Non technical summary

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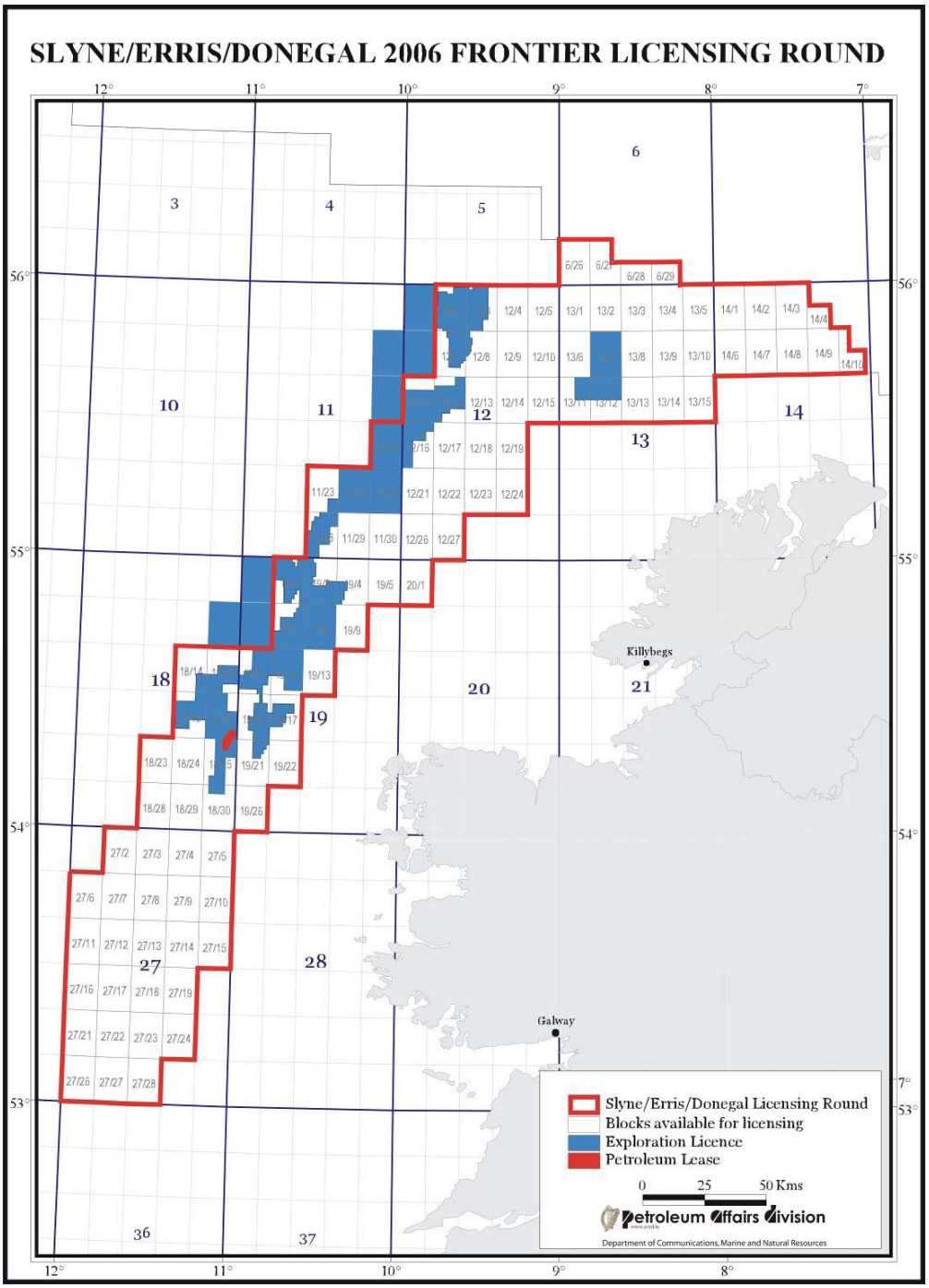
Non-technical summary

Introduction

The Petroleum Affairs Division (PAD) is carrying out a Strategic Environmental Assessment (SEA) on its proposed plan to issue Frontier Exploration Licences for the 2006 Licensing Round over the Slyne, Erris and Donegal Basins. The acreage on offer in the current Frontier Licensing Round will cover unlicensed blocks in an area of approximately 25,000 km^2 as shown in the figure below. The area has been classified as Frontier acreage because of the challenging environment off Ireland's west and northwest coasts.

Location of Slyne, Erris and Donegal Basin Frontier Exploration Licensing Round



This is seen as the first offshore SEA of a series that will be carried out on future plans to issue exploration licenses for the entire offshore area under Irish jurisdiction between 2006 and 2008. As part of the SEA for the current proposed programme, the PAD has commissioned this environmental report in order to highlight the likely significant effects on the environment and to identify any mitigating measures.

The schedule for the IOSEA1 is aligned with that of the current licensing round, to ensure that the process leading up to production of the draft environmental report, and the subsequent consultation, can provide a meaningful input into the decision-making prior to license award. This draft environmental report will be circulated during the consultation phase in April/May, during which expert bodies and the public will be able to provide feedback to the PAD through various channels including specially arranged meetings. The final environmental report will incorporate the findings from the consultation period to support and inform the decision-making process for the Frontier Exploration licensing round.

Policy context

In Ireland there is now some urgency about the need to make further discoveries of indigenous gas. Ireland imports more than 80% of its gas requirement and to date the UK has been its primary source. In 2005 the UK became a net importer of gas as its own indigenous production does not meet its requirements. Until there is production from the Corrib Field the likely source for future Irish gas imports is Eastern Europe. This brings with it issues of security of supply, price stability/volatility and cost. On top of the purchase cost of the gas there is the transport cost over a significant distance. Government policy is to maintain the present licensing and fiscal terms and to continue to promote exploration in the Irish offshore.

Baseline data

Despite the low level of exploration activity in the past, the PAD has continued to conduct and to sponsor environmental data gathering and analysis in the area. This work has been administered under the Petroleum Infrastructure Programme (PIP), a joint oil and gas industry-government partnership established in 1997. As sub-programmes of the PIP, the Rockall Studies Group (established 1997 to 2001) and the Porcupine Studies Group (established 1999 to 2002) actively promoted and commissioned significant research and data gathering projects to improve the environmental understanding of the Rockall Trough and Porcupine areas. These groups were succeeded by the Irish Shelf Petroleum Studies Group, which continues the work of the PIP throughout the Irish offshore area.

In addition, the Geological Survey of Ireland (GSI), with the Irish Marine Institute, has conducted a state-of-the-art survey of Ireland's seabed known as the Irish National Seabed Survey (INSS) over seven years at a cost of €33m. The INSS has also supported a variety of ancillary projects throughout the survey programme, ranging from physical oceanography to cetacean and seabird recording.

Scenario for the Draft Plan

The scenario being considered for exploration activity following licensing awards comprises the undertaking of 2D seismic survey in 2006 to 2007, 3D survey in 2008 to 2010, exploratory drilling 2008 to 2011, and appraisal and development drilling over the period 2009 to 2011. Although IOSEA1 is an assessment of exploration activities only, recognition of the possibility that a proportion of the exploration may ultimately result in development drilling taking place is also made. These activities will take place alongside pre-existing exploration programmes planned as a result of previous licensing rounds.

The seismic survey effort estimated by the PAD for the IOSEA1 area amounts to a likely maximum of 2,500 km of 2D and 7,000 km^2 of 3D survey. In terms of ship time at sea this amounts to approximately 350 days of ship time over the five year period 2006 to 2010, or 70 days per year.

In addition, the pre-existing seismic activity likely to take place under a previous licensing round could amount to between 2,000 km and 3,500 km of 2D seismic over the period 2006 to 2007, and 1,000 km^2 to 3,100 km^2 of 3D seismic over the same two year period. This would require approximately 250 days of ship time for the two year period, or 125 days per year.

Under the maximum drilling activity scenario, a maximum of 19 wells may be drilled over the period 2006 to 2011 (4 to 8 exploration wells, 2 to 6 appraisal wells, 0 to 5 development wells), which works out as just over three wells per year over the six year period. In addition, however, the pre-existing maximum drilling activity likely to take place from previous licensing rounds could involve the drilling of up to 33 wells (6 to 10 exploration wells, 1 to 8 appraisal wells, 6 to 15 development wells). At the

maximum anticipated rate over the period 2006 to 2011, this would average out at between five and six wells per year.

Baseline environment

Information about the environment in the Slyne, Erris and Donegal Basin areas of IOSEA1 has been collated in order to characterise and assess the sensitivities of those features that might be affected by the proposed Draft Plan. The following section provides a brief summary of the baseline environment of the IOSEA1 area.

Physical and chemical environment

Situated between 50 and 250 km off the west and northwest coasts of Ireland, the IOSEA1 area lies on the outer part of the Irish Continental Shelf to the west of Ireland, including the Slyne and Erris Ridges, and on the relatively steep slope that forms part of the eastern flank of the Rockall Trough. Water depths vary widely over the study area, ranging from 42 m in the eastern part of the Donegal Basin to over 2,000 m in the extreme western margins of the IOSEA1 area.

In the IOSEA1 area, the basin margins are steep, with dramatic erosional and depositional features including major slope failure and mass flow events. Glacial processes had a very strong influence on the development of the slope along the eastern margin west and northwest of Donegal; these become progressively less significant in shaping the geomorphology of the margin towards the southern Porcupine Bank.

Due to the low level of exploratory activity in the west coast of Ireland and IOSEA1 area, it is expected that contaminant concentrations of metals, hydrocarbons and persistent compounds in seabed sediments will be similar to background concentrations.

The water masses within the IOSEA1 are a mix of relatively warm and salty water of the north and eastern Atlantic, and deeper colder waters of the Norwegian and Labrador Seas. The pole-ward shelf edge current is associated with high-salinity water in the upper 400 m of the water column with moderate current speeds. Tidal streams for the west coast are generally classed as north for the flood tide and south for the ebb tide.

Sea surface temperatures in the IOSEA1 range from approximately 14°C in August to 8°C in February. Temperatures on the shelf bottom may be 5 to 6°C cooler than at the surface. Surface salinity values follow a general trend of increasing from the coast, across the Irish Continental Shelf to the south and west. Salinity is one of the main driving forces of the Irish Shelf Front which separates coastal shelf water from oceanic water along the edge of the Irish Continental Shelf, although the exact position varies.

The area has been described as having some of the harshest weather and sea conditions in the world with frequent occurrences of severe winds. The dominant wave directions for the majority of the year are from the southwest and west. December to February experiences the highest wave heights while July and August experience the lowest.

Ecology

Phytoplankton are the main primary producers in the marine environment. Because of their limited mobility, the distribution and abundance of plankton is largely influenced by factors such as the availability of nutrients, water currents, mixing in the water column and temperature stratification. In the IOSEA1 area after the initial phytoplankton bloom in May, numbers deplete as the nutrients present in the surface waters are incorporated by phytoplankton growth and because of zooplankton grazing. Many species of zooplankton graze on phytoplankton and form the next step up in the food chain of marine ecosystems. Small crustaceans called copepods are the dominant zooplankton species.

Benthic faunal communities are made up of a wide variety of invertebrate species that live in or on the sea bed. They feed on suspended organic material in the water, on material settled on the sea bed, or scavenge or prey on other animals and their remains. They provide a source of food for fish and other marine animals and may play an important role in the recycling of nutrients in sediments, for example by turning over the surface sediments.

Presently-available information on the infauna is insufficient to allow mapping of benthic community types across the whole shelf west of Ireland. Analysis of INSS samples is ongoing, and should provide essential information on the wider distribution of sublittoral infaunal communities in the IOSEA1 area.

Although the Rockall Trough is one of the better-studied areas of the deep ocean, large tracts of it, particularly on the flanks, have never been sampled, largely because of the difficulties and hazards of using conventional sampling equipment on such steep and irregular topography. The seabed type on the slope ranges from coarse gravelly sea bed with cobbles and boulders, to soft mud, which occurs predominantly on the lower slope. Specific seabed features such as carbonate mounds, together with the complex topography and current regime, add to the diversity of habitats in the area.

The cold-water coral *Lophelia pertusa* has been recorded in scattered localities within the IOSEA1 area, usually occurring at depths of 200 to 700 m, where it is likely that the steady current associated with the upper slope of the Rockall Trough provides suitable feeding conditions for them. Cold-water corals are of particular conservation interest.

The area of IOSEA1 supports a wide variety of habitats, and as such holds a diverse fish fauna. Physical factors, such as water temperature, depth and movement, and also sediment characteristics, can lead to considerable variation in the distribution of each species. In gravelly, tidally dynamic areas, such as the north coast of Ireland, the fish communities are dominated by larger species, including small sharks, gurnard, cod, whiting, and only a few species of flatfish. Muddy sediments have a higher incidence of gadoids and lower densities of plaice and dab than found in shallower sandy areas. Other species more prevalent on soft sediments include long rough dab, witch and burrowing fish species. Sandeels live in close association with the sandy sediments. The offshore shelf regions, made up of large areas of sand or muddy sand, interspersed with patches of gravel or mud, support fisheries for cod, whiting, haddock, anglerfish, hake and saithe. Five species of squid have been identified in continental shelf waters to the south of the licensing area.

Soft muddy sediments provide a habitat for burrowing crustaceans, such as the Dublin Bay prawn *Nephrops norvegicus*, which support important commercial fisheries. Important *Nephrops* grounds occur on the Stanton Bank, which crosses the northern boundary of the licensing area. Edible crabs *Cancer pagurus* are distributed throughout the continental shelf area to the north and west of Ireland and are the basis of an important Irish inshore fishery. Populations of scallops and queen scallops also occur in areas of gravelly sediments along the north coast of Ireland.

Five species of marine turtle have been recorded in Irish waters. Most commonly seen is the leatherback turtle, which is reported in small numbers every year and is considered a regular member of the marine fauna. Loggerhead turtles and Kemp's Ridley turtles occur less frequently, occasionally visiting in winter and spring.

The coastal and offshore waters of Ireland provide seabirds with a rich source of nutrition, particularly at those feeding grounds associated with coastal upwellings and frontal systems. Many seabirds regularly breed on Irish coasts. A number of these migrate outside the area after completion of breeding, whilst others remain throughout the year. Other species of seabirds overwinter in Irish waters, or use the area as a migratory corridor in spring, autumn and winter. The offshore seabirds include members of several families, most notably the petrels and shearwaters, gannets, gulls, skuas and auks. These birds breed on the coasts of the UK and Ireland, but frequently feed far offshore. In winter they become less attached to their nesting sites and range considerable distances in search of food.

During the breeding season, generally between March and June, large numbers of seabirds congregate in coastal breeding colonies. A number of these have been designated as SPAs under the EC Birds Directive. During the breeding season seabirds are constrained by the location of the colonies and exhibit a more inshore distribution. When feeding conditions are favourable, the piscivorous birds feed on sandeels and other small pelagic fish comparatively close inshore.

Significant records of baleen whales have historically been obtained in the IOSEA1 area, particularly along the continental shelf edge. The importance of this area has been shown by the distribution of large whale landings; with fin whale catches, in particular, concentrated along the shelf edge. Visual surveys have confirmed the presence of several baleen whale species, at least in small numbers, during the spring and summer months. This seasonal occurrence may, however, be misrepresented by the uneven distribution of survey effort across the year. Limited passive acoustic surveys have suggested that the large blue, fin and humpback whales are present throughout the year. There are currently not enough data to give a reliable indication of the abundance or distribution of baleen whales in Irish waters.

Two species of seal breed on the west coast of Ireland, the common, or harbour seal, and the grey seal. In Ireland both species lie towards the southern end of their geographical range and as such their numbers are low in comparison to neighbouring UK populations. SACs have been designated for both of seal on the Irish coast.

Conservation

Extensive areas of the north and west coasts of Ireland are of international and national conservation importance. While there are no statutory nature conservation designations within the IOSEA1 area, it does contain features and species of conservation importance and at its nearest point comes within 30 km of the mainland coast. As more information becomes available on the offshore environment to the west of Ireland it is possible that new conservation areas will be designated to include qualifying features under national and international legislation.

The maritime archaeological heritage within the IOSEA1 area is limited due to the water depth, both present and historical, harsh wave climate and limited human use of the offshore environment. Historical wrecks are likely to provide the main archaeological interest, although these are found predominantly in coastal areas.

Other users of the sea

In the IOSEA1 area there are demersal commercial fisheries for cod, haddock and whiting with important bycatches of saithe, plaice, sole and anglerfish. The continental slope is fished for the roundnose grenadier, blackscabbard fish, sharks, blue ling and the orange roughy. There is a pelagic fishery for blue whiting, mackerel and horse mackerel, and to a lesser extent a mix of herring, pilchard, sprat and tuna. Pelagic fishing effort has in the past been considered relatively low within the IOSEA1 area, although slightly higher in the north; up-to-date fishing effort data were not made available for this SEA process. Sightings data from the Irish Naval Service indicate a significant level of fishing activity along the shelf edge west of Ireland by Irish and other EU fleets.

There are 20 finfish farms on the west coast of Ireland and shellfish farming is undertaken in all of the coastal counties adjacent to the IOSEA1 area. Salmon, mussel and oyster are the predominant cultivated species. Other farmed species include razor and surf clams, and more recently turbot, scallops, abalone and char.

Although Ireland's Atlantic seaboard is less busy than the Irish Sea, important shipping ports are found at Galway, along the Shannon Estuary, at Cork and at Derry in Northern Ireland adjacent to the IOSEA1 area. Major shipping routes lie to the south and north.

Existing oil and gas infrastructure on the west coast is limited to the Corrib Field, located off the coast of County Mayo being developed by Shell E&P Ireland along with co-venturers Statoil Exploration (Ireland) Ltd and Marathon International Petroleum Hibernia Ltd. Natural gas will be produced from a number of wells and brought ashore through a pipeline to a terminal at Bellanaboy Bridge, County Mayo. Within the IOSEA1 area the majority of the exploratory wells have reported gas, with oil reported in the Erris Basin area (at one location and in non commercial quantities) and to the south of the IOSEA1 area toward the Porcupine Bank and Basin.

Military activity in the IOSEA1 consists of exercise areas and a submarine transit route with traffic to and from Faslane Naval Base in Scotland. Known marine disposal sites for munitions are located within 10 km of the IOSEA1 area.

Assessment of potential impacts

A scoping procedure was used to identify the main environmental concerns associated with the proposed licensing activities. This process included an environmental issues identification exercise to identify potentially significant impacts, together with scoping input from the Environmental Authorities.

The only operational aspects identified as having a potentially major effect on the environment were the interactions between seismic survey noise generation and cetaceans, and those resulting from atmospheric emissions associated with well testing and fuel combustion. The effects from a number of other activities were identified as potentially moderate, requiring further investigation. In addition, there is a risk of accidental events (hydrocarbons releases in particular) from the proposed exploratory activity.

All of these concerns were taken through for further more detailed impact assessment, in which possible cumulative and transboundary effects were considered, and mitigative measures were proposed in order to minimise the impacts. The assessments took account of the range of possible scenarios and alternatives. The residual environmental impacts and key mitigation measures are described below.

Impacts from seismic survey activities

Seismic impacts - noise generation

Some 39,232 km of 2D data have been acquired between 1972 and 2002. This averages out at 1,308 km per year, which is comparable with the level of 2D acquisition (2,500 km over 2 years) envisaged for 2006 to 2007. For 3D seismic surveys, some 5,015 km^2 of 3D seismic data were obtained within the IOSEA1 area between 1992 and 2002. This equates to roughly 456 km^2 per year, which is significantly less than the 1,000 to 3,000 km^2 per year envisaged for the period 2008 to 2010.

Although the sound levels involved with 3D surveys are generally slightly lower than those generated from a single streamer array 2D seismic survey, the fact that there are more streamers present means that the overall amount of sound energy entering the marine environment will be higher. Therefore, it is generally assumed that the effects of 2D and 3D are more or less the same.

Modelling indicates that baleen whales and fish may show some form of avoidance reaction up to approximately 20 and 11.5 km respectively from a seismic sound source of 248 dB (re 1 µPa). However, field research has indicated that these zones of avoidance behaviour may be extended under certain conditions.

The behavioural response shown by fish may lead them to move away from the seismic survey sound sources temporarily. Research indicates that such migrations are short lived and that the fish stocks will most likely return to the area after completion of the survey. There is very little information on the effects of seismic noise on seals but, on a conservative estimation, the avoidance behaviour might be considered similar to that of baleen whales. It is expected that seismic shots will be heard by marine mammals and fish over a much wider area, but that no significant impacts will result.

The animals most likely to be affected by sound produced from the survey are baleen whales (blue, fin, sei, minke and humpback whales) beaked whales and seals, as it is believed that most toothed whale species are less affected by the sound frequencies used in seismic operations. Individual animals might leave or avoid this area, but may be expected to return soon after operations have ceased.

Seismic impacts - atmospheric emissions

Emissions calculations for the seismic survey scenario show that, on an annual basis, CO_2 production will amount to something in the order of 3,360 tonnes per year, or 16,180 tonnes over the duration of planned exploration activity. Each year, the atmospheric emissions will have a global warming potential (GWP) of 5,003 tonnes CO_2 equivalent, whilst the total seismic survey activity will result in a GWP of 25,014 tonnes CO_2 equivalent.

Atmospheric emissions from fuel combustion also generally have the potential to cause acidification of rain. The main contributors to this are the SO_2 and NO_x content of the fuels in use. The total acidification potential of the estimated annual emissions from seismic survey is 31 tonnes of SO_2 equivalent, whilst that for the whole period 2006 to 2010 is almost 155 tonnes.

At a national level, the proportion of emissions from road transport in Ireland is currently seen as dominating the national transport emissions statistics. Transport in general accounted for 11.5 million tonnes CO_2 equivalent in 2002, of which road transport contributed 93%. Shipping in Ireland is therefore a minor component of emissions nationally at the present time, and the seismic survey emissions estimated on an annual basis, and cumulatively until 2010, is most likely in turn to be a very small proportion of this.

National emissions of SO_2 and NO_x, together the main emission components responsible for acidification, were 76,370 tonnes and 119,750 tonnes respectively in 2003. Against this, the total SO_2 and NO_x emissions from 1 year of seismic surveys (4.20 tonnes and 38.22 tonnes respectively) are very small.

Seismic impacts - physical presence

Acquisition of seismic data requires the towing of a single streamer of between 3 to 12 km in length (2D) or an array of streamers around 3 km in length (3D). Surveys operate on a grid basis and ships therefore need a turning area at the end of each line. In both cases whilst the survey is being undertaken, the survey vessel has limited capability for taking avoiding action in respect of other shipping, and other shipping will therefore need to keep clear of the survey vessel.

Fishing vessels will be unable to fish in the vicinity of a seismic survey and will therefore lose access to grounds in the survey area for the duration of the survey. The number of seismic survey days in a year for IOSEA1 are estimated at ~100 for 2D seismic in 2006 to 2007 and ~250 days for 3D seismic

over 2008 to 2010. Whilst 2D survey levels are comparable to what has taken place in the IOSEA1 area previously, 3D activity is set to be higher. However, the survey effort overall is likely to be met by the equivalent of two vessels working during the summer months each year and when compared to the total area of 25,100 km^2 for the IOSEA1 area, seismic surveys are unlikely to exclude shipping or fishing activities from significant areas for significant periods of time.

Whilst it is known that offshore pelagic and demersal fisheries operate on the continental shelf, slope and in the deep sea, involving vessels from many nations, up-to-date fishing effort data were not made available with which to quantify the likely interactions with the Draft Plan. Fishing effort using all gears has been characterised as low over the IOSEA1 area, although effort is higher in the area of the Donegal Basin in the case of demersal fishing and static gears. However, the sightings data from the Irish Naval Service indicate a significant level of fishing activity along the shelf edge west of Ireland by Irish and other EU fleets.

Shipping routes to and from the Atlantic follow the Irish/UK median line along the top of the IOSEA1 area. The current level of shipping overall is estimated at 8,768 vessels per year in the IOSEA1 area, and on average 27 vessels area likely to be within this area at any one time. Whilst this is relatively light compared to other areas in Europe, this 'routine' shipping will be concentrated along the routes crossing the Donegal and Erris Basins in the northern half of the IOSEA1 area. In addition, there will be the unquantifiable 'non-routine' traffic such as fishing boats and recreational craft, much of which will be concentrated along the coast rather than offshore. The majority of the IOSEA1 area is used by the military for fleet and submarine exercises.

Seismic impacts - accidental events

A kerosene spill from streamer failure is the most likely source of a hydrocarbon spill. The quantities of oil spilled into the marine environment would be relatively low in all but a worst case scenario.

Any seabirds on the water surface would be potentially at risk from any slicks that form, although the extent of such a slick would be expected to be limited. Marine mammals are considered to be less vulnerable to fouling than seabirds, as they would be expected to move away from any oil pollution. Whilst marine mammals are believed to be at risk from inhaling volatile elements in the oil, these would generally evaporate rapidly from the slick**.**

The relatively low volumes of oil involved in most streamer accidents and light nature of the oil in the streamers means that it would quickly evaporate and disperse.

Impacts from drilling activities

Drilling impacts - noise generation

The majority of sounds produced during drilling operations are continuous and of low frequency. The effects on most toothed whales and pinnipeds to such noises are considered to be minor as their sound sensitivity lies outside the main range of low frequency sounds (sounds below 200 Hz) produced by a semi-submersible drilling rig. However, the susceptibility of baleen whale and seal auditory systems to damage from industrial noise may be high, particularly for baleen whales, as it is presumed their hearing sensitivity is good at low frequencies. Continuous sound produced by industrial activities such as drilling may elicit behavioural avoidance in baleen whales at received sound levels of 110 to 130 dB re 1 µPa-m. On the basis of the spherical spreading model for underwater sound, this indicates that the zone within which a baleen whale would show avoidance behaviour to noise would extend to a radius of less than 7 m from a jack-up drilling rig; to a radius of between 675 and 1,040 m in the case of a semi-submersible drilling rig; and to between 2,390 and 6,900 m from a drill ship. These values are conservative compared to published figures reporting avoidance behaviour and it can therefore be argued that they represent a precautionary estimate of drilling noise impacts.

Most cetacean species recorded in the continental shelf waters of the IOSEA1 area are the toothed whales and dolphin species. Of the baleen whales, only minke whales have been commonly recorded in these relatively shallow water areas. However, a number of the large baleen whales have been recorded in the deep water of the IOSEA1 area, along the continental shelf break and into deeper waters. Baleen whales may display avoidance reactions up to 1 km away from a well location during drilling activities from a semi-submersible rig. In relation to the most likely drilling scenario based on a semi-submersible rig on location for up to 50 days, a radius of 1 km from any exploration or appraisal well is therefore a reasonable estimate of the zone of responsiveness during drilling operations.

Close to the drilling site there is the possibility that low frequency drilling noises may mask marine animal calls if they are made within the same frequencies. Auditory damage could occur if a marine mammal were to be exposed to sounds greater than 120 dB for prolonged periods of time. For this to

occur the animal would have to be within 220 to 345 m of a semi-submersible drilling rig, or 840 to 2,900 m of a drill ship during drilling activities. It is considered unlikely that marine mammals would choose to remain close to such a noise source for any length of time.

Drilling impacts - discharge of drill cuttings and disturbance to sea bed

Implementation of the Draft Plan may result in up to 19 wells in total (not including pre-existing activity, dealt with under cumulative impacts) being drilled over the period 2008 to 2011. The impacts of activities such as anchoring, and the discharge of drilling wastes, will be primarily to the sea bed rather than to the sea surface or water column. Impacts on the benthic communities from discharges of WBM and cement may occur in the immediate vicinity of each well, with likely recovery within months or a few years. Assuming an area of impact of 50 m radius around each of 19 wells, a total area of less than 0.15 km^2, would be affected to some extent by burial or smothering impacts.

In the event that drilling is conducted via an anchored drilling rig or ship, direct disturbance and damage to benthic animals will arise mostly from the anchors and anchor chains. Relatively little movement of anchor chains is expected due to the deep water and the number of anchors employed. Assuming eight chains per rig each impacting an area of sea bed 600 m long and 2 m wide, 9,600 m^2 of sea bed may be subject to varying degrees of disturbance over the estimated drilling period of 50 days for each well. For the maximum of 19 wells drilled, a total of 0.18 km^2, of sea bed could be temporarily affected. As a very rough estimate, therefore, the direct seabed disturbance involved from anchoring and discharge of drilling wastes at up to 19 well sites could total 0.33 km^2.

The spatial extent of these impacts is clearly only a very small proportion of the total sea bed area of 25,000 km^2 lying within the IOSEA1 boundary. In addition, the temporary nature of anchoring impacts, and the very localised extent and low toxicity of discharged drilling wastes on the sea bed, lead to good recovery potential in the dynamic benthic environment of the IOSEA1 area. However, the significance of any impact depends on the presence of particularly sensitive or important habitats or species, sea bed features or notable archaeological interest (wrecks most likely) within the affected areas. Cold-water corals, which are of particular ecological and conservation importance, may be more susceptible to direct physical damage and slower to recover than other macrofaunal species likely to be encountered in the IOSEA1 area.

Drilling impacts - atmospheric emissions

Emissions calculations for the drilling activity scenario show that CO_2 production will amount to an indicative level of 5,754 tonnes per well or roughly 109,326 tonnes from the maximum expected total of 19 wells. The atmospheric emissions from each well will have a global warming potential (GWP) of approximately 10,280 tonnes CO_2 equivalent, whilst the total from, say three wells per year could result in a GWP of ~30,840 tonnes CO_2 equivalent.

Atmospheric emissions from fuel combustion also generally have the potential to cause acidification of rain. The main contributors to this are the SO_2 and NO_x content of the fuels in use. The total acidification potential of the estimated annual emissions from drilling activity is approximately 82 tonnes of SO_2 equivalent, whilst that for three wells per year would be 246 tonnes.

In addition to the emissions to the atmosphere from the drilling rig and associated vessels and aircraft support, any well testing needed will also consume fuel and produce exhaust emissions. A requirement for one well test per year may result from the proposed exploratory drilling, and this will result in emissions with a GWP of just over 7,000 tonnes CO_2 equivalent. The acidification potential of the estimated emissions from one well test is approximately 1.5 tonnes of SO_2 equivalent.

To put these emissions in a national context, total emissions in Ireland resulting from energy use rose between 1990 and 2001 from approximately 30 million tonnes CO_2 equivalent to just over 45 million tonnes, and have since declined slightly to approximately 42 million tonnes. The 10,280 tonnes CO_2 equivalent emitted by drilling one well represents just 0.02% of the total emissions in Ireland resulting from energy use, whilst including the well test in the total raises the proportion to 0.04%.

National emissions of SO_2 and NO_x, together the main emission components responsible for acidification, were 76,370 tonnes and 119,750 tonnes respectively in 2003. Against this, the total SO_2 and NO_x emissions from drilling each well are very small, as are the amounts contributed in addition from well testing. Emissions of SO_2 nationally have declined by 60% since 1990, whilst those of NO_x have shown no significant change overall. However, the contribution to NO_x emissions from the power generation industry has declined by 28% since 1990. Both this, and the notable decrease seen in SO_2 emissions, were seen as due to the increasing share of natural gas as a fuel in power generation.

Drilling impacts - physical presence

In order for exploration drilling to take place, a drilling rig is towed into position over the well site by towing vessels and anchored into position by the same vessels performing an anchor handling role. During the drilling operation itself vessels may re-supply the drilling rig with fuel and other supplies and helicopters will facilitate personnel changes. Even if drilling takes place on the eastern boundary of the IOSEA1 area closest to the coast, operations are unlikely to cause significant visual impact to onlookers from the shore. The environmental issues identification process, together with the scoping responses, identified interactions with other sea users (especially the fishing industry and shipping) as having the main potential to cause impacts.

The drilling scenario assumptions suggest that a maximum of 19 wells will be drilled in the period 2008 to 2011. These wells are likely to be drilled by a semi-submersible drilling rig, over a period of around 50 days per well. For safety reasons a 500 m exclusion zone (each 0.79 km^2) will surround the drilling rig whilst on site, patrolled by a safety standby vessel, leading to the temporary loss of access to shipping including fishing vessels. On this basis a total of less than 4 km^2 of sea area would be made inaccessible for fishing or other activities for periods of up to 50 days in each case.

The requirement for support vessels, supply vessels and helicopters will lead to a slight increase in vessel activity in the region. Supply vessels will use ports at Killybegs and Ayr in Scotland to bunker and ship essential supplies. These ports are already currently in use to supply the existing oil and gas activities west of Ireland. Relatively low shipping intensity in the IOSEA1 indicates that impacts upon other shipping facilities and operations in the region will be low.

If the well is plugged and abandoned at the end of the drilling programme, the riser will be completely removed to below the sea bed and will therefore pose no threat to ship anchors or over-trawling by fishing vessels. However if the well is suspended, the 500 m exclusion zone will remain in force.

Drilling impacts - accidental events

The potential exists for accidental events that cause spillage of hydrocarbons or chemicals into the sea. Large spills from catastrophic events have the potential to cause significant environmental impacts, and such impacts would be greatest in coastal and inshore environments and least offshore. However, the risk of a major crude oil spill or gas blowout during exploration, appraisal and development drilling is very low. In the IOSEA1 area, gas is the expected hydrocarbon. Historical data suggest that small diesel spills from rigs and vessels of less than one tonne represent the most likely oil spill scenario.

Small spills of diesel will disperse rapidly from the sea surface within a short time, primarily through evaporation into the atmosphere. Impacts from diesel spills of this magnitude and frequency (once every 50 to 100 wells drilled) would be confined to the offshore environment, where the main concerns would be for impacts to seabirds, fish and fisheries.

Shallow gas blowouts occur in approximately one in every 200 wells drilled. While potentially dangerous, there are few studies available on gas interactions with the marine environment. Naturally occurring gas blowouts have been linked to gas hydrates and these therefore constitute a potential natural geohazard in the marine environment.

A gas blowout would result in atmospheric emissions. Emissions would be reservoir specific and likely to contain a large proportion of methane (CH_4) with smaller amounts of volatile organic compounds. In the unlikely event of an explosion and hydrocarbons burn then combustion products including carbon dioxide (CO_2) and carbon monoxide (CO) will result. Exact emissions would be well specific but could be considered to be large in a worst case scenario.

Cumulative and transboundary impacts

Cumulative impacts occur as a result of a number of activities, discharges and emissions combining or overlapping, potentially creating a significant impact. Potential cumulative impacts could arise as a result of impacts resulting from seismic and exploration activities interacting or combining with those from other activities taking place in the IOSEA1 area. These may include, for example, pre-existing licensed seismic survey and exploratory drilling, marine scientific research, commercial fishing, shipping and military activities. Some of the seismic and drilling impacts assessed also have the potential to combine with each other, and should therefore be considered together or cumulatively.

Cumulative and transboundary impacts - noise

When compared with a single survey or consecutive surveys, simultaneous seismic surveys will increase the area affected by anthropogenic noise. If either the noise source (ie the seismic survey

vessel) or animals move, an individual animal could encounter a potentially harmful sound source on more than one occasion. If several seismic vessels generate sound simultaneously, the sounds received by animal receptors become less directional. In addition, the dispersion of noise in such a complex bathymetric environment will reduce the effectiveness of a directional hearing, and therefore the ability of animals to discriminate sounds of interest from background noise. The short-term effect on animals subject to multiple seismic surveys may be to cause them to move away from the sound source. Longer-term exposure, however, may cause habituation to such noises.

Large numbers of marine mammals are present in the waters west of Ireland. In addition, there is some evidence that the area is used as a migratory pathway by certain baleen whale species. Marine mammal movements could be interrupted and feeding grounds disrupted if several seismic surveys were to occur at the same time. However, studies in northwestern Australia and along the Californian coast have indicated that baleen whales continue to migrate into areas of consistently high survey activity, and along coastlines subjected to decades of seismic activity.

With regard to drilling, the sound levels and frequencies generated by a semi-submersible drilling rig are in many ways comparable with those generated by a large merchant vessel. Sound transmission calculations estimate that a small proportion of any baleen whales in the area may respond to the drilling noise by altering their routes to avoid approaching within 1 km of a drill site. At certain times, multiple drilling operations may be taking place simultaneously within the IOSEA1 area. However, it is unlikely that the underwater sound generated by these operations will overlap in such a way as to cause a significant cumulative impact.

Whilst it is possible that seismic survey and drilling operations will take place simultaneously it is most likely that these noise sources will be separated by some distance and will therefore not overlap to any great extent.

Any transboundary impacts with regard to noise during seismic surveys and drilling activity will be limited in scale and of very short duration. However, in view of the likelihood that seismic surveys can interfere with each other if less than 100 km apart, and can give rise to environmental impacts, notification of seismic activity planned within 100 km of the Ireland/UK boundary will be given to the appropriate licensing authorities.

Cumulative and transboundary impacts - discharge of drill cuttings and disturbance to sea bed

Drilling activity within the IOSEA1 area has been low historically, with some 16 wells drilled between 1978 and 2003, or between one and two wells per year on average. Pre-existing licensed drilling activity in the IOSEA1 area may result in up to 33 wells being drilled between 2006 and 2011, which equates to between five and six wells per year. Implementation of the Draft Plan may lead to the drilling of a further 19 wells between 2008 and 2011, raising the total to 52 wells in the IOSEA1 area between 2006 and 2011, and increasing the drilling rate to between nine and ten wells per year between 2008 and 2011.

The drilling of 19 wells could result in direct physical effects to an area of sea bed totalling less than 0.33 km^2. When considering the pre-existing licensed drilling also, the drilling of up to 52 wells would increase the total area of sea bed affected to less than 1 km^2.

The extent of sea bed disturbance impacts potentially arising from the oil and gas industry amount to a very small proportion of the 25,000 km^2 IOSEA1 area. In addition, the temporary nature of anchoring impacts, and the very localised extent and low toxicity of discharged drilling wastes on the sea bed, lead to good recovery potential in the dynamic benthic environment of the IOSEA1 area. However, the significance of any impact depends on the nature of the benthic environment at the sites concerned, and whether or not particularly sensitive or important habitats or species, sea bed features or notable archaeological interests (wrecks most likely) are present.

Other activities taking place within the IOSEA1 area which lead to physical disturbance of the sea bed include commercial fishing for demersal or benthic species, and telecommunications cable installation. There is currently no aggregate extraction or aquaculture taking place within the IOSEA1 area, and there is no dredging or spoil dumping within the area either.

With regard to submarine cable laying, there is currently one cable running through the IOSEA1 area and there are no plans for additional cables at present.

With regard to fishing, there are demersal or static gear fisheries for Dublin Bay prawn, cod, haddock, whiting, saithe, plaice, sole, anglerfish, various crabs, crayfish, shrimp and scallops on the continental shelf in the IOSEA1 area. There are no data on the areas of sea bed trawled or dredged in or around the IOSEA1 area. There is year-round fishing activity throughout the area indicated by fishing vessels sighting data. It is likely that the area estimated to be affected by the Draft Plan and pre-existing drilling activity would be a relatively small proportion of that affected by fishing.

Exploration drilling activity will be taking place in an environment that has long been used for a variety of economic activities, some of which disturb the sea bed. As the potential impacts from drilling discharges and physical disturbance to the marine environment tend to be localised, of short duration and with generally good recovery potential, the risks of cumulative impacts are considered to be low for this level of exploration and appraisal activity.

Cumulative and transboundary impacts - atmospheric emissions

It is likely that the current licensing round, together with survey work arising from pre-existing licensed activity will see emission rates from seismic survey more than double those previously experienced in the IOSEA1 area per year on average. However, when translated into shipping activity, this approximates to 195 days of ship time per year, or two or three additional vessels working in the offshore IOSEA1 area per year. When set against the context of general shipping activity (8,768 vessels per year, or 27 vessels at any one time within the IOSEA1 area), and the steadily rising trend in ship numbers and tonnage using ports on the Irish west coast, the additional impacts of emissions resulting from seismic survey in the IOSEA1 area are likely to be small.

The emissions potentially resulting from seismic survey over one year from both the proposed Draft Plan and pre-existing licensed activity will potentially cause emissions with a GWP of 13,936 tonnes. This amounts to just over 0.03% of the total GWP from Ireland in 2002.

With regard to drilling, the maximum emissions likely to result from implementation of the Draft Plan could increase the total emissions from drilling activity in the IOSEA1 area by 57% compared to activity since the 1970s. The combined emissions on an annual basis from both seismic survey (13,936.48 tonnes) and drilling (118,288 tonnes) activities, including both pre-existing activity and the Draft Plan, amount to 132,225 tonnes CO_2 equivalent. This equates to 0.31% of the total annual Irish emissions for 2002.

With prevailing wind directions being from the west and southwest, most of the vessel emissions are likely to be deposited in Irish coastal waters or in Ireland. In terms of possible transboundary impacts, a small proportion of the emissions considered might end up in other European states including the UK, particularly those from the Donegal Basin area which is adjacent to the Ireland-UK national boundary. If annual emissions from exploration activity in the IOSEA1 area are 0.31% of Irish annual total, this represents a minor incremental increase on the total likely transboundary impact.

Cumulative and transboundary impacts - physical presence

In terms of timing of physical exclusion to other sea users at a single location, the combination of seismic survey and drilling activity is mutually exclusive; drilling at a location tends to follow on from a seismic survey. Throughout the wider sea area, the total cumulative impact of implementing the Draft Plan could be to exclude other sea users from up to 480 km^2 per day, or less than 2% of the IOSEA1 area.

In the case of drilling, a maximum sea area of 8.7 km^2 would be unavailable to other sea users (due to 500 m exclusion zones around each well) in any one year on a temporary basis as a result of the Draft Plan and pre-existing activity combined. These totals are insignificant in relation to the 25,000 km^2 of offshore area being proposed for the Draft Plan, and are also much smaller than the exclusion that may possibly result from seismic survey activity. Together with the 'worst case' rough estimate for seismic survey of 480 km^2 per day, the total cumulative impact of implementing the Draft Plan could be to exclude other sea users from up to 490 km^2 per day, or less than 2% of the IOSEA1 area.

There are no detailed fishing effort data currently available with which to compare these physical presence impacts directly. Within the IOSEA1 area, the fishing industry may be of closest relevance to the oil and gas industry in comparing levels of exclusion to other sea users (and possibly also disturbance to the sea bed in combination with drilling discharges to the sea bed). However, the impacts of the physical presence of these various users in the IOSEA1 area do not change significantly when considered in combination.

There is little transboundary impact likely to arise from seismic vessel activity within the IOSEA1 area. However, the proposed activity may have the potential to interact with shipping travelling through the area to or from other European ports. In addition, it is possible that some of the seismic vessel activity in the IOSEA1 area will be based in ports in other European States.

Cumulative and transboundary impacts -accidental events

Exploration activities forecast for the IOSEA1 area indicate a maximum of 19 exploration, appraisal and development wells will be drilled between 2008 and 2011. Based on the probabilities outlined for UK and Norwegian production, the incremental risk of a significant hydrocarbon spill is very low.

The cumulative level of hydrocarbons entering the marine environment from spills associated with exploration, appraisal and development drilling is likely to be negligible when considered against other natural and anthropogenic sources. While the impacts from oil spills will differ from those of hydrocarbon inputs from rivers, sewage and shipping for example, even large oil spills associated with tanker accidents do not appear to have had long term chronic impacts on marine ecosystems.

Transboundary impacts on the UK marine environment from hydrocarbon spills could occur, and the significance of these could be similar to those potentially arising in Ireland. The island of Islay off the coast of Scotland is the closest UK landfall some 30 km to the east of the IOSEA1 area. Coastal sensitivities on Islay are high and are similar in nature to those of the northwest of Ireland. The coast of Northern Ireland lies over 50 km south of the eastern edge of the IOSEA1 area.

Any oil spill likely to have impacts in UK waters will be reported by the Irish Coast Guard to the relevant UK authorities. The Irish Coast Guard has a close working relationship with the UK Maritime and Coast Guard Agency (MCA) and is currently finalising a Service Level Agreement for co-operation on search and rescue and oil spill response. Recently the Irish Coast Guard and the UK MCA concluded a joint search and rescue and oil spill response exercise off the Donegal coast.

Cumulative and transboundary impacts from a shallow gas blowout would be reservoir specific. Atmospheric emissions could potentially have cumulative effects, although they would be dependent on the type and volume of gas released into the atmosphere. Similarly transboundary impacts could possibly occur with the UK and other European States.

Mitigation and monitoring

Mitigation - seismic survey: noise generation

Existing measures

- Reducing the noise entering the marine environment is the main measure in minimising the impacts of seismic survey operations. Subcontractor, vessel and equipment selection would be a part of this.
- Operators are required to submit an Application for Approval to PAD to conduct any Geophysical or Other Exploration Survey, Site Survey or Route Survey prior to the planned commencement of the activity. Operators are required to ensure that current best industry practices for the environment are applied with regard to impact mitigation and monitoring measures in relation to marine mammals.
- In the event that there is a requirement for multiple surveys in the same area and at the same time, it is advised these are combined into consecutive surveys through planning and co-operation with other operators and with the regulator.

Potential additional measures

- The timing and location of cetacean calving and migrations should be considered when planning a seismic survey, and if possible avoided. This will have to be assessed at a later stage, on a case by case basis, as current knowledge of these sensitivities is very limited and is still developing.
- As fish eggs and larvae are most at risk from the impacts of seismic activities, sensitive fish spawning areas should be avoided at known breeding times. In this regard, the most sensitive areas would be those used for spawning by herring during August and September and the peak spawning areas for both mackerel and blue whiting over the period April to June each year.
- At present, guidelines for minimising survey impacts to cetaceans, such as those promulgated in the UK by JNCC, are followed on voluntary basis. In Ireland the NPW has issued a draft document Mitigating Measures for Acoustic Surveys. The NPW guidelines should be made a requirement for all seismic surveys and incorporated into the PAD Rules and Procedures
- In addition, passive acoustic monitoring devices (PAM) could be deployed from the survey vessel to detect the presence and proximity of unseen cetaceans within the survey area, as long as this is deemed useful and appropriate by the relevant authorities and specialists. The use of passive acoustic monitoring devices (PAM) should be reviewed in a workshop by the relevant authorities, industry and specialists.

Mitigation - seismic survey: atmospheric emissions

Existing measures

- MARPOL Annex VI sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances.
- Annex VI prohibits deliberate emissions of ozone depleting substances, which include halons and chlorofluorocarbons (CFCs). New installations containing ozone-depleting substances are prohibited on all ships.
- Annex VI also sets limits on emissions of nitrogen oxides (NOx) from diesel engines. A mandatory NOx Technical Code, which defines how this shall be done, was adopted by the Conference under the cover of Resolution 2.
- The Annex also prohibits the incineration onboard ship of certain products, such as contaminated packaging materials and polychlorinated biphenyls (PCBs).

Potential additional measures

- Incorporate the aim of maximising fuel efficiency in the selection process for survey vessels, and ensuring the use of low sulphur fuel. Selection of a contractor with demonstrable planned preventative maintenance procedures will lead to fewer emissions and equipment failures. Finally, environmental awareness training at all levels within the operation will encourage best practice.

Mitigation - seismic survey: physical presence

Existing measures

- The oil and gas industry operators shall check in advance with the Maritime Safety Directorate, the MRCC of the Irish Coast Guard, and Sea Fisheries Control of the DCMNR that the proposed survey will not be carried out in an area and at a time that would conflict with legitimate shipping and fishing operations, including both floating and stationary gear, with consequential disruption of both such activities. In addition, in the case of a survey planned in an area of intensive fishing, discussions with Sea Fisheries Control of the DCMNR shall be initiated as early as possible, and, in any case, at least 45 days before the planned date in order that the implications can be fully considered. Marine Notices advertising such operations are published by the Marine Safety Directorate. Also marine navigation warnings are issued while the survey is taking place, for the duration of the survey.
- In the event that there is a requirement for multiple surveys in the same area and at the same time, these should be combined through appropriate planning and co-operation between operators and regulator.

Mitigation - seismic survey: accidental events

Existing measures

- Selection of a survey contractor with demonstrable planned preventative maintenance procedures will lead to fewer emissions and equipment failures. In addition, training of staff at all levels in environmental awareness will encourage best practice.
- A full risk assessment should be performed as part of survey design.
- Procedural controls, stemming from industry-standard guidelines and best practice procedures, will limit the possibility of accidental events. Quality procedures apply, incorporating the tenet of continuous improvement, and should be considered at the contractor selection stage.

Mitigation – drilling: noise generation

- Rig selection could be guided where possible by noise considerations. However, it is understood that the choice of drilling rig is generally dictated by other factors.
- Consideration should be given to the timing of drilling periods in relation to seasonal environmental sensitivities.

Mitigation – drilling: discharge of drill cuttings and disturbance to sea bed

Existing measures

- All chemicals used are regulated under the OSPAR HOCNF scheme and approved by use of a PUDAC. Selection of all chemicals that may be used in drilling the proposed wells should be

based upon both their technical specifications and their environmental performance, and the use of all chemicals minimised where practicable.

- Actual mud and chemical usage must be monitored during drilling operations, and subsequently reported to the PAD.
- It is prohibited to discharge to sea cuttings contaminated with OBM or SBM.
- Best practice should be followed to minimise the amount of excess cement deposited on the sea bed.
- Mud recovery systems should be used, thus minimising the amount of drill fluids to be discharged.
- Site surveys are undertaken with regard to geohazards such as shallow gas, gas hydrates and slope instability.

Potential additional measures

- Consideration should be given to drilling slimhole wells (ie thinner than usual well bore) where beneficial. These generate fewer cuttings, require less drilling fluid and chemicals, and are generally faster than a conventional drilling programme. However, there are technical and operational difficulties with slim hole drilling that mean these are only feasible under certain conditions.
- Consideration should be given to requesting that modelling of the dispersion of discharged drill cuttings be undertaken for sensitive locations. This would necessitate collection of tidal stream information at different depths through the water column, depending on the overall water depth, and validation of the predictions once drilling was complete.
- As insufficient information is available on the precise occurrence and distribution of key habitats, megafaunal species and historic wreck sites, site-specific survey data will be required in order to assess the impacts resulting from direct disturbance during the installation and removal of drilling structures. This could be carried out as part of the site survey normally undertaken prior to all drilling activities. The PAD may require an environmental survey as part of the EAA approval process and this should be carried out according to OSPAR guidelines. Careful consideration needs to be given to the design of such surveys, making use of non-destructive survey methods where appropriate.
- For areas known to be close to or within likely herring spawning grounds, particularly around the breeding period of August and September, a herring spawning ground assessment survey should take place prior to drilling to ensure that impacts to valued herring spawning habitat are avoided.
- Best practice should be followed in order to limit dragging of anchors and chains.
- The proposed works should be subject to a detailed underwater archaeological impact assessment in advance, and this should follow the format detailed in guidelines being developed on Acquisition and interpretation of geophysical data for archaeological assessment during oil industry geophysical route and site surveys in water depths exceeding 50 m. Any shipwrecks or objects of potential archaeological interest should be reported to the Director of the National Museum of Ireland within 4 days. If wreckage found is more than 100 years old, the Underwater Archaeology Unit and the Garda Siochaná must also be notified within 4 days.

Mitigation – drilling: atmospheric emissions

Existing measures

- In terms of fuel use, measures can be taken from an early stage to include fuel efficiency in the selection process for drilling rigs, support ships and helicopters, and to use low sulphur fuel for example. Such steps could be required through the national legislative and policy framework, as driven by, for example, the European Union strategy to reduce the contribution of shipping to acidification, ground-level ozone, eutrophication, health, climate change and ozone depletion.
- With regard to well testing, emissions may also be influenced by careful selection of drilling rig and contractors and by the use of maximum efficiency 'green' burners (in the case of oil or condensate wells). The amount of fuel flared can also be minimised by appropriate design of the test programme. If appropriate, well testing systems that do without the need for flaring at all can be built into the test programme.

Mitigation – drilling: physical presence

Existing measures

- At the time of submitting a well plan for approval, operators are obliged to inform fishermen by means of the established Irish Offshore Operators Association (IOOA) procedures. In addition, in the case of a well planned in an area of intensive fishing, discussions with the Sea Fisheries Control Division of the Department of Communications, Marine and Natural Resources must be initiated as early as possible, and in any case at least 90 days before planned commencement of drilling. Procedures are in place between IOOA members and the fishing industry to resolve possible disputes over damaged equipment.
- In the event of a well being suspended, over-trawlable protection should be put in place in areas most used for demersal fishing activities.

Mitigation – drilling: accidental events

Existing measures

- Selection of a drilling contractor with demonstrable planned preventative maintenance procedures will lead to fewer emissions and equipment failures. In addition, training of staff at all levels in environmental awareness will encourage best practice.
- A full risk assessment should be performed as part of well design and engineering.
- The potential for shallow gas should be identified and minimised by site survey prior to drilling.
- The BOP is installed to prevent gas blowout once drilling has progressed beyond the riserless stage.
- Gas detection systems are installed on mud shakers to give early indication of any potential for gas blowout.
- Training in safety awareness and response procedures for drilling crews will ensure that the risk of a blowout will be minimised, and be able to make the appropriate response should one occur.
- Procedural (permit to work, drilling and bunkering practices etc) and engineering controls (blowout preventers, choke and kill lines etc) will limit the possibility of accidental events.
- An approved OSCP is required in advance of approval for drilling. This is designed to assist the decision-making process during an oil spill, indicate what resources are required to combat the spill, minimise any further discharges and mitigate its effects. It should conform to PAD guidelines.

Monitoring

The DoEHLG Guidelines for implementation of the SEA Directive describe the requirement to monitor the significant environmental effects of the implementation of the Final Adopted Plan. The primary purpose of monitoring is to cross check significant environmental effects which arise during the implementation stage against those predicted during the plan preparation stage. The Directive leaves considerable flexibility as how monitoring shall be arranged. However, monitoring should concentrate on the likely significant effects that have been identified in the environmental report and the mitigative measures that have been proposed. Monitoring should ensure that the level of activities and subsequent impacts will be consistent with the scenarios developed within this report. This will enable identification by PAD of unforeseen impacts at an early stage and to take appropriate remedial action. The types of monitoring can therefore be thought of at two levels; monitoring the activity levels, and monitoring the impacts of the activities.

Monitoring activity levels

- The oil and gas exploration and appraisal activities resulting from implementation of the PAD's Final Adopted Plan for the current Frontier Licensing Round will be monitored by the PAD. This is to ensure the delivery of exploration commitments made by operators in the agreed work programmes at the time of licensing. An activity scenario has been developed by the PAD for IOSEA1 as a basis for impact assessment. Actual activity levels over the area will therefore need to be compared with predicted levels, in order to monitor the basis for the conclusions in the Environmental Report.
- A 6-monthly report is prepared by the PAD for the government, in line with other sectors, that summarises the activities of the oil and gas industry in Ireland, including a list of current licences, consents issued, wells drilled and surveys undertaken. This could be developed as the basis for the required monitoring of activity levels, and to confirm activity levels are in line with those predicted.

Monitoring the impacts of the activities

- As detailed in Article 10 of the SEA Directive, Member States shall monitor the significant environmental effects of the implementation of plans and programmes in order to identify at an early stage unforeseen adverse effects and to be able to undertake appropriate remedial action.
- The licensing authority should ensure that an appropriate monitoring programme be devised for evaluating the environmental impacts and efficacy of mitigation measures relating to the key potential environmental issues that were identified as significant. This should be carried out in consultation with appropriate statutory bodies and specialists.
- The licensing authority (PAD) will ensure that appropriate best practice guidelines where required are developed and implemented in consultation with other statutory authorities and relevant specialists.
- The current Rules and Procedures for Offshore Petroleum Exploration and Appraisal Operations ('Rules and Procedures') are set out in accordance with the provisions of the Petroleum and Other Minerals Development Act, 1960 (no 7 of 1960), as applied by the Continental Shelf Act, 1968 (no 14 of 1968), as amended and pursuant to the Licensing Terms for Offshore Oil and Gas Exploration and Development, 1992 ('1992 Terms'). These are laid out in the Rules and Procedures Manual for Offshore Petroleum Exploration and Appraisal Operations. PAD approval is required before commencement of certain operations, and such PAD approval may be dependent on prior satisfaction of the specific requirements of other responsible Departments, Agencies and Authorities.

Conclusions and recommendations

Data gaps

The following is a summary of the data gaps identified throughout this report.

- In the context of oil and gas related exploration activity, environmental data (physical, chemical and biological) collected as part of the impact assessment process for oil and gas industry activities, could be collated in a readily accessible database and reviewed at suitable intervals.
- Irish waters support a diverse fish and shellfish fauna, including many commercially important species, but relatively little synthesised information on the species present and their distribution has been made available. This applies in particular to deep water fish species for which the available information is dated and limited. With the further development of deep water fishing, and increasing numbers of deep water surveys, knowledge of the fish and shellfish species is starting to grow.
- Reliable overviews of commercial fish distributions and the fisheries that exploit them were not available to this SEA process. Though a number of surveys have been carried out, including acoustic and groundfish surveys, there is currently insufficient coverage, or correlation between annual results to build up regional and temporal overviews of the area.
- Area-specific fishing effort data was not made available for the IOSEA1 area, with which to conduct impact assessments.
- In the context of climate change and with changes in sea temperature, the fish spawning and nursery ground information is becoming dated. Fish larval surveys are taking place in Irish waters and the findings of these should be used to update the location of fish spawning and nursery grounds.
- There are few data examining the distribution and abundance of cephalopods in the northeast Atlantic, despite fisheries existing that are based on these species. As a food source for certain cetaceans, further data on cephalopod distribution and abundance in the area could link into corresponding cetacean studies.
- Comparatively little is known about the numbers and distribution of marine mammals in the offshore environment, their use of the area and its resources, and their vulnerability to anthropogenic impacts of various types at different times of the year. Visual survey effort is currently limited offshore of the continental shelf break in autumn and winter due to poor weather conditions and reduced daylight hours. There is therefore a need for a strategic co-ordinated survey and monitoring programme based on good science. Irish scientists recently carried out a programme of acoustic monitoring to complement their broadscale visual surveys. It is recommended that such acoustic work be continued over a wider area and throughout the year.
- Existing MMO reports from seismic surveys have not been collated into the main body of knowledge on cetaceans. With suitable co-ordination and methods development, existing cetacean data gathering could be augmented by the MMO reports from seismic

surveys. Approaches to acoustic disturbance mitigation measures in general (such as the benefits or otherwise of 'soft starts') would benefit from ongoing research to evaluate their effectiveness.

- Very little is known about the existing levels of anthropogenic noise in the IOSEA1 area, and the significance of additional anthropogenic sound inputs on either fish or marine mammals.
- Further information on the timing and location of cetacean calving and migrations is needed. At present, SOSUS data have indicated the possibility of a winter migration to the south along the Rockall Basin for humpback whales in late winter or early spring, although there is no indication yet of any returning northward migration, and animals of the same species also appear to be present in the offshore area throughout the year.
- Few data currently exist to identify foraging areas for seal species along the Irish Shelf, including the IOSEA1 area. The first attempts to determine the offshore distribution of both common and grey seals in Irish waters, using tagging and satellite telemetry methods, began this year. A nationwide survey to assess the abundance and distribution of grey seals around Ireland's coasts was carried out by NPW and CMRC. These data will be made available in late 2006 for future environmental assessments.
- Whilst much general information about the sea bed and benthos (including depth, topography and sea bed type) in the IOSEA1 area has been gathered in recent years, much analysis is still underway and is currently unavailable for environmental assessment.
- Comparatively little is known about the numbers and seasonal distribution of seabirds in the offshore environment, and their vulnerability to surface pollution at different times of the year. During the autumn and winter months, visual survey effort is limited to the continental shelf, but rarely extends into the deeper parts of the IOSEA1 area, due to poor weather conditions and reduced daylight hours.
- Block-specific data indicating seabird vulnerability to surface pollution is only currently available from JNCC Seabirds At Sea Team surveys from the 1990s, which only partially cover Irish waters. It is recommended more recent CMRC seabird surveys, looking at the offshore area west of Ireland, should be used to update this information.
- With the exception of the PIP-commissioned study of descriptive regional climatology, there is a lack of data in the Donegal Basin area and a need for greater integration of oceanographic and metocean data. Understanding of the movement of water masses at different depths and of the processes affecting sediment transport and shaping the sea bed.

Overall recommendations

Overall recommendations - data gaps and data management

1) **Regulatory processes should allow the review of operational practices by industry and regulators on a regular basis as appropriate, to facilitate the integration into decision-making of new scientific findings as they come on stream.**
2) **The monitoring programmes resulting from implementation of this licensing programme should be designed to generate datasets that can support both strategic and site-specific approaches to environmental assessment.**
3) **National marine monitoring and data gathering initiatives should be integrated and harmonised across and between the various state agencies, academic institutions and commercial operators.**
4) **Environmental data (physical, chemical, biological and relating to other sea users) collected through IOSEA1, should be collated and held in a co-ordinated and readily accessible database at an identified location (possibly within the PAD or MI) for use in future IOSEAs and other oil and gas-related environmental assessments.**

Overall recommendations - SEA process

5) **A minimum period of 6 months should be allowed from the start of the SEA process to production of the Draft Environmental Report.**
6) **A 4 week notice of the start of public consultation should be given in future IOSEAs, and the consultation period should be extended to 6 weeks.**
7) **The statutory authorities should evaluate the most appropriate and effective means of involving coastal communities or regional authorities in future IOSEAs including at the data gathering and consultation stage.**

Overall recommendations - licensing and regulation

8) **The EAA and its surveys should be consistent with the OSPAR guideline 2004-11 for monitoring the impact of offshore oil and gas activities, and should be used to advise the decision making process.**

9) **Site-specific surveys as part of EAA should be carried out in advance of drilling in accordance with the OSPAR guidance. These should describe the existing physical, chemical and biological conditions and where necessary archaeology. The EAA should also describe the likely impacts on pelagic organisms and specific natural resources.**

10) **The application and EAA should be assessed by the appropriate statutory bodies prior to issue of the drilling permit.**

11) **A framework for consultation regarding proposed activities and developments with the relevant statutory bodies needs to be developed. For example, guidelines for site survey procedures should be developed with the appropriate statutory authorities to ensure that damage does not occur to sensitive heritage features. Exploratory drilling should be subject to a detailed underwater archaeological impact assessment in advance, and this should follow the format detailed in guidelines being developed on Acquisition and interpretation of geophysical data for archaeological assessment during oil industry geophysical route and site surveys in water depths exceeding 50 m. The appropriate Underwater Archaeology Unit within DoEHLG should be sent a copy of the site survey report for assessment prior to issue of the drilling permit. In addition, any shipwrecks or objects of potential archaeological interest should be reported to the Director of the National Museum of Ireland within four days. If wreckage found is more than 100 years old, the Underwater Archaeology Unit and the Garda Siochaná must also be notified within 4 days.**

12) **The Minister should, in certain circumstances, consider requesting the submission of a more detailed assessments up to and including an EIS. Criteria which might indicate or support this greater level of assessment could include:**

- **distance from offshore European sites, coastline and international boundaries;**
- **proximity to vulnerable concentrations of marine mammals or seabirds;**
- **the presence of spawning, nursery and fishing grounds for commercially valuable fish and shellfish species (particularly herring, sandeel and Dublin Bay prawn for example);**
- **proximity to features of ecological interest identified within the Habitats Directive;**
- **where proposed operations may significantly interfere with other sea users.**

13) **The communication and enforcement measures for exclusion zones around the sea bed infrastructure of the oil and gas industry (such as suspended wells and sub-sea field developments) should be reviewed and strengthened. The aim here is to improve mapping, information exchange, integration with fisheries monitoring procedures and interfaces with other marine users such as the Irish Naval Service and marine research establishments.**

14) **The existing regulatory framework and decision making process, as outlined in the Rules and Procedures documents of the PAD should be updated with a view to greater clarity and transparency for the benefit of all stakeholders.**

Overall recommendations - seismic survey

15) **The application for approval to conduct seismic survey should include an assessment of the information available at the time on the marine environment (and specifically including marine mammals and fish spawning/timing in the proposed survey area) together with any specific mitigation measures proposed.**

16) **The application for seismic survey should be sent to appropriate statutory bodies for environmental and heritage consideration within an agreed timeframe. These bodies may recommend changes to the timing or other aspects of mitigation.**

17) **The NPW guidelines should be made a requirement for all seismic surveys and incorporated into the PAD Rules and Procedures. These guidelines should be regularly reviewed as new scientific data emerges in order to ensure their credibility and effectiveness.**

18) **The use of passive acoustic monitoring devices (PAM) should be reviewed in a workshop by the relevant authorities, industry and specialists.**

19) **Multiple surveys in the same area and at the same time should be combined into consecutive surveys through appropriate planning and cooperation. The PAD should**

work with operators to ensure that surveys are co-ordinated in this respect according to currently available best practice guidance from appropriate specialists.

20) If surveys must be carried out simultaneously, a separation distance of 100 km should be observed between survey vessels, so that marine mammals and fish have the chance to avoid these areas and migration routes are not impeded.

21) Notification of seismic activity planned within 100 km of the Ireland/UK boundary should be exchanged between the appropriate licensing authorities.

22) Comparatively little is known about the numbers and distribution of marine mammals in the offshore environment, their use of the area and its resources, and their vulnerability to anthropogenic impacts of various types at different times of the year. Visual survey effort is currently limited offshore of the continental shelf break in autumn and winter due to poor weather conditions and reduced daylight hours. There is therefore a need for a strategic co-ordinated survey and monitoring programme based on good science. Irish scientists recently carried out a programme of acoustic monitoring to complement their broadscale visual surveys. It is recommended that such acoustic work be continued over a wider area and throughout the year.

Overall recommendations - exploration drilling

23) Pockmark features and the biological communities that may be associated with them should be excluded from exploration drilling activity (with a 1.5 km buffer zone) until detailed ground truth surveys are carried out. This measure is proposed in order to prevent potential damage to these features from anchoring or the discharge of drilling wastes, but the size of the area may be amended in the future following appropriate survey work and assessment. It may be that exploration drilling near or within these areas is subject to site-specific assessments or EIS.

24) On the basis of current knowledge, drilling activity in areas used for spawning by herring (parts of Blocks 13/13, 13/14 and 13/15) should be avoided during the spawning period in August and September.

25) For areas known to be close to or within likely herring spawning grounds, particularly around the breeding period of August to September, a site-specific herring spawning ground assessment survey should take place prior to drilling to ensure that impacts to valued herring spawning habitat are avoided.

26) The results of the herring spawning survey should be assessed by competent authorities, and any recommendations for amending the assessment process or the drilling plan made prior to issue of the drilling permit.

27) Best practice should be followed to minimise the amount of excess cement deposited on the sea bed, to minimise the amount of dragging (and damage to sea bed and features) by anchors and chains, and also to minimise the quantities of drill fluids discharged.

28) In the event of a well being suspended, over-trawlable protection should be put in place in areas most used for demersal fishing activities.

Overall recommendations - monitoring and reporting

29) A 6-monthly report is prepared by the PAD for the government, in line with other sectors, that summarises the activities of the oil and gas industry in Ireland, including a list of current licences, consents issued, wells drilled and surveys undertaken. This should be developed as the basis for the required monitoring of activity levels, and to confirm activity levels are in line with those predicted.

30) The licensing authority should ensure that an appropriate monitoring programme be devised for evaluating the environmental impacts and efficacy of mitigation measures relating to the key potential environmental issues identified. This should be carried out in consultation with appropriate statutory bodies and specialists.

31) The PAD should consult with relevant bodies including the Marine Institute in order to review the environmental monitoring framework and any gaps therein in light of the IOSEA1 assessment.

Overall recommendations - future oil and gas activity in the IOSEA1 area

32) In the event of Phases 1 and 2 of the current round being successful (ie that commercially viable hydrocarbon reserves are located) or by 2011, the competent authority should decide on the arrangements for follow-up SEA in the IOSEA1 area.

This decision should be informed by up-to-date information (eg the PAD activity level reports) and should also consider the full life-cycle of development from exploration to decommissioning, with the aim of providing an integrated SEA framework for the individual EIAs that will be taking place.

33) The licensing authority (PAD) will ensure that appropriate best practice guidelines are developed where required, implemented in consultation with other statutory authorities and relevant specialists, and kept updated in line with scientific knowledge and to lead the way for industry best practice. Developments in best practice will be applied to existing as well as to new licenses.

34) Environmental awareness training should be carried out at all levels to promote best practice within industry operations.

35) Fuel efficiency should be maximised in the selection process for survey vessels, and the use of low sulphur fuel is recommended. Selection of a contractor with demonstrable planned preventative maintenance procedures will lead to fewer emissions and equipment failures.

Overall conclusions

The Draft Plan is to offer offshore blocks for hydrocarbon exploration in the current Frontier Exploration Licensing Round in the Slyne, Erris and Donegal Basins. A strategic assessment has been carried out on the potential for environmental impacts, based on scenarios for the likely scale of activity, a literature search, a data gathering exercise, and inputs from public consultation feedback combined with the expert judgement of the Steering Group, ERT consultants and the Environmental Authorities. On the basis of the assessment conducted, certain constraints have been proposed. If these constraints, together with the mitigation, monitoring measures and recommendations are put into place, the Steering Group is of the opinion that the Draft Plan can be adopted and implemented without causing significant environmental impacts.