16. ASSESSMENT OF ENVIRONMENTAL EFFECTS

16.1 Introduction

This Section summarises the potential environmental effects associated with the proposed Corrib Field development. It lists the general sources of impact associated with the project, such as:

- physical presence of the facilities;
- atmospheric emissions;
- discharges to sea;
- solid waste; and
- accidental events.

Aspects of the development may have one or more of the following interactions with the environment:

- disturbance of habitats, as well as interaction with shipping and fisheries, as a result of physical presence of the facilities;
- impact on air quality from atmospheric emissions;
- contributions to climate change;
- impact on water quality from discharges to sea;
- land use for waste disposal;
- impact on the environment from accidental releases; and
- the requirement for use of natural resources.

The predicted impacts (the impacts which are still expected to occur despite the mitigation measures proposed), the are often referred to as “residual impacts”, from scheduled operations are covered in the first part of this section, while those impacts which have the potential to occur as a result of accidental events are discussed in the second part. This section also summarises the mitigation measures which have been identified to reduce the potential for impact.

The planned activities have the potential to affect the receiving environment in the vicinity of the Corrib Field, this will encompass the pipeline route, including Broadhaven Bay, the area around the landfall and the areas around the crossings of the Sruwaddacon. Upset conditions and accidental events could affect a wider geographic area.

The development has been broken down into constituent activities and impacts are identified for each activity. Activities which have potential environmental impacts are identified as ‘**aspects**’. The types of **potential environmental impacts** have been identified for each aspect.

Consideration has been given to prevention, **mitigation or control** measures incorporated into the project design, or operating strategy, which reduce the potential environmental impacts. Sometimes the potential for impact has been eliminated. In other cases there remains a possibility for environmental impact, in spite of the mitigation measures. The remaining impact is estimated where possible and listed as a **predicted environmental impact.**

This Section presents the evaluation of the relative significance of the environmental effects, with particular reference to the sensitivities of the flora and fauna identified in **Section 7**. The relative ecological significance of predicted impact is summarised by applying a keyword from a scale from significant through to negligible (or beneficial).

16.2 Evaluation of Relative Ecological Significance

Criteria for assessing the ecological significance of predicted environmental impacts have been closely defined. **Table 16.1** presents the definitions.

Table 16.1: Criteria for assessing significance of effect

Significance Category		Severity of Impact (after implementation of appropriate mitigation measures/actions)
I	Significant	Substantial adverse changes in an ecosystem. Changes are well outside the range of natural variation and unassisted recovery could be protracted.
II	Moderate	Moderate adverse changes in an ecosystem. Changes may exceed the range of natural variation. Potential for recovery within several years without intervention is good, however, it is recognised that a low level of impact may remain.
III	Minor	Minor adverse changes in an ecosystem. Changes might be noticeable, but fall within the range of normal variation. Effects are short-lived, with unassisted recovery occurring in the near term, however, it is recognised that a low level of impact may remain.
IV	Negligible	Changes in an ecosystem that are unlikely to be noticeable (i.e. well within the scope of natural variation).
V	Beneficial	Changes resulting in positive, desirable, or beneficial effects on an ecosystem.

Notes:
1. The definitions are intended to categorise predicted effects. Predicted effects are impacts expected following the implementation of mitigation measures or controls. An effect that would have been 'Significant' without action by the Project may be assessed to be 'Moderate', 'Minor', or 'Negligible', after effective mitigation or control measures are in place.
2. The term 'ecosystem' in the above can be taken to mean the physical environment and the biological communities that live within that environment. Typically, impacts to populations and communities are considered, rather than impacts to individuals. However, in certain cases involving threatened or endangered species, impacts to individuals may be of greater concern.

The evaluation considers the vulnerability, temporal sensitivity and recoverability of the receiving environment and the geographical extent of the effect.

Table 16.2 presents the aspects, potential impacts, mitigation measures, predicted impacts and the assessment of the ecological significance of the predicted impacts. The table considers the normal scheduled operations associated with the development. The impacts of non-scheduled eventualities are considered separately, later in this chapter (see **Table 16.4).**

The most significant predicted environmental impacts are discussed in more detail in the relevant sections of this EIS. The reader is referred to the relevant chapters and sections, where further information is given.

Table 16.2: Assessment of Potential Impacts, Proposed Mitigation Measures and Predicted Impacts

Aspect/Potential Impact		Control / Mitigation Measures	Predicted Impact / Ecological Significance
DRILLING OPERATIONS (PER WELL)			
1	TOW RIG TO AND FROM DRILLING LOCATION: The mobilization of the MODU to the drilling location involves the MODU and tugboats traveling for a period of seven days. **Use of MODU's propulsion system** • disturbance to marine traffic; emissions to air from rig engines; and • subsea noise. **Use of Tugs** • emissions to air from vessel engines.	• Notices to Mariners advising of the mobilization; • consultation with authorities to agree a routing and schedule which minimizes interference with other sea users; • MODU is equipped with navigation lights and equipment, and will continuously monitor marine traffic; • existing shipping lanes will be used as far as possible; and • maintenance of vessel engines scheduled to ensure efficient combustion of fuel.	**NEGLIGIBLE** emissions to air: refer to Chapters 10 and 13 interference with other sea users: refer to Chapter 15
2	RIG POSITIONING, RUNNING & SETTING OF ANCHORS AND PULLING OF ANCHORS: The MODU will be positioned precisely over the well location and ballasted. Eight 15 ton anchors will be laid with chains 5000ft long, with three additional piggy-back anchors. **Use of Anchor Lay Vessels** • emissions to air from vessel engines. **Setting Anchors** • disturbance to seabed sediments. **Running Anchor Chains** • disturbance to seabed sediments.	• written procedures are established for positioning and mooring; • ballast water fills dedicated ballast tanks, and does not come into contact with stored bilge or bulk fluids; • ROV seabed survey of well spud site ensures it is free of obstructions; and • the footprint of the development has been reduced by use of directional drilling, allowing a cluster of five wells close by the manifold.	**NEGLIGIBLE** emissions to air: refer to Chapters 10 and 13 seabed disturbance: sediments are not likely to release pollutants. Disturbance will be localized and transient, and restored by the seabed current regime. Refer to Section 7.8.1.1 seabed disturbance – covered in geology Chapter 8

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
DRILLING OPERATIONS (PER WELL)			
3	PHYSICAL PRESENCE OF RIG AND SUPPORT VESSELS AT THE DRILL SITE: The MODU and accompanying stand-by vessel remain on location for an average of 85 days per well (including the well test programme). The MODU has a crew of around 80, the stand-by vessel has a crew of around 20. Helicopters make 3 flights per week to the rig for crew changes. **Anchor Spread** • seabed disturbance from movement of anchor chains.	• the relevant authorities will be consulted and notified with regard to the drilling location; • the MODU will be equipped with navigation lights to SOLAS DNV/MRS standards; and • the MODU or stand by vessel will keep a continuous watch on marine traffic.	**NEGLIGIBLE** interference with other sea users: refer to Chapter 15 seabed disturbance: Localized and transient. Refer to section 7.8.1.1
4	PHYSICAL PRESENCE OF RIG AND SUPPORT VESSELS AT THE DRILL SITE: **Routine non-drilling discharges** • rain run-off; • separated water discharge from closed drain system; • black and grey sewage discharges; • putrescible galley wastes;solid wastes; • noise; and • light. **Helicopter traffic** emissions to air from helicopter engines.	• untreated rainwater run-off will only be permitted from 'clean' deck areas. Other areas, including areas where drilling mud is handled, will drain via closed drains and oil/water separators; • black and grey waters will be processed by a sewage unit to meet the requirements of MARPOL 73/78 Annex IV; • putrescible galley wastes macerated to particles smaller than 25 mm before release; and • solid wastes will be contained and transported to shore.	**NEGLIGIBLE** waste waters: refer to Chapter 9 for estimate of discharge and impacts putrescible galley waste: refer to Chapter 9 for estimate. Refer to section 7.8.1.1 for minor local impacts on plankton and fish solid wastes: refer to Chapter 15 for estimate of waste arisings emissions to air: refer to Chapters 10 and 13

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
DRILLING OPERATIONS (PER WELL)			
5	DRILL INTERVALS I & II (WITH RETURNS DIRECT TO THE SEABED) Drilling, casing and cementing operations scheduled to take about 10 days. Sea water is used with frequent WBM viscous sweeps. **Drilling** • emissions to air from rig engines; • noise; • scrap metal/solid waste; and • spent lube oil. **Use of Drilling Fluid** • use of chemicals; discharge to sea of 840 tonnes of WBM drilling fluid in retention on cuttings; and • onboard mud testing using small volumes of indicator chemicals and reagents. **Cuttings** • discharge to sea of 388 tonnes of formation cuttings per well. **Running Casing** **Cementing** • discharge of 11 tonnes unset cement slurry to the seabed; • drilling of 13 tonnes set cement and discharge to the seabed; and • discharge of 1 tonne cement slops from cleaning cement unit.	• Predetermined drilling programme of short duration; • reuse of appraisal wells as producers reduces the number of wells to be drilled; • slim hole well design reduces the requirement for drilling fluid; • procedures in place for storage, handling and mixing of mud chemicals; • selection of mud formulations giving preference to chemicals which have HOCNF category E, or which are on OSPAR's PLONOR list; • use of Barite with very low trace heavy metal content (Cd <0.5mg/kg, Hg<0.01mg/kg); • reagents from mud testing collected in sealed containers for onshore disposal; • slim hole well design reduces the tonnage of cuttings generated in the WBM sections; and • slim hole well design cuts out one complete cement job, with associated release of slurry and drilled cement cuttings.	**NEGLIGIBLE** emissions to air: refer to Chapters 10 and 13 noise: refer to Chapter 11 waste: refer to Chapter 15 for estimates MINOR WBM, WBM Cuttings and cement cuttings: minor localized smothering. The discharges are not expected to release toxins in bio-available form. refer to Section 7.8.1.1 wet cement: will disperse on contact with seawater. Solids will settle out rapidly, temporary localized increase in pH will be buffered by the sea. refer to Section 7.8.1.1 impacts discussed in Section 9

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
DRILLING OPERATIONS (PER WELL)			
6	DRILL INTERVALS III & IV (WITH LTOBM WITH MARINE RISER IN PLACE) Drilling, casing and cementing scheduled to take about 32 days. **Drilling** • emissions to air from rig engines; • noise; • scrap metal/solid waste; and • spent lube oil. **Use of Drilling Fluid** • containment of LTOBM drilling fluid, with surplus volumes backloaded at end of operations; • onboard mud testing using small volumes of indicator chemicals and reagents; and • use of 3000 litres rig wash detergent. **Cuttings** • containment of 835 tonnes of LTOBM coated (wet) cuttings; • containment of 130 tonnes of LTOBM coated centrifuge solids; and • onshore use of recycled LTOBM base fluid and cuttings. **Cementing of casing** • discharge of 3 tonnes unset cement (over-mixed volume) discharged at sea surface; • possible discharge of mud/cement interface; • containment of 10 tonnes drilled set cement with 4 tonnes of residual LTOBM; and • discharge 2 tonnes of cement slops from cleaning cement unit.	• predetermined drilling programme of short duration; • reuse of appraisal wells as producers minimises the number of wells to be drilled; • slim hole well design reduces the requirement for drilling fluid and reduces the tonnage of cuttings generated in the LTOBM sections; • procedures in place for storage, handling and mixing mud chemicals; • mud handling within bunded areas, with drains blocked. Use of mud vac units to recover spilt LTOBM, and rigwash detergent for cleaning decks and equipment; • rigwash discharge will be gradual. Average use is around 35 litres/day. The rigwash is diluted by washwater before entering drains; • zero discharge of LTOBM; • reagents from mud testing collected in sealed containers for onshore disposal; and • cuttings and centrifuge solids are containerized for transport for onshore re-cycling. The base fluid may be recovered, and the processed cuttings re-used.	**NEGLIGIBLE** noise: refer to Chapter 11 air: refer to Chapter 10 for estimates solid wastes: refer to Chapter 15 for estimates MINOR wet cement: In the event that water based spacer fluid and wet cement returns are taken to the surface and discharged, they will disperse on contact with seawater. Solids will settle out rapidly, Temporary localized increase in pH will be buffered by the sea. refer to Section 7.8.1.1 offshore discharge of diluted rigwash may have slight local effects, but will rapidly disperse. refer to Section 7.8.1.1 discussion of these aspects including use of drilling muds refer to Chapter 8 and 9.

Aspect/Potential Impact		Control / Mitigation Measures	Predicted Impact / Ecological Significance
DRILLING OPERATIONS (PER WELL)			
7	BLOW OUT PREVENTER OPERATION AND TESTING Routine (weekly) testing of the BOP stack is a safety feature. The BOP is also closed for routine formation integrity tests at the start of each section. **Routine BOP Tests** • subsea release of glycol BOP control fluid. **Leak-Off Tests** • subsea release of glycol BOP control fluid.	• use of an environmentally benign water/glycol based BOP control fluid.	NEGLIGIBLE refer to Section 7.8.1.1
8	VERTICAL SEISMIC PROFILING Short tests using seismic source to confirm geological profile of well **Firing of seismic source from close to sea surface**	• short term operation (approximately 8 hours); and • soft-start will be used to give an cetaceans in the vicinity the opportunity to leave the area.	NEGLIGIBLE short term impact, from low volume seismic source. Cetaceans able to leave area of effect
9	WELL LOGGING /PERFORATING Logging of the production zone, perforating for flow test **Running Wireline Tools** **Running tools with radioactive source material** • handling radio active materials such as gamma ray sources. **Perforating** • handling and use of perforation guns; and • noise.	• written procedures for handling radio active material; • written procedures for handling perforation equipment; and • perforation noise source will be 3000 m below seabed.	NEGLIGIBLE noise from perforating gun unlikely to be perceived by marine mammals.

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
DRILLING OPERATIONS (PER WELL)			
10	RESERVOIR STIMULATION Hydraulic fracturing of the reservoir **Recording success of fracturing by use of radioactive tracers** • handling radio active materials such as gamma ray sources.	• written procedures for handling radio active material; • any use of radioactive material will be in accordance with licence conditions set down by the Radiological Protection Institute of Ireland; and • any radioactive material which does not stay in the well will be retained on-board the drilling rig and returned to shore for disposal.	NEGLIGIBLE no discharge anticipated
11	PRODUCTION WELL TEST Well clean-up involves displacement to brine, chemical treatment to remove solids from wellbore, flowing the well to remove mud and filtrate from reservoir formation. Drill stem test, involves flowing the well at constant rate, typically for 48 hours, and flaring the produced hydrocarbons. **Well Clean-Up** • use and discharge of clean-up chemicals; and use of completion brine chemicals. **Flowing the Well** • emissions to air from well test.	• preference given to clean-up chemicals (detergents/flocculants etc) which are environmentally benign. Limited discharge of chemicals in HOCNF categories C-D, justified on performance and proven efficacy; • well cleaning fluid containing base oil will be contained and backloaded; and • no well testing is planned for future production wells P6-P8.	NEGLIGIBLE emissions to air: refer to Chapters 10 and 13

Aspect/Potential Impact		Control / Mitigation Measures	Predicted Impact / Ecological Significance
CONSTRUCTION OPERATIONS WITHIN CORRIB FIELD			
12	COMPLETION OF SUSPENDED WELLS The MODU returns to suspended wells, drills out the cement plugs, runs production tubing and christmas tree, reperforates and retests the wells. The MODU is on location for 25 days per well. Well testing would be of short duration. **Presence of Rig** • ballast water discharge; • rain run-off; • separated water discharge from closed drain system; • black and grey sewage discharges; • putrescible galley wastes; • solid wastes; • noise; • light; and emissions to air. **Drilling out Plugs** • use of completion brine chemicals; and • discharge of approximately 12 tonnes cement cuttings to the sea. **Running tubing and christmas tree** **Re-perforation** • handling and use of perforation guns; and • noise. **Well Test** • emissions to air from short well test.	• the MODU will be equipped with navigation lights to SOLAS DNV/MRS standards; • the MODU will keep a continuous watch on marine traffic; • untreated rainwater run-off will only be permitted from 'clean' deck areas; • black and grey waters will be processed by a sewage unit to meet the requirements of MARPOL 73/78 Annex IV; • putrescible galley wastes macerated to particles smaller than 25 mm before release; • solid wastes will be contained and transported to shore; • cement cuttings drilled with completion brine; • written procedures for handling perforation equipment; • written procedures for Well Testing; and • high efficiency burner used. 99% efficiency expected with gas/condensate mix.	NEGLIGIBLE solid waste: refer to Chapter 15 liquid waste: refer to Chapter 9 emissions to air: refer to Chapters 10 and 13 cement: the cement and additives are set, and all toxic substances are bound in the matrix of the cement. Refer to Section 7.8.1.1

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
CONSTRUCTION OPERATIONS WITHIN CORRIB FIELD			
13	WELL TIE-IN AND INSTALLATION OF FLOWLINE: The infield flowlines and manifolds will be set in place on the seabed and connected to the wellhead christmas trees. This is scheduled to take two months. **Presence of heavy lift vessel, support vessel, anchor handling vessels and survey vessel** • emissions to air from vessel engines; • disturbance to seabed sediments from anchor laying; • black and grey sewage discharges; • putrescible galley wastes; • solid wastes; • noise; and light. **Seabed Preparation** • seabed disturbance **Use of Trencher** • seabed disturbance from remote trenching vehicle. **Installation of Manifold/protective structure** • seabed disturbance. **Installation of Subsea Flowlines/protective mats** • seabed disturbance; **Installation of PLEM/protective structure** • seabed disturbance.	• other marine users informed of installation activities; • pre installation seabed survey; • preferential selection of flat relief areas of seabed reduces requirement for sea bed preparation; • burial of flowlines reduces the seabed profile of the installation, and reduces risk of fishnet snagging; • seabed currents are sufficient to fill in track marks of trencher with silt in a matter of months; • trenches will fill with silt in a matter of months; • overtrawlable protective structures will be installed over the manifold and PLEM which stand proud of the seabed; and • concrete mats will protect the sections of flowline close to the manifold which stand proud of the seabed.	NEGLIGIBLE emissions to air: refer to Chapters 10 and 13 waste: refer to Chapter 15 waste waters: refer to chapter 9 seabed disturbance from trencher: short term with scope for rapid recolonisation. refer to Chapter 7 seabed disturbance from mats and protective structures limited to lifetime of project. These are expected to be removed at decommissioning, allowing recolonisation see Chapter 7 pre installation seabed survey and risk of fish net snagging: refer to Chapter 8

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
CONSTRUCTION OPERATIONS WITHIN CORRIB FIELD			
14	RECOVERY OF DEBRIS AND TEMPORARY CONSTRUCTION WORK ITEMS: Clearing of dropped items and post construction seabed survey **ROV Survey**	• this work is a mitigation of accidental and temporary disturbance to the seabed during construction.	NEGLIGIBLE
OFFSHORE PIPELAYING OPERATIONS			
15	PRESENCE & MOVEMENT OF PIPELAY VESSEL & OTHER VESSELS: The lay vessel, rock placement vessel, pipeline plough, pipe haul vessels, backhoe and survey vessel will move along the route of the pipeline from the landfall to the field during a 25 day period. Supply vessels will bring lengths of pipeline from onshore storage area. **Requirement for Exclusion Zone** • disturbance to other sea users. **Routine emissions from Vessels** • emissions to air from vessel engines; • black and grey sewage discharges;putrescible galley Wastes; • solid wastes; • noise; and • light. **Helicopter** • emissions to air from engines.	• the vessels will be equipped with navigation and warning equipment and will keep a continuous watch on marine traffic; • black and grey waters will be processed by a sewage unit to meet the requirements of MARPOL 73/78 Annex IV; • putrescible galley wastes macerated to particles smaller than 25 mm before release; and • solid wastes will be contained and transported to shore.	**NEGLIGIBLE** waste waters: refer to Chapter 9 for estimate of discharge putrescible galley waste: refer to Chapter 9 for estimate. refer to section 7.8.1.1 for minor local impacts on plankton and fish solid wastes: refer to Chapter 15 for estimate of waste arisings emissions to air: refer to Chapters 10 and 13 noise: low levels of noise from vessels in transit – see Chapter 11

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
CONSTRUCTION OPERATIONS WITHIN CORRIB FIELD			
16	PIPELAY VESSEL OPERATIONS: • emissions to air from pipelay vessel.	• use of a dynamically positioned (DP) pipelay vessel will limit the seabed disturbance, as no anchors are laid, but DP vessel operations involve higher rates of emissions to air, as engines are run to power thrusters to enable station keeping.	NEGLIGIBLE emissions to air: refer to Chapters 10 and 13
17	PIPE LAYING ACTIVITY: Weld lengths of pipe and lower them to the seabed along selected route. **Pipelaying** • emissions to air from welding; and • seabed disturbance where pipe is laid.		NEGLIGIBLE disturbance to seabed communities: refer to Chapter 7
18	TRENCHING OPERATIONS: The seabed will be surveyed for a route requiring least preparation. Where necessary, e.g., at the edges of iceberg scours, the pipeline will be buried. **Prelay Survey** • emissions to air from survey vessel. **Use of Trencher for profiling** • seabed disturbance.	• The route has been surveyed and optimized to reduce the need to profile undulations, minimize free spanning, and avoid scour marks; and • if buried, a trenching plough or jet will be used, so that the pipeline will quickly be covered over by the removed sediments.	NEGLIGIBLE seabed disturbance : refer to Section 7.8.1.3
19	UMBILICAL LAYING OPERATIONS • the umbilical will be buried in the seabed by a trencher.seabed disturbance from burial by trencher.	• seabed currents are sufficient to fill in track marks of trencher with silt in a matter of months; and • use of a remote jetting vehicle for trenching creates smaller trenches than a remote trench digging vehicle. The trenches will fill with silt in a matter of months.	NEGLIGIBLE seabed disturbance : refer to Section 7.8.1.3

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
CONSTRUCTION OPERATIONS WITHIN CORRIB FIELD			
20	BACKFILLING OPERATIONS Freespans along the length of the pipeline will be filled in by rock placement. **Rock placement on spans** • seabed disturbance from rock placement . **Postlay survey** • emissions to air from survey vessel; and • noise from vessel movement.	• rock placement via a fall pipe will maximise the accuracy of deposition and reduce the volume of rock required; • adherence to Foreshore Licence Conditions as required; • grading of the rock used for placement; and • post construction survey.	NEGLIGIBLE OR BENEFICIAL the introduction of new substrates may encourage bio-diversity. Refer to Section 7.8.1.3 emissions to air: refer to Chapters 10 and 13 noise: low levels of noise from vessels in transit – see Chapter 11
NEARSHORE/LANDFALL PIPELAYING OPERATIONS			
21	NEARSHORE GEOPHYSICAL SURVEY A survey taking samples of the seabed in the approaches to the landfall. Scheduled to last 3 months. **Use of small self elevating Platform** • visual impact; and seabed disturbance. **Use of Boats/Vehicles** • emissions to air from vessels.	• short-term survey, using small vessels.	NEGLIGIBLE emissions to air: refer to Chapters 10 and 13 seabed disturbance: refer to Chapter 7 noise: low levels of noise from vessels in transit – see Chapter 11

Aspect/Potential Impact		Control / Mitigation Measures	Predicted Impact / Ecological Significance
NEARSHORE/LANDFALL PIPELAYING OPERATIONS			
22	NEARSHORE TRENCHING OPERATIONS: A 3 m deep trench will be dug in the seabed. In places this may require rock to be removed by blasting. Material dug from the trench will be piled alongside the line of the trench, to be used for infill. **Blasting** • noise; • disturbance to marine mammals; and seabed disturbance. **Establishing Trench** • seabed disturbance. **Storing fill material** • seabed disturbance.	• a route will be surveyed which minimizes the requirement for blasting; • sediment and rock will be dredged from the trench and deposited along the licenced route of the pipeline for storage. Once the pipe is laid, the material will be used for infill; • Dúchas will be notified and supplied with a construction method statement before operations commence; • sonar scans will establish that the area is clear of marine mammals before blasting operations commence; • marine mammals encouraged away from area by providing positive stimuli, e.g., laying food trail; • blasting operations will commence with a reduced charge number; and • blasting work to be completed as quickly as possible	MINOR residual risk of traumatizing marine mammals is low. refer to Section 7.8.2.1 smothering of seabed from trenching is temporary. Rapid recolonisation is likely. Refer to Section 7.8.2.1 blasting – refer to Chapter 11

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
NEARSHORE/LANDFALL PIPELAYING OPERATIONS			
23	LANDFALL WORKS The trench will be continued across the landfall and through the small cliff. Excavated material is stored alongside the trench. Concrete foundations are laid for two large winches. An area is excavated behind the line of the cliff to accommodate an underground blockhouse. **Establishing Trench** • visual impact; • habitat disturbance; • noise; • increased traffic; and emissions to air from plant. .**Storage of fill material** • visual impact. **Winch Emplacement** • construction of concrete emplacements; and • disturbance from positioning of winches. **Construction of underground chamber** • excavation.	• hard standing will be constructed in areas to be used regularly by heavy plant; • any additional drainage works required at the landfall will be constructed in accordance with local authority regulations; • Dúchas to be notified before works commence; • preparatory survey to avoid sensitive habitats and protected species; and • no local sand to be removed from the site.	MINOR visual impact: refer to Chapter 12 possible minor disturbance to terns. refer to Section 7.8.3.1

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
NEARSHORE/LANDFALL PIPELAYING OPERATIONS			
24	PIPELINE/UMBILICAL INSTALLATION The pipeline will be pulled ashore, and through the line of the cliff, from the laybarge, in the prepared trench. **Pipeline Pull Operation** • emissions to air from plant; and noise. **Umbilical Pull Operation** • Seabed disturbance • noise	• this is an operation of short duration, scheduled to last two days. • done using remote jet trenching machine	NEGLIGIBLE emissions to air: refer to Chapters 10 and 13 noise: refer to Chapter 11 seabed disturbance : refer to Chapter 7
25	BACKFILLING OPERATIONS **Nearshore Pipe Burial** • disturbance to sea users; and • seabed disturbance/water quality. **Onshore Pipe Burial** • visual impact;emissions to air from plant; and • noise. **Landfall Reinstatement** potential for environmental improvement.	• the seabed will be reinstated by filling the trench using sediments removed from the trench; • reinstatement of the landfall will involve replacement of the excavated material in reverse order, so that the topsoil is returned as topsoil; • the landfall site will be restored to a condition at least as good as that found on the pre-entry survey. Local species will be used; and • excess material to be spread on site following consultation with Dúchas.	NEGLIGIBLE, POSSIBLY BENEFICIAL emissions to air: refer to Chapters 10 and 13 noise: refer to Chapter 11

Aspect/Potential Impact		Control / Mitigation Measures	Predicted Impact / Ecological Significance
CROSSING THE SRUWADDACON			
26	SITE PREPARATION The pipe assembly location will be prepared and winches set in place. **Prepare pipe assembly area** • noise; and • disturbance of land. **Location of Winches** • winches weighing 25 tonnes located on cast concrete bases with rock anchors; and • visual impact. **Temporary Jetty Construction** • visual impact.	• liaison with local authority and local communities; • Dúchas to be notified prior to commencing work; • work scheduled to avoid impacts on breeding, migrating and overwintering birds. Refer to Section 7.7.3.1; • work will not go ahead on the north shore crossing points (or onshore pipeline) between April and August if corncrakes are present; and • construction site fenced off with public warning signs.	NEGLIGIBLE visual impact: refer to Chapter 12 noise: refer to Chapter 11 land use: refer to Chapter 5
27	OPEN CUT OPERATIONS A 3 m deep trench will be cut in the bed and banks of the river from a pontoon. **Establish Trench** • disturbance of river bed/land; and • release of silt to the river water, with impacts on water quality.	• the excavated material will be deposited for storage within the working-width of the onshore pipeline.	MINOR the bed at the downstream Sruwaddacon crossing has sandwaves, indicating that sediment movement already occurs by natural processes. Additional silting due to the works will be of short duration refer to Construction Chapter 3

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
CROSSING THE SRUWADDACON			
28	PIPELINE/UMBILICAL INSTALLATION The pipeline is pulled across the Sruwaddacon in a trench excavated from the estuary bed. **Pipeline Assembly** • emissions to air from welding; and solid waste. **Pull Operation** • emissions to air from plant; • noise; and • riverbed disturbance releasing silt.	• the pull procedure is of short duration; and • buoyancy is applied to the pipeline. The pull is scheduled for high water to ease the pull.	NEGLIGIBLE emissions to air: refer to Chapters 10 and 13 waste: refer to Chapter 15 noise: refer to Chapter 11 riverbed disturbance: refer to Chapter 7
29	BACKFILLING OPERATIONS Pontoon mounted backhoes will fill the trench in the estuary bed. **Pipe burial on estuary bed** • disturbance of estuary bed.	• the estuary bed trench will infill with silt by natural process; and • where excavated material is stored, it will be replaced in reverse order, with the topsoil on top.	NEGLIGIBLE

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
HYDROTEST AND COMMISSIONING:			
30	HYDROTESTING The completed pipeline is filled with chemically treated seawater, and pressure in the pipeline is increased to 1.5 times normal operating pressure for 30 hours. The offshore and onshore sections of pipeline are tested separately. **Offshore Pipeline** • discharge of about 20,000 m^3 hydrotest water with dye, corrosion inhibitor and biocide. **Onshore Pipeline** • abstraction of about 2,000 m^3 hydrotest water with dye, corrosion inhibitor, biocide **Umbilical** • tested prior to delivery to laybarge	• the water winning line will be sited to minimize effect. Filters and flotation devices will minimize sediment disturbance; • the concentrations of biocide, corrosion inhibitor and fluorescent dye in hydrotest water are typically very low; • hydrotest water will be discharged via the subsea installation, and will rapidly disperse. The rate of discharge will be controlled to enhance dilution; • the umbilical is pressure tested before delivery to the laybarge or Sruwaddacon crossing sites; and • the umbilical from the landfall to the field will have one connection only. This is located 42 km from the shore, in a box protected by a concrete mattress.	NEGLIGIBLE around the offshore field installations water quality will only be affected temporarily. Refer to Section 7.8.1.3 discharges to water: refer to Chapter 9
POST CONSTRUCTION SURVEYS			
31	POST CONSTRUCTION SURVEY The length of the pipeline route from landfall to field will be surveyed • emissions to air from survey vessel;subsea noise; and • interference with other sea users.	• survey will use low energy sonar, which has negligible effects on cetaceans; and • fishery liaison procedures will be employed.	NEGLIGIBLE emissions to air: refer to Chapters 10 and 13 interaction with other sea users: refer to Chapter 15

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
SUBSEA FACILITIES OPERATION			
32	USE OF CONTROL FLUIDS • release of glycol control fluids into the sea during routine operation of manifold and christmas tree valves. USE OF SCALE INHIBITOR • discharge of scale inhibitor at the Terminal. Present in low concentrations in formation water. Recovered in effluent water stream. USE OF INTERNAL CORROSION INHIBITOR • discharge of corrosion inhibitor at the Terminal. Present in low concentrations in formation water. Recovered in effluent water stream. USE OF HYDRATE INHIBITOR • recovery of methanol hydrate inhibitor at the Terminal. USE OF EXTERNAL CORROSION PROTECTION • heavy metals (zinc) from sacrifical anodes dissolving into the sea water; and • chemicals from pipeline coatings dissolving into seawater.	• the control fluid and hydrate inhibitor are on PLONOR list; • the liquid phase separated at the Terminal, including dissolved corrosion inhibitor, scale inhibitor and hydrate inhibitor, is treated before discharge; • sacrifical anodes are designed to dissolve very slowly, so that the dissolved heavy metal concentration is extremely low; and • The corrosion inhibitor used will separate in methanol and subsequently, can be recycled with the methanol.	NEGLIGIBLE water quality: refer to Chapter 9

	Aspect/Potential Impact	Control / Mitigation Measures	Predicted Impact / Ecological Significance
OUTFALL AND OUTFALL DISCHARGES			
33	FORMATION WATER • water from the reservoir formation, separated at the terminal by the slug catcher, treated and released via the outfall; and • slow release of formation water solutes into Broadhaven Bay. WATER OF CONDENSATION • water condensed from the gas stream at the terminal. RAIN WATER • channeled through the closed drain system to prevent contamination and discharged to the Bellanaboy river.	• for the first years of operation, formation water will be separated in very small quantities; • formation water sample shows low heavy metal content; • modelling of currents in Broadhaven Bay has taken place to determine the optimum location of the outfall; • water separated from the gas stream will be treated to reduce pollutants to Environmental Protection Agency ELV levels in compliance with the IPC licence; • the treated waste water is diluted with rainwater before discharge; and • monitoring of end of pipe concentrations will be carried out in accordance with the IPC licence.	NEGLIGIBLE water quality: refer to Chapter 9 aqueous emissions will dilute and disperse. Effects would be confined to the immediate vicinity of the discharge plume
MAINTENANCE AND REPAIR OPERATIONS			
34	PIGGING • disposal of solid scale. INSPECTION • emissions to air from vessel noise from vessel. REPLACEMENT OF SUBSEA INSTALLATION PARTS • potential release of gas to sea; and • solid waste.	• inspection of pipeline integrity is routine, ensures that the pipeline functions correctly and removes scale build up; • scale is disposed of to licenced landfill site; and • subsea equipment is designed for project life. Replacement would not be a routine event. Written procedures would be followed.	NEGLIGIBLE emissions to air: refer to Chapter 10 waste: refer to Chapter 15 noise: low levels of noise from survey vessels – see Chapter 11

16.3 Accidental Events

16.3.1 The Environmental Risk Assessment Process

The assessment of risks for abnormal operations and accidental events, collectively called non-routine events, utilises the probability, consequence and risk categories presented in **Table 16.3** below.

Risk is defined as the combination of the probability, or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

Potential hazard scenarios are identified and the likelihood of their occurrence and the subsequent consequences are assessed in terms of impacts on the environment.

Table 16.3: Probability, response requirement / ecological consequence and risk categories used for assessment of the non-routine events

Probability Category / Response Requirement /Ecological Consequence	A Possibility of repeated incidents	B Possibility of isolated incidents	C Possibility of occurring sometime	D Not likely to occur
I (extended duration / full scale response) **SEVERE**	**Higher Risk**	**Higher Risk**	**Higher Risk**	**Medium Risk**
II (Serious / significant resource commitment) **MAJOR**	**Higher Risk**	**Higher Risk**	**Medium Risk**	**Medium Risk**
III (Moderate / limited response of short duration) **MODERATE**	**Higher Risk**	**Medium Risk**	**Medium Risk**	**Low Risk**
IV (Minor / little or no response needed) **MINOR / NEGLIGIBLE**	**Medium Risk**	**Low Risk**	**Low Risk**	**Low Risk**

16.3.2 Assessment of Non-Routine Events

Non-routine events include those associated with upset conditions and those associated with emergency / accidental events.

Table 16.4 provides information on the potential causes of a range of accidental events, the control and mitigation measures which are applied to minimise the environmental risk of such events, and the potential ecological consequences of these events. The consequences of events such as spill of fuel oil (diesel) would change in magnitude depending upon a number of factors such; size of spill and location of spill. The ecological consequences column in **Table 16.4** reflects the variability in magnitude of impact, discussing briefly the potential impacts upon different locations, assuming a worst case event. **Table 16.5** provides a summary of the risk events and shows in which row of **Table 16.4** more information on the various events can be found.

Table 16.4: Environmental risk assessment of the sources of effect associated with the key hazard scenarios identified for non-routine events for the Corrib drilling programme

	Source / Scale of Effect	Control and Mitigation	Overall Risk Category
DRILLING OPERATIONS			
1	**USE AND DISCHARGE OF CONTINGENCY CHEMICALS:** Discharge of WBM, which is contaminated with contingency chemicals • release to water column and sediments of mica, ground nutshell and other loss control material additives.	• there is zero discharge of LTOBM, and LTOBM cuttings are contained and transported to shore for re-cycling; • drilling with WBM is scheduled to last about six days per well; and • the suite of contingency chemicals proposed are mainly of HOCNF category E.	**Ecological Consequence Category: IV (NEGLIGIBLE)** **Probability Category: B** **Overall Risk Category: LOW** • the chemicals will settle out around the well location
2	**WELL KICK LEADING TO BLOWOUT:** Uncontrolled subsea release of gas (well broaching; well kick; loss of riser integrity; failure of BOP) • emission of hydrocarbons to the air; and • fire/explosion at the sea surface or on the MODU.	• geohazard survey and positioning of well away from overpressured gas or salt lenses, if feasible; • study of offset well data; • sufficient barite inventory on MODU to prepare heavy kill mud for spotting in the hole; • monitoring of mud returns; • BOP and riser installed prior to drilling Interval III; • contingency plan and response provisions; and • HAZID assessment to identify all potential accidental / emergency scenarios.	**Ecological Consequence Category: IV (MINOR)** **Probability Category: D** **Overall Risk Category: LOW** • gas will rapidly disperse upon release

	Source / Scale of Effect	Control and Mitigation	Overall Risk Category
DRILLING OPERATIONS			
3	**LOSS OF RISER INTEGRITY:** Release of riser inventory (around 70 m^3) (unplanned disconnect of riser from anchor slippage, collision, vortex induced vibrations, or well blowout, equipment failure) • release of whole LTOBM to the sea; and • release of hydrocarbon gas to sea (or to air).	• HAZID assessment to identify all potential accidental / emergency scenarios; • continuous monitoring throughout the drilling programme; • riser design; • riser shut off valve to isolate the inventory of the riser during a planned disconnect; and • navigation and communications equipment; emergency warning systems; and notices to mariners.	**Ecological Consequence Category: III (MODERATE)** **Probability Category: D** **Overall Risk Category: LOW** • contamination of the water column leading to toxic effects from particular chemicals and smothering of the seabed
4	**CHEMICAL, MUD, WASTE, OR FUEL SPILL DURING ROUTINE STORAGE USE AND TRANSFER OPERATIONS:** Spill during transfer or handling of fuel or chemicals (bunkering, overfilling of tanks, tank rupture, leak from storage vessel or equipment • diesel fuel or bulk chemical discharge to sea; and • hydrocarbon or chemical evaporation or venting to air.	• all storage tanks are bunded; • procedures for handling, storage and transfer of wastes and other materials; • spills in storage areas directed to oily bilge tank; • backloading and bunkering operations will be restricted to daylight hours; • a supply of absorbent materials will be kept near areas where there is the potential for leaks or spillage; • a wet vacuum will be used in mud handling areas to collect mud spillage; • high level fill alarms fitted to bulk tanks; • routine inspection of bulk transfer hoses and couplings; • procedures for loading and unloading; • routine maintenance of equipment to prevent spills; • drip trays positioned under engines to collect any leaks; • procedures to minimise operational leaks and spills; and • oil spill control plan (OSCP) in place to provide instructions on control measures depending upon size of spill.	**Ecological Consequence Category: IV (NEGLIGIBLE) to II (MAJOR)** **Probability Category: B (small spills and leaks) to D (large spills or chronic leaks)** **Overall Risk Category: LOW-HIGH** • overall risk dependent on the nature of the material spilled and the size of the spill; • contamination of the water column leading to toxic effects from particular chemicals and smothering of the seabed; • distance to shore is at least 65 km, volumes of fuel transferred are unlikely to reach any sensitive receptors on the shore; and • spills at sea have the potential to affect flightless birds which are present in the vicinity of the Corrib Field in late summer and autumn.

	Source / Scale of Effect	Control and Mitigation	Overall Risk Category
DRILLING OPERATIONS			
5	**CHEMICAL, MUD, WASTE OR FUEL SPILL AS A CONSEQUENCE OF FIRE / EXPLOSION ON THE RIG:** Uncontrolled release of stored materials onboard as a result of damage to the rig from fire / explosion caused by accidental ignition of flammable materials or gas accumulation or accidental detonation of perforating gun / string shot / wireline retainer • emission of combustion products to air; and • release of material to the sea.	• procedures in place to eliminate risk of fire/explosion; • contingency plans in place for any fire or explosion regardless of size; and • oil spill control plan (OSCP) in place to provide instructions on control measures if spill results.	**Ecological Consequence Category: III (MODERATE) to II (MAJOR)** **Probability Category: D** **Overall Risk Category: MEDIUM** • overall risk dependent on the nature of the material spilled and the size of the spill; and • contamination of the water column leading to toxic effects from particular chemicals and smothering of the seabed.
6	**WASTE, AND WASTE WATER HANDLING INCIDENT:** • discharge of unacceptable levels of garbage, galley waste, and effluents as a consequence of failure of equipment or personnel error or inadequate storage and containment.	• routine inspection and monitoring of equipment and discharge effluents; • procedures in place; and • training of personnel.	**Ecological Consequence Category: IV (NEGLIGIBLE)** **Probability Category: C** **Overall Risk Category: LOW** • consequence dependent on the nature of the discharged material. Some effluents could lead to toxic effects on plankton and fish in the water column. Persistent garbage could reach the shoreline
7	**LOSS OF LOGGING EQUIPMENT DOWNHOLE:** • irretrievable loss of radioactive logging equipment downhole leading to the requirement to contain the equipment downhole and drill a sidetrack.	• creating a cement plug downhole to contain and isolate the equipment; and • drilling of a mechanical well sidetrack.	**Ecological Consequence Category: IV (NEGLIGIBLE)** **Probability Category: D** **Overall Risk Category: LOW** • material will be contained downhole. However, the drilling of the sidetrack would result in a small increase in the volume of cuttings generated and extend the drilling time. The cuttings estimates provided in the EIS include sufficient contingency to account for such an event

	Source / Scale of Effect	Control and Mitigation	Overall Risk Category
INSTALLATION ACTIVITIES (SIMULTANEOUS OPERATIONS (SIMOPS))			
8	**WELL BLOWOUT** Damage to christmas tree from vessel anchor or cable • uncontrolled gas release to sea.	• protection structures to cover live pipeline interactions; • implementation and use of anchor deployment procedures which are strictly monitored; • ensure that design philosophy reflects route selection to avoid interaction with existing wells; and • wellhead protection, including subsea safety valve.	**Ecological Consequence Category: IV (NEGLIGIBLE)** **Probability Category: D** **Overall Risk Category: LOW** • gas will rapidly disperse upon release
9	**CHEMICAL, WASTE OR FUEL SPILL DURING ROUTINE STORAGE USE AND TRANSFER OPERATIONS:** Spill during transfer or handling of fuel (bunkering, overfilling of tanks, tank rupture, leak from storage vessel or equipment) • diesel fuel discharge to sea; and • hydrocarbon evaporation or venting to air	• operational: the bunkering of fuels and transfer of material at sea will be carried out in accordance with adequate procedures to minimise risks to the environment; • contingency plans and clean-up materials will be available in case of spill to minimise effect; • OSCP developed and approved for all marine operations; and • environmental awareness training and toolbox talks with contractor	**Ecological Consequence Category: IV (NEGLIGIBLE) to II (MAJOR)** **Probability Category: B (small spills and leaks) to D (large spills or chronic leaks)** **Overall Risk Category: LOW - HIGH** • overall risk dependent on the size of the spill; and • contamination of the water column, in worst case leading to hydrocarbon beaching

	Source / Scale of Effect	Control and Mitigation	Overall Risk Category
INSTALLATION ACTIVITIES (SIMOPS)			
10	**VESSEL COLLISION** Spills of chemicals/fuel • diesel fuel or bulk chemical discharge to sea; and • hydrocarbon or chemical evaporation or venting to air.	• SIMOPS hazard workshop will identify potential for vessel interactions for all operations; • Guard vessels in attendance when large, slow moving vessels are operating; • All vessels will carry warning lights; and • oil spill control plan (OSCP) in place to provide instructions on control measures depending upon size of spill	**Ecological Consequence Category: III (MODERATE) to I (SEVERE)** **Probability Category: D** **Overall Risk Category: LOW-MEDIUM** • overall risk dependent on the nature of the material spilled, the size of the spill and proximity to land; • contamination of the water column leading to toxic effects from particular chemicals and smothering of the seabed; and • spills at sea have the potential to affect flightless birds which are present in the vicinity of the Corrib Field and closer to shore in late summer and autumn.
LANDFALL CONSTRUCTION			
11	**SPILLS OF STORED CHEMICAL AND FUEL** (Diesel, paints, solvents, oils, greases etc) • potential for contamination of land.	• the landfall work sites will be subject to a strict EMP that will be closely monitored to ensure conformance; • storage areas will be cleared and re-instated to their original condition and appearance, immediately upon completion of the construction work at the landfall and Sruwaddacon crossing sites; and • works at the landfall and crossings will be of relatively short duration.	**Ecological Consequence Category: IV (NEGLIGIBLE) to II (MAJOR)** **Probability Category: B (small spills and leaks) to D (large spills or chronic leaks)** **Overall Risk Category: LOW - HIGH** • potential to contaminate ground, ground water and surface waters with knock-on effects to marine and terrestrial species

	Source / Scale of Effect	Control and Mitigation	Overall Risk Category
SYSTEM HYDROTESTING AND COMMISSIONING			
12	**RELEASE OF SEAWATER CONTAINING TESTING CHEMICALS TO NEARSHORE/ONSHORE AREA** • release of chemicals to soil and eventually water.	• Procedures in place to ensure that no hydrotest chemicals are spilled nearshore (pipeline will be filled with water from Corrib Field); and • hydrotest water will be discharged offshore	**Ecological Consequence Category: III (MODERATE)** **Probability Category: D** **Overall Risk Category: LOW** • potential to contaminate ground, ground water and surface waters with knock-on effects to marine and terrestrial species, if leak found in onshore section of pipeline
SUBSEA FACILITIES OPERATION			
13	**CORROSION OF PIPELINE BY SAND, FAILURE OF CP SYSTEM** • release of gas to sea.	• pipeline inspection procedures will include routine CP survey to monitor corrosion. Fluid velocity is less than erosion velocity. Sand production is not predicted from the Corrib reservoir.	**Ecological Consequence Category: IV (NEGLIGIBLE)** **Probability Category: D** **Overall Risk Category: LOW** • gas will rapidly disperse upon release
14	**MECHANICAL DAMAGE TO PIPELINE** Pipeline damage caused by dropped objects or dragging of anchors during maintenance activities in Field, or tie-in of future wells, or by third party or survey vessel at any point along pipeline route • release of gas to sea.	• Pipeline design has considered risks from fishing interactions and includes protection where necessary; • work procedures used are well established and dropped object protection will be provided on vulnerable sections of the pipeline and flowlines; and • implementation and use of anchor deployment procedures which are strictly monitored.	**Ecological Consequence Category: IV (NEGLIGIBLE)** **Probability Category: D** **Overall Risk Category: LOW** • gas will rapidly disperse upon release
15	**MECHANICAL DAMAGE TO UMBILICALS** Umbilical damage caused by dropped objects or dragging of anchors during maintenance activities in Field, or tie-ing in of future wells, or by third party or survey vessel at any point along umbilical route • release of glycol hydraulic fluid, methanol, corrosion inhibitor and scale inhibitor to sea.	• umbilical is buried; and • work procedures used are well established and dropped object protection will be provided on vulnerable sections of the umbilical and infield umbilicals; • flow monitoring system will detect leakage and shutdown valve supplying infield umbilical from SDU; and • subsea hydraulic valves are safe fail upon umbilical loss. Impact protection will be provided to umbilical.	**Ecological Consequence Category: IV (NEGLIGIBLE)** **Probability Category: D** **Overall Risk Category: LOW** contamination of the water column leading to potential toxic effects from corrosion and scale inhibitor. Glycol and methanol are environmentally benign.

	Source / Scale of Effect	Control and Mitigation	Environmental Consequence and Overall Risk Category
SUBSEA FACILITIES OPERATION			
16	**SPILLS OF FUEL FROM PIPELINE SURVEY VESSELS OR WELL MAINTENANCE VESSELS AS A RESULT OF COLLISION OR FUEL TRANSFER OPERATIONS** • diesel fuel discharge to sea; and • hydrocarbon evaporation or venting to air.	• operational: The bunkering of fuels and transfer of material at sea will be carried out in accordance with adequate procedures to minimise risks to the environment; • contingency plans and clean-up materials will be available in case of spill to minimise effect; and • OSCP developed and approved for all marine operations.	**Ecological Consequence Category: IV (NEGLIGIBLE) to II (MAJOR)** **Probability Category: B (small spills and leaks) to D (large spills or chronic leaks)** **Overall Risk Category: LOW - HIGH** • overall risk dependent on the size of the spill; and • contamination of the water column, in worst case leading to hydrocarbon beaching.
ONSHORE GAS PIPELINE, UMBILICAL AND DISCHARGE PIPELINE OPERATION			
17	**FRACTURE OF PIPELINE** • release of hydrocarbon to air.	• Pipeline walls are of high-grade steel, failure rates are extremely low; • Automatic flow monitoring system will detect any leaks; • Emergency response plan in place to deal with all pipeline risks; and • Position of pipeline is marked, third-party activity will be monitored by regular aerial inspection.	**Ecological Consequence Category: III (MODERATE) Probability Category: D** **Overall Risk Category: LOW** • gas will rapidly disperse upon release.
ONSHORE GAS PIPELINE, UMBILICAL AND DISCHARGE PIPELINE OPERATION			
18	**FRACTURE OF UMBILICAL** • release of liquids to ground, and eventually water.	• Umbilical protected by concrete sheath; • Automatic flow monitoring system will detect any leaks and close system down if necessary; • emergency response plan in place to deal with all umbilical risks; and • Position of umbilical is marked, third-party activity will be monitored by regular aerial inspection.	**Ecological Consequence Category: III (MODERATE) Probability Category: D** **Overall Risk Category: LOW** • contamination of the soil, leading to potential water column toxic effects from corrosion and scale inhibitor.

	Source / Scale of Effect	Control and Mitigation	Environmental Consequence and Overall Risk Category
ONSHORE GAS PIPELINE, UMBILICAL AND DISCHARGE PIPELINE OPERATION			
19	**FRACTURE OF PIPELINE** • release of Terminal discharge water to soil.	• Automatic flow monitoring system will detect any leaks, treated water will be stored on-site until pipeline is repaired; and • Position of pipeline is marked, third-party activity will be monitored by regular aerial inspection.	**Ecological Consequence Category: III (MODERATE) Probability Category: D** **Overall Risk Category: LOW** • Saline water in soil and freshwater environment
TERMINAL FACILITIES OPERATION			
20	**FAILURE OF WATER TREATMENT SYSTEM** • release of untreated water from Terminal to Broadhaven Bay.	• Terminal water treatment system has capacity to store large volumes of water before discharge. Untreated water can be stored and re-cycled through treatment system once repaired.	**Ecological Consequence Category: IV (NEGLIGIBLE) Probability Category: C** **Overall Risk Category: LOW** • gas will rapidly disperse upon release.

Table 16.5 provides a summary of the risk analysis carried out following an environmental hazards workshop. The colour of the cells in the table indicate the overall risk (see **Table 16.3**), and the number in the cell directs the reader to the relevant row in **Table 16.5** in which more information on the event is provided.

Table 16.5: Summarised Environmental Risk Assessment

Location of event	Offshore						Nearshore					Landfall/ Sruwaddacon				
	Solids release to water column	Mud release to seabed	Chemical release to water column	Fuel release to water column	Gas release to sea	Fuel or other emissions to air	Solids release to water column	Chemical release to water column	Fuel release to water column	Gas release to sea	Fuel or other emissions to air	Chemical release to water column	Fuel release to water column	Fuel or other emissions to air	Chemical release to land	Seawater release to land
Drilling Operations																
Discharge of contingency materials/chemicals	1		1			1										
Well blowout			2		2	2										
Loss of marine riser integrity	3	3	3													
Spill from chemical/material transfers	4		4	4		4										
Explosion/Fire on rig	5		5	5		5										
Waste/Water handling incident	6		6													
Loss of logging equipment downhole		7														
Installation Activities																
Well blowout due to dropped objects/anchor dragging					8											
Spill from chemical/material transfers	9		9	9			9	9	9		9					
Vessel Damage	10		10	10			10	10	10		10					
Landfall Construction																
Chemical/fuel spill												11	11		11	
Commissioning/Testing																
Loss of pipeline integrity during testing/chemical spill								12				12		12	12	
Subsea Facilities Operation																
Corrosion of pipeline, failure of CP system						13					13					
Damage to pipeline						14					14					
Damage to umbilicals			15					15								
Survey/Maintenance vessel damage				16		16			16		16					
Onshore Facilities Operation																
Damage to gas pipeline														17		
Damage to umbilical												18				18
Damage to water discharge pipeline								19				19				19
Terminal Operation																
Failure of water treatment system								20								

- overall category - high
- overall category - medium
- overall category - low

1 - row number in Table 16.4 for more information