankton occurs in the top 20m of the sea, known as the photic zone, which is the layer that light penetrates to allow photosynthesis (Johns & Reid, 2001).

Planktonic organisms constitute a major food resource for many commercial fish species, such as cod and herring (Brander, 1992), as well as benthic species and marine mammals, therefore any changes in their abundance, distribution and composition are of considerable importance.

Phytoplankton generally encompasses a wide range unicellular organisms and are the marine primary producers that fix the energy of sunlight by means of photosynthesis. They are grazed by the secondary producers, including some zooplankton species. The most common phytoplankton groups are the diatoms, dinoflagellates and the smaller flagellates. The phytoplankton community in the northern North Sea is dominated by the dinoflagellate genera *Ceratia* (Johns & Reid, 2001). Plankton in the North Atlantic and North Sea has been monitored using the Continuous Plankton Recorder (CPR) over the last 70 years, and the results of this programme have shown an increase in the dinoflagellates, with a gradual decrease in the diatom species (DTI, 2001; John & Reid, 2001).

Zooplankton consists of a variety of taxonomic groups, with a diverse range of both herbivorous and carnivorous organisms, ranging in size from microscopic larval life stages of fish and copepods such as *Calanus finmarchicus*, to large jellyfish.

The zooplankton communities of the northern and southern North Sea regions are broadly similar. The most abundant group is the copepods, which are dominated by *Calanus* (Johns & Reid, 2001).

The larger zooplankton (or megaplankton) includes the euphausiids (krill), thaliacea (salps and doloids), siphonophores and medusae (jellyfish). Blooms of salps and doloids produce large swarms in late summer to October, depleting food sources for other herbivorous plankton with subsequent effects to the higher trophic levels. Siphonophores (colonial hydrozoa) can also reach large densities in the North Sea (Johns & Reid, 2001). Krill is very abundant throughout the North Sea and is a primary food source for fish and whales.

Meroplankton is the larval stages of benthic organisms that spend a short period of their lifecycle in the pelagic stage before settling on the benthos. Important groups within this category include the larvae of starfish and sea urchins (echinoderms), crabs and lobsters (decapods), and several fish species (Johns & Reid, 2001).

Changes in nutrient inputs affect the size structure of phytoplankton populations, which in turn affects the energy fluxes in the ecosystem and the subsequent transfer to species higher up the food chain (NSTF, 1993). Most phytoplankton species have short maximum doubling times, and when light and nutrient conditions are favourable, ‘blooms’ of these organisms can develop. In the North Sea, a bloom of phytoplankton occurs every spring, often followed by a smaller bloom in the autumn; essentially, these spring and autumn blooms are normal events. Under certain conditions, however, blooms can occur at other times of year. The concentrations of organisms in these blooms can be very high (Reid *et al.*, 1990), and may involve nuisance or noxious species. These ‘Harmful Algal Blooms’ (HAB) can have detrimental effects, such as deoxygenation, foam formation, fish and marine mammal mortality and a change to the ecosystem. HABs can result in paralytic, amnesic and diarrhetic shellfish poisoning in humans (Johns & Reid, 2001).

Anthropogenic impacts can influence the frequency and extent of HABs, especially through the addition of carbon/nitrogen compounds. The addition of oil, in conjunction with high nutrient concentrations, can result in a monospecific bloom (Johns & Reid, 2001).

SENSITIVITY: The planktonic community is potentially sensitive to chemical releases into the sea. The planktonic community in the vicinity of the proposed pipeline is typical of the area and has the capacity to recover quickly because there is a continual exchange of individuals with surrounding waters. Any impacts associated with the proposed operations are likely to be small in comparison with the natural variations. However, any decrease in the distribution and abundance of planktonic communities, which may result from discharges of, for example, biocides or oil, could result in secondary effects on organisms that depend on the plankton as a food source.

5.4.2 Benthic communities

Benthic fauna comprises species which live either within the seabed sediment (infauna) or on its surface (epifauna). Benthic species may be either sedentary (sessile) or motile, have a variety of feeding habits (i.e. filter-feeding, predatory or deposit-feeding) and occupy a variety of different niches.

The distribution of benthic fauna is primarily influenced by water depth and sediment type; the major influence for epifauna appears to be depth, whereas sediment characteristics are more important for infauna (Basford *et al*., 1990). Other important factors include the influence of different water masses and the food supply to the benthos (Basford *et al*., 1993). Fluctuations in benthic populations may also be caused by natural spatial or temporal variations in the environment, such as salinity, temperature and available oxygen, as well as by pollution-induced effects. For example, the typical infaunal community response to organic disturbance is a reduction in species richness and diversity, usually accompanied by an increase in the density of species which are able to exploit disturbed environments.

Various attempts have been made to describe the macrobenthic invertebrate communities in the North Sea, with the model of Künitzer *et al.* (1992) being one of the most widely accepted. The proposed development occurs in the northern North Sea where the deep-water infaunal assemblage is characterised by high densities (2,863±1,844 individuals per m^2) and species richness (51±13 species). Kunitzer *et al.* (1992) classified the infauna of the deeper (>100m) northern North Sea into two groups according to sediment type, with the indicator species on finer sediments being the polychaetes *Minuspio cirrifera, Aricidea catherinae* and *Exogene verugera*, and the bivalve *Thyasira* spp., and on the coarser sediments the polychaetes *Ophelia borealis, Exogone hebes, Spiophanes bombyx* and *Polycirrus* spp.

Data from benthic surveys around the Brent facilities (UKCS Block 211/29) indicate that characteristic infaunal species associated with this region of the North Sea include the polychaete *Owenia fusiformis* (tube worm), *Thyasira* spp (bivalve mollusc) and *Myriochele* spp (UKOOA, 2000b).

Epifauna species typically identified in the area include the starfish *Astropecten irregularis* and *Asterias rubens*, the echinoid *Echinocardium flavescens*, the hermit crab *Pagurus bernharus*, the crustacean *Crangon allmani*, the purple heart urchin *Spatangus purpureus*, the gastropods *Neptunea antique*, *Colus gracilis* and *Scaphander lignarius*, tunicates and sponges (Basford *et al*., 1989).

A regional environmental study of Region IV in the North Sea commissioned by Statoil and Norsk Hydro included a macrofaunal assessment of the Statfjord ABC field (Akvaplan niva, 2002). In general, there were large variations in the number of individuals (293-3955 individuals per station), taxa (35-110) and diversity (H’ 2.1-5.8) over the Statfjord ABC field. While the sediments in Region IV are classified as fine to medium sand, large variations in sediment composition over the area was noted.

During this survey, the numerically dominant species at the sampling station closest to the Brent field included the polychaetes *Owenia fusiformis* (juvenile), *Ophiuroidea indet*. (juvenile), *Sphiophanes kroyeri, Pista bansei* and *Amythasides macroglossus.* Other numerous species included the echinoderm *Ophiuroidea indet*. (juvenile) and *Phoronis* sp.. The benthic community at this station, in water depths of 143m, was undisturbed, as indicated by a Shannon-Wiener diversity index value of 5.6 (94 taxa, 355 individuals). This represents a community with a low dominance and a broad range of taxa from several major groups (polychaetes, echinoderms, crustaceans); taxa known to represent disturbed conditions are absent or occur in very small numbers (Akvaplan niva, 2002).

The benthic communities in this region of the northern North Sea comprise species typical of the deep water and soft, fine sediments at this latitude in the North Sea. The seabed communities are diverse and abundant; however, most of the northern North Sea does not appear to contain any species of particular conservation concern (DTI, 2001).

SENSITIVITY: Benthic infaunal communities are vulnerable to physical and chemical disturbances to the sediment. Sources of physical disturbance include smothering by sediment during pipeline installation. Such disturbance would occur as a result of the project implementation, but will be limited to a small area.

The potential impact on benthic fauna from the proposed pipeline installation operations are discussed further in **Section 7.**

5.4.3 Fish and Shellfish Populations

A total of 224 species of fish have been recorded in the North Sea; most are common species typical of shelf seas, although deepwater species are found along the northern shelf edge and in the deepwater channel of the Norwegian Trench and the Skagerrak. It is estimated that fewer than 20 species constitute over 95% of the total fish biomass. North Sea fish can be broadly classified into pelagic species, those that live in mid-water and demersal species, those that live on or close to the seabed. Shellfish species comprise demersal (bottom-dwelling) groups including molluscs, crustaceans such as shrimps, crabs, *Nephrops norvegicus* (Norway lobster), mussels and scallops.

The North Sea constitutes an important fishing ground, although several key species have declined to critical levels. Cod stocks were confirmed to be on the verge of collapse in 2000, and other major fisheries for haddock and plaice are now are considered to be outside 'safe biological limits' and are reliant on single good breeding years and young fish (WWF, 2001).

The spawning grounds of fish that release their eggs into the water column are widely distributed over the North Sea. Fish that lay their eggs on the sediment (e.g. herring and sandeels) use spawning grounds that are more localised (NSTF, 1993) and are, therefore, vulnerable to disturbance by offshore activities. Species which live in intimate contact with the sediments (e.g. sandeels and most shellfish) are also vulnerable to potential seabed disturbance from the activities associated with pipeline installation.

Spawning and nursery grounds are dynamic features of fish life history and are rarely fixed in one location from year to year. While some fish species exhibit the same broad patterns of distribution from one year or season to the next, others show a large degree of variability. In addition, fish may spawn earlier or later in the season in response to environmental change. For sediment spawners, not all suitable sediment areas might be used in every year and areas used will depend on the size of the spawning stock. Therefore, the information provided represents the widest known distribution given current knowledge and should not be seen as rigid, unchanging descriptions of presence or absence. Spawning times represent the generally accepted maximum duration of spawning (Coull *et al*., 1998).

The proposed route for the pipeline (UKCS 211/29 and 211/30) coincides with the spawning grounds for cod (January to April, peak spawning period is in February and March), haddock (February to May, peak period is February to April), saithe (January to April, peak period is in January and February) and Norway pout (January to April, peak period is in February and March), and is close to spawning areas used by sandeels (November to February) (Figure 5-2; Table 5-1; Coull *et al*., 1998).

Nursery areas for mackerel, haddock, Norway pout and blue whiting occur within the proposed pipeline route (Figure 5-3; Table 5-1; Coull *et al*., 1998).

The proposed pipeline does not coincide with recognised spawning or nursery grounds for shellfish species such as *Nephrops*.

Cod occur throughout the northern and central areas of the North Sea. Spawning areas used by cod are dispersed over the North Sea, although there are several areas where spawning is concentrated, included areas in the in the northern North Sea. Cod are pelagic spawners, and distribute their larvae in the upper 30m of the water column. After 3-5 months the young move down to the bottom. Spawning mainly takes place between January and April, peaking in February and March (CEFAS, 2001; Coull *et al*., 1998).

Haddock occur throughout the northern North Sea. Haddock are generally regarded as benthic fish but can also be found in mid-water. In the North Sea, haddock spawn between February and May, with peak spawning activity between mid-March and early April. The main spawning area is in the northern North Sea between the Shetland Islands and the Norwegian Deep, which extends southwards towards the Fladen Ground. Haddock eggs and larvae are pelagic for the first seven months and remain within surface waters to a depth of 40m, after which they enter a bottom-dwelling (demersal) phase. After spawning, adult haddock disperse and migrate westward toward the Orkney and Shetland Islands and into the central part of the North Sea to feed (CEFAS, 2001; Coull *et al*., 1998).

Saithe is a northern species and is widely dispersed in northern European waters. Adults are generally found in continental shelf and slope waters at depths of 80-450m. The main spawning areas for saithe are in the northern North Sea, east of the Shetland Islands and along the edge of the Norwegian Deep. Spawning takes place mainly over the period January to March. After a short pelagic phase, the young fish migrate into inshore and coastal waters for 3 or 4 years before migrating to deeper water (CEFAS, 2001).

Norway pout is a benthic predator and is generally found in waters of 80-200m over sandy and muddy substrates, but also occur in waters of up to 450 m depth, for example in the Norwegian Deep. They are typically found in the northern and central areas of the North Sea, with the centre of distribution lying midway between the Shetland Islands and the Norwegian coast. Spawning usually takes place between January and April on the continental shelf, with the period of most intense activity during February and March. In deeper water, spawning takes place between March and May (Coull *et al*., 1998). The precise location of spawning areas is not well understood, but most spawning activity appears to be restricted to waters within the depth range of 50-200m. Norway pout are not generally considered to have specific nursery grounds, but pelagic 0-group fish remain widely dispersed in the northern North Sea close to spawning grounds (CEFAS, 2001). Norway pout are not suitable for human consumption due to their small size, but they are important as a source of prey for haddock, whiting, cod and hake (Muus & Dahlstrom, 1974).

Mackerel are fast swimming pelagic fish that are widespread in North Atlantic shelf waters. The North Sea stock of mackerel has been at a very low level for many years due to high fishing pressure and poor recruitment. North Sea mackerel over-winter in the deep water to the east and north of the Shetland Islands, and on the edge of the Norwegian Deeps. In spring, they migrate south to spawn in the North Sea between May and August (CEFAS, 2001). Nursery areas extend from the Norwegian coast towards the Shetland Islands.

There are five species of sandeel in the North Sea, though the majority of commercial landings are of *Ammodytes marinus*. Sandeels are a shoaling species which lie buried in the sand during the night, and hunt for prey in mid-water during daylight hours. Spawning of *A. marinus* usually takes place between November and February. Spawning activity occurs throughout much of the North Sea, but especially near sandy sediments off the coasts of Denmark, northeastern England, eastern Scotland, and the Orkney and Shetland Islands. Sandeel eggs are demersal and on hatching, the larvae become planktonic, resulting in a potentially wide distribution. Sandeels adopt a demersal habit around 2-5 months after hatching and are believed to over-winter buried in the sand. There appears to be little movement between spawning and feeding grounds. Sandeels are an important food item for mackerel, whiting, cod, salmon, and other fish species, as well as sea birds and marine mammals (CEFAS, 2001).

The consequences of oil and gas activities for fish populations are largely a result of exploration and production operations, such as the use of seismic surveys, and the placement of structures on the seabed (DTI, 2001). These have the potential to impact on fish spawning areas, and on commercial fisheries due to loss of access to fishing grounds, but there is no direct evidence to suggest any significant disturbance to nursery areas (CEFAS, 2001).

There are no specific periods of concern with regards to spawning sites for UKCS Blocks 211/19 and 211/30, although there are periods of concern for seismic surveys between January and May (DTI, 2006).

Table 5-1: Spawning and nursery areas/periods of fish which coincide with the proposed pipeline [Months in yellow indicate the proposed development schedule]

Species	J	F	M	A	M	J	J	A	S	O	N	D	Nursery
Cod		*	*										
Haddock		*	*	*									
Mackerel					*	*	*						
Saithe	*	*											
Norway pout		*	*										
Sandeels													
Blue whiting													

spawning period   * Peak spawning period   nursery/juveniles

Source: Coull *et al*. (1998)

SENSITIVITY: Fish are most vulnerable to offshore activities associated with the oil and gas industry during the egg and juvenile stages of their life cycles. In particular, ecologically sensitive demersal spawning species, such as sandeels, are vulnerable to any physical disturbance of their spawning and nursery grounds that may be caused by operations to install the pipeline. The proposed route for the pipeline lies within spawning grounds for cod, haddock, saithe, Norway pout and mackerel, which are all pelagic spawners. Most of these species have a widespread distribution and extensive spawning areas. However, this region of the North Sea constitutes an important area for cod spawning activity.

The potential impact of the proposed pipeline installation operations on fish spawning grounds are discussed further in **Section 7.**

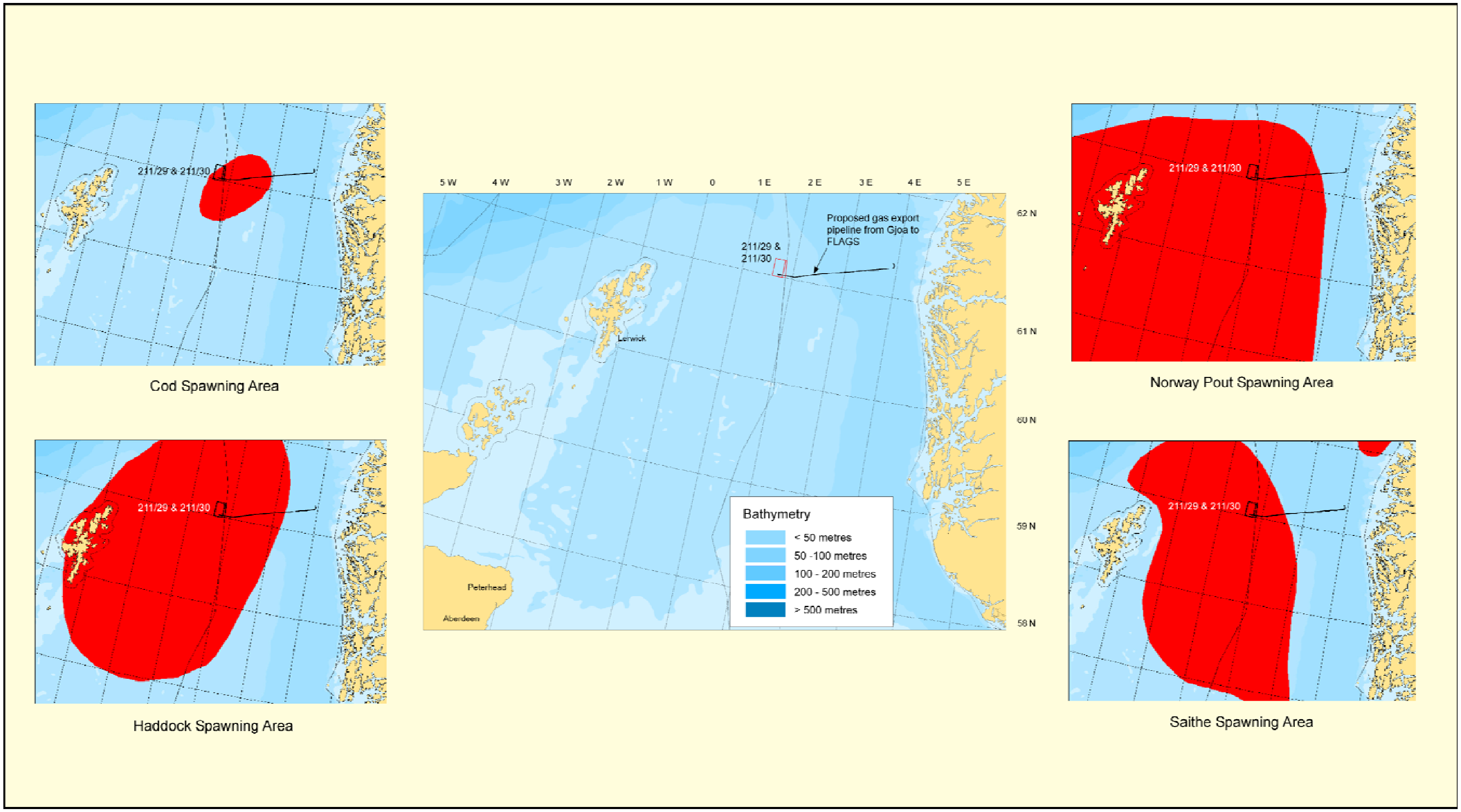


Figure 5-2: Fishing spawning sites in the vicinity of the proposed development in the northern North Sea

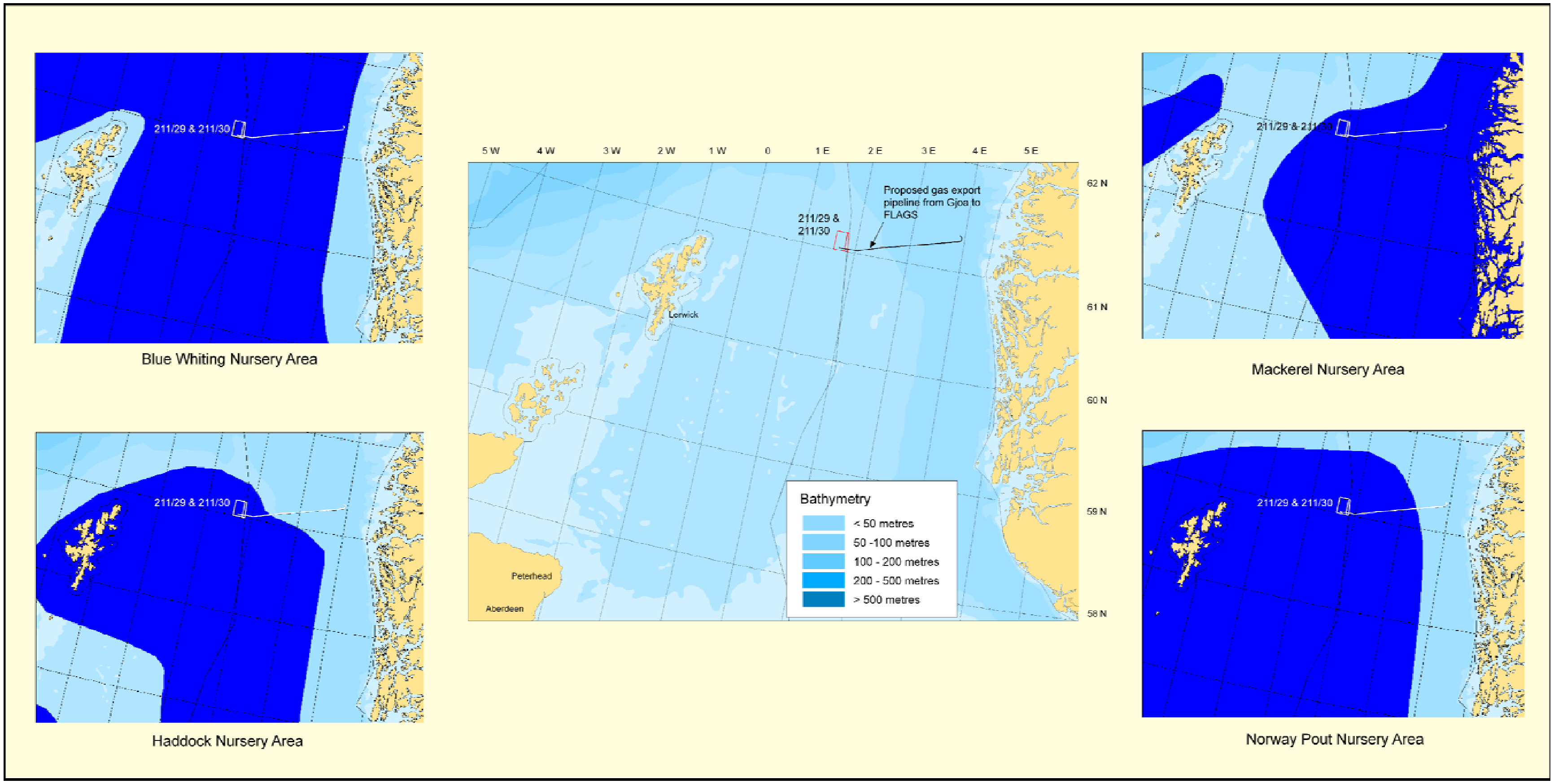


Figure 5-3: Fish nursery grounds in the vicinity of the proposed development in the northern North Sea

5.4.4 Commercial Fisheries

An assessment of the fishing industry in the proposed development area has been derived from International Council for the Exploration of the Seas (ICES) fisheries statistics, provided by the Scottish Executive Environment and Rural Affairs Department (SEERAD). For management purposes, ICES collates fisheries information for individual rectangles measuring 30nm by 30nm. Data have been obtained for ICES rectangle 51F1, which coincides with the proposed development area (UKCS Blocks 211/29 and 211/30).

The total value of fish landed by UK vessels over 10m from ICES rectangle 51F1 was £6.9 million in 2004 and £0.8 million between January and August 2005 (Table 5-2). Both pelagic and demersal species are caught in the area, with pelagic species accounting for approximately 85% of the value of the catch landed in 2004 (SEERAD, 2006a).

Table 5-2: Landings by UK vessels over 10m for ICES rectangle 51F1 by species type between January 2004 and August 2005

Year	Species type	Live weight (tonnes)	Value (£000)
2004	Crustacean	0.8	2.1
	Demersal	882.0	1,038.9
	Mollusc	1.0	1.7
	Pelagic	9,223.8	5,896.6
2004 Total		10,107.6	6,939.3
2005	Crustacean	1.0	3.0
	Demersal	603.9	691.4
	Mollusc	0.5	0.7
	Pelagic	303.5	87.5
2005 Jan to Aug Total		908.9	782.6

Source: SEERAD (2006a)

The 'relative value in 2004' of all commercial fisheries in the area of the proposed pipeline is high in comparison to other areas in the North Sea (SEERAD, 2006b). The 'relative value' of the demersal fishery is moderate, the pelagic fishery is high and the *Nephrops* and shellfish fishery is low (SEEARD, 2006b).

In 2004, the landings by UK vessels (over 10m) from ICES rectangle 51F1 were dominated by mackerel (8,825.6 tonnes, approximately 87% of the total live weight of landings), herring (approximately 4% of the total live weight of landings), haddock (approximately 3%) and saithe (approximately 2%), other species included whiting, cod, monk fish and ling (SEERAD, 2006a).

In 2004, the total annual fishing effort for UK vessels (greater then 10m) in ICES rectangle 51F1 was 459 days (SEERAD, 2006a). Fishing effort was dominated by bottom otter and pair trawls and mid-water otter and pair trawls (Table 5-3). Fishing occurs throughout the year in this area. In 2004, the fishing effort was higher in the months of April, May, October and December and the value of landings was greatest in October and December (Figure 5-4).

In comparison to other areas in the North Sea, fishing effort in the proposed development area (ICES rectangle 51F1) is moderate for demersal species, low for pelagic species, very low for *Nephrops* and shellfish and very low for beam trawl (Coull, *et al*., 1998).

Table 5-3: Fishing effort (days by vessels over 10m) by gear type used in ICES rectangle 51F1 between January 2004 and August 2005

Gear	2004	2005
Otter trawls - bottom	176	102
Otter trawls - midwater	70	5
Otter twin trawls	32	13
Pair seines	15	14
Pair trawls - bottom	93	59
Pair trawls - midwater	56	6
Scottish seines	18	6
Total	459	205

Source: SEERAD (2006a)

Information on the Norwegian fishery in the area of the proposed development indicates that saithe is the most important species of the Norwegian whitefish trawling, blue whiting is important in the Norwegian industrial trawling, i.e. fishing for reduction to fish meal and oil, and herring and mackerel are the main species caught in the Norwegian purse seine fishery (Acona, 2006).

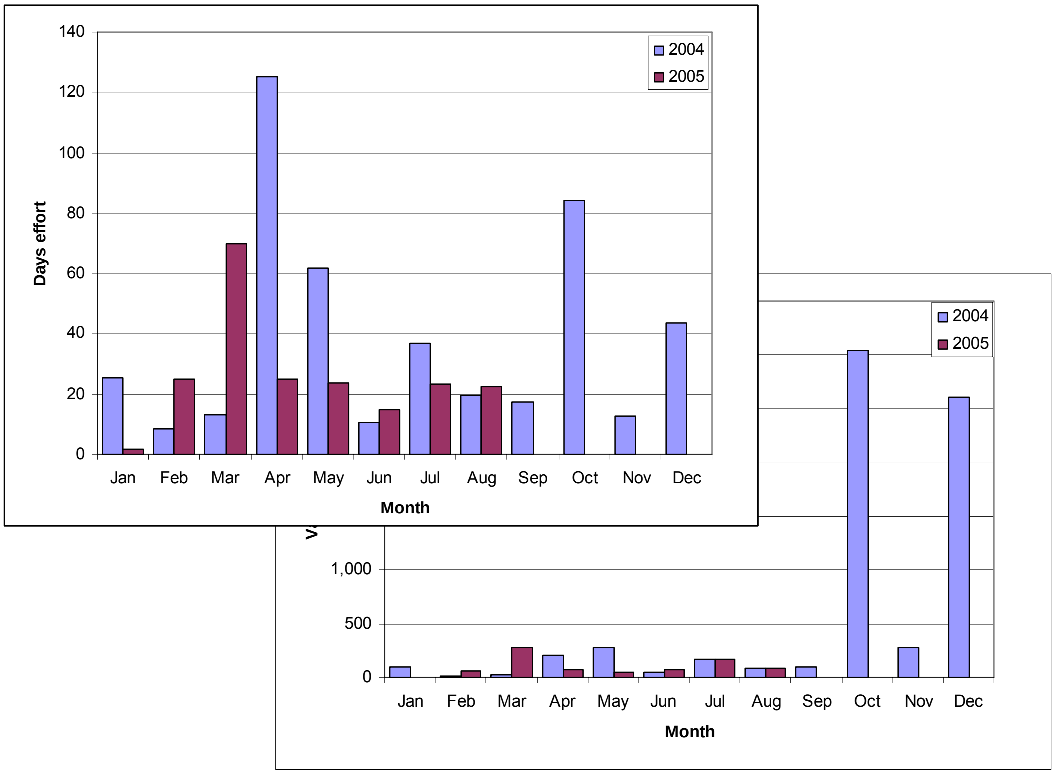


Figure 5-4: Commercial fishing effort (days) and value (£000) for UK vessels over 10m for ICES rectangle 51F1 between January 2004 and August 2005

SENSITIVITY: Commercial fisheries are sensitive to both natural changes in fish stocks and the high anthropogenic demand for fish, and several species are in an ecologically sensitive position. Sensitive commercial species may be more vulnerable to the physical disturbance caused by pipeline installation.

The pipeline installation operations will involve vessel restrictions temporarily from a small area. Although UK vessels fish in this area throughout the year, fishing effort is moderate in comparison to other areas of the North Sea. Both pelagic and demersal species and caught by UK fishing vessels in this area, including mackerel, herring, haddock and saithe.

Once installed the physical presence of the proposed pipeline, rock dump areas, including pipeline crossings and any anchor marks from pipelay vessels, can potential pose a risk to fishing gear, especially bottom trawls. Fishing effort by UK vessels in the area was dominated by both otter and pair bottom trawls.

The impact of the proposed pipeline on fishing is discussed further in **Section 7.**

5.4.5 Seabirds

Seabirds comprise those species of bird that depend wholly or mainly on the marine environment for their survival. They spend the major part of their lives at sea and most of these species only come ashore only to breed. Twenty-five species of seabird in six families (*Procellariidae* – petrels and shearwaters; *Hydrobatidae* – storm-petrels; *Phalacrocoracidae* – cormorants and shags; *Stercoraridae* – skuas; *Laridae* – gulls and terns; and *Alcidae* – auks) breed in the UK. In addition, many other non-breeding species can occur regularly in the seas around the UK at various times throughout the year (JNCC, 2006).

Internationally important numbers of several species of seabird breed around the coastal margin of the North Sea and depend on offshore areas for their food supply and, for much of the year, their habitat. Seabird species which breed regularly around mainland UK coasts include the fulmar, cormorant, shag, gannet, six species of gull and five species of tern (DTI, 2001). In general, offshore areas contain peak numbers of seabirds following the breeding season and through winter, with birds tending to forage closer to coastal breeding colonies in spring and early summer. Feeding areas utilised by seabirds are as important as the colonies themselves (DTI, 2001). Seabird prey varies from zooplankton to small fish and habitats that concentrate any of prey are preferred.

Seabirds in the vicinity of the proposed development in the northern North Sea include the fulmar, which is present throughout the year, with higher densities in this area occurring from April to July and in September, October and December. Kittiwakes are also present throughout the year, with higher densities between January and April. Guillemots and razorbills have also been recorded throughout the year, with highest numbers found in July. Gannets are present in the area in low to moderate densities mainly from March to August and the great skua is widespread between May and September, but generally in low to moderate densities (Skov, *et al*., 1995; Stone, *et al*., 1995; UKDMAP, 1998).

Seabirds are not normally affected by routine offshore oil and gas operations (DTI, 2001). However, in the event of an oil spill, birds are vulnerable to oiling from surface oil pollution. Seabirds are vulnerable to oil spills in several ways, including direct mortality. Primarily, oil soaks into the plumage and destroys insulation and buoyancy causing hypothermia, starvation and drowning. Oiled birds are at risk from starvation due to increased energy demands, reduced ability to feed, due to loss of buoyancy and mobility, and depletion of food sources. In addition, oiled birds spend more time preening and less time foraging (Mosbech, 2000). Oil ingested when they attempt to clean the oiled plumage, and when they feed on oil-contaminated food, can be directly and severely toxic, although the toxic effect of oil varies with different types and compositions of oil. Ingested oil can have more subtle effects at low doses, both acute and chronic, that can significantly affect survival and reproduction (Fry and Lowenstine, 1985, Leighton *et al*., 1985). For example, even lightly oiled adult birds may transfer oil to eggs when incubating, thereby diminishing the hatching success (Lewis and Malecki, 1984).

The vulnerability of seabirds to oil spills varies species and time of year. The more time birds spend on the sea-surface the more susceptible they are to be fouled with oil. Both birds that feed at sea throughout the year (e.g. auks, diving ducks, many terns and gulls) and for a part of the year (e.g. some ducks, grebes and divers) are sensitive to oil spills. Species, which spend most of their time swimming or diving, are most vulnerable to oil. Birds which congregate in large numbers on the sea, such as auks and ducks, are particularly vulnerable, but other more solitary species, such as cormorants and gannets, can also be affected. Guillemots, razorbills and puffins moult their flight feathers after the breeding season (July-August) and are unable to fly for 2-7 weeks. They spend this flightless period at sea, where they are safe from terrestrial predators; however, this significantly increases the vulnerability of these birds to oil spills (DTI, 2001; Mosbech, 2000).

Of the species commonly present offshore, gannet, skuas and auk species (e.g. guillemot, razorbill and puffin) may be considered to be most vulnerable to oil pollution due a combination of heavy reliance on the marine environment, low breeding output with a long period of immaturity before breeding, and the regional presence of a large percentage of the biogeographic population. In contrast, the aerial habits of the fulmar and gulls, together with large populations and widespread distribution, reduce vulnerability of these species. Offshore seabird vulnerability to surface pollution is generally associated with proximity of breeding colonies and post-breeding dispersal of auks and is therefore seasonal. Seabird vulnerability to surface pollution generally peaks in late summer, following breeding when the birds disperse into the North Sea, and during the winter months with the arrival of over-wintering birds.

The Joint Nature Conservation Committee (JNCC) Seabirds at Sea Team (SAST) has developed an index to assess the vulnerability of bird species to the threat of oil pollution. This offshore vulnerability index (OVI) is derived by taking account of the following four factors (Williams *et al.*, 1994):

- the amount of time spent on the water;
- total biogeographic population;
- reliance on the marine environment; and
- potential rate of recovery.

The seasonal vulnerability of the seabirds in the proposed development area (UKCS Blocks 211/29, 211/30 and surrounding blocks) is derived from the JNCC block-specific vulnerability data (JNCC, 1999; Table 5-4).

The overall vulnerability of seabirds to oil pollution in the area of the proposed development (UKCS 211/29 and 211/30) is low. The most sensitive times of the year are July and November, when vulnerability is high. Seabird vulnerability is rated as moderate to low for the reminder of the year (Table 5-4). The proposed pipeline installation activities are schedule to occur between May and September (**Section 4.5**), which will coincide with the period of high seabird vulnerability in July.

Table 5-4: Monthly vulnerability of seabirds to oil pollution in the area of the proposed development (UKCS Blocks 211/29, 211/30 and surrounding blocks) [Months in yellow indicate the proposed drilling schedule]

Block	J	F	M	A	M	J	J	A	S	O	N	D	All
211/29	3	3	4	4	4	4	2	4	3	3	2	4	4
211/30	3	3	4	4	4	4	2	4	3	3	2	4	4
211/23	3	3	2	4	3	4	2	4	3	2	2	4	4
211/24	3	3	4	4	3	4	2	4	3	3	2	4	4
211/25	3	3	4	4	3	4	2	4	3	3	2	4	4
211/28	3	3	3	4	3	4	2	4	3	3	4	4	4
3/3	2	3	2	3	4	4	2	4	2	2	2	3	4
3/4	3	3	4	3	4	4	2	4	3	3	2	3	4
3/5	3	3	4	3	4	4	2	4	3	3	2	3	4

KEY		
	1	Highest Seabird Vulnerability
	2	High
	3	Moderate
	4	Lowest Seabird Vulnerability

Source: JNCC (1999)

The vulnerability of seabirds in the area is related to the position of the proposed development area in relation to the Northern Isles (particularly Shetland), which are of significant importance for large numbers of birds during the breeding season. Many species returning to and departing from their breeding colonies in the Northern Isles during the year pass through this region. Vulnerability is highest in the post-breeding season (July), when many birds disperse out to sea from their coastal colonies and nearby waters.

SENSITIVITY: Seabirds populations are vulnerable to surface pollution, particularly oil. Guillemot, razorbill and puffin are at their most vulnerable to oil pollution in their moulting season, when they become flightless and spend a large amount of time on the water surface. Seabird vulnerability to surface oil pollution in this area is rated as "low" to "moderate" throughout the year and "high" in July and November.

The potential impact of the proposed pipeline on seabirds is discussed further in **Section 7.**

5.4.6 Marine Mammals

5.4.6.1 Cetaceans

Numerous cetacean species (whales, dolphins and porpoises) are found in coastal and offshore waters of the North Sea. These include, baleen whales, such as minke and humpback whales, and the largest toothed whale, the sperm whale. Medium-sized whales are represented by the long-finned pilot and killer whales, while small species include Risso's, white-sided, white-beaked, common and striped dolphins as well as the harbour porpoise and bottlenose dolphin (Reid *et al*., 2003; SMRU, 2006). Cetaceans are widely distributed in the North Sea and are recorded throughout the year (Reid *et al.,* 2003; Stone 2003; UKDMAP, 1998).

Cetacean distribution may be influenced by variable natural factors such as water masses, fronts, eddies, upwellings, currents, water temperature, salinity and length of day. A major factor likely to influence cetacean distribution is the availability of prey, mainly fish, plankton and cephalopods (Stone, 1997).

Marine mammals (cetaceans and pinnipeds) can be vulnerable to the effects of oil and gas activities, with potential impacts including disturbance, noise, contaminants, oil spills and any effects on prey availability (SMRU, 2001). The abundance and availability of prey, including plankton and fish, can be of prime importance in determining the reproductive success or failure of marine mammals. Changes in the availability of principal prey species may be expected to result in population level changes of marine mammals but it is currently not possible to predict the extent of any such changes (SMRU, 2001).

The effects of noise on marine mammals range from mild irritation through impairment of foraging behaviour to hearing loss, and in extreme cases injury or death (SMRU, 2001).

All species of cetacean are protected under the Wildlife and Countryside Act 1981 and the Wildlife (Northern Ireland) Order 1985, and are listed on Annex IV (Animal and Plant Species of Community Interest in Need of Strict Protection) of the EC Habitats Directive. Under Annex IV, the keeping, sale or exchange of such species is banned as well as their deliberate capture, killing or disturbance. In addition, the harbour porpoise, bottlenose dolphin, grey seal and harbour seal are also listed in Annex II of the Habitats Directive. Member countries of the EU are required to consider the establishment of Special Areas of Conservation (SACs) for Annex II species (**Section 5.5.2**).

Minke whales, white-beaked and white-sided dolphins and harbour porpoises may occur regularly in the northern North Sea. Killer, long-finned pilot and sperm whales, and common, striped, Risso's and bottlenose dolphins are less frequently sighted in the northern North Sea, while other species including northern bottlenose, Sowerby's beaked, fin and humpback whales are encountered very infrequently (Hammond *et al*., 2002; Northridge *et al*., 1995; Reid *et al*., 2003; SMRU, 2001; Stone 1997, 1998, 2000, 2001, 2003; UKDMAP, 1998). Table 5-5 gives an indication of the species of cetaceans commonly found in the area of the proposed development in the northern North Sea.

Harbour porpoises are the most commonly-recorded cetacean in this area and sightings occur throughout the year (see **Section 5.5.2.4**). During the SCANS (small cetacean abundance in the North Sea) survey in the summer of 1994 there were an estimated 268,000 porpoises in the North Sea (Hammond *et al*., 2002). The northern and central areas of the North Sea appear to be important areas for harbour porpoises, especially in summer (SMRU, 2001). Harbour porpoises have been recorded in the northern North Sea in February and between April and September, with high densities (>0.5 individuals/km) recorded in Quadrant 211 in July (Table 5-5; UKDMAP, 1998).

White-beaked dolphins are distributed over the continental shelf, and in the North Sea they tend to be more numerous within about 200nm of the Scottish and north-eastern English coasts (Northridge *et al.*, 1995). The abundance of white-beaked dolphins in the North Sea areas during the SCANS survey in the summer of 1994 was 7,856 (95% confidence interval 4,000–13,300). This estimate includes shelf waters to the west of Shetland and Orkney (Hammond *et al*., 2002). White-beaked dolphins are present throughout the year in the North Sea, with most sightings recorded between June and October (Reid *et al*., 2003). Low to moderate (0.01-0.19 individuals/km) numbers of white-beaked dolphins have been recorded in the northern North Sea in February, March, June, July and September (Table 5-5; UKDMAP, 1995).

Minke whales occur throughout the central and northern North Sea, particularly during the summer months (SMRU, 2001). There is no direct evidence that minke whales in the Northern Hemisphere migrate, but in some areas there appear to be shifts in latitudinal abundance with season (SMRU, 2001). This is true for the North Sea, where minke whales appear to move into the North Sea at the beginning of May and are present throughout the summer until October (Northridge *et al.*, 1995). The estimated summer abundance of minke whales in North Sea areas during the SCANS 1994 survey was 7,200 (approximate 95% confidence interval 4,700 – 11,000). This estimate includes shelf waters to the west of Shetland and Orkney (Hammond *et al*., 2002). During the SCANS survey, the highest densities were recorded in the northwest North Sea, particularly off the mainland coast of Scotland (SMRU, 2001). It is apparent that the central and northern areas of the North Sea are important for minke whales in summer (SMRU, 2001).

Killer whales have been observed throughout the northern North Sea in most months (SMRU, 2001; Reid *et al*., 2003). Between Shetland and Norway, the species has been regularly recorded from November to March (Reid *et al*., 2003). In the area of the proposed development killer whales have been recorded in May, June and August (Table 5-5; UKDMAP, 1998). Seasonal movements may be associated with particular prey, including seals and herring (Reid *et al*. 2003). An association of killer whales with oil platforms has been reported (SMRU, 2001).

The Atlantic white-sided dolphin is primarily an offshore species, but has been recorded during a number of surveys in the North Sea, especially during summer (Northridge *et al.*, 1997; Reid *et al*., 2003). It shares most of its range with the white-beaked dolphin, but in the eastern North Atlantic it has a mainly offshore distribution and is consequently rarer than white-beaked dolphin over shelf waters (SMRU, 2001). Its presence in the North Sea is seasonal, with the majority of sightings recorded between May and September (SMRU, 2001).

In the North Sea, bottlenose dolphins are occasionally sighted outside coastal waters (see **Section 5.5.2.3**). Individuals from the resident population in the Moray Firth are known to range widely along the east coast of Scotland (Wilson *et al*., 2004) and they may also move off-shore during the winter (SMRU, 2001). However, the proposed development is over 135km from the UK coast, so the occurrence of bottlenose dolphins is likely to be low and infrequent.

Sightings of Risso's dolphins in the northern North Sea are mainly between July and August, although some animals are present off north-east Scotland and Shetland in winter (Reid *et al*., 2003). Common dolphins are occasionally sighted in the North Sea, also mainly in summer (June to September) (Reid *et al*., 2003). Common dolphins are generally found in oceanic and shelf-edge waters, but do occasionally use coastal waters. Striped dolphins are generally rare in UK waters, although they have been observed in the North Sea (Reid *et al*., 2003; Stone, 2001).

Most records of long-finned pilot whales around the UK are from waters greater than 200m deep, with relatively few occurrences in the shallower waters of the North Sea. Incidental sightings of pilot whales in the North Sea do, however, appear to be more numerous between November and January (Reid *et al*., 2003), although they have been recorded in the northern North Sea in August (Table 5-5; UKDMAP, 1998).

Sperm whales are normally distributed to the west and north of the UK on, and beyond, the continental shelf break. They have also been recorded fairly regularly in waters around the Orkney Islands and the Shetland Islands, with sightings and strandings reported in most months (SMRU, 2001). Several sightings and strandings have been recorded from the North Sea in the last decade. Males migrate to high latitudes to feed and, as a result, all sperm whales sighted or stranded in the North Sea to date have been males (SMRU, 2001).

Several cetacean species are present in the northern North Sea throughout most of the year (Table 5-5); however, the majority of cetacean sightings have been recorded at some distance from the proposed pipeline route (UKDMAP, 1998). As a result of the low numbers of cetaceans recorded in close vicinity, it is unlikely that operations to lay the pipeline would have a significant impact on the viability of populations.

5.4.6.2 Pinnipeds

Harbour or common seals (*Phoca vitulina*) are one of the most widespread pinniped species and are found in all coastal waters around the North Sea. A minimum population estimate in the North Sea is 38,000; just over half of the Northeast Atlantic subspecies (SMRU, 2001). During the pupping and moulting seasons in June to August they spend more time ashore than at other times of the year.

Grey seals (*Halichoerus grypus*) are restricted to the North Atlantic; total abundance is approximately 300,000 animals. The population in the northeast Atlantic is estimated to be around 130,000-140,000 individuals, of which approximately 70,000 are associated with breeding colonies in the North Sea. In the North Sea, pupping occurs from October (in the north) to January (in the south) and moulting occurs in February-March. Most of the population will be on land most of the time for several weeks during these periods and densities at sea will be lower (SMRU, 2001).

There is little data available with regards to the presence of seals in the area of the North Sea in which the proposed development would be located (see **Sections 5.5.2.1 and 5.5.2.2**). However, as the site is over 135km from the coast, it is unlikely that significant numbers of seals would be found in the vicinity of the proposed development.

Table 5-5: Sightings of cetaceans in the area of the proposed development in the northern North Sea [Months in yellow indicate the proposed development schedule]

Species	J	F	M	A	M	J	J	A	S	O	N	D
Harbour porpoise												
White-beaked dolphin												
White-sided dolphin												
Killer whale												
Long-finned pilot whale												
Minke whale												

KEY

- 0.01-0.09 animals/km
- 0.10-0.19 animals/km
- 0.20-0.49 animals/km
- >0.5 animals/km

Source: UKDMAP (1998)

SENSITIVITY: Marine mammals are vulnerable to chemical discharges, acoustic disturbance from vessel operations and injury from collisions with vessels. The effects of noise on marine mammals range from mild irritation through impairment of foraging behaviour to hearing loss, and in extreme cases injury or death (SMRU, 2001). Although there is no evidence to show that vessel noise adversely affects seals or small cetaceans, there are indications that large whales may avoid areas of intense activity (DTI, 2001; Richardson *et al*., 1995). Cetaceans have been recorded in the area throughout the year, although densities are generally low.

The potential impact of the proposed pipeline installation operations on marine mammals is discussed further in **Section 7**.

5.5 Offshore Conservation Areas

The European Community (EC) Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (the Habitats Directive), and the EC Directive 79/409/EEC on the Conservation of Wild Birds (the Birds Directive), are the main instruments of the European Union (EU) for safeguarding biodiversity.

The Habitats Directive includes a requirement to establish a European network of important high quality conservation sites that will make a significant contribution to conserving the habitat and species identified in Annexes I and II of the Directive. Habitat types and species listed in Annexes I and II are those considered to be in most need of conservation at a European level (JNCC, 2002). The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 implement the EC Habitats Directive (92/43/EEC) in UK Law. These regulations apply to UK waters beyond 12 nautical miles and up to 200 nautical miles offshore.

The UK government, with guidance from the Joint Nature Conservation Committee (JNCC) and the Department of Environment, Food and Rural Affairs (Defra), has statutory jurisdiction under the EC Habitats Directive to propose offshore areas or species (based on the habitat types and species identified in Annexes I and II) to be designated as Special Areas of Conservation (SAC). These designations have not yet been finalised, but will be made to ensure that the biodiversity of the area is maintained through conservation of important, rare or threatened species and habitats of certain species.

Special Areas of Conservation (SACs) are sites that have been adopted by the European Commission and formally designated by the government of each country in whose territory the site lies. Candidate SACs (cSACs) are sites that have been submitted to the European Commission, but not yet formally adopted. Candidate SACs will be considered in the same way as if they had already been classified or designated, and any activity likely to have a significant effect on a site must be appropriately assessed. Possible SACs (pSACs) are sites that have been formally advised to UK Government, but not yet submitted to the European Commission. Draft SACs (dSACs) are areas that have been formally advised to UK government as suitable for selection as SACs, but have not been formally approved by government as sites for public consultation (JNCC, 2006).

In relation to UK offshore waters, four habitats from Annex I and four species from Annex II of the Habitats Directive are currently under consideration for the identification of cSACs in UK offshore waters (JNCC, 2002; Table 5-6).

Table 5-6: Annex I habitats and Annex II species occurring in UK offshore waters

Annex I habitats considered for SAC selection in UK offshore waters	Species listed in Annex II known to occur in UK offshore waters
• Sandbanks which are slightly covered by seawater all the time • Reefs (bedrock, biogenic and stony) – Bedrock reefs – made from continuous outcroppings of bedrock which may be of various topographical shape (e.g. pinnacles, offshore banks); – Stony reefs – these consist of aggregations of boulders and cobbles which may have some finer sediments in interstitial spaces (e.g. cobble and boulder reefs, iceberg ploughmarks); and – Biogenic reefs – formed by cold water corals (e.g. *Lophelia pertusa*) and the polychaete worm *Sabellaria spinulosa*. ▪ Submarine structure made by leaking gases ▪ Submerged or partially submerged sea caves	▪ Grey seal (*Halichoerus grypus*) ▪ Harbour or common seal (*Phoca vitulina*) ▪ Bottlenose dolphin (*Tursiops truncatus*) ▪ Harbour porpoise (*Phocoena phocoena*)

Source: JNCC (2002)

Table 5-7: Possible and draft Special Area of Conservation (dSAC) in UK Offshore Waters

Name	Description	Location	Site Location	Area (km^2)	Status
Braemar Pockmarks	Submarine structures made by leaking gas	Northern North Sea	58.99oN, 1.48oW	21.34	dSAC
Darwin Mounds	Cold water corals	NW Scotland, Atlantic Ocean	59.76oN, 7.229oW	100	pSAC
Dogger Bank	Large sublittoral sand bank	Southern North Sea	54.81oN, 2.12oW	13,405	dSAC
Haig Fras	Submarine, isolated bedrock outcrop	Celtic Sea	50.26oN, 7.78oW	757	dSAC
North Norfolk Sandbanks and Saturn Sabellaria spinulosa reef	Sandbanks, seldom covered by more than 20m water. Biogenic reef consisting of colonies of polychaete worms	Southern North Sea	53.34oN, 2.13oW	4327	dSAC
Scanner Pockmark	Shallow depression approx. 600m by 300m and 20m deep	Northern North Sea	58.28oN, 0.97oW	7.25	dSAC
Stanton Banks	Bedrock reef	West of Scotland, Atlantic Ocean	56.24oN, 7.91oW	1923	dSAC
Wyville Thomson Ridge	Transition area between two biogeographic areas.	NW Scotland, Atlantic Ocean	59.98oN, 6.78oW	1,533	dSAC

* all pSAC and dSAC boundaries are subject to confirmation; therefore the site centre location and area are provisional, and give only a general indication of the pSACs/dSACs.
Source: JNCC (2006)

5.5.1 Annex I Habitats occurring in UK Offshore Waters

Currently in UK offshore waters there are no SACs, cSACs or SCIs (Sites of Community Importance); there is one possible SAC and seven draft offshore sites that have not yet been submitted to the European Commission (Table 5-7; JNCC, 2006).

5.5.1.1 Sandbanks

Sandbanks which are slightly covered by sea water all the time consist of sandy sediments that are permanently covered by shallow sea water, typically at depths of less than 20m below chart datum (but sometimes including channels or other areas greater than 20m deep). The main aggregations of "offshore sandbanks slightly covered by seawater all the time" occur in the shallow waters of the southern North Sea, around the north and north-east coast of Norfolk, in the outer Thames Estuary, off the south-east coast of Kent, and off the north-east coast of the Isle of Man (JNCC, 2002). The proposed pipeline development is located in the northern North Sea, in a water depth of approximately 140m and therefore outside the area where "offshore sandbanks slightly covered by seawater all the time" occur.

5.5.1.2 Reefs

Annex I reef habitats are defined as "submarine, or exposed at low tide, rocky substrates and biogenic concretions, which arise from the seafloor in the sublittoral zone but may extend in to the littoral zone where there is an uninterrupted zonation of plant and animal communities". These reefs generally support a zonation of benthic communities of algae and animal species including concretions, encrustations and corallogenic concretions" (EC, 2003). The UK has interpreted the habitat further to include bedrock, boulders and cobbles (generally >64mm in diameter), including those composed of soft rock, e.g. chalk. Aggregations of species that form a hard substratum (biogenic concretions) which enable an epibiotic community to develop are also considered in this habitat category.

Reef habitat occurs in the English Channel, Celtic Sea, Irish Sea and west and north of Scotland extending far out into the North Atlantic; however reef habitat is scarce in the North Sea (JNCC, 2002). Potential bedrock and stony reef habitats are much more common in western UK offshore waters and are virtually absent from UK offshore waters in the North Sea (DTI, 2001; 2002).

One of the main potential Annex I reef habitats likely to occur to the east of Shetland is a composite of sedimentary rock platform (the East Shetland Shelf) and a basement high (Pobie Bank) (JNCC, 2002). Sediment cover is patchy over the rock surfaces, generally very thin when present, and mainly consists of gravely sand (Graham *et al*., 2001). The region is contiguous with similar habitat which runs into the coast of the Shetland Islands (JNCC, 2002). There are no known Annex I reef habitats in the vicinity of the proposed pipeline.

The reef-forming worm *Sabellaria spinulosa* is widespread in UK offshore waters, particularly in the North Sea, Irish Sea and English Channel. The full extent and location of the reefs formed by these organisms is, however, not known (JNCC, 2002). Based on available information, there are no *Sabellaria* reefs in the vicinity of the proposed pipeline (DTI, 2002).

In the UK, the cold-water coral *Lophelia pertusa* has been found frequently in small colonies from north of the Shetland Islands to the far west of Rockall, with the majority of the findings from Rockall westwards (Wilson, 1979). However, the true extent of reefs in the UK is unknown (JNCC, 2002). Samples of *L. pertusa* have been recovered in the region of the proposed development, but these samples are likely to be at the extreme edge of the species' range and potentially poorly developed (Wilson, 1979). There is evidence of extensive colonisation of *L. pertusa* on the base of the flare structure on the Brent facilities (Bell and Smith, 1999) and several colonies of *L. pertusa* growing on the major installations in the northern North Sea, such as the NW Hutton platform (BMT Cordah, 2002). The presence of *L. pertusa* colonies on North Sea installations appears to be an artefact resulting from the presence of man-made structures in the sea and there is no evidence to suggest any formations of naturally occurring reefs of *L. pertusa* in the area that are of conservation interest.

5.5.1.3 Submarine structures made by leaking gases

'Submarine structures made by leaking gases' in Annex I are defined as "spectacular submarine complex structures, consisting of rocks, pavements and pillars up to 4m high. These formations (Methane-Derived Authigenic Carbonate (MDAC)) are due to the aggregation of sandstone by carbonate cement resulting from microbial oxidation of gas emissions, mainly methane. The methane most likely originated from the microbial decomposition of fossil plant materials. The formations are interspersed with gas vents that intermittently release gas. These formations shelter a highly diversified ecosystem with brightly coloured species" (EC, 2003).

'Marine columns' (the name of this habitat in the original Habitats Directive Annex I), such as those found in Danish waters (see Jensen *et al.*, 1992), are not known to occur in UK waters. However, gas seep depressions (commonly referred to as 'pockmarks'), some of which have carbonate structures associated within them, do occur in UK waters. Therefore, it remains to be determined whether those 'pockmarks' with carbonate structures (MDAC) fit within the Annex I habitat definition for 'submarine structures made by leaking gases, and sites may be selected for this habitat type. However, if on further investigation the 'pockmarks' with carbonate structures are not deemed to be 'spectacular submarine complex structures', then this habitat will not be represented in UK offshore waters (JNCC, 2002).

Pockmarks are shallow seabed depressions, typically several tens of metres across and a few metres deep, and they are generally formed in soft, fine-grained seabed sediments (Judd, 2001). Most pockmarks are relict features but a few continue to leak natural gas and may contain carbonate rocks (MDAC) which provide a habitat for encrusting and other surface living seabed animals (DTI, 2001).

In the North Sea the majority of pockmarks have been found in the sediments of the Witch Ground Formation (in the Central/Northern North Sea depression known as the Witch Ground Basin) and their equivalents, the Flags Formation (which occupies hollows in the northern North Sea plateau). They are also found in the Kleppe Senior Formation (in the Norwegian Trench) (Judd, 2001).

UKCS Blocks 211/29 and 211/30 are located outside of the Witch Ground and Flags Formation. Pockmarks have been identified in Blocks 3/11, 211/7 and 211/8 (Judd, 2001). Pockmarks were not identified during seabed surveys of the Tampen Link gas export pipeline (Stolt Offshore, 2004). The Scanner Pockmark (dSAC) in Block 15/25 and Braemar Pockmarks (dSAC) in Block 16/3 are located approximately 318km and 296km, respectively, from the proposed development site (DTI, 2001; JNCC, 2006; Figure 5-5).

5.5.1.4 Submerged Sea Caves

Submerged or partially submerged sea caves are widely distributed in inshore waters, but no examples are currently known offshore (between 12 and 200 nautical miles from the coast) (JNCC, 2006) and, therefore, this habitat type is absent from the northern North Sea.

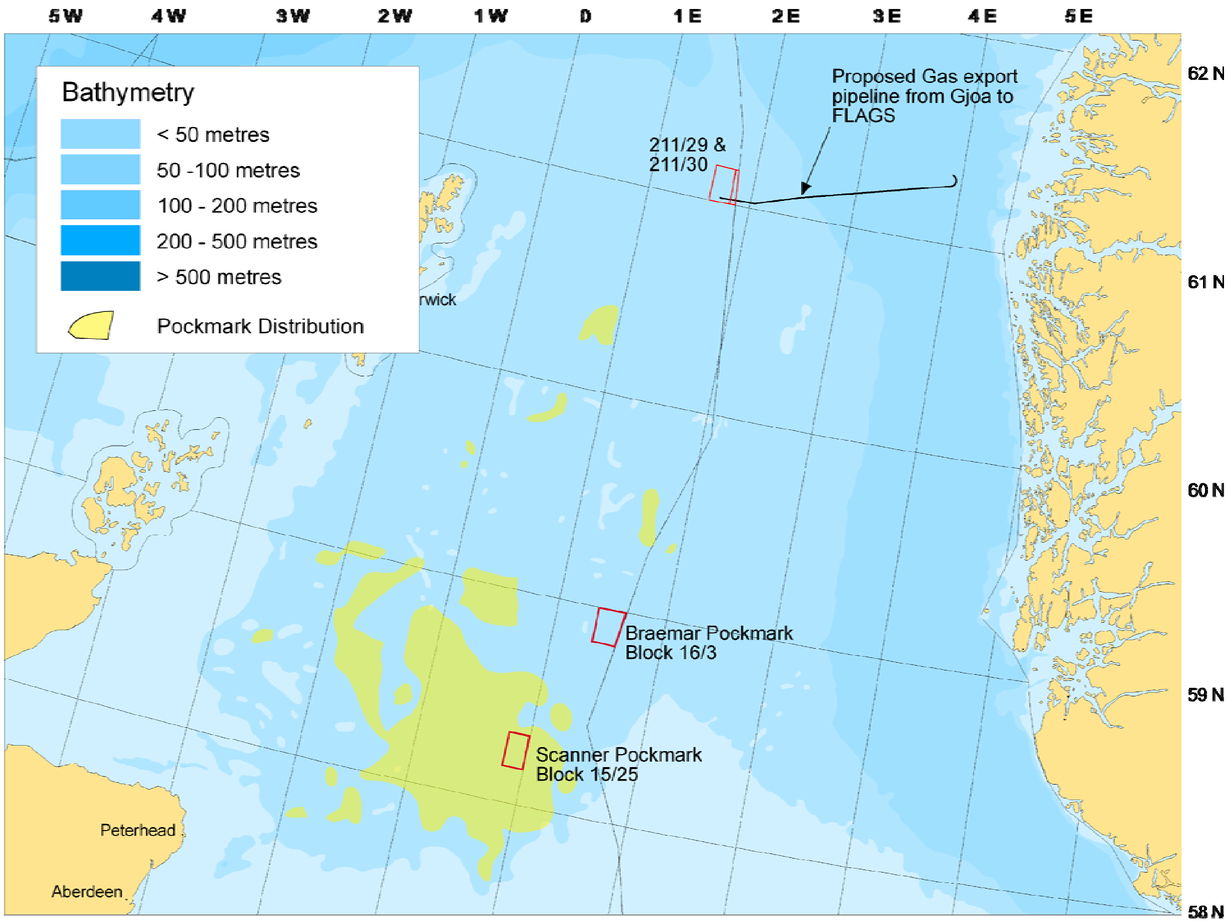


Figure 5-5: The proposed development area in relation to the distribution of pockmarks in the northern North Sea, the Scanner Pockmark (dSAC) and Braemar Pockmark (dSAC)

5.5.2 Annex II Species occurring in UK Offshore Waters

Annex II Species are defined as "species of community interest whose conservation requires the designation of Special Areas of Conservation (SAC)". There are four species listed on Annex II of the Habitats Directive known to occur in UK waters for which selection of offshore SACs will be considered: grey seal, common or harbour seal, bottlenose dolphin and harbour porpoise (**Table 5-6**). The four species could, as could all marine mammals, potentially be impacted by activities associated with the oil and gas industry, such as noise, contaminants, oil spills and any effects on prey availability (SMRU, 2001).

For the two seal species, coastal SACs have already been designated in the UK to protect breeding colonies, moulting and haul out sites, and two coastal SACs have been designated for bottlenose dolphin within UK territorial waters. The UK currently has no proposed SACs for harbour porpoise. The above four species are typically wide ranging, so it is difficult to identify specific areas which may be deemed essential to their life and reproduction, and which may, therefore, be considered for proposal as SACs (JNCC, 2002). Relevant information on the distribution of Annex II species in UK offshore waters is limited. Further analysis of data, and further survey in some cases, will be required to identify any areas in UK waters away from the coast which may qualify as SACs for these species (JNCC, 2002).

All cetacean species are listed in Annex IV of the EC Habitats Directive, which protects them from any deliberate disturbance, particularly during the periods of breeding and migration.

5.5.2.1 Grey seals

Grey seals spend most of the year at sea and may range widely in search of prey. Information on the distribution of British grey seals at sea, although limited, shows that they do occur offshore in UKCS Blocks; however the population as a whole does not appear to spend significant time in these offshore areas (SMRU, 2001). The occurrence of grey seals in the vicinity of the proposed pipeline development is likely to be low, however, as the site is located approximately 135km from the nearest point on the UK coastline.

5.5.2.2 Harbour or common seals

Data on the distribution of harbour seals at sea is even sparser than that for grey seals. However, studies suggest that they have a more inshore distribution at sea than do grey seals, and tend to forage within 75km of haul-out sites (JNCC, 2002). It is highly unlikely, therefore, that harbour seals regularly forage in offshore UKCS Blocks, including the area of the proposed development (SMRU, 2001).

5.5.2.3 Bottlenose dolphins

There are two main areas of UK coastal waters where there are semi-resident groups of bottlenose dolphin: Cardigan Bay, Wales and the Moray Firth, north-east Scotland. Both these areas have been designated SACs for bottlenose dolphins. Away from these two areas, there are smaller groups off south Dorset, around Cornwall and in the Sound of Barra, Outer Hebrides. Dolphins from all of these areas may occasionally move some distance from their apparent core range. For example, regular sightings in the Firth of Forth probably involve dolphins from the Moray Firth. Other dolphin groups, presumed to be of transients, are recorded further offshore in deeper water to the west of Scotland (JNCC, 2006).

In the North Sea, bottlenose dolphins are rarely sighted outside coastal waters; most sightings are within 10km of land. However, it is possible that some inshore dolphins move offshore during the winter months. For example, in the Moray Firth the population of dolphins is estimated consist of approximately 129 individuals (95% confidence interval 110–174). Although these dolphins are considered to be resident in the Moray Firth, numbers decrease during winter (Wilson *et al.,* 1997). Because sightings elsewhere around the coast do not increase accordingly, it is possible that animals from this population move offshore at this time of year (SMRU, 2001).

There have been no recorded sightings of bottlenose dolphins in the area of the proposed development (Reid *et al*., 2003; SMRU, 2001; UKDMAP, 1998). Therefore, although it is possible that bottlenose dolphins may be present in the area, the numbers are likely to be low and the occurrence infrequent.

5.5.2.4 Harbour porpoises

Harbour porpoises have been recorded in the area of the proposed development thoughout the year (**Section 5.4.6.1**; Reid, *et al*., 2003; SMRU, 2001; Stone 2001).

The harbour porpoise is widespread throughout the cold and temperate seas of north-west Europe, including the North Sea, the Skagerrak, Kattegat, Irish Sea, west of Ireland and Scotland, northwards to Orkney and Shetland and off the coast of Norway (Jackson & McLeod, 2002). In the North Sea, sightings from shipboard and aerial surveys indicate that harbour porpoises are widely and almost continuously distributed, with important concentrations in the central North Sea, along the Danish and northern German coasts (Donovan & Bjørge, 1995; Hammond *et al.*, 2002; IWC, 1996).

There is limited information available on the overall distribution and abundance of this species in UK waters. The estimated summer abundance of harbour porpoises in North Sea areas during the SCANS survey in July 1994 was 268,452 (approximate 95% confidence interval of 210,000 – 340,000). This estimate includes shelf waters to the west of Shetland and Orkney (Hammond *et al.,* 2002). The highest densities were observed north of 56ºN, mostly in a north-south band between 1ºE and 3ºE (SMRU, 2001). Numbers of porpoises present in UK waters vary seasonally, however, and more animals are likely to pass through UK waters than are present at any one time (Jackson & McLeod, 2002).

Harbour porpoises are generally described as a coastal species that typically occurs in continental shelf waters with depths less than 200m (Klinowska, 1991). However, they have been observed in the deep water areas such as the Norwegian Rinne, between Iceland and the Faroe Islands, and on the Rockall and Faroe Banks (Northridge *et al.*, 1995). Porpoises have also been sighted in offshore waters of the North sea and off north-west Scotland (Atlantic Frontier) (Hammond *et al.*, 2002; MacLeod *et al.*, 2003). By-catch data from Ireland also suggest that porpoises occur regularly offshore, with records from up to 220km from land (Rogan & Berrow, 1996).

Currently the UK has no proposed SACs for harbour porpoises, although the UK Government is re-examining distribution data for this species in inshore and offshore waters, in an attempt to identify likely areas as SACs, taking into account:

- the continuous or regular presence of the species (subject to seasonal variations);
- good population density (in relation to neighbouring areas); and
- high ratio of young to adults during certain periods of the year (JNCC, 2002).

SENSITIVITY: Based on available information there are no known reef habitats of conservation value or any other Annex I habitats in the area of the proposed pipeline. The harbour porpoise is the only species defined under Annex II of the Habitats Directive that has been regularly sighted in this area.

The impact of the proposed pipeline on conservation areas and species will be discussed further in **Section 7.**

5.6 Other sea users

5.6.1 Shipping

Statoil commissioned Anatec UK Ltd. to identify the shipping routes passing within a 10nm (~18.4km) radius around the Tampen Link gas export pipeline. The radius search encompassed the entire length of the Tampen Link pipeline and the UK Sector of the proposed pipeline. The study provides details on all shipping routes crossing or passing the central position (61°06'41"N 01°45'43"E) of the Tampen Link pipeline which is located less than 1km from the centre point (61°01'17"N 01°46'36"E) of the UK Sector of the proposed pipeline route. The survey has been conducted using Anatec's ShipRoutes software (Anatec UK Ltd, 2004).

Table 5-8: Shipping routes in the vicinity of the proposed pipeline route

Route No.	Description	Ships per year	% of Total
1	Nordfjord-Lerwick*	8	1%
2	Humber-Statfjord Term.*	32	4%
3	Gullfaks Term.-Milford Haven*	44	6%
4	Sognefjorden-Faroes*	136	18%
5	Moray Firth-N Norway/Russia	24	3%
6	Statfjord Term.-Hamburg*	188	25%
7	Aberdeen-Brent Shell*	130	18%
8	Brent-Lerwick Shell*	130	18%
9	Statfjord Term.-Milford Haven*	32	4%
10	Iceland-Sognefjorden*	8	1%
11	Sognefjorden-Statfjord Term.	8	1%
	TOTAL	740	100%

*Where two or more routes share the same position, the description lists the sub-route with highest traffic.

Eleven shipping routes pass within 10nm of the Tampen Link pipeline centre and these routes are trafficked by an estimated 740 vessels per annum, which corresponds to an average of approximately 2 vessels per day (Table 5-8 and Figure 5-6).

The majority of the vessels identified in the area are large tankers (61%) and offshore vessels (35%). The remaining traffic is made up of cargo vessels (Anatec UK Ltd, 2004). The majority of the tanker vessels (68%) trafficking the area are large tanker, ≥ 40,000 dead weight tonnage (DWT).

Shipping densities vary along the Tampen Link pipeline, with the highest shipping densities in the northern part of the pipeline due to tanker movements associated with the Gullfaks Field (Figure 5-7; Anatec UK Ltd, 2004).

Based on the available data, only one route could pass over the proposed pipeline, route number 2 (Figure 5-6 and Table 5-8). Overall, the traffic levels in the area of the pipeline are low to moderate for the UKCS, with no 1 x 1 nm cell having an average shipping density greater than one vessel per day (Figure 5-7: Anatec UK Ltd, 2004).

5.6.2 Oil and Gas Activity

The northern North Sea is an area of intensive oil and gas activity; numerous installations are present in the vicinity of the proposed development in both UK and Norwegian waters. In addition to Statfjord and Brent, other nearby fields in the UKCS include Hutton (Kerr-McGee), NW Hutton (BP Amoco), Dunlin/Dunlin SW (Shell), Ninian (Kerr-McGee) and Strathspey (Texaco) (DTI, 2001). In the Norwegian sector, the surrounding installations operated by Statoil ASA include Tordis, Gullfaks, Gullveig and Rimfaks.

The proposed pipeline will cross to pipeline in the UK Sector, the 10" oil pipeline between Brent South and Brent A and the 8" umbilical between Brent A and Brent South (further details are provided in **Section 4.3.2**).

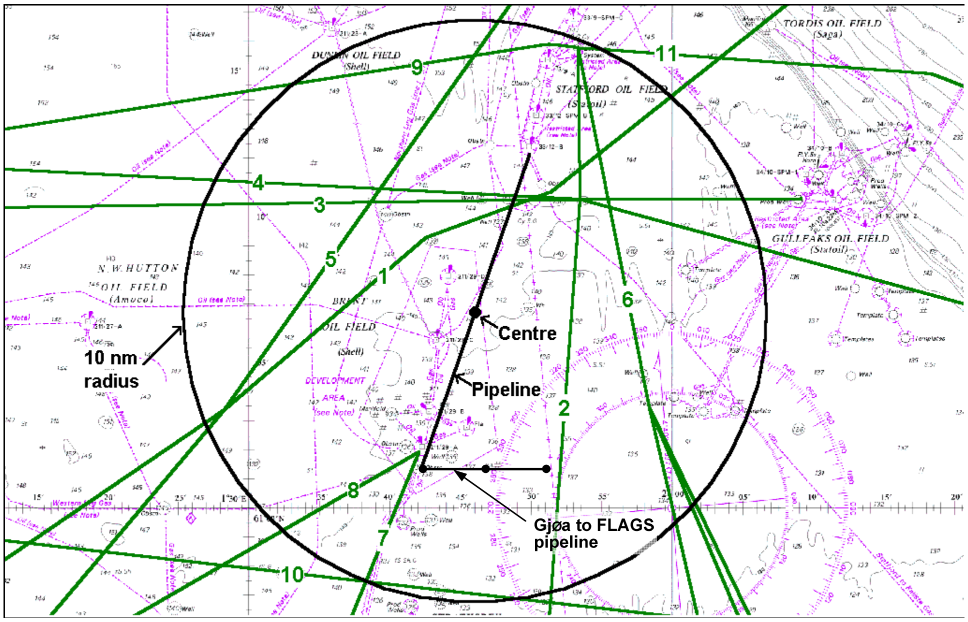
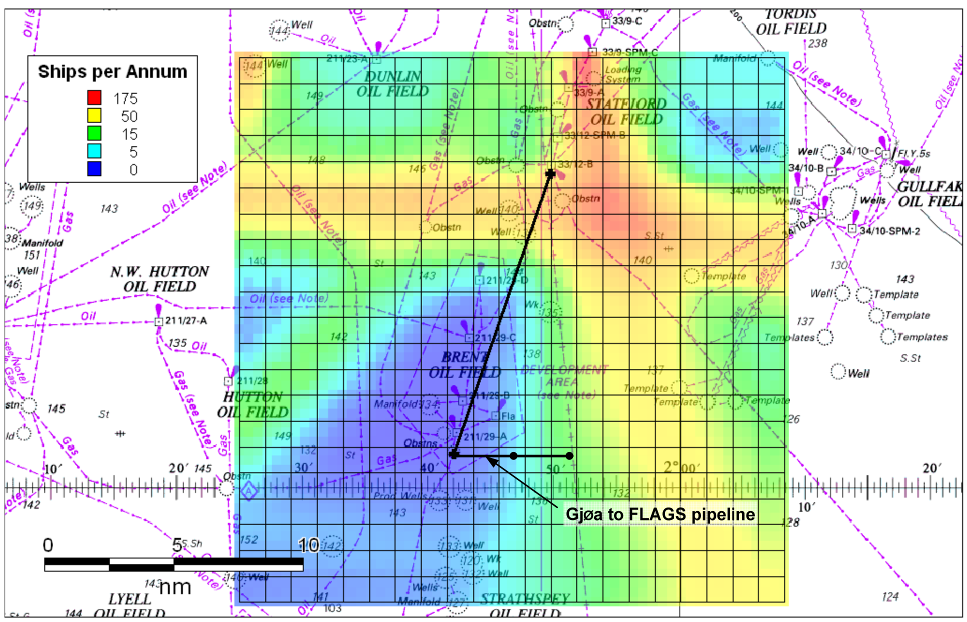


Figure 5-6: Shipping route positions within the vicinity of the proposed pipeline



Source: Anatec UK Ltd (2004)

Figure 5-7: Shipping density in the vicinity of the proposed pipeline

5.6.3 Ministry of Defence

No routine military activities, e.g. submarine exercises, are known to occur in this area.

5.6.4 Wrecks

There are two charted wrecks in this area which are marked on navigational maps; one lies 9km northeast of Brent B and the other lies 9km south of Brent A.

5.6.5 Submarine cables

There are no known submarine telecommunication or power cables in close proximity to the proposed pipeline route. SENSITIVITY: The relatively intense programme of vessel activity during pipeline installation could result in interference with other sea users, such as fishing vessels or supply vessels. This is an area of low to moderate shipping activity, with 11 shipping lanes known to occur in the area. Regular MoD activities have not been recorded in the area. No known submarine telecommunication or power cables occur in this area. The two known wrecks are marked on navigational maps.

The impact of the proposed pipeline on other sea users is discussed further in **Section 7.**

5.7 Summary of Environmental Sensitivities

Table 5-6 provides a summary of the seasonal sensitivities for the proposed development area. The proposed project schedule refers to the installation of the pipeline (**Section 4.3**).

Table 5-6: Seasonal Environmental Sensitivities

KEY

- Very high sensitivity
- High sensitivity
- Moderate sensitivity
- Low sensitivity
- Unsurveyed / No data available

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Proposed Project Schedule : May to August 2009											
Plankton Plankton are vulnerable to oil and chemical discharges, but due to their wide distribution there is no direct threat to the viability of the populations. Indirect effects may exist for organisms further up the food chain. Main periods of bloom are in spring and summer. Any impacts from offshore oil and gas operations, including operations to install the pipeline, are likely to be small in comparison with natural variations.											
Benthic Fauna Benthic fauna are an important food resource for fish and shellfish, and are vulnerable to the disturbance of seabed sediments which is likely to occur during pipeline installation operations. However, no rare benthic species are known to occur in this area and the benthic communities in the development area are similar to those found throughout the surrounding area. Therefore, there is no direct threat to the viability of the local benthic community.											
Fish Populations Fish are vulnerable to pollution, particularly during the egg, larval and juvenile stages of their lifecycle. The proposed pipeline is located in spawning grounds for cod, haddock, saithe and Norway pout. With the exception of cod, fish communities in this area are present throughout large areas of the North Sea, therefore there is no direct threat to the viability of the populations. However, this region of the North Sea constitutes an important area for cod spawning activity. The main schedule for the pipeline laying activities will not coincide with peak spawning (February and March) for this species.											
Fisheries The development area is of “high” commercial value, compared to other areas in the North Sea. Fishing occurs throughout the year, with the highest fishing effort (>40 days) in April, May October and December during 2004. Fishing efforts in the area is moderate to low compared to other areas in the North Sea. Both pelagic and demersal species of fish are targeted in the area. Although demersal trawling dominated fishing methods; pelagic species, such as mackerel, dominate the landings in recent years. The value of landings in 2004 was highest in October and December.											
Seabird populations Seabird vulnerability to surface pollution have been described by the JNCC as “low” to “moderate” for most of the year, but is “high” in July and November. Vulnerabilities are related to the position of the proposed development area in relation to the Northern Isles (particularly Shetland) which are of significant importance for large numbers of birds during the breeding season. Important species in this area include fulmar gannet, kittiwake and skua.											
Marine mammals Harbour porpoises are the most commonly recorded cetacean in this area and high numbers have been recorded in July. Other species of cetacean recorded in the area, include killer whales, long-finned pilot whales, minke whales, white-beaked dolphins and white-sided dolphins. Cetaceans have been recorded in the area throughout the year, but numbers are relatively low. Marine mammals are vulnerable to chemical discharges, acoustic disturbance from vessel operations, and injury from collisions with vessels.											
Conservation areas Based on available information there are no reef habitats of conservation value or any other Annex I Habitats in the area of the proposed pipeline. The harbour porpoise is the only Annex II species known to occur regularly in this region of the North Sea. The JNCC and other country agencies are currently analysing distribution data for harbour porpoise in UK waters to determine whether any suitable sites for SAC designation can be found. No conservation designation.											

6 RISK ASSESSMENT METHODOLOGY

6.1 Methodology

6.1.1 Description of the method used

The method used to undertake this Environmental Impact Assessment is based on an Environmental Risk Assessment (ERA) approach that has been widely applied internationally in the exploration and production industry, and in other industrial sectors. The methodology has been adapted from the approach to risk assessment and rating given in the British Standard BS 8800:1996 (BSI, 1996a), the DTI Guidelines for Environmental Statements (DTI, 2003), and the methods used in numerous statutory ESs for UK offshore oil and gas projects. The study method is also in accordance with Norwegian EIA requirements.

The ERA method assesses **risk** to the environment by examining the possible effects of activities on various receptors (e.g. benthic community, seabirds, commercial fishing) in the natural and socio-economic environment. The number and range of receptors examined is determined by the nature and scale of the activity being assessed.

The severity of each risk is determined by assessing two criteria, the **probability** of the occurrence of an event that could cause an impact and the **consequence** to the environment if the impact occurs. The ERA method therefore comprised three steps:

1. The systematic identification of the environmental risks associated with each of the activities taking place during the Gjøa to FLAGS gas export pipeline project. This identification was made on the basis of the project description (**Section 4**), the description of the environment and its sensitivities (**Section 5**), and information obtained during meetings with Statoil. This identification took account of potential interactions between the development project and sensitive receptors.

2. The classification of each of the environmental risks according to pre-defined probability and consequence criteria (Tables 6-1 and 6-2). The assessment was based on the findings of detailed modelling where appropriate or available, knowledge from experience of similar events offshore, published information, and expert judgement. The risk assessment is based on 'residual risk', which takes account of the control and mitigation measures that reduce both probability and consequence during the pipeline project. The assessment of the consequence of each impact takes account of both the physical extent of the impact and its duration, and, where appropriate, also includes the effects of transboundary and cumulative impacts.

3. The assignment of an overall risk rating to each of the risks. Table 6-3 provides a matrix that shows how the combined levels of probability and consequence have been used to determine the risk rating. These fall into three negative categories, and one positive category. The four risk ratings are:

   Highly Significant Risks (Red zone in Table 6-3). This rating would typically signify an unacceptable level of risk. Highly significant risks would be managed by eliminating or avoiding the activity that gave rise to the risk, by further investigation or modelling studies to clarify uncertainties, or by the development of controls or mitigation measures to reduce the risk to tolerable or acceptable levels.

   Significant Risks (Amber zone in Table 6-3). These risks would generally be regarded as being at a tolerable level that is considered "As Low As Reasonably Practicable" (ALARP) (UKOOA, 1999). Typically the causes, controls/mitigation, and outcomes would be defined, and the risk would be judged to be tolerable because the benefits of carrying out the activity causing the risk would balance or outweigh apparent disadvantages. Within this risk category, however, there could be some scope for further investigation of causes and consequences or improvement of control and mitigation.

Not Significant Risks (Green zone in Table 6-3). These risks would be managed by standard controls/mitigation and would have a trivial effect.

Positive Effects (Blue zone in Table 6-3). These effects would be beneficial because they resulted in the avoidance of environmental harm, the enhancement of resource stewardship, or other socio-economic or environmental gain.

Table 6-1: Probability criteria for defining the likelihood of routine and non-routine activities or events.

Category	Description	Probability (unplanned events) or frequency (planned events)
Definite	Will definitely occur (e.g. during every planned emission or discharge). Applies to all planned events.	Probability: one occurrence per causal event. Frequency: continuous or intermittent occurrence whenever the causal event takes place.
Likely	Likely to occur during normal operation, given the controls/mitigation proposed.	Probability: one occurrence per 2 to 50 events. Frequency: daily to three-monthly.
Possible	Could occur infrequently during normal situations given the controls/mitigation proposed, or more readily during abnormal or emergency situations, e.g. minor spillages during fuel loading operations at sea.	Probability: one occurrence per >50 to 1,000 events. Frequency: >three-monthly to yearly.
Unlikely	Unlikely during normal operation given the controls/mitigation proposed, but may occasionally occur during abnormal or emergency situations, e.g. 'significant' (>1 tonne) overboard spill.	Probability: one occurrence per >1,000 to 10,000 events. Frequency: >yearly to 10-yearly.
Remote	Extremely unlikely given the controls/mitigation to be put in place, e.g. serious tier 3 spill event.	Probability: one occurrence per >10,000 events. Frequency: >10-yearly.

Table 6-2: Consequence criteria for defining the characteristics of environmental effects

Environmental Consequences	Social Consequences
SEVERE	
▪ Degradation or loss of habitats or ecologically, commercially or culturally important species. ▪ Extent: At a regional, national or international scale. ▪ Duration: Low prospects of recovery to a representative state, within several decades in highly affected areas. ▪ Permanent, widespread impacts on resource quality and availability (i.e. of water, energy or raw material) to the long-term detriment of dependent businesses, communities, individuals, environment and socio-economic conditions. ▪ Permanent impact on status of internationally important or nationally protected sites or species, e.g. coastal regions of Shetland. ▪ Tier 3 spill or catastrophic emergency event, with consequences on a national or international scale.	▪ Well-established and widely held areas of concern in society on a national or international scale, including possible perception of threats to the global environment, e.g. global warming, and wider issues of sustainability. ▪ Permanent, detrimental health impacts (any number of people) ▪ Permanent and widespread negative effects on human well-being (typically, but not necessarily, arising from nuisance). ▪ Permanent disruption to business, communities or individuals, with permanent consequential loss of revenue, assets or amenities. ▪ Requirement to dispose of controlled waste beyond national disposal capacity.
MAJOR	
▪ Degradation or loss of habitats or ecologically, commercially or culturally important species over a wide area of seabed. ▪ Extent: Generally more than 1,000m from the source of the impact, or beyond the perimeter boundaries of onshore sites. ▪ Duration: Limited prospect of recovery to normal healthy conditions. Recovery to a representative state would generally be in the order of decades in highly affected areas. ▪ Substantial but ultimately reversible impacts on resource quality and availability (i.e. of water, energy, or raw material) to the detriment of dependent businesses, communities, individuals, environment and socio-economic conditions. ▪ Serious, long-term, but ultimately reversible, impact which would affect the status and/or management of internationally important or nationally protected sites or species e.g. coastal regions of Shetland. ▪ Tier 2 or 3 oil spill or major emergency event, with consequences on a local or regional scale.	▪ Concern on a regional rather than local or global level involving multiple interest groups. Perception of threat to the regional environment and issues of regional sustainability. ▪ Reversible, detrimental health impacts (any number of people). ▪ Widespread and sustained negative effects on human well-being (typically on a scale of months to years; also typically, but not necessarily, arising from nuisance). ▪ Long term (typically on a scale of months to years) disruption to businesses, communities or individuals, with sustained consequential loss of revenue, assets or amenities. ▪ Requirements to dispose of controlled waste beyond 50% of the annual disposal capacity of the waste management region (e.g. county or regional level).
MODERATE	
▪ Degradation or loss of habitats, or ecologically, commercially or culturally important species over a wide area of seabed. ▪ Extent: Generally within, but may extend beyond, 1,000m from the source of impact, or beyond the perimeter boundaries of onshore sites. ▪ Duration: This generally leads to short-term disruption with the potential for recovery to normal conditions within several years -typically less than a decade - but may extend beyond this period close to the impact source. ▪ Temporary (scale of weeks to months) impacts on resource quality or availability (i.e. of water, energy or raw material) causing nuisance to dependent communities, groups of people or affected individuals, but not to the detriment of the local environment or socio-economic conditions. ▪ Short-term, reversible impact on internationally important or nationally protected sites or species e.g. coastal regions of Shetland, which could not compromise the status or management of these sites or species. ▪ Uncontrolled tier 1 oil spill or small-scale emergency event.	▪ Concern at the community, rather than individual or single interest group, level. Perception of a threat to the community environment and issues of local sustainability. ▪ Local negative effects on human well-being (but not health), typically on a scale of weeks to several months (also typically, but not necessarily, arising from nuisance). ▪ Short-term (typically on a scale of days to weeks) disruption to businesses, communities or individuals, with short term consequential loss of revenue, assets or amenities. ▪ Requirement to dispose of controlled wastes at 10% to 50% of the disposal capacity of the waste management region (e.g. county or regional level).

Table 6-2 continued: Consequence criteria for defining the characteristics of environmental effects

Environmental Consequences	Social Consequences
MINOR	
▪ Disruption to habitats, or ecologically, commercially or culturally important species over a localised area of seabed. ▪ Extent: Generally within, but may extend beyond, 500m from the impact source, or within the perimeter of an onshore site. ▪ Duration: Short-term disruption, with the potential for rapid recovery to a normal, representative state typically within months depending on the timing of the event in relation to the annual recruitment pattern. ▪ Localised and transient impact on resource quality or availability (i.e. of water, energy, raw material or labour) affecting the well-being of individuals. ▪ Highly transient, reversible impact on locally protected sites which could not affect or compromise the status or management of these sites. ▪ Contained and non-notifiable oil spill.	▪ Concern at the level of individual people, individual businesses or single interest groups. Perception of a threat to the environment used by, and issues of sustainability relating to, individuals and single interest groups. ▪ Short-term (typically on a scale of hours to days) nuisance which causes inconvenience to individuals. ▪ Short-term disruption (typically on a scale of hours to days) to individual businesses rather than to communities, with transient consequential loss of revenue, assets and amenities. ▪ Requirement to dispose of controlled wastes at 1% to 10% of the disposal capacity of the waste management region (e.g. county or regional level).
NEGLIGIBLE	
▪ Transient disruption to habitats, or ecologically, commercially or culturally important species. ▪ Extent: Within 500m of the source of the impact ▪ Duration: Potential for recovery to a normal, representative state, generally within hours to days. ▪ Negligibly small impacts on resource availability or quality which is not to the detriment of people, the environment, or socio-economic conditions. ▪ No impact on status of protected sites or species. ▪ No spills or emergency events.	▪ No concern or perception of threats by people, communities or interest groups. ▪ Transient nuisance (scale of hours) which does not cause negative effects on human health, well-being, revenue sources, assets or amenities or social disruption. ▪ Requirement to dispose of controlled wastes at less than 1% of the disposal capacity of the waste management region (e.g. county or regional level).
POSITIVE	
▪ Enhancement of habitats, or ecologically, commercially or culturally important species.	▪ Enhancement of human prosperity, health, well-being or amenities. ▪ No requirement to dispose of controlled waste to land-fill.

6.1.2 Discussion of the method

In this method, the probability and the consequence of each identified risk are assigned to one of a number of pre-defined qualitative categories. There are no universally adopted quantitative or qualitative definitions that can be applied to the two sets of criteria; different qualitative definitions may be used in different projects. The method used to set the definitions ensured that all the aspects of the project were encompassed.

In this ERA, every effort has been taken to use the best available data to assess potential impacts, and to apply the defined criteria uniformly and objectively. The ERA attempts to provide a transparent account of the judgements that have been made in the risk assessment. This transparency is provided by the tables (Table 6-4, Table 6-5 and Table 6-6) which show the values of probability and consequence for the each of the individual risks, and by clearly documenting the justifications for each of the assessments.

The ERA for each of the planned and unplanned events associated with the Gjøa to FLAGS gas export pipeline should be viewed as a systematic scoping exercise, which allows all of the possible risks to be identified. Importantly, it differentiates between trivial risks, which can justifiably be excluded from more detailed investigation in the EIA, and those risks that are likely to have significant implications for the project because of the possible level of uncertainty, severity of residual impact, concerns of interested parties, or specific requirements for control and mitigation (Table 6-7, Table 6-8 and Table 6-9).

The ERA is not the end-point of the investigation, but the initial part of the process of identifying likely significant risks and seeking to assess their true implications. The results are used as the starting point for a more detailed assessment of the nature, scale, duration, and reversibility of the environmental and socio-economic impacts of each of the likely significant risks. These detailed assessments seek to put the risk into the context of the project and the receiving environment as accurately and as objectively as possible. **Section 7** documents these detailed assessments.

6.1.3 Final Classification of Results

Assigning the risks to one of four categories allowed a wide range of potential risks to be screened, so that attention could be focussed on important "significant" risks. Table 6-3 indicates how criteria for probability and consequence are combined to give the final risk classification.

Table 6-3: Risk Matrix

Consequence	Probability				
	Remote	Unlikely	Possible	Likely	Definite
Severe	R.6	U.6	P.6	L.6	D.6
Major	R.5	U.5	P.5	L.5	D.5
Moderate	R.4	U.4	P.4	L.4	D.4
Minor	R.3	U.3	P.3	L.3	D.3
Negligible	R.2	U.2	P.2	L.2	D.2
Positive	R.1	U.1	P.1	L.1	D.1

Key:	Highly Significant Zone	Significant Zone	Not Significant Zone	Positive Zone

6.2 Identification of Significant Environmental Risks

Table 6-4 to Table 6-6 present the risk assessment matrices for the various activities associated with the Gjøa to FLAGS gas export pipeline project, based on the ERA process described in **Section 6.1**. The tables are listed by pipeline activity, with each table following a similar format (project events and risks against receptors). The codes shown in these tables (e.g. "L.3", "P.3") demonstrate how the evaluation was made during the risk assessment process, based on the combination of the two criteria, probability and consequence (Table 6-1 and Table 6-2).

For risks that were considered to be "not significant" or "positive", Table 6-7 to Table 6-9 provide a justification for the assessment made, and for excluding these risks from further investigation in the environmental assessment. The tables provide a brief description of the environmental risks, and summarise some of the standard or project-specific measures that could or would be taken to control or mitigate the identified risks. The majority of these measures would be standard practice for marine and offshore operations. Where possible, risks of a similar nature have been grouped to avoid repetition.

Table 6-4: Risk assessment of installation of pipelines, risers and subsea structures

	Physical and Chemical							Biological						Socio-Economic						
	Sediment structure / chemistry Chemistry/structure	Water Quality	Use of Resources	Use of disposal facilities	Air quality (local)	Trans-boundary issues	Cumulative impacts	Sediment biology (benthos)	Water Column (plankton)	Finfish and shellfish	Seabirds	Sea mammals	Integrity of conservation sites	Commercial fishing	Shipping	Military operations	Other users	Stakeholder concerns	OVERALL SIGNIFICANCE	JUSTIFICATION SECTION REFERENCE
INSTALLATION																				
Presence of vessels														D.4					D.4	7.1
Noise from pipelaying vessels										P.2		P.2							P.2	6.2
Power generation			L.2		L.2	L.2	L.2												L.2	6.2
Treated bilge discharge		L.2				L.2	L.2		L.2	L.2	L.2	L.2							L.2	6.2
Sewage discharge		L.2				L.2	L.2		L.2	L.2	L.2	L.2							L.2	6.2
Anchoring of pipelay vessel	L.2							L.4		L.2		L.2		P.3	L.2				L.4	7.2
Rock-dumping	L.2		L.2					L.4		L.2		L.2		L.2	L.2				L.4	7.3
COMMISSIONING																				
Testing and commissioning of pipeline	L.2	L.2							L.2	L.2			L.2						L.2	6.2
ACCIDENTAL EVENTS																				
Pipeline rupture / failure leading to remedial engineering or escape of hydrotest chemicals	U.2	U.4							U.4	U.4			U.2						U.4	7.6
Snagging of fishing gear on PLEM, or pipeline														U.4			U.2	U.4	U.4	7.6
Spills of Fuel (aviation and diesel)	U.3	U.4			U.3	U.3	U.3	U.3	U.4	U.3	U.3	U.3	U.3	U.3					U.4	7.6

Consequence of impact	Probability of impact				
	Remote	Unlikely	Possible	Likely	Definite
Severe	R.6	U.6	P.6	L.6	D.6
Major	R.5	U.5	P.5	L.5	D.5
Moderate	R.4	U.4	P.4	L.4	D.4
Minor	R.3	U.3	P.3	L.3	D.3
Negligible	R.2	U.2	P.2	L.2	D.2
Positive	R.1	U.1	P.1	L.1	D.1

Significance of identified risk	Number of risks
Highly significant	0
Significant	6
Not significant	5
Positive	0

Table 6-5: Risk assessment of production activities

	Physical and Chemical							Biological						Socio-Economic						
	Sediment structure / chemistry Chemistry/structure	Water Quality	Use of Resources	Use of disposal facilities	Air quality (local)	Trans-boundary issues	Cumulative impacts	Sediment biology (benthos)	Water Column (plankton)	Finfish and shellfish	Seabirds	Sea mammals	Integrity of conservation sites	Commercial fishing	Shipping	Military operations	Other users	Stakeholder concerns	OVERALL SIGNIFICANCE	JUSTIFICATION SECTION REFERENCE
PIPELINES AND UMBILICALS																				
Presence of pipelines, crossings and subsea structures	D.2							D.2						D.3				D.3	D.3	**7.4**
Emissions from anodes		L.3							L.2	L.2		L.2		L.2					L3	**7.5**
ACCIDENTAL EVENTS																				
Snagging of fishing gear on PLEM, or pipeline														U.4			U.2	U.4	U.4	**7.6**

Consequence of impact	Probability of impact				
	Remote	Unlikely	Possible	Likely	Definite
Severe	R.6	U.6	P.6	L.6	D.6
Major	R.5	U.5	P.5	L.5	D.5
Moderate	R.4	U.4	P.4	L.4	D.4
Minor	R.3	U.3	P.3	L.3	D.3
Negligible	R.2	U.2	P.2	L.2	D.2
Positive	R.1	U.1	P.1	L.1	D.1

Significance of identified risk	Number of risks
Highly significant	0
Significant	3
Not significant	0
Positive	0

Table 6-6: Risk assessment of decommissioning activities

	Physical And Chemical							Biological						Socio-Economic						
	Sediment structure / chemistry Chemistry/structure	Water Quality	Use of Resources	Use of disposal facilities	Air quality (local)	Trans-boundary issues	Cumulative impacts	Sediment biology (benthos)	Water Column (plankton)	Finfish and shellfish	Seabirds	Sea mammals	Integrity of conservation sites	Commercial fishing	Shipping	Military operations	Other users	Stakeholder concerns	OVERALL SIGNIFICANCE	JUSTIFICATION SECTION REFERENCE
VESSEL OPERATIONS																				
Physical presence if anchored	L3							L.3		L.2				L.2	L.2	L.2	L.2		L.3	**7.2**
Power generation						L.2	L.2												L.2	**6.2**
Treated bilge discharge		L.2				L.2	L.2		L.2	L.2	L.2	L.2							L.2	**6.2**
Sewage discharge		L.2				L.2	L.2		L.2	L.2	L.2	L.2							L.2	**6.2**
PIPELINES																				
Removal of PLEM, and other forms of subsea intervention	L.2	L.2		L.2				L.2	L.2	L.2				L.2					L.2	**6.2**
Presence of pipelines	L.2													L.4			L.2	L.4	L.4	**7.4**
ACCIDENTAL EVENTS																				
Operational diesel spill		U.3							U.3		U.4	U.3		U.4					U.4	**7.6**
Dropped objects	P.2							P.2						P.2					P.2	**6.2**

Consequence of impact	Probability of impact				
	Remote	Unlikely	Possible	Likely	Definite
Severe	R.6	U.6	P.6	L.6	D.6
Major	R.5	U.5	P.5	L.5	D.5
Moderate	R.4	U.4	P.4	L.4	D.4
Minor	R.3	U.3	P.3	L.3	D.3
Negligible	R.2	U.2	P.2	L.2	D.2
Positive	R.1	U.1	P.1	L.1	D.1

Significance of identified risk	Number of risks
Highly significant	0
Significant	3
Not significant	5
Positive	0

Table 6-7: Justification for excluding the causes of risks assessed to be *Not significant* or *Positive* from further investigation in the environmental assessment for the installation of pipelines, risers and subsea structures

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
		INSTALLATION	
Noise from pipelaying vessel	Noise emitted from the activities associated with the proposed pipeline operations could potentially disturb marine mammals (seals, whales, dolphins and other cetaceans). Many marine mammals exhibit an overt behavioural reaction at a received noise level of 120dB for continuous noise. Noise levels in excess of 120dB may be tolerated for a period of time, but the likelihood of behavioural response increases. Prolonged sound could result in marine mammals moving away from preferred areas.	The equipment used during the proposed activities will be well maintained and this will help to keep the noise from operating machinery as low as possible, and thus minimise potential disturbance to marine mammals.	Using formulae from Richardson *et al*. (1995) and Erbe and Farmer (2000), the predicted threshold distance from a noise source for a received level of 120dB (potential threshold for overt behavioural response by marine mammals) is within approximately 1km of pipeline operations. Data indicate a low density of marine mammals along the pipeline route. For the pipeline operations the impact is expected to be low because of the relatively small area that would be exposed to noise above the threshold level, and the low number of marine mammals anticipated in the area.
Power generation on vessels	Deterioration in air quality around exhaust outlets. Contribution to global processes such as global warming and acid rain deposition (cumulative and trans-boundary impacts).	Atmospheric emissions from vessels are inevitable but would be managed through use of well-maintained equipment, and burning low-sulphur diesel fuel in line with the requirements of MARPOL.	Short-term deterioration of local air quality within a few metres of the point of emission. Rapid dispersion and dilution of the emissions in exposed conditions offshore. The route of the pipeline is remote from other significant sources of atmospheric pollution, and so there would be no risk of cumulative effects. Overall very small scale contributor to global warming and to trans-boundary effects such as acid rain. No sensitive receptors in the area.
Discharges of treated bilge from vessels	Deterioration in seawater quality around the discharge point and the potential for oil slick formation.	Compliance with MARPOL which requires: ➢ Oil-water separation and filtration equipment, monitoring and discharge to ensure oil concentration is below 15ppm. ➢ Retention of the bulk oil fraction after separation for recycling or incineration onshore. ➢ UK or International Pollution Prevention Certificate for vessel drainage systems. ➢ Vessel audits to ensure compliance.	The permitted intermittent discharge of low concentrations of hydrocarbons would be dispersed and broken down rapidly in the offshore environment. A slick should not form at the permitted concentration.

Table 6-7 continued: Justification for excluding the causes of risks assessed to be *Not significant* or *Positive* from further investigation in the environmental assessment for the installation of pipelines, risers and subsea structures

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
INSTALLATION			
Sewage discharged from vessels	Localised increase BOD (Biological Oxygen Demand) around the point of discharge (caused by bacterial degradation of the sewage). Input of organic nutrients results in localised increase in productivity in fish, plankton and micro-organisms.	Sewage treated prior to disposal at sea or contained and shipped to shore. Vessel audits to ensure compliance.	Relatively few people involved in vessel operations. Therefore, BOD and organic input from sewage will be low. Sewage would be readily dispersed in currents offshore and broken down.
COMMISSIONING			
Testing and commissioning of pipeline	The permitted discharge to sea of pipeline testing and commissioning chemicals could affect water quality at the discharge site.	Only the range and amounts of chemicals essential to demonstrate the integrity and fitness of the pipeline would be used The chemicals would be carefully selected so as to minimise potential environmental effects, in accordance with **Offshore Chemical Regulations 2003**.	The concentrations of chemicals in the pipeline during testing and commissioning would be low. Discharged chemicals would be rapidly dispersed and diluted by the strong currents in northern North Sea. Assessment under the **Offshore Chemical Regulations 2003** will have demonstrated that the discharge of such chemicals would not be likely to have a significant environmental effect.

Table 6-8: Justification for excluding the causes of risks assessed to be *Not Significant* or *Positive* from further investigation in the EA for production activities

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
ACCIDENTAL EVENTS			
Dropped objects	The creation of artificial substrata to be colonised by marine organisms. Possible obstruction to fishing.	Accurate accounting for all and pipeline sections (which have individual test certificates and records) and major items of equipment. Adherence to lifting and handling procedures. Use of certified equipment for lifting. Requirement to retrieve major items of debris from the seabed before leaving the site.	Pipe sections and major items would be recovered from the seabed. Loss of individual hand-tools and other minor items of equipment would not constitute a threat to species, habitats or fishing.

Table 6-9: Justification for excluding the causes of risks assessed to be *Not Significant* or *Positive* from further investigation in the EA for decommissioning activities

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
VESSEL OPERATIONS			
Power generation	Refer to corresponding topic in Table 6-7		
Bilge discharge	Refer to corresponding topic in Table 6-7		
Sewage discharge	Refer to corresponding topic in Table 6-7		
PIPELINES			
Removal of PLEMs, HTTs and other forms of subsea intervention	Temporary disturbance of seabed and benthos	Although disturbance will occur as a result of the removal of the structures, the seabed will be returned to its previous state.	Area of seabed disturbance is minimal and would be re-colonised.
ACCIDENTAL EVENTS			
Dropped objects	Refer to corresponding topic in Table 6-8		

7 EVALUATION OF SIGNIFICANT ENVIRONMENTAL RISKS

This section provides a detailed evaluation of each of the environmental risks that were assessed to be "significant" (**Section 6**). The evaluation is structured to provide evidence of:

- The magnitude and duration of transient and residual environmental impacts and risks (i.e. those that remain after mitigation).
- The consequences for sensitive receptors.
- The consequences for protected habitats and species, including designated or proposed conservation sites
- The contribution to cumulative, transboundary and global processes.
- Resolution of the issues and concerns of stakeholders.
- The adequacy and effectiveness of the proposed risk-reduction measures.

The following aspects of the proposed pipeline installation associated with the Gjøa to FLAGS gas export pipeline project were assessed in **Section 6** as having "significant" risks:

- Physical Presence of Vessels (**Section 7.1**)
- Anchoring of vessels during pipeline Installation (**Section 7.2**).
- Pipeline installation (**Section 7.3**).
- Physical presence of the pipeline and subsea structures (**Section 7.4**).
- Emissions from anodes (**Section 7.5**)
- Accidental spills of diesel (**Section 7.6**).

7.1 Physical Presence of Vessels

7.1.1 Magnitude and Duration

Installation the Gjøa to FLAGS gas export pipeline may result in some interference with commercial fishing, shipping or military operations in the area. At this stage, there is the option to install the pipeline using an anchor laybarge or a DP vessel (**Section 4.3.3**).

If an anchor laybarge is to be used temporary restrictions or access to shipping and fishing during the installation operations will be limited to a radius of 2,000m centred on the laybarge (the area occupied by the length of the anchor wires and the associated pennants); this gives a total area of approximately 12.6km^2.

If a DP vessel is to be used, restrictions or access to shipping and fishing will be limited to a radius 500m centred on the vessel and pipeline; this gives a total area of approximately 0.8km^2. Access restrictions along the proposed pipeline route are expected to last approximately 5 months in total.

7.1.2 Impact on Sensitive Receptors

The presence of the pipelay vessels (laybarge and support vessels) will restrict all traffic (fishing and shipping); such restrictions will be confined to a relatively localised area (0.8km^2 to 12.6km^2) and will occur' over a limited period (5 months). This would not significantly affect navigation or access to fishing grounds. Fishing effort in the area is moderate for the North Sea and the pipeline will be installed outside the most important fishing periods (**Section 5.4.4**). Shipping in the area is low to moderate for the UKCS (**Section 5.6.1**).

Noise emanating from the DP vessel may disturb cetaceans in the area (**Section 4.3.7.3**). Generally low numbers of cetaceans occur in the proposed area (**Section 5.4.6**) and those present would move away during operations, but would return to the area once the noise disturbance had ceased.

7.1.3 Impact on Proposed or Designated Conservation Sites

There are no proposed or designated conservation sites in the vicinity of the proposed operations.

7.1.4 Trans-boundary, Cumulative and Global Impacts

The proposed pipeline lies within UK and Norwegian waters, and there will be no impacts in any other region of the North Sea. Approximately 121.5km of the 130km pipeline will be laid within Norwegian waters. The impact assessment is equally valid on both sides of the UK / Norwegian borderline.

7.1.5 Stakeholder Concerns

No specific concerns have been expressed by stakeholders regarding the vessel presence during the Gjøa to FLAGS gas export pipelaying activities.

7.1.6 Adequacy of Proposed Mitigation Measures

The planned mitigation measures that Statoil would take to minimise the impact of the presence of vessels during the proposed activities are detailed in Table 7-1. The proposed mitigation measures represent standard industry practice and are judged to be sufficient.

Table 7-1: Potential sources of impact and planned mitigation measures for the presence of pipelay vessels.

Potential source of impact	Planned mitigation measure
Physical presence of pipelay vessels	Statoil will notify the Hydrographic Offices in both the UK and Norway, which will issue Notices to Mariners to advise fishing and shipping traffic of the potential hazards to navigation that are associated with the project. The operational area will be monitored with respect to vessel traffic during pipeline installation. The pipelaying vessel will have necessary communication equipment to alert shipping and fishing vessels of potential navigational hazards.

7.2 Anchoring of Vessels during Pipelaying Activities

7.2.1 Magnitude and Duration

The pipe-lay contractor will be selected during 2006/2007 and the contractor will be required to prepare a detailed method statement for the installation of the pipeline. At this stage, there is the option to install the pipeline using a conventional anchored lay barge or a DP vessel (**Section 4.3.3**).

An anchored lay barge would be positioned on the seabed by 10 to 14 anchors in a pre-determined ‘anchor pattern’ (Figure 7-1). In such a system, the anchors are attached to the lay-barge with a chain and cable combination; for each anchor line approximately 300m of chain would be in contact with the seabed, providing additional holding power. The anchors will be deployed and retrieved several times during the course of the pipelaying operation. The number of anchors to be used and their deployment pattern will be determined when the lay-barge to be used has been selected.

Depending on the nature of the seabed, the seabed sediments that are displaced when anchors are retrieved can create mounds up to 1m high, and anchor chains lying on, and sweeping over, the sediments can create gouges and scour marks. On a clay seabed, such anchor mounds can form and potentially become long-term obstructions when mobile fishing gear is used on the seabed. Geological surveys for the Tampen Link to FLAGS pipeline (Statoil, 2004) indicate that surface sediments are composed of fine to medium sand, and the sub-surface sediments (at depths of 0.1m to >10m) along the majority of the pipeline route comprise stiff clay (**Section 5.3.2**). It is possible, therefore, that persistent anchor mounds may be created along the Gjøa to FLAGS gas export pipeline route. The potential area of impact would be highly localised, and all the sites so disturbed would be confined within approximately 1 to 2km on either side of the pipeline corridor.

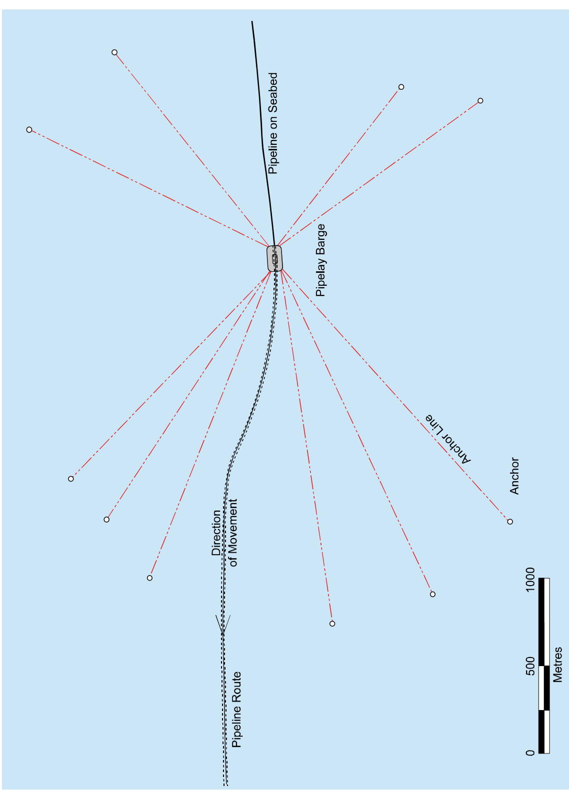


Figure 7-1: Typical anchor pattern for pipelay barge

A pipeline route survey for the Gjøa to FLAGS gas export pipeline will be undertaken in 2007, prior to pipeline installation. The results of this route survey and a post installation survey will be used to identify any potentially seabed hazards.

If it cannot be ruled out that the anchor mounds represent a hazard, Statoil will ensure that any significant mounds formed during the pipelaying activities are flattened using suitable methods.

7.2.2 Impact on Sensitive Receptors

With persistent anchor mounds the main issue is potential for intermittent impacts to fishing gear. Anchor mounds and scours also have the potential to cause disruption to benthic communities. The deployment and retrieval of anchors would cause some direct impact of invertebrates living on and in the sediments, and some physical disturbance of their environment as a result both of the ploughing of sediments and of the covering of sediments by disturbed material. This disturbance, however, will be small in comparison to the seabed disturbances already created by the fish trawling activities occurring within the area. In all cases, however, the disturbed sediments would be clean, and recolonisation from adjacent undisturbed communities would begin very quickly after the disturbance ceased. The area of seabed that could be physically disturbed by such operations would be very small in relation to the adjacent areas of comparable undisturbed seabed along the pipeline route.

7.2.3 Impact on Proposed or Designated Conservation Sites

There are no proposed or designated conservation sites in the vicinity of the proposed operations

7.2.4 Trans-boundary, Cumulative and Global Impacts

Anchor mounds are small and localised, and would not, therefore, contribute to transboundary or global impacts.

7.2.5 Stakeholder Concerns

No specific concerns have been expressed by stakeholders regarding the effects of anchoring during the Gjøa to FLAGS gas export pipelaying activities.

7.2.6 Adequacy of Proposed Mitigation Measures

The planned mitigation measures that Statoil would take to minimise the impact of anchoring the pipelay barge during the proposed activities are detailed in Table 7-2. The proposed mitigation measures represent standard industry practice and are judged to be sufficient.

Table 7-2: Potential sources of impact and planned mitigation measures for anchoring of vessels.

Potential source of impact	Planned mitigation measure
Anchoring the pipelay vessel	Statoil will plan the exact location of the anchors and will use a ROV (post-lay) to ensure that they were placed correctly on the seabed. Although it is likely that persistent anchor mounds will form, Statoil will undertake a survey of the pipeline route immediately after the pipeline has been laid to identify any seabed discontinuities. If it cannot be ruled out that the anchor mounds do not pose a hazard, Statoil will ensure that any significant mounds formed during the pipelaying activities are flattened using suitable methods.

7.3 Pipeline Installation

7.3.1 Magnitude and Duration

The 130km, 30” (28” internal diameter) gas export pipeline will be placed on the seabed, in a conventional lay formation, with the 8.5km of the pipeline placed in the UKCS (**Section 4.3.3**).

During this pipelaying activity there will be disturbance to the seabed sediments, and benthic organisms living within the sediments, along the length of the pipeline route. It is estimated that the total area of the seabed that would be affected by the direct placing of the pipeline, rock dumps and protective structures is approximately 0.091km^2. The spatial extent of the impact will therefore be confined to a relatively small area compared to the available habitat area in this part of the North Sea.

Eight crossings (**Section 4.3.2**) will be constructed to support the proposed pipeline and protect the existing pipelines, with 2 pipeline crossings in the UKCS. At each crossing, the pipeline will be surrounded and covered by a gently sloping protective “skirt” of rock. The graded, crushed rock will range in diameter from 3.2cm to 12.5cm. The existing pipeline that is being bridged will remain “live” during the construction of these crossings.

Rock-dumping will be required at various locations along the line and at the pipeline crossings. Approximately 76,750m^3 of intermittent rock-dump would be required to stabilise the pipeline, with 12,000m^3 of intermittent rock-dump in the UKCS. The total amount of rock-dump required over the 2 pipeline crossings in the UKCS would be approximately 6,500m^3.

7.3.2 Impact on Sensitive Receptors

Laying the pipeline and creating the rock-dumps will disturb the seabed sediments, and benthic organisms living in or on these sediments, in the relatively small area of seabed directly below the pipeline and rock-dumps. The total area covered by these structures will, however, be small in relation to the area of undisturbed benthic habitat adjacent to the line, and the overall ecological impact will be very small.

The pipeline, pipeline crossings and rock-dump areas will create new habitats for benthic organisms that live on hard surfaces. Such organisms typically include tubeworms, barnacles, hydroids, tunicates and bryozoans, which are commonly found on submerged rocky outcrops, boulders and offshore structures. These structures could also provide habitats for crevice-dwelling fish (e.g. ling) and crustaceans (e.g. squat lobsters and crabs). The overall ecological change or benefit would be negligible, however, because these structures will have a small surface area.

A very small number of demersal and pelagic fish might be temporarily disturbed by the pipelaying operations, and, if large amounts of seabed sediment were re-suspended into the water column, it is possible that small areas of spawning ground could become degraded for a time. After the pipeline has been installed, however, it is anticipated that a variety of fish species would be found along its entire length, making use of the shelter provided by this new structure on the seabed.

7.3.3 Impact on Proposed or Designated Conservation Sites

There are no proposed or designated conservation sites in the vicinity of the proposed operations.

7.3.4 Trans-boundary, Cumulative and Global Impacts

There are several existing pipelines in this area (**Section 4.3.2**). Since all of them were installed several years ago, the seabed will have recovered from any previous trenching operations, and therefore the installation of the new pipeline will not lead to any cumulative impacts.

7.3.5 Stakeholder Concerns

No specific concerns have been expressed by stakeholders regarding the effects of installing the Gjøa to FLAGS gas export pipeline on the seabed.

7.3.6 Adequacy of Proposed Mitigation Measures

The planned mitigation measures to be taken by Statoil to minimise the impact of installing the Gjøa to FLAGS gas export pipeline are detailed in Table 7-3. The mitigation measures represent standard industry practice and are judged to be sufficient.

Table 7-3: Potential sources of impact and planned mitigation measures for pipeline installation.

Potential source of impact	Planned mitigation measure
Pipelaying	The pipeline route will be surveyed in order to determine the detailed bathymetry and seabed conditions, and to identify the optimum pipeline route. This survey will include sidescan sonar, echo soundings, core samples and visual inspections by ROV. Careful control will be carried out to ensure that the pipe is laid in exactly the correct location and according to specifications.
Rock-dumping	The rock-dumping operations will be monitored and controlled to ensure that all of the required rock-dumps are created in the correct locations and according to the planned specifications. The location and profile of rock-dumps will be made available to fishermen and fishing interests. The characteristics and profiles of the rock-dumps will be designed so that the risk of snagging to fishing gear is minimised.

7.4 Physical Presence of the Pipeline and Subsea Structures

7.4.1 Magnitude and Duration

Untrenched offshore pipelines lying on the seabed surface have the potential to interact with fishing gear and anchors. The presence of the new gas export pipeline, the pipeline crossings and the subsea structures (FLAGS HTT and Gjøa PLEM) with protective covers and rock-dumps may therefore result in some interference with commercial fishing or shipping operations in the area.

7.4.2 Impact on Sensitive Receptors

The proposed pipeline is located in an area of high commercial value for fish species caught by both UK and Norwegian fishermen, and the main fishing gears used in the area are demersal / bottom trawling methods (**Section 5.4.4**) which have the greatest potential to interact with subsea pipelines.

Fishing with passive gears, such as nets and lines, can also be impacted during pipeline installation (Hansen, 1992). After a pipeline has been laid, it is unlikely to represent any hazard to passive fishing gears. For this reason, the following section focuses on the interaction of active, rather than passive, fishing gear and the pipeline. It examines the following:

- Interaction with the pipeline itself;
- Interaction with rockdump; and
- Interaction with HTT and PLEM.

Interaction with the pipeline: The gas export pipeline will be designed to withstand interactions with fishing gear, and to present a profile that will, in so far as practicable, minimise the risk of impedance of mobile fishing gear which traverses the pipeline. The pipeline is regarded as over-trawlable.

In areas where fishing with bottom trawl gear is likely, the industrial practice in the North Sea has been to protect all pipelines with diameters less than 16” from trawl interaction by burying or rock dumping the entire length (Tornes *et al.,* 1998).

Studies undertaken in Norway concluded that pipelines laid directly onto the seabed and exposed to interaction with fishing gear, need to have a protective coating, usually of concrete (Verley, 1994). Research on the interaction between trawling and pipelines in the North Sea has shown that small diameter pipelines (16” to 20”) are more likely to cause snagging and possible loss of gear than large diameter pipelines (RSK Environment Ltd, 1992). Available evidence indicates that the interaction between large diameter pipelines and fishing gear is rare (RSK Environment Ltd, 1992). The Gjøa to FLAGS gas export pipeline will be concrete coated, and will fall within the category of a ‘large diameter pipeline’.

Fishing in the vicinity of pipelines incurs the risk of hooking the trawl gear on the pipelines. Hooking is an accidental load condition on the pipeline, where the gear becomes attached to the pipeline and brings the fishing vessel to a halt (Trevor Jee, 1999). Although hooking is rare and can occur to any type of gear, it is the most other serious type of interaction, because it can result in damage to the fishing gear, displacement of or damage to the pipeline, and in extreme cases damage to the fishing vessel. Pipeline hooking is:

- limited to otterboards rather than beam trawls;
- associated with larger diameter pipelines (>16”); and
- linked to fishing practices and, in, particular vessels fishing along the pipeline rather than across it.

During 1988, a Norwegian project on "Trawling over Pipelines", which included pipelines ranging between 28" and 30", proved that, if trawls are to pass over pipelines without being damaged, the route and the alignment of the pipeline are important (RSK Environment, 1992). Tests showed there were no problems as long as the fishing gear passed the pipeline at an angle of 45° or more. Passing the pipeline at an angle of <45° makes it difficult for the gear to surmount the pipeline (Hansen, 1992). The operational problems will increase with increasing angle (Hansen, 1992). The route of the pipeline will be shown on Admiralty Charts, from which fishermen can judge the location of their gear and direction of the tow relative to the pipeline. There is no evidence that the trawling direction has any bearing on the volume of the catches in this particular area. In addition, UK vessels operating in the proposed area often (20% of fishing effort in 2004; **Section 5.4.4**) conduct pair trawling (two vessels towing a common bottom trawl). These vessels are not equipped with trawl doors that may hook onto the pipeline (Acona, 2004).

Interaction with rockdump: The proposed pipeline will be rock-dumped along sections of the route to provided support and stability. Pipelines protected on the surface by rock-dumping can present a hazard to towed fishing gears. While trawling over a rock-dump section of a pipeline, graded rock can be dragged off a rock-dump by bottom fishing gear and spread over the seabed. In addition the rock can:

- cause wear and tear on the net;
- damage the pump when the fish are unloaded; and
- crush or damage the fish when caught.

During 1997, the Norwegian Institute of Marine Research conducted an over-trawling experiment to assess the risk of rock-dumped pipelines to bottom trawling fishing gears (Soldal, 1997). The trial concluded that lighter fishing gear with weighted ground line was not suitable for crossing rock-dumped pipelines. However, fishermen trawling this trial area for whitefish, have towed their gear without reported difficulty (Soldal, 1997).

In addition, over-trawling tests were conducted over areas of rock-dump along Statoil's 20" Sleipner condensate pipeline, an area extensively fished by prawn trawlers. These 1998 trials indicated that over-trawling could be harmless even for light equipment if the trawl gear was rigged for demersal fish trawling (Statoil, 1998).

During 2002, meetings were held with fishermen regarding Norsk Hydro's Ormen Lange pipeline in the Norwegian sector of the northern North Sea. The fishermen confirmed that they trawled over pipeline rock-dumps without operational problems or fishing gear damage, due mainly to their heavy net trawl gear and rock protective netting (Aaserød, 2002). Heavy gear trawling in Norwegian waters, across areas of new rockdumps, has resulted in large amounts of gravel / rock being dragged over the surrounding seabed (Kolle, 2006).

In relation to the Gjøa to FLAGS gas export pipeline, the use of heavier equipment by whitefish trawlers is predominant, and the rock placement will be well graded (**Section 4.3.2**), which enables rocks to pass through the mesh if they enter the fishing net, but also providing adequate pipeline protection. No significant operational problems for demersal trawling due to rock-dumping along the pipeline are therefore forseen.

Interaction with HTT and PLEM: These subsea structures will be located within protective tubular steel frames, which are designed to have a fishing friendly profile with sloping sides designed to deflect trawls. No significant operational problems for demersal trawling are foreseen from the presence of the protective covers on the seabed.

In summary, Statoil's detailed design of the concrete-coated pipeline, the graded and profiled rockdump, and the fishing-friendly protective covers on the HTT and PLEM, will minimise the potential impact to the fishing industry. Mariners will be notified of the precise location, dimensions and heights of all seabed structures; the locations of all subsea structures will be recorded on Admiralty charts.

In addition, there is no known military activity in the vicinity of the proposed development (**Section 5.6.3**).

7.4.3 Impact on Proposed or Designated Conservation Sites

There are no proposed or designated conservation sites in the vicinity of the proposed operations

7.4.4 Trans-boundary, Cumulative and Global Impacts

The proposed pipeline, crossings and subsea structures lie within UK and Norwegian waters. The impact assessment is equally valid on both sides of the UK / Norwegian median line.

7.4.5 Stakeholder Concerns

No specific concerns have been expressed by stakeholders regarding the physical presence of the Gjøa to FLAGS gas export pipeline or associated subsea structures.

7.4.6 Adequacy of Proposed Mitigation Measures

The mitigation measures that Statoil plan to enact to minimise the main risks of fishing interactions with the subsea structures are detailed in Table 7-4. The proposed mitigation measures represent standard industry practice and are judged to be sufficient.

Table 7-4: Planned mitigation measures for the presence of the pipeline, crossings and structures

Potential source of impact	Planned mitigation measure
Loss of access to fishing grounds	The area covered by the new structures would represent a tiny fraction of the available seabed. A post-lay survey of the seabed will be conducted to verify that the structures are installed according to plan, and are over-trawlable. Mariners will be notified of the precise location, dimensions and heights of all seabed structures. All subsea structures, including pipelines, will be recorded on Admiralty charts.
Potential impedance to navigation and military exercises	No military activities have been found in the area.
Damage or loss of fishing or vessel caused by gear entanglement on the pipeline	The design of the pipeline would minimise potential impacts to the fishing industry. The HTT and PLEM, and their protective structures, will be designed so that they do not impede fishing activities. The characteristics and profiles of the planned areas of rock-dump will be designed to minimise the risk of snagging to fishing gear.

7.5 Emissions from Anodes

7.5.1 Magnitude and Duration

The 30" gas export pipeline would bear 677 sacrificial anodes, each weighing 20.2kg, which would protect the pipeline against corrosion which could lead to pipeline failure and the release of hydrocarbons. The anodes that would be used on the gas export pipeline would be suitable for long-term continuous service in sea water, saline mud or alternating seawater and saline mud environments. Sacrificial anodes are typically made from either zinc (Zn) or aluminum (Al), and the typical composition of such anodes is shown in Table 7-5.

Table 7-5: Typical composition of aluminium and zinc anodes

Element	Aluminium Anodes	Zinc Anodes
Aluminium	95.4%	0.3%
Bismuth	0.1%	0%
Cadmium	0%	Trace (about 0.03 to 0.05%)
Copper	Trace (about 0.006%)	Trace (about 0.005%)
Indium	Trace (about 0.02%)	0%
Iron	0.1%	Trace (about 0.005%)
Lead	0%	Trace (about 0.02%)
Mercury	Trace (about 0.05%)	0%
Silicon	0.1%	0.1%
Titanium	Trace	0%
Zinc	4.2%	99.5%

When the sacrificial anodes waste, Al and Zn go into solution. The Al will dissolve, with oxidation, in seawater producing hydrated Al ions. Because seawater is practically saturated in Al, the Al ions, although initially soluble, will not remain in solution. Some will be removed by sorption onto colloid particles, and bottom muds, but most will flocculate, forming amorphous, submicron to micron-size particulates. It is therefore predicted that the Al will form a floc of approximate composition $Al(OH)_3nH_2O$, which is essentially inert. The majority of such floc would remain within the sediment because the pipeline would be buried. Any floc that was released into the water column would be rapidly and widely dispersed by currents, because the floc would be of small particle size and low density (about 1.25)(UKOOA, 1995).

The Zn will dissolve slowly with oxidation, but its fate is subject to some uncertainties. The Zn content of seawater is somewhat less than saturation and the observed balance is probably maintained between replenishment and removal by (i) ion exchange into seabed oxide minerals, (ii) sorption by colloids and (iii) removal in anoxic zones, with formation of sulphides.

A conservative assumption has been made that the anodes on the gas export pipeline would be fully wasted after 20 years. Furthermore, it has been assumed that the wastage rate would be steady and linear throughout this period.

The discharge of dissolved contaminants from the pipeline anodes cannot be modelled using point-source models or equations such as CORMIX. However, the concentration of dissolved contaminants in the water column around the pipeline can be estimated on the basis of the amount of material dissolving into the water column each day, and the volume of water over the pipeline. This is a conservative estimate since it des not take account of any diffusion of contaminants in the water column or any gross mixing that would take place around the pipeline.

The 130km gas export pipeline has a diameter of 30" (0.7112m), with 8.5km of the pipeline occurring in the UKCS. The maximum current in the area flows at 0.5m/s, so approximately 4 billion m^3 of water flows around the whole pipeline each day, with approximately 261 million m^3 of water flowing around the 8.5km of pipeline in the UKCS. On the assumption that the 677 aluminium anodes would last for 20 years, approximately 1,873g of anode material would dissolve into this body of water every day from the whole pipeline and 527g of anode material would dissolve into this body of water every day from the 8.5km of pipeline in the UKCS.

The resulting theoretical concentrations of various elements are shown in Table 7-6a and b, and compared with the concentrations of these elements in seawater.

7.5.2 Impact on Sensitive Receptors

Dilution in the marine environment will reduce the concentration of Al and Zn quickly so that organisms at distances of more that 100 to 200m from source are likely to be exposed to very low concentrations (UKOOA, 1995). The physical and chemical processes of biodegration and complexing with proteins will render some of the metals unavailable or largely unavailable to marine organisms.

Table 7-6a: Estimated concentrations of elements released to seawater through dissolution of sacrifical anodes on the whole gas export pipeline and comparison with concentrations in North Sea water.

Element	Proportion of anode (%)	Estimated daily input from anodes (g)	Estimated concentration without diffusion current at 0.5m/s (µg/l)	Typical concentration in seawater (µg/l)	General concentration in seawater (µg/l)	EQS value for nearshore water(µg/l)
Aluminium	94.500	1,787.17	0.43442		1	200(1)
Bismuth	0.100	1.87	0.00046		0.02	
Copper	0.006	0.11	0.00003	0.05 to 0.36 (2)	0.9	5
Indium	0.020	0.37	0.00009		No Data	
Iron	0.100	1.87	0.00046	0.0028 to 1.23	3.4	1,000
Mercury	0.050	0.94	0.00023	0.0002 to 0.0005(3)	0.15	0.3(5)
Silicon	0.100	1.87	0.00046	0 to 10,000	2,900	
Zinc	4.200	78.68	0.01913	0.01 to 0.075(4)	5	40

Notes:

(1) No EQS for marine water, this is for drinking water
(2) For North Sea, 75ng/Kg for North Atlantic (OSPAR Commission,2000)
(3) 0.5 to 3ng/l open sea; 2 to 15ng/l coastal water; 0.15 to 0.3ng/kg North Atlantic
(4) For North Atlantic (OSPAR Commission, 2000)
(5) EAC for Hg is 5 to 50µg/l

Table 7-6b: Estimated concentrations of elements released to seawater through dissolution of sacrifical anodes on the 8.5km of pipeline in the UKCS and comparison with concentrations in North Sea water.

Element	Proportion of anode (%)	Estimated daily input from anodes (g)	Estimated concentration without diffusion current at 0.5m/s (µg/l)	Typical concentration in seawater (µg/l)	General concentration in seawater (µg/l)	EQS value for nearshore water(µg/l)
Aluminium	94.500	502.89	1.86956		1	200(1)
Bismuth	0.100	0.53	0.00196		0.02	
Copper	0.006	0.03	0.00012	0.05 to 0.36 (2)	0.9	5
Indium	0.020	0.11	0.00039		No Data	
Iron	0.100	0.53	0.00196	0.0028 to 1.23	3.4	1,000
Mercury	0.050	0.26	0.00098	0.0002 to 0.0005(3)	0.15	0.3(5)
Silicon	0.100	0.53	0.00196	0 to 10,000	2,900	
Zinc	4.200	22.14	0.08231	0.01 to 0.075(4)	5	40

Notes:

(6) No EQS for marine water, this is for drinking water
(7) For North Sea, 75ng/Kg for North Atlantic (OSPAR Commission,2000)
(8) 0.5 to 3ng/l open sea; 2 to 15ng/l coastal water; 0.15 to 0.3ng/kg North Atlantic
(9) For North Atlantic (OSPAR Commission, 2000)
(10) EAC for Hg is 5 to 50µg/l

The concentrations of dissolved elements in the water column caused by the steady dissolution of the anodes over the 20 year period, estimated on the basis of the assumptions stated above, would be very low in comparison with existing natural concentrations in the North Sea, and, where available, existing environmental quality standards (EQS) or Environmental Action Concentrations (EAC) (Table 7-6a and b). It should be noted that EQS values are set primarily to ensure the quality of nearshore waters used for abstraction or bathing, and are thus more stringent than levels that might be set on the basis of known effects on marine organisms.

7.5.3 Impact on Proposed or Designated Conservation Sites

There are no proposed or designated conservation sites in the vicinity of the proposed operations

7.5.4 Trans-boundary, Cumulative and Global Impacts

Given the much larger inputs of contaminants into the North Sea from other sources (Table 7-6a and b; OSPAR Commission, 2000), the contribution from the wastage of anodes on the proposed gas export pipeline (2,904kg over 20 years) would be insignificant even if it were all to be released into the water column.

7.5.5 Stakeholder Concerns

No specific concerns have been expressed by stakeholders regarding emissions from anodes on the Gjøa to FLAGS gas export pipeline.

7.5.6 Adequacy of Proposed Mitigation Measures

The mitigation measures that Statoil plan to enact to minimise the main risks of fishing interactions with the subsea structures are detailed in Table 7-7. The proposed mitigation measures represent standard industry practice and are judged to be sufficient.

Table 7-7: Planned mitigation measures for the presence of the pipeline, crossings and structures

Potential source of impact	Planned mitigation measure
Emissions from anodes	Industry-standard sacrificial anodes will be used on the pipelines. The pipelines will have a design life of 20 years and will have cathodic protection systems for offshore pipelines. The total mass of anodes on the pipelines would be as small as possible commensurate with ensuring the integrity of the pipeline over its planned life.

7.6 Accidental Diesel Spill

7.6.1 Magnitude and Duration

The Gjøa to FLAGS pipeline will carry gas so there is no likelihood of a crude oil spill. Consequently accidental spills could only arise from vessels working on marine operations, such as the laybarge or other types of ship. Potential sources of oil spills from the project's vessels include:

- Upsets in the treatment system for bilge water.
- Loss of containment in a storage tank (e.g. of lube oils, fuel oil, or chemicals).
- Damage to a fuel bunker caused by a collision, grounding or fire.

Diesel is a non-persistent oil that rapidly evaporates from the surface of the sea. In the unlikely event of an accidental spill of diesel fuel from a vessel, a diesel slick would form on the sea surface. The slick would disperse and degrade rapidly as a result of wave, current, microbial and photolytic action.

A worst-case oil spill scenario of an instantaneous release of 1,000m^3 of diesel caused by a major loss of fuel containment during a serious collision involving the laybarge) was modelled using the Oil Spill Information System Software version 3 (OSIS) (BMT Cordah, 2006). Both the stochastic and deterministic modelling were undertaken. The 1,000m^3 volume of diesel is considered to be a typical storage capacity for a pipelay vessel, although the operating capacity is usually much lower than this.

The stochastic model was allowed to run over a 240-hour (10 day) period for October (which is the month with strongest current speeds). Stochastic modelling combines the results from a series of model runs at different wind speeds and directions to give a probability of surface oiling and beaching. The OSIS stochastic model runs either for a set duration or until the amount of diesel on the surface becomes insignificant. The model run duration was set to 240 hours (10 days), even though diesel oil would not be expected to persist for this period.

The contour plots (Figure 7-2) shows the probability of sea surface oiling (down to the 1% probability). Modelling indicates that under null wind conditions the diesel persisted for 30 hours, under minimal wind conditions the diesel persisted for 17 hours, and under the strongest wind conditions the diesel persisted for a maximum of 8 hours. The results indicate than an area of 3km^2 would have a 50% probability of sea surface oiling, with a 10% probability of sea surface oiling covering an approximate area of 100km^2.

Deterministic modelling simulates a point source spill scenario under a single set of metocean conditions. The final results from deterministic modelling are presented on a map indicating the trajectory of the oil, the area of the slick, and beaching location of the spill after a specified period.

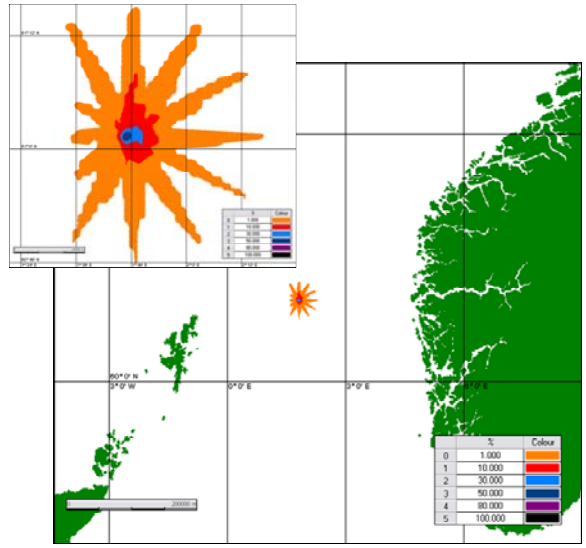


Figure 7-2: Stochastic modelling of 1000m^3 diesel release at a mid-point location along the UK Section of the gas export pipeline

Deterministic modelling was also been completed for the instantaneous 1000m^3 tonne spill of diesel oil from a pipelay vessel. The scenario was based on a winter release date with an 80 degree, 40 knot wind. Under these conditions the spill is expected to extend by no more than 13km from the release location. No diesel is expected to beach and it would disperse naturally within 9 hours (Figure 7-3).

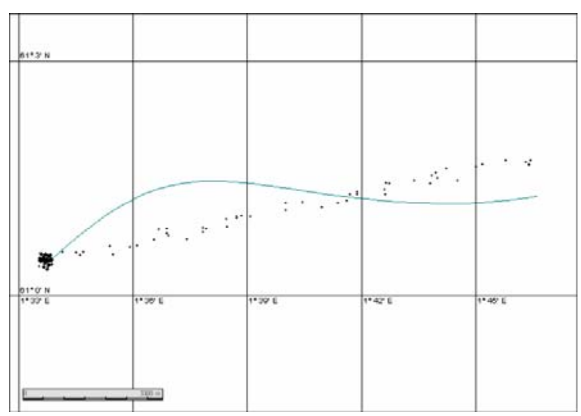


Figure 7-3: Deterministic modelling of 1000m^3 diesel release

7.6.2 Impact on Sensitive Receptors

The potential risk to birds from diesel pollution arises as a result of damage to feathers which reduces mobility, buoyancy, insulation and waterproofing. Birds may also ingest the hydrocarbons, which are toxic, and may face starvation if their food sources are depleted as a result of the spill. The species most at risk from oil pollution are those that spend large amounts of their time on the water, such as guillemots, razorbills and puffins. The Joint Nature Conservation Committee (JNCC) Seabirds at Sea Team (SAST) have developed an index to assess the vulnerability of birds to the threat of oil pollution (JNCC 1999). The offshore vulnerability index is based upon four factors (Williams *et al.*, 1994):

- the amount of time spent on the water
- total biogeographic population
- reliance on the marine environment, and;
- potential rates of recovery

Seabird vulnerability in the area of the gas export pipeline is high in July and November (**Section 5.4.5**). In the other months, vulnerability is moderate to low.

Cetaceans have smooth virtually hairless skins over a thick layer of insulating blubber, so oil is unlikely to adhere persistently or cause hypothermia. However, they may inhale vapours given off by spilt diesel and their eyes may be vulnerable to gross contamination in the event of a large spill. A major release of oil or diesel may pose a significant indirect threat by contaminating or depleting the sea mammals' prey species. There are generally very few cetaceans in the area of the pipeline at any one time (**Section 5.4.6**), however, so it is unlikely that the viability of any specific species would be impacted in the event of a diesel spill.

The eggs and juveniles of fish are most vulnerable to surface oil spills, because the adult fish are generally highly mobile and thus able to move away from polluted areas. Fisheries sensitivity maps show that the proposed project area lies within the spawning areas for cod, haddock, saithe and Norway pout (**Section 5.4.3**). These species spawn over wide areas of the North Sea, and the viability of the species would not be impacted in the unlikely event of a diesel spill.

Sensitive coastal sites would not be at risk from a diesel spill; OSIS modelling has shown that no beaching of diesel would occur (Figure 7-2).

7.6.3 Impact on Proposed or Designated Conservation Sites

There are no proposed or designated conservation sites in the vicinity of the proposed operations.

7.6.4 Trans-boundary, Cumulative and Global Impacts

Should a major diesel spill occur during the pipeline activities, OSIS modelling predicted that diesel could spread over a 100km^2 area, which if this were to happen, would impinge predominantly upon the Norwegian Sector of the North Sea.

There would be no global or cumulative impacts as a result of a diesel spill.

7.6.5 Stakeholder Concerns

No specific concerns have been expressed by stakeholders regarding the effects of an accidental spill of diesel during the Gjøa to FLAGS gas export pipelaying activities.

7.6.6 Adequacy of Proposed Mitigation Measures

The mitigation measures that Statoil plan to take during the proposed development activities to minimise the main risks of hydrocarbon spills are detailed in Table 7-8. The proposed mitigation measures represent standard industry practice and are judged to be sufficient.

Table 7-8: Sources of oil spills and planned mitigation measures

Potential source of impact	Planned mitigation measure
Diesel	Statoil will put in place the following mitigation measures to reduce the risk of oil spills from the pipelaying vessels: ▪ All vessels will comply with IMO / MCA codes for the prevention of oil pollution and all vessels will have onboard Shipboard Oil Pollution Emergency Plans (SOPEPs). ▪ As far as possible, Statoil will use vessels which have experience of operating in the northern North Sea and are familiar with the weather and operating conditions in the area. ▪ Before mobilisation all vessels will be audited. This will ensure that the detailed list of spill prevention procedures which will be stipulated in the contract are in place.
Loss of pipelay vessel inventory (collision with another vessel)	To ensure that the risk of collision is minimised, Statoil will have the following mitigation measures in place: ▪ The ocean area in the vicinity of they pipelaying vessel will be continuously monitored for any approaching vessels. Approaching vessels will be alerted. The pipelay vessel will be fitted with all necessary navigational and communication equipment. ▪ All relevant maritime authorities and fishing organisations will be notified of the proposed pipelaying activities.
All spills	As stated above, and as required under international legislation (MARPOL 73/92 Amended), the laybarge and other qualifying vessels will have in place Shipboard Oil Pollution Emergency Plans (SOPEPs). The plans will detail the actions to be taken in the event of a loss of shipboard containment. Vessels will have sufficient equipment to enable them to respond, contain on board and clean up minor pollution events. In the unlikely event that a large release occurred from vessel, there is the capacity to engage specialist spill response organisations, who can provide advice, support and an on-scene response, if required. These third party specialists would be brought in under the provisions that vessel operators have with their insurers. Statoil also have in place agreements with third party specialists.

8 ENVIRONMENTAL MANAGEMENT

This section assesses the proposed mechanisms for implementing the measures to reduce significant environmental impacts and risks. The assessment focused on the framework and systems for assuring and monitoring environmental performance, and managing the interface between the operator and contractors during the construction and operational phases of the project.

8.1 Company Policy

Statoil has an Environmental Policy which supports the goals of zero harm to the environment, and of sustainable development. Statoil's environmental policy is set by the company's senior management and applies to all the company's activities worldwide and to the whole workforce. Statoil's Environmental Policy is summarised as follows:

- We will act according to the precautionary principle
- We will minimise impact on the environment, whilst continuing to address health, safety and economic issues
- We will comply with applicable legislations and regulations
- We will continuously improve our energy efficiency, environmental performance and products
- We will set specific targets and improvement measures based on relevant knowledge of the area affected, and by applying risk analyses to assess environmental health effects
- We will consult and cooperate with relevant stakeholders and strive for solutions acceptable to all affected parties
- We will make our policy available to the public, openly report our performance and use a competent and independent body to verify our reported data
- We will seek to make the best possible utilisation and use of natural resources
- We will contribute to the reduction of Green House Gases (GHG) by reducing relevant emissions from our activities and by participating in emission trading and utilising project based mechanisms
- We will prepare for a carbon constrained energy market and engage in the development of non-fossil energy sources and carriers

8.2 Policy Implementation and Environmental Management Systems

The commitments of the environmental policy are enacted by mechanisms that Statoil puts in place to effectively implement, measure, control and improve the activities and processes that are carried out by the company and its contractors. These activities and processes form an integral part of the business, commercial planning and decision-making processes at Statoil. Statoil's requirements for managing activities and processes are described in the document *HSE management in Statoil*.

This document specifies standards for management, the organisation, expertise, risk management and emergency response, as well as technical requirements for health and the working environment, the natural environment, safety, emergency response and security. HSE is a line management responsibility in Statoil. Managers have a particular duty to ensure that goals are met, but all employees in the company share a personal responsibility for this. Statoil requires that all entities have established and documented appropriate systems, which ensure that HSE requirements are met.

Such a system will apply to the Gjøa to FLAGS gas export pipeline project, and this Environmental Statement being a planning and decision making document within that system.

8.3 Project Specific Environmental Management

All of the mitigation measures and controls identified in the Environmental Statement have been summarised in Tables 8-1 and 8-2.

Table 8-1: Significant environmental impacts and planned mitigation measures

Potential source of impact	Potential impact or risk to the environment	Planned mitigation measures
Physical presence of pipelay vessels	▪ Temporary restrictions to sea access during construction period (0.8km^2 to 12.6km^2) in an area of moderate levels of fishing effort and shipping traffic in the UKCS. Noise may disturb low densities of cetaceans in the area.	▪ The pipelaying and details work will be advertised through Notice to Mariners in the UK and Norway. ▪ A guard vessel will alert shipping and fishing vessels on approach to the proposed area. ▪ Activities and restrictions will only last for 4 months. ▪ Low densities of cetaceans in the proposed area. ▪ Noise will be mitigated by use of well maintained vessels and equipment.
Anchoring of vessels during pipeline installation.	▪ Anchor mounds can form on clay seabed, and potentially become long-term, localised obstructions that could interact with fishing gear.	▪ Exact location of the anchors will be planned. ▪ An ROV will be used to ensure anchors placed on the seabed correctly. ▪ A survey of the pipeline route will be undertaken on completion of the activities to identify any seabed discontinuities. ▪ Statoil will ensure any significant mounds formed will be flattened using suitable methods.
Pipeline installation	▪ Installation will disturb the seabed sediments, and the benthic organisms living in or on the sediments, in a small area of seabed beneath the pipeline. ▪ The pipeline and rock-dump will create a new area of habitat for benthic organisms that live on hard surfaces, and provide additional habitat for crevice-dwelling fish. Note, however, there is no implication that this localised area of new habitat would constitute an enhancement of the benthic environment. ▪ Potential impedance to commercial fishing (see also **Physical presence of pipelines**)	▪ Pipeline route survey of the area will be used to plan the optimum the route. ▪ A survey vessel will be on station during installation to ensure that the pipeline is laid in the correct location. ▪ Rock-dumping will be supervised by an ROV to ensure that material is placed accurately and in the correct location. ▪ FEPA licence and Pipeline Works Authorisation (PWA) applications will be made. ▪ Location and profile of rock-dumps will be made available to fishermen and fishing interests. ▪ Characteristics and profiles of the rock-dumps will be designed to minimise the risk of snagging to fishing gear.
Physical presence of the pipeline and subsea structures	▪ Potential impedance to navigation and military exercises. ▪ Loss of access to fishing grounds. ▪ Damage or loss of fishing gear or vessel caused by gear entanglement on the pipeline, subsea structures or rock-dump. ▪ The area covered by the new structures would represent a tiny fraction of the available seabed, and fishermen would be able to secure their annual catches at nearby locations.	▪ No military activities occur in the area. Mariners will be notified of the location, dimensions and heights of all seabed structures. ▪ Locations of all subsea structures, including pipelines, will be recorded on Admiralty charts. ▪ Design of the pipeline will minimise potential impacts to the fishing industry. ▪ HTT and PLEM, and their protective structures, will be designed so that they do not impede fishing activities. ▪ Characteristics and profiles of the rock-dumps will be designed to minimise the risk of snagging to fishing gear. ▪ The seabed will be surveyed after the 22" or 32" gas export pipeline has been laid and any significant obstructions will be levelled.
Emissions from anodes	▪ Release of contaminants into the water column and onto the seabed.	▪ Industry-standard sacrificial anodes will be used on the pipelines. ▪ The pipelines will have a design life of 20 years and will have cathodic protection systems for offshore pipelines. ▪ The total mass of anodes on the pipelines would be as small as possible commensurate with ensuring the integrity of the pipeline over its planned life.

Table 8-1 continued: Significant environmental impacts and planned mitigation measures

Potential source of impact	Potential impact	Planned mitigation measures
Accidental spill of diesel	▪ Diesel would disperse rapidly. No residual impacts would be expected on the local environment.	▪ Statoil will put in place a number of mitigation measures to reduce the risk of oil spills from the pipelaying vessels. ▪ The sea area in the vicinity of the pipelay vessel will be continuously monitored for any approaching vessels; ▪ The pipelay vessel will be equipped with all necessary navigation and communication equipment; and ▪ All the relevant maritime authorities, and representative fishing organisations, will be notified of the proposed pipelaying activities. ▪ As required under MARPOL 73/92 Amended, the laybarge and other qualifying vessels will have in place Shipboard Oil Pollution Emergency Plans (SOPEPs). ▪ The plans will detail the actions to be taken in the event of a loss of shipboard containment. ▪ Vessels will have sufficient equipment to enable them to respond, contain on board and clean up minor pollution events. ▪ In the unlikely event that a large release occurred, there is the capacity to engage specialist spill response organisations, who can provide an on-scene response, if required. These third party specialists would be brought in under the provisions that vessel operators have with their insurers. ▪ Statoil also have in place agreements with third party specialists.

These measures will be incorporated into the Environmental Management Plan (EMP), which will be implemented prior to the start of construction. The EMP will be a key part of the system for implementing Statoil's company policies and commitments made within the ES during the construction of the Gjøa to FLAGS gas export pipeline.

The main objectives of the EMP will be:

- Ensure compliance with legislation, Codes of Practice and Regulations;
- Ensure compliance with any conditions set by the local planning authority, or other consent granting bodies;
- Ensure compliance with Statoil group's environmental policy; and
- Ensure implementation of the mitigation measures identified in the EIA process.

In addition, it will address the following:

- Contingencies for unforeseen events;
- Roles for Gjøa staff and Contractor staff;
- Briefing of personnel on matters such as environmental awareness;
- Monitoring, watching briefs and audit of construction works; and
- Restoration, after-care and post-completion inspections.

Table 8-2: Non-significant environmental impacts and planned mitigation measures

Potential source of impact	Potential impact or risk to the environment	Planned mitigation measures
Noise from vessels during pipelaying activities	▪ Noise could potentially disturb low densities of marine mammals in the area.	▪ Noise will be minimised through well maintained equipment
Power generation on vessels during pipelaying and decommissioning activities	▪ Short-term, localised air quality deterioration around exhaust outlets.	▪ Emissions will be managed through the use of well maintained equipment and burning low sulphur diesel fuel.
Discharge of treated bilge from vessels during pipelaying and decommissioning activities	▪ Localised deterioration in seawater quality around discharge point. ▪ Potential for oil slick formation	▪ Compliance with MARPOL. ▪ Local environmental conditions will rapidly disperse any hydrocarbon discharges.
Sewage discharged from vessels during pipelaying and decommissioning activities	▪ Localised increase in biological oxygen demand around point of discharge. ▪ Increase in fish and plankton productivity	▪ Sewage treated prior to disposal or contained and shipped to shore. ▪ Vessel audits. ▪ Offshore currents will readily disperse sewage.
Testing and commissioning of pipeline	▪ The permitted discharge to sea of pipeline testing and commissioning chemicals could affect water quality at the discharge site.	▪ Only the range and amounts of chemicals essential to demonstrate the integrity and fitness of the pipeline would be used ▪ The chemicals would be carefully selected so as to minimise potential environmental effects, in accordance with **Offshore Chemical Regulations 2002.**
Dropped objects during production and decommissioning activities	▪ Possible obstruction to fishing. ▪ Creation of artificial substrata to be colonised by organisms.	▪ Adherence to procedures and use of certified equipment. ▪ Retrieval of major items of debris on seabed
Removal of PLEMs, HTTs and other forms of subsea intervention	▪ Temporary disturbance to seabed and benthos.	▪ Temporary seabed disturbance over a minimal area.

9 CONCLUSIONS

The environmental assessment undertaken for the Gjøa to FLAGS gas export pipeline has established that sufficient information has been obtained on both the environment and the proposed pipeline operation to evaluate the potential environmental consequences of the development.

Selection of pipeline chemicals will be finalised after the ES has been completed, but will be subject to a separate permit under the **Offshore Chemical Regulations 2002**. The regulations require that operators use only approved chemicals, and support their permit application by providing detailed chemical information and environmental risk assessments for each chemical discharged. Statoil will comply in full with these regulations.

The potential environmental impacts of the project can be summed up as follows:

- The Gjøa to FLAGS gas export pipeline will have an impact in a small area in the middle of the northern North Sea. In the area in question, both environmental resources and fishing activities are relatively evenly distributed over a large area. The area directly affected by the pipeline project is very small. Accordingly the potential for coming into conflict with environmental or fishery interests is limited.
- The area of influence of the Gjøa to FLAGS gas export pipeline does not include any habitats listed in Annex I to the **EU Habitat Directive**.
- Seabirds in the area, which lies in the middle of the northern North Sea, may be particularly vulnerable to surface oil pollution, e.g. from an accidental spill of diesel from vessels involved in the project. . Statoil has established procedures to ensure that all necessary measures to prevent accidental spills will be implemented.
- Fishing activities in the area are limited. The most common fishing method is bottom trawling. It is considered that any conflicts with fishery interests in the operating phase of the Gjøa to FLAGS gas export pipeline will be minimal, since all subsea systems are designed to be overtrawlable. During the pipeline installation, certain traffic restrictions must be expected in the vicinity of the pipelaying operation.. Notification and monitoring procedures will be established.,..

No project activity would result in impacts or risks that were of such a magnitude or consequence that the project could not be undertaken. The following routine project activities would, however, result in impacts that were assessed to be significant:

- The presence of pipelaying vessels
- The anchoring of vessels during pipeline installation.
- The various operations to install the pipeline.
- The physical presence of the pipeline and subsea structures on the seabed.
- Emissions from the anodes on the pipeline.
- The potential for accidental spillage or release of diesel fuel from a vessel during installation operations.

Although there will be some environmental impact as a result of the installation and presence of the proposed pipeline, none the above project activities would result in serious impact or risks that would prevent the project from going ahead. Mitigation to avoid or reduce these environmental consequences is in line with industry best practice, and Statoil will ensure that the mitigation measure will be implemented. In addition, Statoil has made, or intends to make, the necessary provisions to comply with all other legislative and company policy requirements during the implementation of the development.

Overall, the ES has evaluated the environmental risk-reduction measures to be taken by Statoil, and it concludes that Statoil has put, or intends to put in place, sufficient safeguards to mitigate environmental risk, and to monitor the implementation of these safeguards.

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APPENDIX A ENVIRONMENTAL IMPACT ASSESSMENT SUMMARY

The present environmental impact assessment has been prepared by Statoil ASA on behalf of RWE Dea Norge AS, A/S Norske Shell, Petoro AS, Gaz de France Norge AS and Statoil ASA. The environmental impact assessment concerns the development, installation and operation of the Gjøa field. The field lies in the Troll area, in the northern region of the North Sea, close to land.

A.1 The impact assessment process

Pursuant to the Norwegian Petroleum Act, an environmental impact assessment must be prepared before development may take place. The purpose of the environmental impact assessment is to lay the best possible foundation for an evaluation of how the development will affect environmental and community interests, and describe the possibilities that exist for curbing or avoiding negative effects.

The planned pipeline for export of gas from the Gjøa field will cross the dividing line into the British sector. The length of the part of the pipeline that is subject to British impact assessment rules will be 8.5 kilometres. A separate environmental impact assessment (environmental statement - ES) has been prepared to meet the reporting requirements of the British authorities. A summary of the ES is provided in Appendix F to the present environmental impact assessment. The British environmental statement will be circulated for comment in parallel with the circulation for comment in Norway of the environmental impact assessment for the Gjøa field.

In parallel with the environmental impact assessment for the Gjøa field, Hydro is preparing a separate environmental impact assessment for a third-party connection to the Gjøa field: Vega (formerly Camilla, Belinda and Fram B). The two impact assessments will be circulated for comment simultaneously and should be considered jointly to provide an overall picture of the two development projects.

A.2 Reservoir description

The principal reservoirs of the Gjøa field consist of Upper Jurassic sandstones belonging to the Viking Group. In addition, oil and gas have been found in Mid-Jurassic sandstone belonging to the Brent Group in the northern parts of the field.

The pressure in the reservoir is hydrostatic and is around 230 bars. The reservoir temperature is about 80°C.

A.3 Resources and production plans

A preliminary estimate places the economically recoverable quantities in the Gjøa field at about 10 million Sm^3 liquid (oil and condensate) and 40.4 billion Sm^3 gas.

These figures applied at the time when the provisional project sanction was granted, and will in all likelihood be updated when the PDO/PIO Part 1 "Development and installation" is submitted.

The oil will be produced through a total of nine horizontal oil wells, four of which have two lateral branches, representing a total of thirteen drainage points in the oil zone. The gas will be produced through four vertical gas wells, which will be located in the structurally highest points of the field.

Production start is provisionally set for October 2010. The production period is estimated to be about 15 years.

A.4 The chosen development solution

The plan is to develop the field with templates connected to a semi-submersible production platform. A total of thirteen wells will be drilled: nine oil wells and four gas wells. The wells will be distributed among four templates, three in the south and one in the east. In addition, a satellite well will be drilled in the north.

Oil from the field will be exported through a new oil pipeline connected to the existing Troll oil pipeline II (TOR II) and on to Mongstad.

Gas from the field will be exported through a new pipeline that is connected directly to the existing FLAGS pipeline system (Far North Liquid and Associated Gas System) in the British sector.

A.4.1 Third-party connection

The Vega field will be connected to the Gjøa field. Gas and condensate from the field will be processed and exported along with gas, condensate and oil from the Gjøa field.

A.5 Implementation of emission-reduction measures and assessment of BAT

It has been decided to implement the following emission-reduction measures in connection with the development, installation and operation of the Gjøa field:

- Use of low-NOx burners in connection with the installation of a new gas turbine for the export compressor
- Import of power from land
- Use of closed high-pressure flare
- Installation of recovery plant for waste heat
- Produced water will be treated using EPCON treatment technology and then discharged into the sea
- Water-based drilling fluid will be used for drilling the uppermost sections
- The plan is to send cuttings from drilling with oil-based drilling fluids ashore for further processing
- Arrangements will be made for recycling water-based and oil-based drilling fluids

Treatment has been chosen as the main means of handling produced water. The produced water treatment that has been chosen has been assessed as the best available technology (BAT). The choice was based on assessments of environmental impact, technical feasibility and financial factors.

The power supply solution chosen for the Gjøa field is a combined solution with installation of an alternating current cable for importing power from land to cover the bulk of power requirements and the installation of a gas turbine offshore to operate the export compressor. The gas turbine will be equipped with low-NOx technology. The power generation solution has been assessed as BAT. The choice was based on assessments of environmental impact, technical feasibility and financial factors.

Documentation for the decisions regarding the choice of handling method for produced water and for power generation is provided in Appendix D and Appendix E, respectively, of the environmental impact assessment.

A.6 Costs, income and social profitability

The preliminary estimate of total investment and operating costs is close to NOK 36 billion. Of this, a good NOK 23 billion are investment costs, NOK 8 billion are the costs of operating field installations and pipelines, while the remainder, NOK 5 billion, represents tariff costs for the transport of petroleum.

Total revenues from production on the Gjøa field amount to just over NOK 53 billion, distributed over the production period. These revenues consist of NOK 12.5 billion from oil, NOK 30.5 billion from gas and NOK 10.5 billion from condensate.

Total net cash flow is estimated at NOK 18 billion in the production period. Net cash flow consists of NOK 0.6 billion in indirect taxes to the government, NOK 17.7 billion in corporate tax to the government and about NOK 6.7 billion in 2006-NOK to the oil companies with stakes in the Gjøa project.

These figures applied when the provisional project sanction was granted, and will be updated when the PDO/PIO Part 1 “Development and installation” is submitted.

A.7 National and regional deliveries

Total domestic (Norwegian) deliveries of goods and services for the development and operation of the Gjøa field through the entire life of the field are estimated at about NOK 24 billion. The deliveries comprise about NOK 14.5 billion in the development phase and NOK 9.5 billion in the operating phase. Domestic deliveries of goods and services in the development phase will account for around 62 per cent of total investments. Overall, the domestic share of deliveries for operations is expected to be about 87 per cent.

Regional deliveries are expected to come from Hordaland and Sogn og Fjordane counties. Total regional deliveries of goods and services to the Gjøa field are estimated to be worth about NOK 5.2 billion. The deliveries comprise about NOK 2.7 billion in the development phase and NOK 2.5 billion in the operations phase. Regional deliveries of goods and services in the development phase will account for around 19 per cent of the domestic deliveries. Overall, the regional share of deliveries for operations is expected to account for about 26 per cent of the domestic deliveries.

A.8 National and regional employment

The overall employment effect at national level will be about 35 600 man-years over a good 20 years in the period 2007 to 2026. Employment will comprise around 23 000 man-years in the development phase and 12 600 man-years in the operations phase. At regional level, employment is similarly calculated to be 6 200 man-years over 20 years, of which 3400 man-years in the development phase and 2 800 man-years in the operating phase.

A.9 Decommissioning

In line with current provisions, well before the close-down of production a decommissioning plan will be submitted with proposals for disposal of installations and pipelines. The decommissioning plan will include proposals for how the various installations should be handled.

A.10 Previously considered development solutions

A number of different development solutions have been considered through earlier phases of the project development for the Gjøa field. The solutions have covered various types of floating production platforms, solutions with seabed development only, several processing solutions and a number of solutions for the export of oil and gas. The different solutions considered are outlined in Appendix C of the environmental impact assessment.

A.11 Natural resources and environmental factors

The environmental impact assessment is based on the description of natural resources and resource utilisation in the area of influence specified in the regional environmental impact assessment for the North Sea (RKU). Emissions to the air and sea and the risk of acute spills are described there in more detail, together with possible consequences in terms of area-related conflicts for fisheries, aquaculture, corals and cultural heritage.

A.12 Emissions to the air during the development phase

Emissions to the air during the development phase stem from drilling operations, installation activities and necessary transport activities in connection with the development.

The total emissions in connection with drilling operations are estimated at about 70,000 tonnes CO_2, 1 500 tonnes NOx and 110 tonnes VOC.

Correspondingly, the total emissions in connection with the installation of field facilities and pipelines are estimated at about 23,000 tonnes CO_2, 500 tonnes NOx and 35 tonnes VOC.

In addition to emissions from drilling rigs and installation activities there will be emissions associated with visits from supply vessels, the transport of personnel by helicopter to the field and dedicated standby vessels on the field during the development. The total annual emissions in connection with transport activities during the development phase are estimated at about 10,000 tonnes CO_2, 210 tonnes NOx and 15 tonnes VOC.

A.13 Emissions to the air during the operations phase

During the operations phase there will be emissions to the air in connection with the production and processing of oil and gas, necessary flaring, export of oil and gas and necessary transport activities in connection with operation of the field.

The maximum emissions (in 2013) from the production platform will be in the order of 142,000 tonnes CO_2, 150 tonnes NOx and 70 tonnes VOC.

The total annual emissions associated with transport activities during the operation of the field are estimated at about 5,000 tonnes CO_2, 110 tonnes NOx and 8 tonnes VOC.

A.14 Impact of emissions to the air

The environmental effects of CO2 include contributions to the greenhouse effect and to global warming.

The environmental effects of NOx and VOC are acid precipitation, over-fertilisation and the formation of tropospheric ozone.

Solutions that minimise discharges of CO_2, NOx and VOC have been chosen for the development of the Gjøa field. Emissions from the field will amount to a maximum of 1.5 per cent, 0.4 per cent and 0.2 per cent, respectively, of total CO_2, NOx and VOC emissions in the North Sea. The impact of the development and operation of the Gjøa field and third-party connected fields will thus be marginal in relation to the current situation.

A.15 Discharges to the sea during the development phase

Discharges to the sea during the development phase will stem from drilling operations and the preparation of pipelines for operation.

Stringent requirements will be attached to drilling operations, and a recycling arrangement is planned for drilling fluid. Water-based drilling fluid is to be used in connection with the drilling of the uppermost and middle well sections, and the cuttings with residual drilling fluid will be discharged into the sea. Operational factors require the use of oil-based drilling fluid in the lowermost well sections (in the reservoir), and cuttings with residual oil-based drilling fluids will be transported ashore for treatment.

The choice of drilling fluids and handling of waste from drilling operations will be based on the use of the best available technology.

Pipelines within the field and export pipelines will be filled with fresh water and seawater, respectively, to which oxygen remover has been added. In connection with the preparation and connection of pipelines there will be discharges of the chemicals used to prevent corrosion and fouling, and of colorants used for pressure and leakage testing. The discharge water will be released into the sea on the Gjøa field.

A.16 Discharges to the sea during the operating phase

Produced water will be treated using EPCON treatment technology.

The largest discharge quantities from the Gjøa field and third-party connected fields are assessed as just over 12,000 m^3 per day, or about 4 million m^3 in the peak year 2013. This is equivalent to 2.6 per cent of all discharges of produced water into the North Sea and 3.4 per cent of the discharges in Region North this year (2006).

A.17 Impact of discharges into the sea

The environmental effects of drilling operations are largely associated with the limited effect on the benthic fauna of the physical covering of bottom sediments. The greatest effects can be expected in the immediate vicinity and represent a very small area within a radius of about 100 to 200 metres from the borehole.

Discharges associated with the preparation of pipelines have been assessed as having only local effects for a limited period.

The rapid dilution of produced water results in exposure times that are too short to have any significant acute effects on organisms. Field monitoring has shown that produced water components occur in those marine areas with most discharges of produced water, but negative environmental impacts have not been detected.

A.18 Acute discharges and oil-spill emergency response

In connection with the planned development, an environmentally oriented risk analysis has been carried out of the risk level of the activity, expressed as environmental risk associated with an uncontrolled oil blow-out.

In addition, an assessment has been made of other environmental risks such as spills from risers and pipelines.

In general, the results show a low environmental risk associated with both the development and the operation of the Gjøa field. The greatest impact is estimated for the European shag, with just over 3 per cent of the acceptance criterion in the impact category "moderate" in the development year. The relatively low environmental risk reflects a low discharge frequency for the activity, low environmental risk associated with subsea blowouts, and in addition the shares of the national seabird populations are limited within the area of influence.

An analysis of emergency response requirements has been carried out as a gap analysis in relation to existing emergency response resources in Region 3, where the Gjøa field is located. A verification has been carried out of the gap between needs and existing emergency response resources, and a preliminary assessment of the possibilities of meeting contingency needs. The results indicate that there will be a need for further systems in barrier 1, and reveal a probable increased systemic need in the coastal and shore zones. Drift time and quantities washed to shore indicate that the field could be dimensioning for regional contingency for NOFO region 3.

A.19 Fisheries and aquaculture

Because of the safety zone, the field installation will occupy an area of approximately one square kilometre. In view of the limited fisheries activity in the affected area, the field installation is not expected to significantly impede operations during the operating phase. No noticeable reductions are expected in catches.

Subsea installations and in-field pipelines will be made overtrawlable, and will not impede the operations of the fishing fleet once the installation work has been completed. Gravel will be dumped on export pipelines as required. The gravel dumps will be designed so that it is fully possible to trawl over them. Overall, the impact on the fishing fleet of the area occupation and physical encroachments in connection with the installation of subsea facilities and pipelines is assessed as small during the operating period.

The aquaculture industry is generally very important for habitation and employment along the coast of Western Norway. The industry may be affected by any acute discharges of oil in the drilling or operating phase. Regular operation of the Gjøa field will not have any impact on the aquaculture industry.

A.20 Corals

So far, corals have not been registered in the development area. The potential for conflicts with coral reefs is therefore regarded as low.

A.21 Cultural heritage

The depths of the various areas affected by the development imply that there may be Stone Age traces in the area, and there is a potential for shipwreck discoveries. The development of the Gjøa field implies only a very limited occupation of space, and so far there are no known examples of conflicts with cultural heritage interests in connection with offshore development projects.