Corrib
natural gas

Corrib Onshore Pipeline

Environmental Impact Statement

Volume 1 of 3

Non Technical Summary &

Environmental Impact Statement

RPS

MAY 2010

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Environmental Impact Statement

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MAY 2010

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VIEWING & PURCHASING THE ENVIRONMENTAL IMPACT STATEMENT (EIS)

The Environmental Impact Statement (EIS), of which this is a Non-Technical Summary, can be viewed and purchased at the offices of:

- An Bord Pleanála, 64 Marlborough Street, Dublin 1.

The EIS may also be viewed at the offices of:

- Mayo County Council, Áras an Chontae, Castlebar, Co. Mayo
- Mayo County Council, Church Road, Béal an Mhuirthead (Belmullet), Co.Mayo
- Corrib Project Information Office, 4 Údarás na Gaeltachta, Béal an Mhuirthead, Co. Mhaigh Eo

The EIS may also be viewed at Garda Stations at Béal an Mhuirthead (Belmullet), Gleann na Muaidhe (Glenamoy), Bangor Iorras (Erris) and Ballina, or viewed from www.corribgaspipelineabpapplication.ie and downloaded from www.corribgaspipeline.ie

1 INTRODUCTION & BACKGROUND

1.1 INTRODUCTION

Shell E&P Ireland Limited (SEPIL) is developing the Corrib Gas Field off the coast of Co. Mayo. The Corrib Gas Development will operate as a subsea production facility tied back to an onshore processing terminal, and will include:

- The offshore wells;
- subsea facilities and offshore pipeline to a landfall in Mayo;
- onshore pipeline; and
- a gas terminal at Béal an Átha Buí (Bellanaboy), Co. Mayo (see Figure 1).

By the end of 2004, all of these elements had received full regulatory approval and, other than the onshore pipeline, are at an advanced stage of construction completion.

Following the granting by An Bord Pleanála of planning permission for the Gas Terminal in 2005, public concerns were raised about the onshore pipeline. The (then) Minister for Communications, Marine and Natural Resources, who has statutory responsibility for the safety of the pipeline, commissioned Advantica (an independent company) to carry out an independent safety review. A mediation process, which was conducted by Mr Peter Cassells, also took place during 2006. SEPIL agreed to implement recommendations from both of these processes. Principal among these were:

- To limit the pressure in the onshore section of the pipeline to 144 barg (previously 345 barg) or less (Advantica); and
- To modify the route of the pipeline in the vicinity of Ros Dumhach (Rossport) to address community concerns regarding proximity to housing (Cassells).

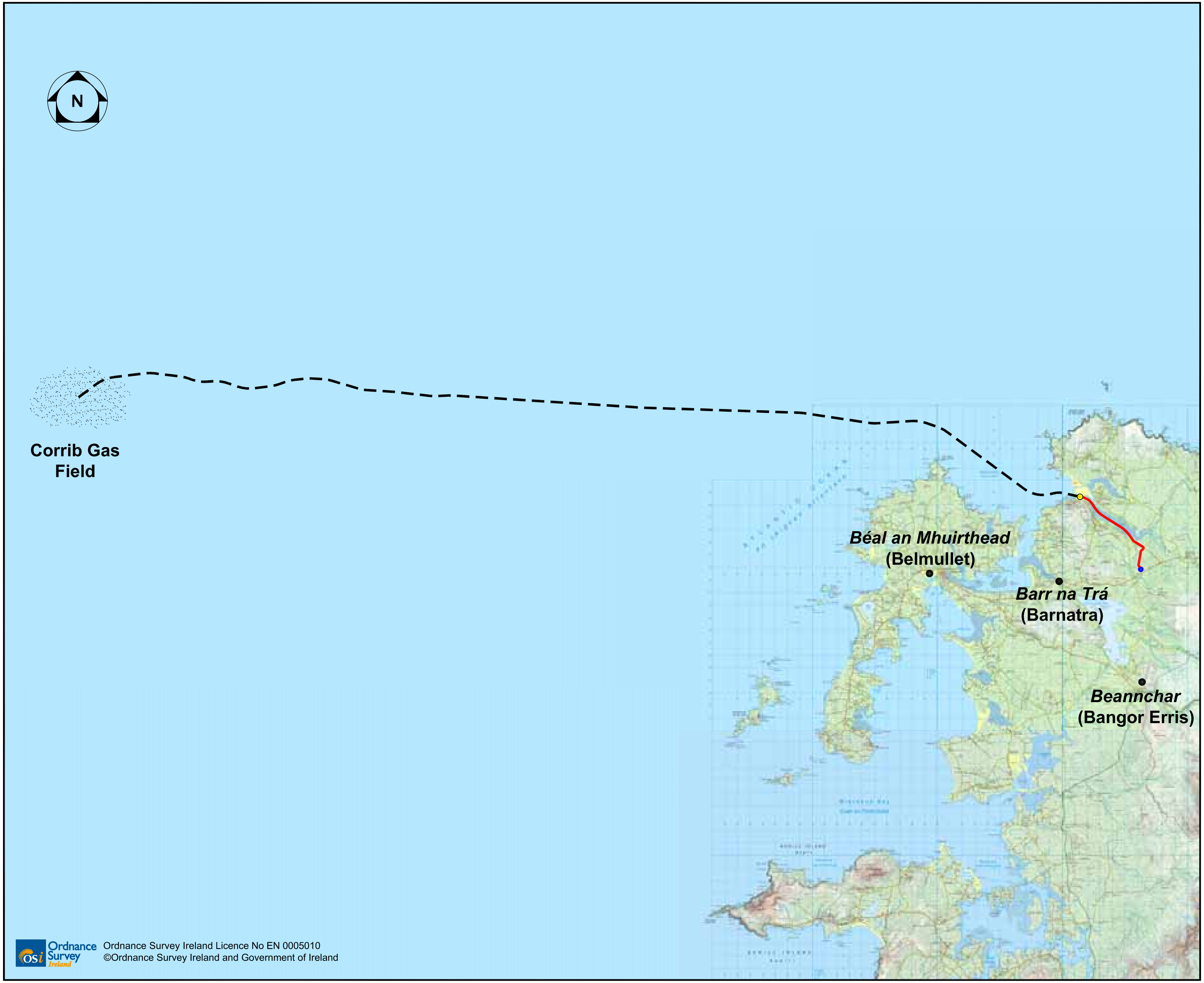
Between 2007 and 2009 extensive engineering design activities in parallel with pipeline routing and environmental studies were undertaken in respect of the proposed development. This included public consultation and engagement with competent and prescribed statutory bodies in respect of safety and environmental assessment. Applications for statutory approval of the proposed onshore pipeline development were submitted to the following statutory bodies in February 2009:

- An Bord Pleanála (under the 'Strategic Infrastructure Act');
- Department of Communications, Energy and Natural Resources (under the Gas Act); and
- The Foreshore Unit of the Department of Agriculture, Forestry and Food (under the Foreshore Act).

The applications were accompanied by an Environmental Impact Statement (EIS).

Following a statutory period of public consultation, an Oral Hearing was conducted by An Bord Pleanála in Béal an Mhuirthead (Belmullet) during May and June, 2009. In November, 2009, An Bord Pleanála requested further information on the proposed development including:

- Alteration to the route of the pipeline between Gleann an Ghad (Glengad) and na hEachú (Aghoos); and
- A complete, transparent and adequate demonstration that the proposed pipeline does not pose an unacceptable risk to the public.



OFFSHORE PIPELINE ROUTE

PROPOSED ONSHORE PIPELINE ROUTE

LANDFALL VALVE INSTALLATION

BELLANABOY BRIDGE GAS TERMINAL

Corrib Gas Field Development

Figure 1

File Ref: COR25MDR0470Fg1.0A03
Date: May 2010

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In their letter requesting further information, An Bord Pleanála set out both risk and consequence based safety criteria against which the proposed pipeline development would be assessed, the latter being that "the proximity to a dwelling shall not be less than the appropriate hazard distance for the pipeline in the event of a (full bore) pipeline failure". Furthermore, An Bord Pleanála requested that the revised development proposal be accompanied by a revised EIS, including an Appropriate Assessment (now known as a Natura Impact Statement) of the impact of the development on Natura 2000 sites.

SEPIL proceeded to commission further, extensive engineering design and environmental studies resulting in the development proposal described in this revised EIS. To meet the concerns expressed by An Bord Pleanála, key revisions have been made to the proposed development which include routing the pipeline in a tunnel under Sruwaddacon Bay (which has the effect of maximizing the distance to occupied dwellings) and reducing the maximum allowable operating pressure in the onshore and offshore pipelines (to 100 barg and 150 barg respectively) which will reduce the consequence in the (highly unlikely) event of a pipeline failure.

The revised EIS demonstrates that the proposed Corrib Onshore Pipeline is safe, does not pose an unacceptable risk to the public, meets or exceeds all relevant international and Irish pipeline codes and standards, meets the safety criteria established by An Bord Pleanála and will not have a significant residual impact on the human, natural or cultural heritage of the area in the long term.

The revised EIS will accompany the response to An Bord Pleanála and revised applications for statutory approval to:

- Department of Communications, Energy and Natural Resources (under the Gas Act); and
- The Foreshore Unit of the Department of Environment, Heritage and Local Government[1] (under the Foreshore Act)

This revised EIS deals explicitly with the onshore section of the pipeline development. A revised Supplementary Update Report in respect of the offshore section of the pipeline has been prepared (by RSK Environment Ltd.) as an Addendum to the 2001 Corrib Field Development Offshore (Field to Terminal) EIS.

This document is the Non-Technical Summary of the revised EIS for the Corrib Onshore Pipeline.

1.2 BACKGROUND

By global standards the Corrib Gas Field is a small-to-medium sized gas reservoir. It is approximately two thirds the size of the Kinsale Head Gas Field, on which Ireland's natural gas network was initially developed. The Corrib Field is intended to supply up to 60% of Ireland's gas needs during peak production and is estimated to have a field life of 15 to 20 years. The gas in the Corrib Field is a pure form of natural gas similar to Kinsale Natural Gas consisting of approximately 97% methane/ethane, 3% nitrogen with small amounts of liquids.

The Corrib Gas Field is being developed using subsea technology tied back to an onshore gas terminal. This means that there will be no need for a permanent offshore platform structure, as the gas wells will be controlled from the gas terminal. This represents best practice for a field of this type and size and is similar in design to some of the most modern gas field developments, such as the Ormen Lange Field in Norway and the Casino Field in South East Australia.

[1] Under the Foreshore and Dumping at Sea (Amendment) Act 2009, responsibility for all foreshore energy-related developments (including oil, gas, wind, wave and tidal energy) was transferred to the Minister for the Environment, Heritage and Local Government with effect from 15th January, 2010

SEPIL, the developer of this project, is part of Shell's European Upstream International Organisation, which has extensive experience in developing and operating both onshore and offshore oil and gas fields, subsea developments, gas pipelines and gas plants across Europe since the 1960's.

SEPIL has two partners in the Corrib Gas Project, Statoil Exploration (Ireland) Ltd and Vermilion Energy Ireland Limited.

2 PROJECT DESCRIPTION

2.1 DESCRIPTION OF THE DEVELOPMENT

The proposed Corrib Onshore Pipeline will consist of the following elements:

- Onshore gas pipeline which will transport gas to the Gas Terminal;
- Services umbilicals which are used to prevent the formation of methane hydrates and control the subsea wells;
- Outfall pipeline which carries discharge water from the Gas Terminal; and
- Landfall Valve Installation (LVI) (located approximately 50m from the cliff edge at Gleann an Ghad (Glengad)). The purpose of the LVI is to limit the Maximum Allowable Operating Pressure (MAOP) in the onshore pipeline to 100 barg.

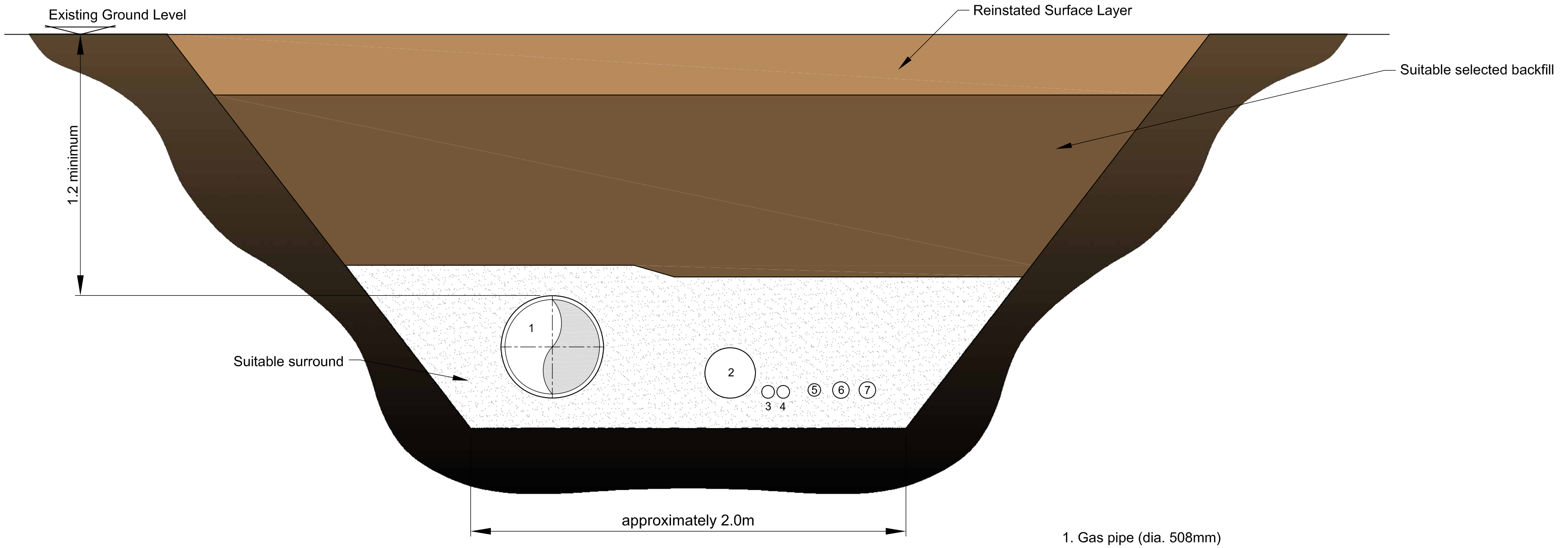
The proposed onshore pipeline is approximately 8.3km long. The pipeline will be fabricated from high grade steel, will have a diameter of 508mm (20 inch) and will have a nominal wall thickness of 27.1mm (>1”). The normal operating pressure for the Corrib Onshore Pipeline at the Terminal inlet will be approximately 85barg (equivalent to approximately 90 barg at the LVI).

Approximately 4.9km of the pipeline between Gleann an Ghad (Glengad) and na hEachú (Aghoos) (approximately 4.6km of which will be laid underneath Sruwaddacon Bay) will be constructed within a tunnel. The tunnel will be installed with a minimum depth of cover of approximately 5.5m. The tunnel will be 4.2m in diameter and will be constructed using a tunnel boring machine. The tunnel will be lined with precast concrete segments. The services umbilical and the outfall pipeline will also be placed in the tunnel. The tunnel will be backfilled with cement grout.

The remaining 3.4km of gas pipeline, together with services and outfall pipeline, will be laid underground with a minimum depth of cover of 1.2m (see Figure 2). Temporary working areas, site compounds and haul roads will be required to facilitate construction.

2.2 CODES AND STANDARDS

The codes and standards applicable to the design, construction, commissioning and operation of the proposed onshore pipeline were established in 2006 by the Minister for Communications, Energy and Natural Resources (who has statutory responsibility for the safety of the Corrib Project). In November 2009, An Bord Pleanála set out additional criteria against which the proposed development would be assessed. The proposed development meets or exceeds the applicable codes and standards and An Bord Pleanála’s safety criteria; this is comprehensively demonstrated in Appendix Q of this revised EIS.



1. Gas pipe (dia. 508mm)
2. Outfall pipeline (dia. 250mm)
3. Fibre Optic cable (dia. 63mm)
4. Signal cable (dia. 63mm)
5. Umbilical #1 (dia. 62mm)
6. Umbilical #2 (dia. 82mm)
7. Umbilical #3 (dia. 82mm)

TYPICAL TRENCH DETAIL

Note: Positions of gas pipeline, outfall pipeline and services are indicative

Typical Trench Detail

Figure 2

File Ref: COR25MDR0470Fg2.0A03
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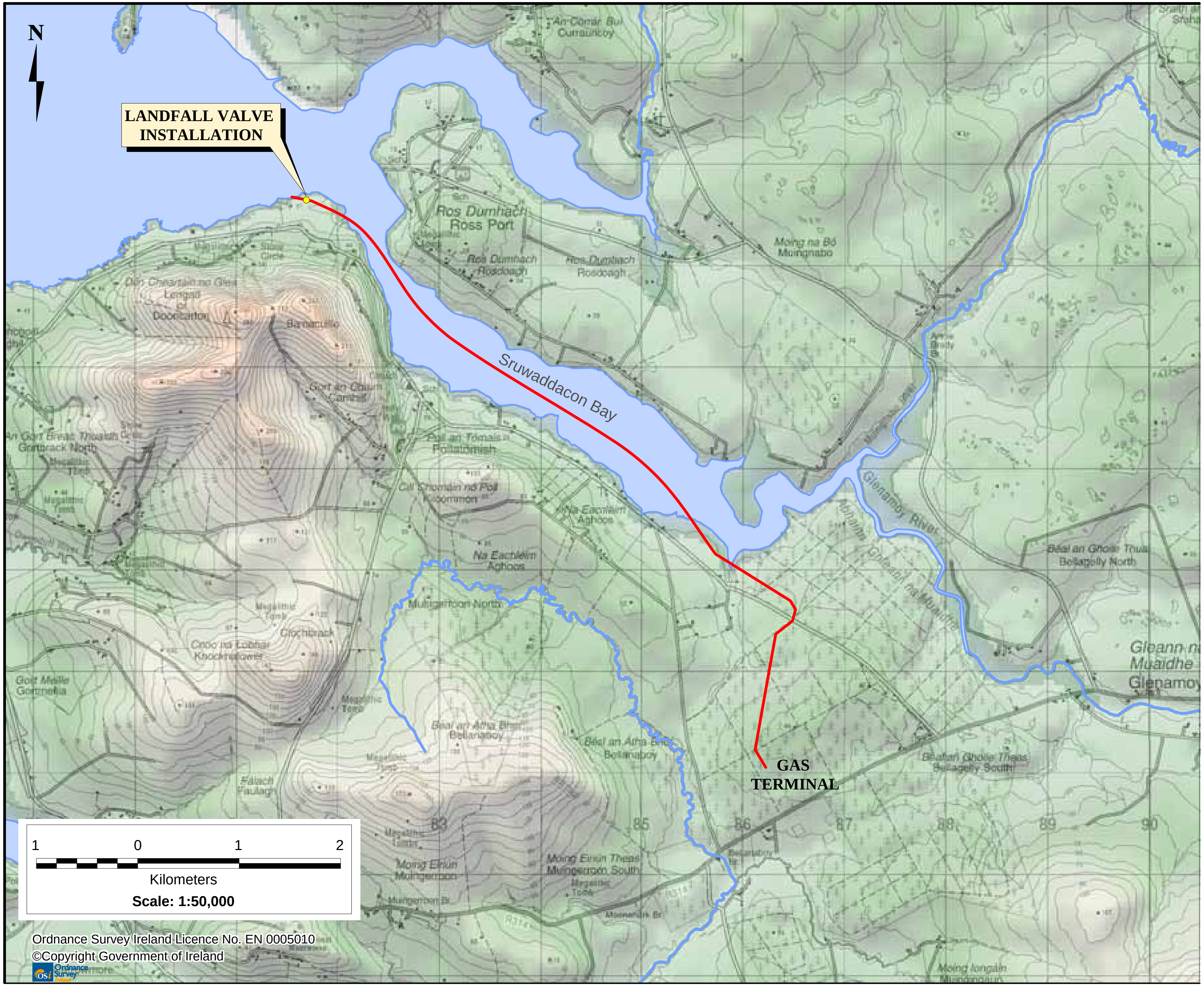
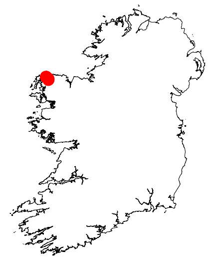
2.3 ROUTE DESCRIPTION

The proposed development (see Figure 3) is located in the Iorras (Erris) area of northwest County Mayo, approximately 15km east of Béal an Mhuirthead (Belmullet). Approximately 25% of the route follows, or is adjacent to, the route approved previously. In accordance with An Bord Pleanála's invitation, the remaining section of the pipeline route is in new landholdings, in land owned by Coillte or underneath Sruwaddacon Bay.

The offshore pipeline comes onshore in the townland of Gleann an Ghad (Glengad) 1.5km west of Ros Dumhach (Rossport). The proposed onshore pipeline route traverses this headland, in an east-south-easterly direction, for approximately 640m. From here, the pipeline route traverses Sruwaddacon Bay in a south-easterly direction towards na hEachú (Aghoos) for approximately 4.9km in a tunnel. Approximately 4.6km of the tunnel will be beneath Sruwaddacon Bay. The pipeline emerges from the tunnel at na hEachú (Aghoos), where the pipeline route turns in an easterly direction for approximately 0.9km, traversing an area of peatland where it crosses an approximately 40m wide estuarine river channel. The route then enters an area of forested bog (approximately 2.2km long) where it turns in a southerly direction, rejoins the previously approved route and enters the Bellanaboy Bridge Gas Terminal site.

Aerial view (looking north west) showing na hEachú (Aghoos), Sruwaddacon Bay, Dún Ceartáin (Dooncarton), Gleann an Ghad (Glengad) and Ros Dumhach (Rossport)





Proposed Pipeline Route

Overall Layout of the Onshore Pipeline and Landfall Valve Installation

Figure 3

File Ref: COR25MDR0470Mi2145A03
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The dominant physical feature within this scenic landscape along the pipeline route is Sruwaddacon Bay which is a tidal inlet off Broadhaven Bay to the south of Ros Dumhach (Rossport) and into which the Glenamoy and Muingnabo Rivers flow.

As shown on Figure 4, the route crosses a designated conservation site, the Glenamoy Bog Complex candidate Special Area of Conservation (cSAC), between Gleann an Ghad (Glengad) and na hEachú (Aghoos). This includes Sruwaddacon Bay, which is part of the Blacksod Bay / Broadhaven proposed Special Protection Area (pSPA) and the Blacksod Bay and Broadhaven Ramsar site. As it is proposed to tunnel the pipeline under Sruwaddacon Bay, the development is not predicted to have a significant impact on the pSPA/cSAC. The pipeline route at Gleann an Ghad (Glengad) is through an area of improved grassland and avoids the priority sand dune habitat (EU Habitats Directive Annex 1) to the north of the route.

2.4 GAS PIPELINE, SERVICES AND OUTFALL PIPE

The onshore pipeline will carry hydrocarbon gas (mainly methane), a small amount of associated water (which will contain methanol), small amounts of production chemicals injected at the wellheads, as well as hydrocarbon condensate.

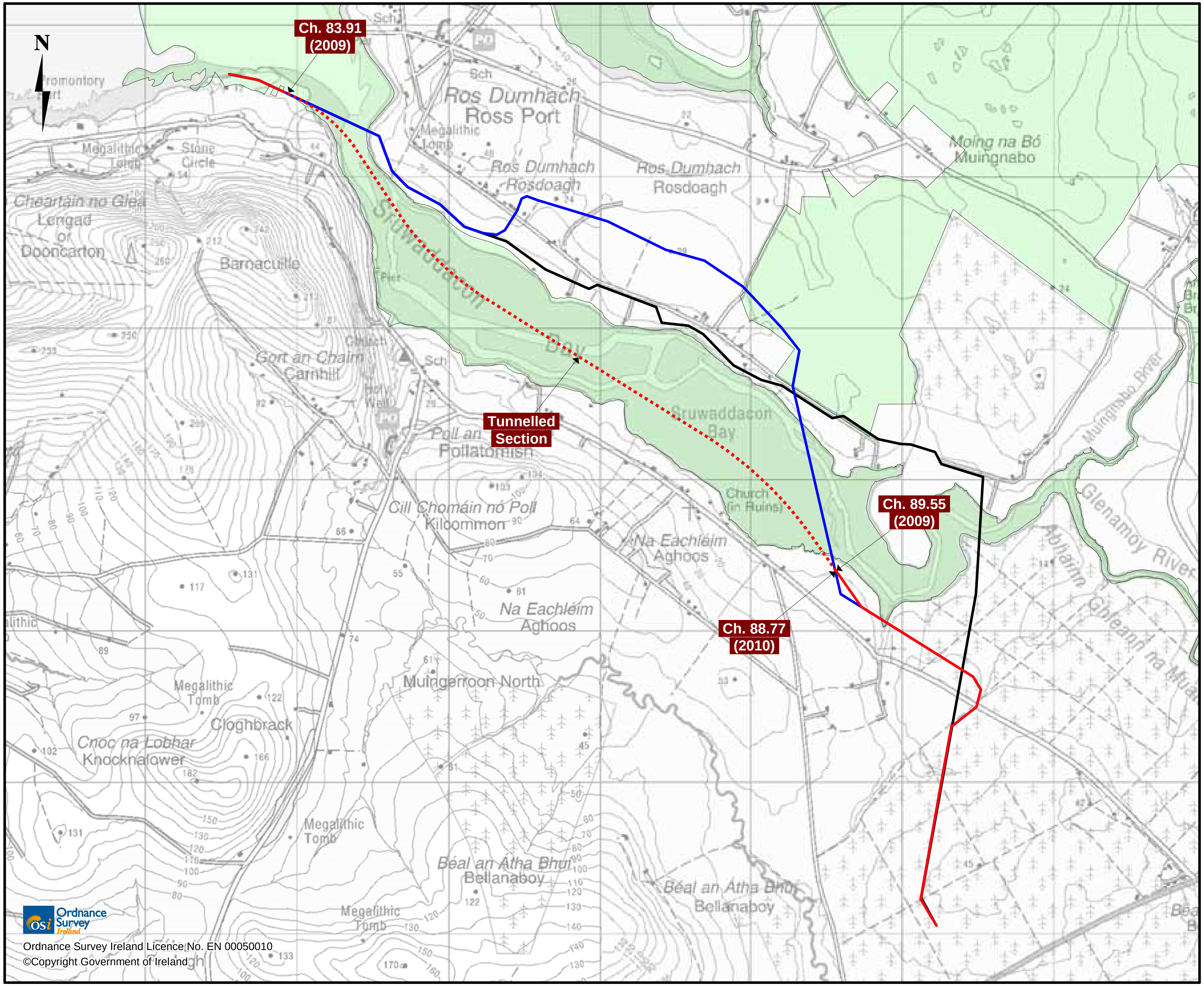
The services umbilical link between the Gas Terminal and the offshore subsea facilities will contain hydraulic fluid supply lines, chemical supply lines (methanol and corrosion inhibitor), water discharge lines, and data communication, electrical control and power cables.

A ‘spare duct’ and spare umbilical will be installed within the tunnel. These spare elements will permit renewal of the control elements of the pipeline system (electrical, fibre optic or umbilical lines) and the water discharge pipeline within the tunnel (should this ever be required).

2.5 OPERATION, MAINTENANCE AND DECOMMISSIONING

The pipeline will be operated from Bellanaboy Bridge Gas Terminal. During operation the pipeline route and the LVI will be inspected regularly by maintenance personnel.

Decommissioning of the pipeline after its useful life will involve the removal of any above ground facilities at the LVI and any remaining gas and hydrocarbon residues from the pipeline and services. A decommissioning plan will be prepared to ensure that the operations will comply with relevant EU and national legislation relevant to decommissioning at that time.



LEGEND:

- Proposed Route 2010
- Proposed Route 2009
- Previously Approved Route
- Glenamoy Bog Complex (SAC) (Indicative)

Note:
Approximate Chainage Points Shown

Proposed Pipeline Route Showing Tunnelled Section

Figure 4

File Ref: COR25MDR0470Mi2107A03
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3 NEED FOR THE PROJECT

Gas consumption in Ireland has continued to increase (currently at a rate of approximately 5% per year). Consequently, Ireland has required additional imports of gas from abroad since the mid 1990's in order to meet demand. This, combined with Ireland's peripheral location in Europe and its small market scale, leaves the country vulnerable to supply disruption and imported price volatility. Furthermore, the UK, from where Ireland imports over 90% of its gas, has itself become a net importer of gas from Norway, central Europe and further afield. Ireland is therefore largely dependent on a gas supply from a country, which is itself a net importer of gas.

The Irish Government has three key priorities in relation to energy policy; security of supply, sustainability of supply and competitiveness of supply. This is outlined in the recently published Energy Policy Framework 2007-2020. With imported energy required to meet over 90% of Irish energy needs, security of supply is seen as being crucial for the development of the economy and society as a whole. It requires that Ireland has reliable access to oil and gas supplies and the infrastructure in place to import, distribute and store both oil and gas.

At its peak output, the Corrib Gas Field will meet up to 60% of Ireland's gas needs, thus reducing Ireland's dependence on imported gas. Consequently, this project is of national strategic importance as Corrib gas will be a reliable and secure indigenous source of clean energy for the Irish economy. Figure 5a (prepared by Goodbody Economic Consultants in 2007), forecasted gas demand in Ireland for the period up to 2015. This graph was prepared on the basis of energy demand figures produced by the Economic Social & Research Institute (ESRI). It is clear that the Kinsale Head Gas Field will contribute ever less to meeting projected gas demand in Ireland in the near future. Figure 5b also shows clearly that the Corrib Gas Field will make a major contribution to meeting projected national gas demand when it comes on stream[2].

In addition, the development of the Corrib Field is likely to have significant regional and local benefits to Co. Mayo. The Corrib project has already stimulated expansion of the onshore transmission system in the west and northwest of Ireland.

Bord Gáis Éireann (BGÉ) has extended the gas transmission network from Galway to the Bellanaboy Bridge Gas Terminal and is extending the network under the Gas West Project. Gas connections to towns in Mayo and North Galway completed include Ballina, Ballinrobe, Castelbar, Claremorris, Crossmolina, Craughwell, Headford, Gort, Loughrea and Westport. The remaining towns scheduled for completion in 2010 are Ballyhaunis and Knock in Co. Mayo and Athenry and Tuam in Co. Galway. Figure 6 shows the full extent of the Natural Gas Transmission Network in Ireland.

[2] When the Goodbody Report was published, it was anticipated that Corrib Gas would come on line in 2009. This will not now be achieved until 2013 at the earliest

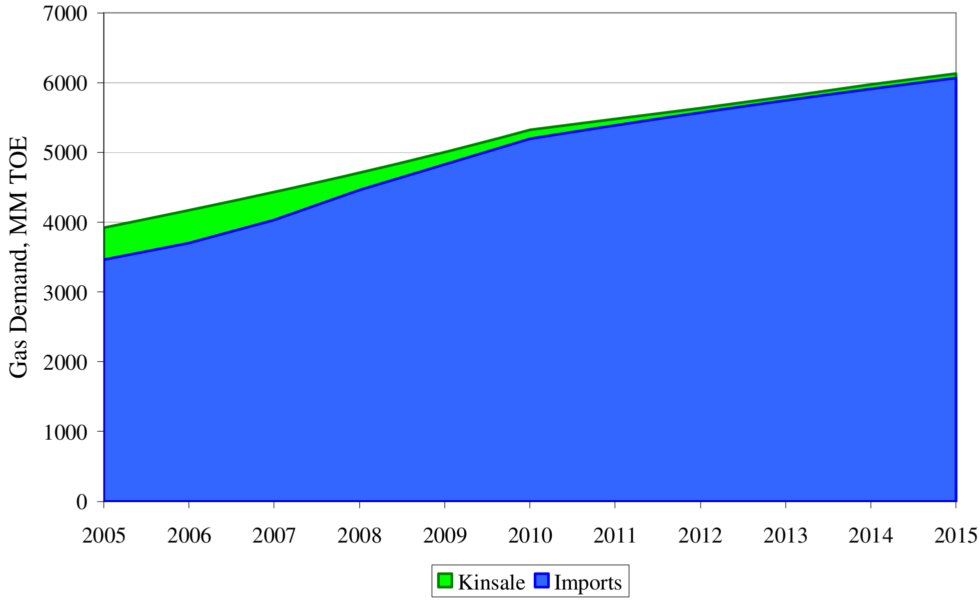

Figure 5a: Projected Gas Demand in Ireland (2005 – 2015)
Source: Economic Assessment of the Corrib Gas Project, (Goodbody Economic Consultants, November, 2007)

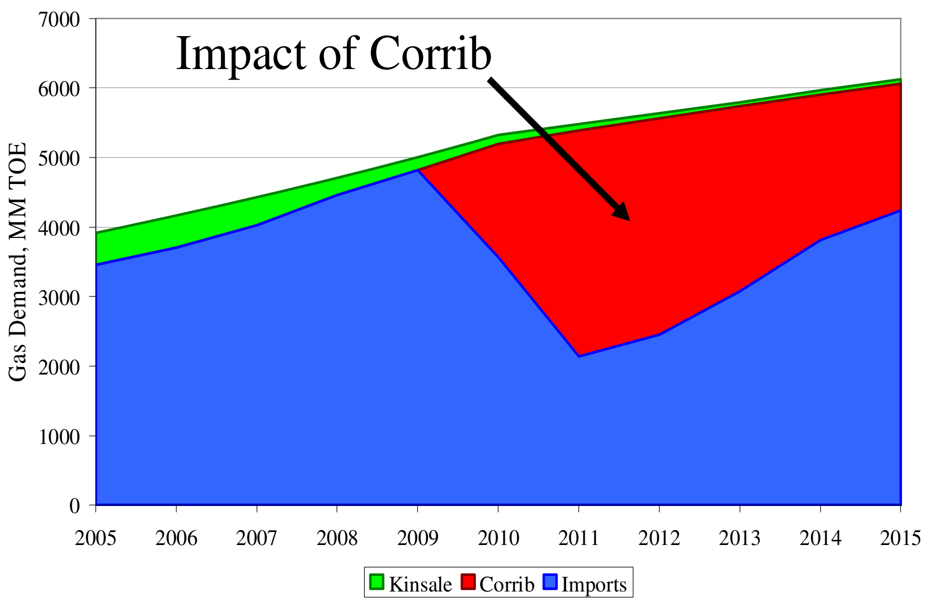

Figure 5b: Contribution of Corrib Gas Field to Projected Gas Demand in Ireland (2005 – 2015)
Source: Economic Assessment of the Corrib Gas Project, (Goodbody Economic Consultants, November, 2007)[3]

[3] Note: When the Goodbody Report was published it was anticipated that Corrib Gas would come on line in 2009. This will not now be achieved until 2013 at the earliest.

Gas Transmission Network in Ireland

Figure 6

CORRIB ONSHORE PIPELINE

File Ref: MDR0470GrEIS040 Rev A03
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4 PLANNING PROCEDURES

Separate statutory approvals are required for the revised onshore pipeline from the following three bodies (see Figure 7 overleaf):

- An Bord Pleanála;
- The Minister for Communications, Energy and Natural Resources (DCENR); and
- The Minister for Environment, Heritage and Local Government (DEHLG).

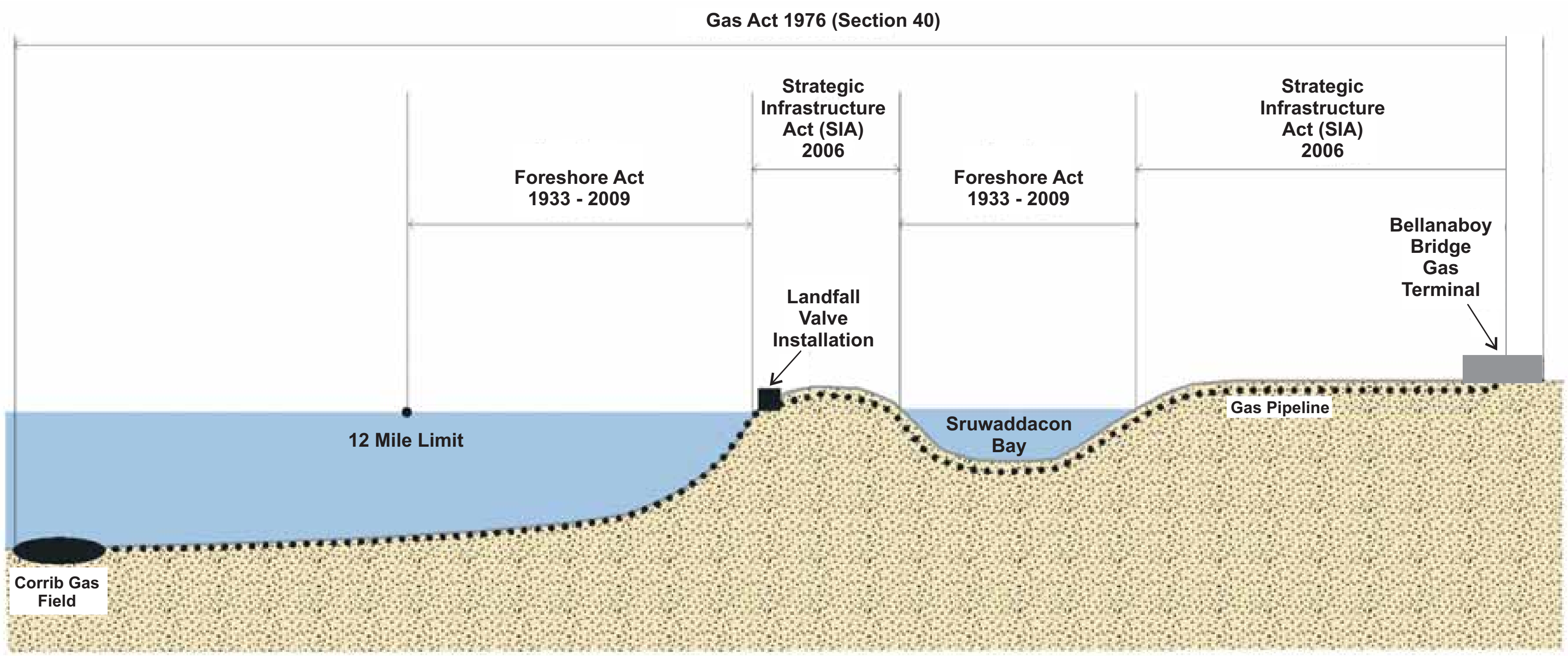
The onshore pipeline (comprising those sections that are within the functional area of the Planning Authority, i.e. above the high water mark) will require An Bord Pleanála's approval under the Strategic Infrastructure Act (SIA).

Sections of the pipeline route that are below the high water mark including the offshore pipeline between the '12 mile limit' and the high water mark at the landfall at Gleann an Ghad (Glengad), as well as those within Sruwaddacon Bay, will require a Foreshore Licence issued by the Minister for Environment, Heritage and Local Government under the Foreshore Acts.

Consent for the entire pipeline (onshore and offshore sections) from the Minister for Communications, Energy and Natural Resources under Section 40 of the Gas Act will also be required.

Consent is also required under the Strategic Infrastructure Act for the acceptance and deposition of up to 75,000m^3 of peat arising from the construction of the onshore pipeline, within the existing boundary of the peat deposition site at An Srath Mór (Srahmore). Planning permission for the Srahmore Peat Deposition Site was granted by An Bord Pleanála in October 2004 for activities associated with the Gas Terminal. A waste licence will also be required from the Environmental Protection Agency (EPA) for the deposition of peat. The proposed peat deposition operations at An Srath Mór (Srahmore), are described in an EIS (including a non technical summary), which forms Volume 3 of this Corrib Onshore Pipeline EIS.

A Compulsory Acquisition Order (CAO) to enable the construction and operation of the proposed development from An Bord Pleanála under the Gas Act will also be required.



Corrib Gas Field -

Statutory Approvals

Figure 7

File Ref: MDR0470GrEIS039 RevA03
Date: May 2010

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5 CONSULTATION

Following the appointment of RPS by SEPIL (January, 2007) to select a modified onshore pipeline route, a local RPS Project Office in Béal an Mhuirthead (Belmullet), Co. Mayo was set up to assist the consultation process. The consultation process was designed to be open and transparent and to facilitate the exchange of project information and views of the local and wider community. It commenced with the introduction of RPS in February, 2007 to the community, followed by a Community Workshop at the end of March, 2007 and the subsequent identification of criteria for route selection, which formed the cornerstone of the route selection process.

Each stage of the route selection process was marked with the publishing of a Community Up-date Brochure, which was widely distributed in the local community. Each brochure included a ‘Tell Us Your Views’ section, which allowed members of the community to return comments or queries to RPS. A dedicated project website (www.corribgaspipeline.ie) was also set up where up-to-date project information, including copies of all material published about the route selection process, could be conveniently obtained.

Public Consultation during Open Day in February 2007.

The principal issues raised about the onshore pipeline during the public consultation process were:

- pipeline safety;
- proximity to dwellings;
- the local environment (particularly Sruwaddacon Bay and the Glenamoy Bog Complex cSAC);
- the transportation of unprocessed gas;
- the landfall valve installation;

- peat stability concerns associated with the Poll an tSómais (Pollatomish) landslide in 2003;
- the issue of 'community consent';
- intimidation within the community;
- community gains; and
- the previous handling of CAOs.

Following An Bord Pleanála's request for SEPIL to modify the proposed pipeline, further local consultation was carried out in March and April, 2010. This included the publication of a Community Up-date Brochure, an up-date to the project website, letters to members of the community and meetings with individuals and small groups from the community.

6 ROUTE SELECTION

RPS was tasked with finding a modified route for the Corrib Onshore Pipeline. The route selection process was carried out by a multi-disciplinary team in the following main steps:

- Consultation with the local community on route selection criteria (February - June, 2007);
- Examination of the study area and identification of indicative route corridor options (February - June, 2007);
- Short-listing of route corridor options (June - September, 2007);
- Detailed corridor development to select routes and possible variations (September - December, 2007); and
- Final route development and selection (December 2007 - April, 2008).

The route selection process sought to find an optimum balance between the relevant community, environmental and technical criteria. As a result of Peter Cassells' recommendations, achieving increased distance from local housing was given greater significance than it had during the route selection process for the previously approved route. The route selection criteria, which were established early in the process, included:

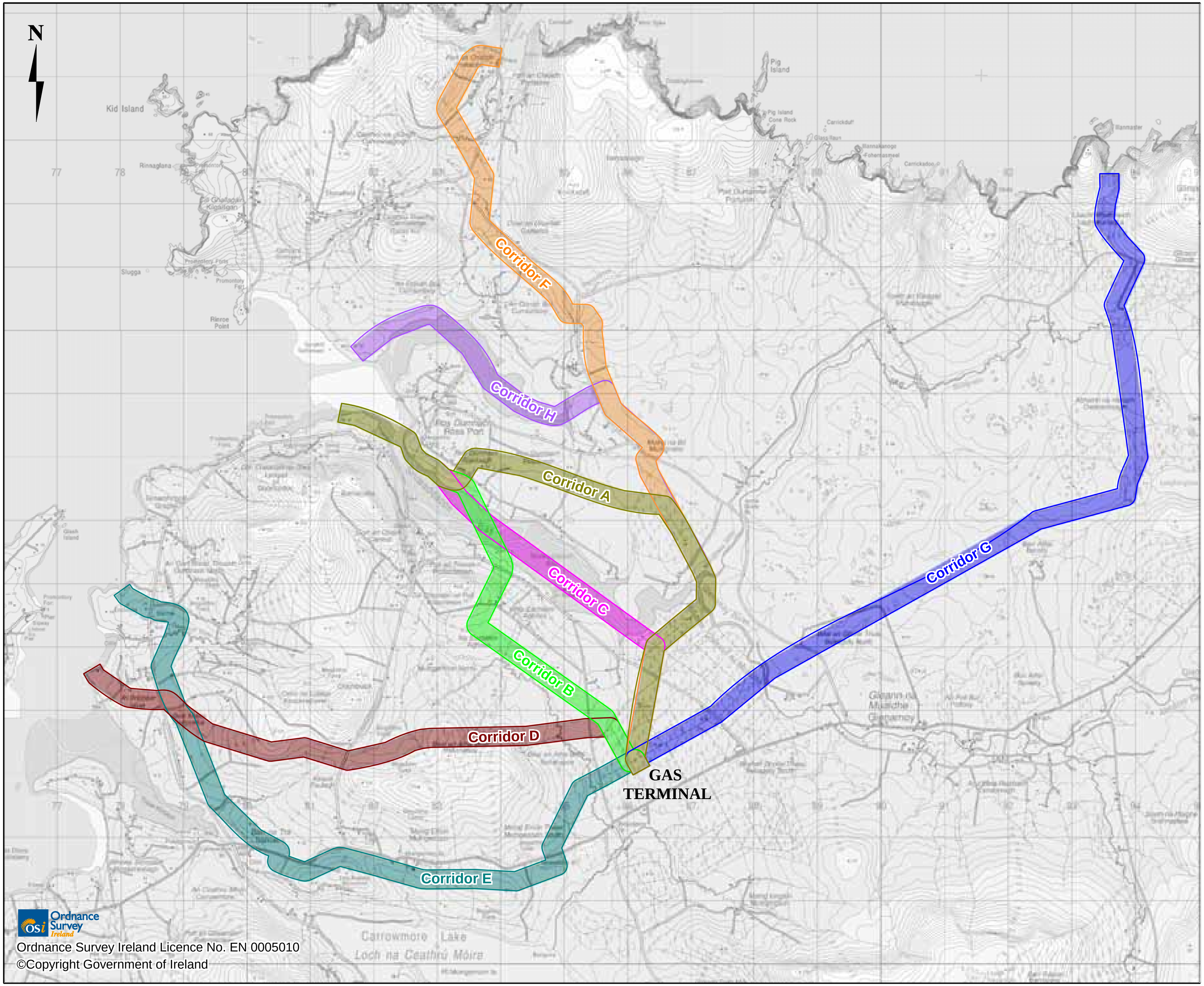
- Separation from local housing;
- Minimisation of impacts on wildlife and habitats, particularly designated areas; and
- Constructability of the pipeline, e.g. complexity and hazards

The route selection process took place over a period of approximately 18 months during which a large amount of consultation with the local community took place (as discussed in the previous section).

During this time a total of eight indicative route corridor options were identified based on desk based studies, in parallel with community and statutory consultation. The eight corridors, labelled A to H (see Figure 8) extended from four different landfall points to the Bellanaboy Bridge Gas Terminal. Technical and environmental specialists examined the route corridor options, and subsequently short-listed three of the eight corridors. Route corridors A, B and C represented the corridors with the least environmental and technical constraints. Variations to route corridors A and C were developed to minimise possible environmental impact. At this stage, five route options, namely A, A1, B, C and C1, remained (see Figure 9).

Route C1 was selected as the proposed route for the following reasons:

- Route C1 offered the best balance between community concerns, environmental issues and the technical aspects of the project;
- The route met or exceeded all Irish and Internationally recognised Codes and Standards for gas pipelines as of February 2009 (as confirmed by the Technical Advisory Group appointed by the Minister of Department of Communication, Energy and Natural Resources); and
- The route would have minimal impact on designated conservation sites such as the Blacksod Bay/Broadhaven pSPA and the Glenamoy Bog Complex cSAC.



Ordnance Survey Ireland Licence No. EN 0005010

LEGEND:

Preliminary Route Corridors

- **Corridor A Rossport**
- **Corridor B Aghoos**
- **Corridor C Sruwaddacon Bay**
- **Corridor D Inver Upland**
- **Corridor E Inver / Barnatra**
- **Corridor F Portacloy**
- **Corridor G Glinsk - Glenamoy Bog**
- **Corridor H North Bay**

Preliminary Route Corridors

Figure 8

File Ref: COR25MDR0470Mi2146A03
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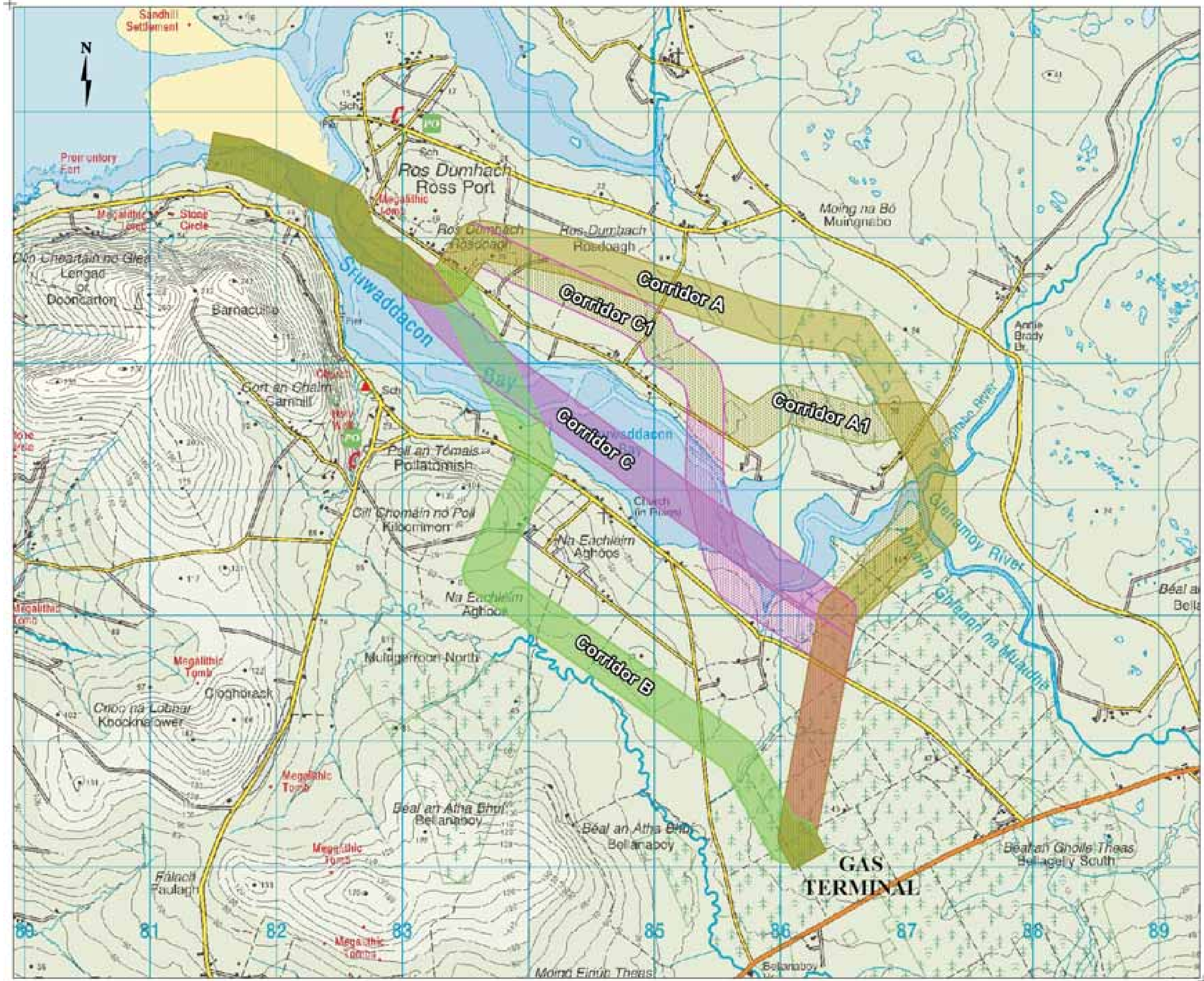


Detailed Route Corridor Development - Variations

Figure 9

File Ref: MDR0470GrEIS101 RevA03
Date: May 2010

CORRIB ONSHORE PIPELINE

In its letter of 2nd November, 2009, An Bord Pleanála invited SEPIL to modify the pipeline route between chainage points 83.91 and 89.55 such that it ‘would be generally in accordance with that indicated as Corridor C (that is, within Sruwaddacon Bay) in the route selection process’. An Bord Pleanála was specifically concerned about proximity to housing, traffic impact and the impact on residential amenities associated with the proposed Route C1.

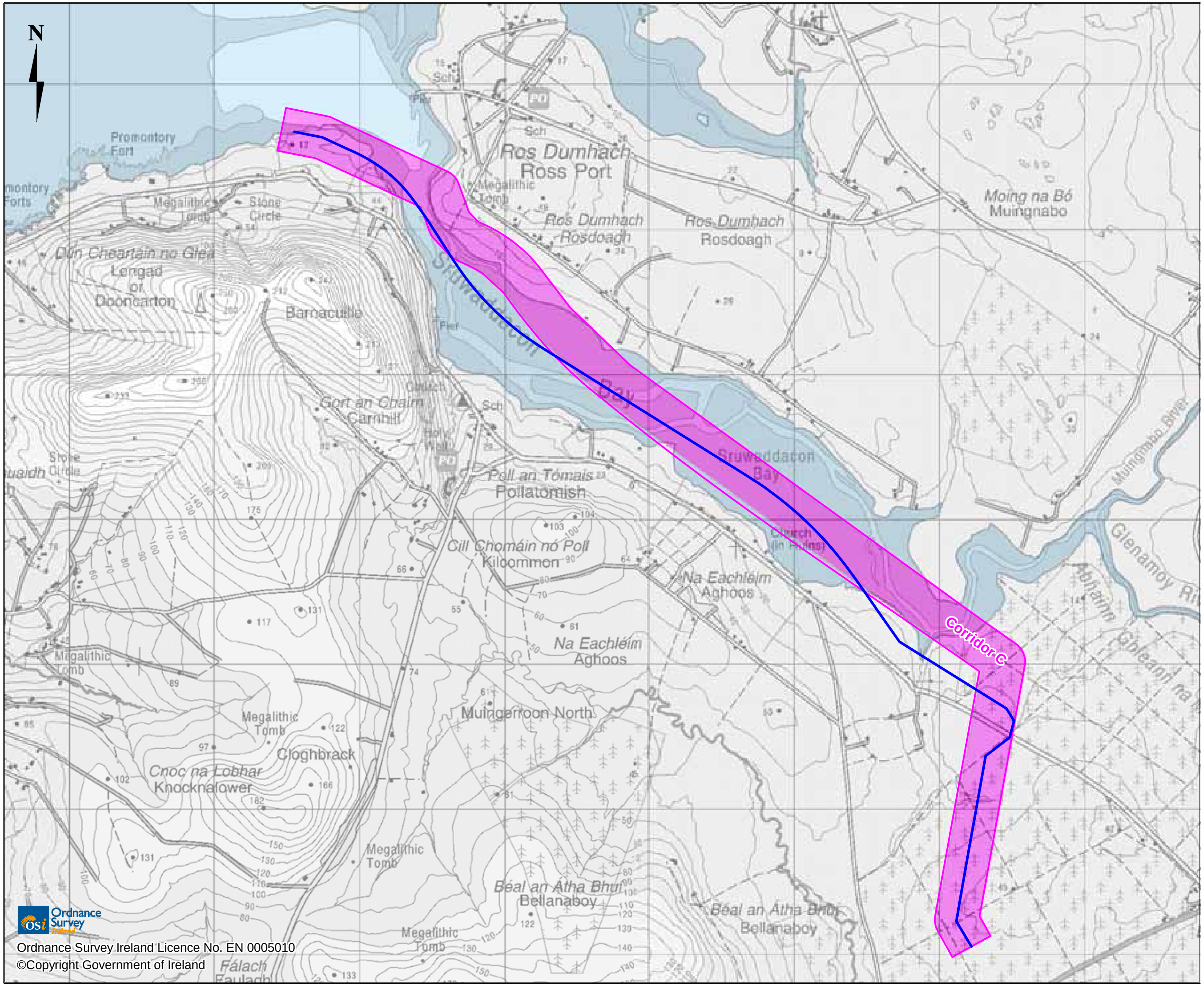
Following a detailed examination of the (limited) alignments available that would be within Sruwaddacon Bay, a revised pipeline route as shown in Figure 10 is now proposed on the following basis:

- The proposed pipeline complies with An Bord Pleanála’s standard that the proximity of the pipeline to dwellings shall not be less than the appropriate hazard distance for the pipeline in the event of a pipeline failure. One house in the townland of na hEachú (Aghoos), which is the property of SEPIL and is not used as a dwelling, does not meet the criteria.

- The proposed construction methodology (segment lined tunnelling) minimises the potential environmental impacts on Sruwaddacon Bay, which is part of the Glenamoy Bog Complex (cSAC) and the Blacksod Bay / Broadhaven proposed Special Protection Area (pSPA).

- The proposed route addresses key community concerns such as proximity to housing and protection of the environment. The proposed pipeline route is significantly further from occupied housing than the 2002 and 2009 pipeline routes; and

- The proposed route retains the permitted landfall at Gleann an Ghad (Glengad), at which the offshore pipeline (already constructed) terminates.



LEGEND:

Corridor C

Proposed Pipeline Route 2010

Corridor C and Proposed Pipeline Route

Figure 10

File Ref: COR25MDR0470Mi2470A02
Date: May 2010

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7 CONSTRUCTION METHODOLOGIES

A number of activities must take place prior to construction of the onshore pipeline. These include consultation and liaison with landowners, statutory bodies and the public. Pre-construction surveys will comprise ground investigations, environmental surveys and archaeological testing required to support the construction process. Such pre-construction surveys are standard practice for infrastructural projects.

Construction will be carried out using two methods:

1. Tunnelling from na hEachú (Aghoos) to Gleann an Ghad (Glengad) for approximately 4.9km (approximately 60% of the pipeline route). Approximately 4.6km of the tunnelled section is underneath Sruwaddacon Bay.

2. Conventional ‘open-cut’ technique (‘Spread Technique’) for approximately 3.4km on land (approximately 40% of the route).

The construction methods proposed have been selected to prevent and/or minimise the potential for impact on the receiving environment along the route of the pipeline. The tunnel will be bored from na hEachú (Aghoos) to Gleann an Ghad (Glengad). This will minimise community and environmental impact in the area of Poll an tSómais (Pollathomish) and Gleann an Ghad (Glengad). It is anticipated that the overall construction programme for the onshore pipeline will be approximately 26 months, with temporary construction compounds at na hEachú (Aghoos) and Gleann an Ghad (Glengad) established throughout this period.

7.1 SRUWADDACON BAY TUNNEL

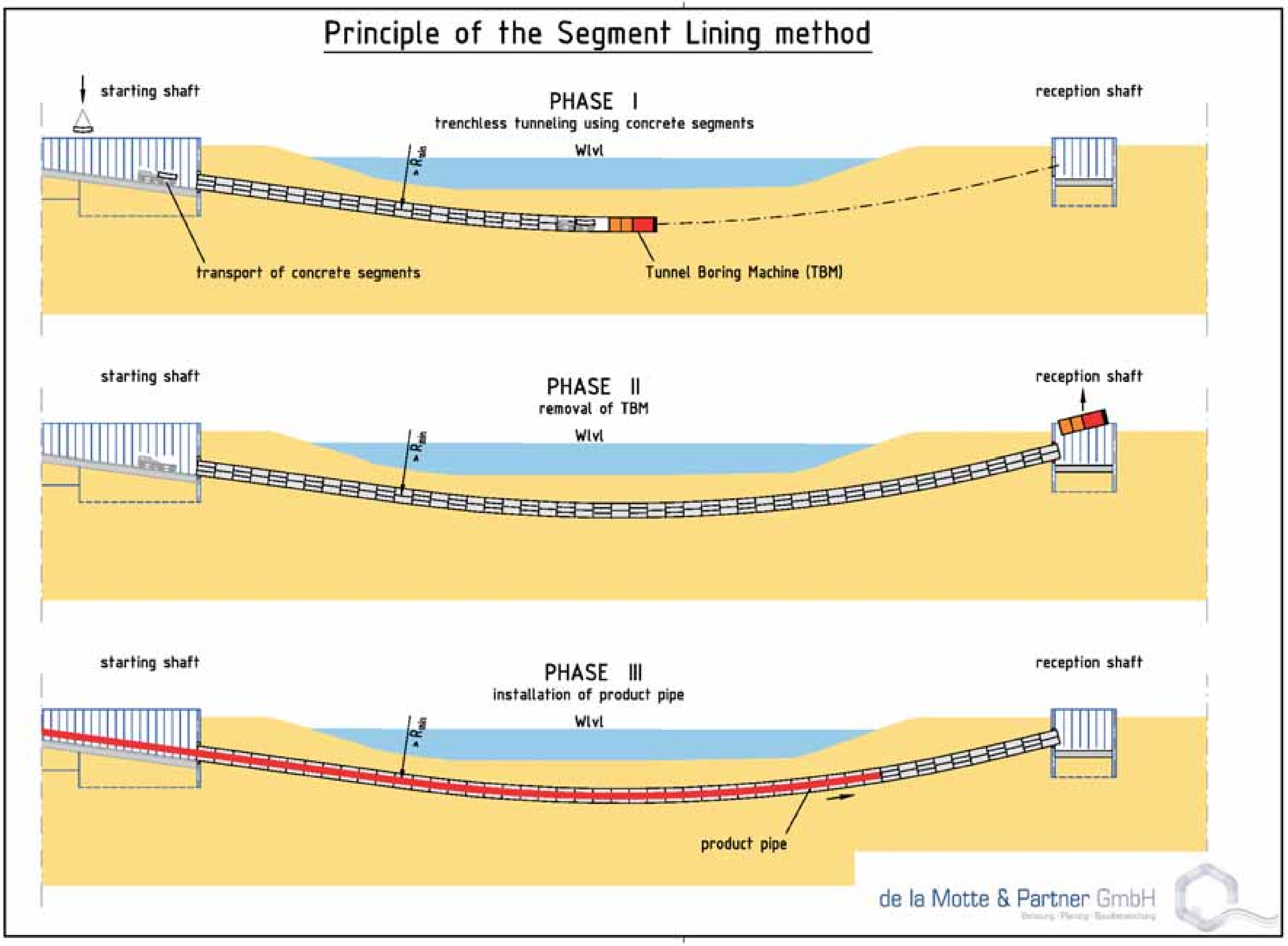
The proposed tunnel will be installed mainly within sands and gravels. The tunnel will be concrete lined, and have an outside diameter of approximately 4.2m. The proposed tunnelling methodology has been selected to minimise surface disturbance during construction (see Figure 11).

The tunnel will be excavated using a Tunnel Boring Machine (TBM). These machines use sophisticated guidance/control equipment to ensure that the tunnel can be excavated along a predetermined path to within very small tolerances.

Construction staff will work within the tunnel on a 24 - hour basis. A small railway line running within the tunnel will be used to transport staff and materials from the tunnelling compound to the rear of the TBM.

As the TBM gradually excavates its way forward, the tunnel will be lined (from within) using concrete rings. Each concrete ring is made up of six segments to allow these to be brought through the tunnel to the rear of the TBM where the next concrete ring needs to be assembled. During a typical hour of tunnel construction, 15 – 20 minutes will be spent tunnelling. The remaining 40 – 45 minutes will be spent erecting tunnel segments, and extending utility systems such as ventilation ducting, drilling fluid and tunnel arising transport lines and rail track.

The TBM will use a drilling fluid normally consisting of a suspension of water and bentonite for lubrication and cooling of the cutting head, removal of cuttings and stabilisation of the cut. The drilling fluid will be pumped to the TBM via hoses within the tunnel. As the tunnel is excavated, tunnel arisings will pass through a crusher at the rear of the TBM cutting head and will be transported to the surface via return lines.



Outline of Segment Lined Tunnelling

Figure 11

File Ref: MDR0470GrEIS099 RevA03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

A temporary tunnelling compound (approximately 260m x 65m in size) will be established at na hEachú (Aghoos). The tunnel will be bored from this location. It is proposed that works associated with the tunnelling process at this site take place on a 24 - hour / 7 day per week basis. This compound is estimated to be in place for approximately 26 months and will include the following elements:

- Diesel powered generators to power the TBM and provide electricity at the site;
- Bentonite handling plant and storage tanks;
- Separator plant to separate the tunnel arisings from drilling fluid;
- Stock-piling areas for tunnel arisings;
- Fresh water storage;
- Cranage for general handling of concrete segments, pipeline sections etc.;
- Concrete segment storage; and
- Workshop, Offices and Welfare facilities.

A period after tunnelling has commenced, the compound at na hEachú (Aghoos) will be extended to include a pipe stringing area where the gas pipeline and associated services will be assembled before being installed within the tunnel.

Shortly before the TBM reaches its destination at Gleann an Ghad (Glengad), a temporary reception pit will be set up to receive and allow its removal. This compound will be approximately 65m x 55m in size and is estimated to be in place for less than a year.

After the gas pipeline and associated services have been installed within the completed tunnel, the tunnel will be filled with a cement grout. Therefore, the gas pipeline and services within the tunnel will be surrounded and supported permanently and the tunnel will be permanently sealed.

7.2 PIPELINE AND LVI CONSTRUCTION

Approximately 3.4km of the pipeline will be installed on land, 730m in grassland and 2.7km in peatlands. A conventional "open-cut" technique ("Spread technique") will be used where the gas pipeline and associated services will be laid underground in a single trench.

In general, construction activities on land will be carried out within a temporary working area of approximately 40m wide, along the pipeline route. The various stages of construction include:

- Mobilisation i.e. compound set up, pre-construction preparatory works;
- Fencing off of temporary working area;
- Topsoil stripping;
- Installation of stone road in areas of peatland;
- Pipe stringing, bending and welding;
- Excavation of trenches (within the stone road where this method is used) and installation of pipeline, services and outfall pipeline into the trench;
- Backfilling of trench;

- Reinstatement of temporary working area; and
- Removal of fencing.

Reinstatement taking place on section of pipeline in Co. Galway (Gas Pipeline to the West)

A construction technique referred to in the EIS as the 'Stone Road Method' will be used in the 2.7km of the pipeline route which occur in peatland in order to minimise the potential for environmental impact, to facilitate construction and to ensure that the pipeline is stable within the trench. This involves the construction of a stone road structure within which the pipeline and services will be installed.

Placement of stone road at Upper Glencullin
(Mayo - Galway Pipeline, 2006)

The stone road method involves:

1. Excavation of peat, including the removal of the top vegetated layer of peat (which will be carefully set aside, and saved for reuse in reinstatement); and

2. Addition of stone to displace the remaining in situ peat, and build a stone road structure which is founded upon the mineral soils.

When the structure is completed, a trench will be excavated to accommodate the installation of the pipeline and services. After the pipeline is installed, the surface of the stone road will be reinstated with vegetated peat, which will be kept aside for this purpose.

A similar method of construction will be used for the construction of the temporary tunnelling compound and pipe stringing area at na hEachú (Aghoos).

In an area of recovering eroded blanket bog east of the Leenamore River crossing (for approximately 190m along the pipeline route) it is proposed to remove and preserve the top vegetated layer of peat in sections (turves). In this area, the width of the stone road will be restricted to 9m. The turves removed will be approximately 2m x 1m x 0.5m deep. A specially designed excavator bucket will be used to lift and place turves carefully onto wooden bog mats so that they do not break up. These bog mats are located alongside the stone road within the temporary working area. The storing of turves on bog mats will facilitate their later removal and reinstatement of the wayleave without damaging the underlying bog.

Turves will be stored in a single layer in order to minimise the potential damage to the turves, and to minimise compaction of the peat beneath the bog mats. The turves will be kept moist and will be monitored during storage.

The stone road in this section of bog will be constructed using stone sourced from local quarries.

Upon completion of construction, a 14m wide permanent wayleave will remain in place for the lifetime of the pipeline, except in peatland where a 20m wide permanent wayleave will be required to accommodate the stone road. Some restrictions will apply to the use of land within the permanent wayleave (building of structures, tree planting, deep ploughing etc.) but otherwise the land in this area will return to normal use once construction and reinstatement have been completed.

The area of the Landfall Valve Installation (LVI) will be set out and fenced off prior to construction. A separate compound will also be established from which construction activities in this area will be based. Access to the LVI will be via the access road from local road L1202.

The first stage of the construction of the LVI will be to excavate the site to the required levels. Topsoil will be stored separately to preserve the local seed bank and facilitate reinstatement. Bedrock is located approximately 3 - 4m below ground level. After completion of the excavation, various civil works will be undertaken. These include the construction of foundations, fencing and the surface water drainage system. Most of the LVI pipework and associated equipment will be fabricated in sections off site, brought to the site and assembled in situ and then connected with the onshore and offshore pipeline, as appropriate.

Upon completion of the construction works, the area surrounding the LVI will be reinstated using temporarily stored topsoil. The temporary compound established at Glengad to support LVI construction will also facilitate pipeline testing and commissioning and the offshore umbilical lay, and will be in place throughout the 26 month construction period.

7.3 ACCESS

The mobilisation of construction plant and personnel as well as the delivery and removal of construction materials will generate the bulk of the traffic associated with the project. A significant amount of construction activities will take place from the temporary tunnelling compound at na hEachú (Aghoos). Two access points are proposed from this compound to the adjacent L1202 public road.

As pipeline construction proceeds on land, associated traffic will move in tandem with construction. The public road network will provide access to the works where the temporary working area cannot be used for access. All temporary access points and temporary construction facilities will be removed once construction is complete and the land will be reinstated.

7.4 ENVIRONMENTAL MANAGEMENT

To ensure that environmental impacts of construction works are minimised, a comprehensive Environmental Management Plan (EMP) will be established in consultation with relevant statutory bodies, including Mayo County Council, the National Parks and Wildlife Service of the Department of Environment, Heritage and Local Government, and the North Western Regional Fisheries Board. The implementation of this plan will ensure that the mitigation and monitoring measures identified in this EIS will be applied throughout the construction phase and ensure that all environmental effects associated with the proposed development are avoided or minimised.

7.5 TESTING AND COMMISSIONING

Testing and commissioning of the onshore pipeline will begin once it is mechanically complete. Testing will be carried out in accordance with relevant industry standards.

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8 THE HUMAN ENVIRONMENT

8.1 COMMUNITY AND SOCIO ECONOMIC

The principal concern of SEPIL is that human beings in the vicinity of the proposed pipeline experience no significant reduction in quality of life as a consequence of the construction and operation of the proposed development and that the project should not damage the sense of place and attachment to local culture and heritage.

Road signage in Irish indicating a Gaeltacht region.

The construction project will bring employment and economic benefit, but a development of the overall nature and scale proposed in this location would have the following temporary short term local impacts on the local resident, visiting and working community, during construction:

- Increased vehicular traffic;
- Increased noise, dirt and dust generation;
- Increased severance across existing landholdings;
- Visual impact of the works; and
- Increased disturbance, including temporary restricted local access.

The residential population with greatest potential for disturbance is situated in the local vicinity of the proposed onshore pipeline including in particular Na hEachú (Aghoos), Gleann an Ghad (Glengad), Poll an tSómais (Pollatomish), and Béal an Átha Buí (Bellanaboy) Bridge.

Community Liaison Officers (CLO) are available to liaise with the community and address any concerns throughout the construction phase of the proposed development.

The development of the onshore pipeline will have benefits for the local community. The construction phase of the overall Corrib Gas Field development, of which the proposed onshore pipeline development comprises one element, generated direct peak construction employment in 2009 of approximately 1,500 personnel. It is predicted that some 120 to 140 persons will be employed during construction of the onshore pipeline. This primarily construction - related employment will be available to suitably qualified members of the local workforce. However, a number of the jobs will go to pipeline and tunnelling specialists, such as welders, TBM operators etc. The proposed development will also indirectly benefit or consolidate employment in local support industries, including building suppliers, caterers, general retail and accommodation. It is also anticipated that some 55 persons will be directly employed during operation of the Corrib Gas Field development, with a further 76 persons indirectly employed. Therefore, the potential impact during both construction and operation is considered to be significant and positive in socio-economic terms.

In addition, the local community will benefit from the ongoing implementation of the Corrib Gas Partners' Community Social Investment Programme, a major programme of community gain in the Iorras (Erris) Area. This investment programme consists of three elements; Corrib Natural Gas Erris Development Fund, The Local Grants Programme, and The Scholarship Programme.

8.2 TRAFFIC

A Traffic Impact Assessment (TIA) was undertaken to assess the impact of the proposed development on the local road network.

The R314 regional road, which links Béal an Mhuirthead (Belmullet) to Ballycastle, runs to the south of the proposed development. All other roads in the immediate vicinity of the proposed pipeline route are of local road status and provide linkages to villages such as Ros Dumhach (Rossport), Ceathrú Thaidhg (Carrowteige), Port Durlainne (Porturlin), An tInbhear (Inver), Na hEachú (Aghoos), Gleann na Muaidhe (Glenamoy) and Poll an tSómais (Pollatomish). Currently traffic on these roads is light and associated with local trips.

The only significant traffic impact associated with the proposed development will be during the construction stage which is estimated to last for 26 months. The peak construction period for heavy commercial vehicle (HCV) movements on the overall road network is predicted to be Month 2 due to the required export of peat, the importation of stone and delivery of fencing, site cabins, concrete, plant and equipment. It is estimated that during the peak construction period, there will be a total of 236 daily HCV round trips and 331 daily car/bus round trips associated with the works. Even though it will be necessary for the tunnelling works to be carried out on a 24-hour basis, traffic movement associated with the works will not occur outside of restricted hours typical for construction projects.

A Traffic Management Plan (TMP), which will be subject to detailed consultation with Mayo County Council, will be put in place to ensure minimal impact on local people and activities. The TMP will include, among others, the following mitigation measures:

- Heavy Commercial Vehicle (HCV) movement associated with the construction stage will be restricted to the hours of 07:00 – 19:00, Monday to Friday, 08:00 – 16:00 on Saturday with no HCV movements on Sundays or Bank Holidays. HCV movement will also be restricted in the vicinity of the school in Poll an tSómais (Pollatomish) during school opening and closing times.

- A maximum speed limit of 60 km/hr will be imposed for HCVs on the Haul Route on the R313, L1204, R314, L1202 and all other local roads during the construction phase, with lower speeds enforced at certain locations. A pacing vehicle will be deployed from time to time as part of the enforcement of this requirement.

Road maintenance works will be required during the course of the project. These will be agreed in consultation with Mayo County Council following visual and road condition surveys.

The operational stage of the proposed pipeline will have minimal traffic movements with only maintenance checks required periodically.

The Traffic Impact Assessment carried out shows that adverse traffic impacts during construction can be satisfactorily mitigated. It can be stated, therefore, that the overall residual traffic impact will be imperceptible.

8.3 AIR QUALITY

Air quality in the area is very good, with pollutant levels well below the relevant air quality standards.

Impacts during the construction phase (approximately 26 months) have been assessed on a local scale to determine impact on human health. The main impacts on air quality will be from

- Construction dust;
- Construction plant emissions; and

- Construction traffic related emissions.

These have the potential to impact on human health and sensitive ecosystems and to cause an environmental nuisance.

Dust related impacts on residential receptors will be minimal and are considered to have a negligible impact on local agricultural properties. The impacts of the construction traffic on the local road network and proposed haul routes is predicted to range from negligible to moderate adverse over the short term of the construction period. The predicted impact on air quality from the operation of the generators at the Na hEachú (Aghoos) tunnelling compound on the nearest residential dwellings will be a slight adverse impact in the short term, still well below the limit for the protection of human health.

A set of mitigation measures will be implemented to ensure the minimisation of dust, traffic and plant emissions. Good working practices will be implemented as part of an Environmental Management Plan and Traffic Management Plan.

There will be no direct impacts on local air quality as a result of the operation of the proposed development.

There will be no residual impact on air quality as a result of the proposed Corrib Onshore Pipeline development.

8.4 CLIMATE

Emissions with the potential to cause climate change will arise from activities during the construction of the proposed development including fuel consumption during the transport of materials and carbon losses from peat removal. However, the contribution of greenhouse gas emissions arising from the construction of the onshore pipeline in the context of the national emission levels will be negligible.

Gas has lower CO2 emissions than coal or oil, when used as fuel for power generation, and it represents the fuel of choice as a back up to wind power because of low CO2 emission and quick start up. There will therefore be positive impacts on climate as a result of the operation of the proposed Corrib Onshore Pipeline in the context of the overall Corrib gas development.

8.5 NOISE AND VIBRATION

The area of the proposed development is rural and sparsely populated, resulting in low baseline noise level, especially at night. A background noise survey was undertaken to quantify the existing noise environment at a number of locations along the proposed pipeline route and haulage route. In general, the main contributing noise sources along the pipeline and haulage routes included wind borne noise, birdsong, ocean noise and intermittent traffic.

Elevated noise and vibration impacts above the existing baseline levels will arise from construction traffic and construction activities associated with the proposed development, but these will be short term in nature. The principal source of construction related noise and vibration impacts will be the tunnelling compound at na hEachú (Aghoos) as this is where the construction works relating to the tunnelling operation will be carried out. This will be a short term impact. Construction traffic associated with the haulage of plant and materials is the main source of noise and vibration along the haulage route, but again this will be a short-term impact.

There is a potential for low frequency groundborne vibration generated during tunnelling to be detected within the sands forming the sea bed within Sruwaddacon Bay. This vibration will also be transmitted to water within the bay and will generate low levels of sound within the water body. The nature and extent of the sound levels will vary with the amount of water in the bay and the actual location of the TBM. The potential impacts have been assessed by the relevant ecological specialists.

During the pass-by of the TBM, vibration levels at the nearest dwellings (between Poll an tSómais (Pollatomish) and Gleann an Ghad (Glengad)) have been predicted to be considerably below the threshold of human perception for vibration. Even allowing for possible amplification of groundborne vibration within buildings (e.g. by suspended floors), the vibration level within houses between Poll an tSómais (Pollatomish) and Gleann an Ghad (Glengad) during the pass-by of the TBM is likely to be significantly less than the threshold of human perception for vibration. As such, tunnelling will not cause any significant disturbance to human beings in the area.

In order to minimise noise and vibration during construction, a series of mitigation measures and good working practices will be implemented as part of the Environmental Management Plan for the construction phase. This includes, for example, the installation of a 3m high sound barrier fence around the perimeter of the tunnelling compound at na hEachú (Aghoos). In addition, a programme of noise and vibration monitoring at sensitive receptors (i.e. those dwellings and buildings, which may experience noise/vibration effects) will be undertaken during the construction phase. This will allow for ongoing review of noise and vibration levels generated by the construction works and will highlight the need for further mitigation measures should they be required to ensure that noise nuisance does not occur.

Once the development is operational there will be no significant noise or vibration impacts.

8.6 LANDSCAPE AND VISUAL IMPACT

The predominant landscape in this region is a gently undulating rounded grassland landscape that is extremely open due to the lack of topographical features and tall vegetation. The landscape has a smooth appearance that offers extensive and panoramic views along the coast and bays. The proximity to the coast results in an exposed and rugged landscape. The high rounded upland hills of Dún Ceartáin (Dooncarton) and Cnoc an Ghairtéil (Garter Hill) sweep down to the coast in dramatic fashion and provide an attractive background for views across bays and inlets.

The County Road (L1202) around Dún Ceartáin (Dooncarton) from the R314 at Barr na Trá (Barnatra) to a point approximately 2km west of the R314 at Béal an Ghoile Theas (Bellagelly South) overlooking Broadhaven Bay and Sruwaddacon Bay is designated as a scenic route. A series of protected views are also designated along the scenic route.

As the gas pipeline, services and outfall pipeline will be buried throughout its length and will be in a tunnel under Sruwaddacon Bay there will be no permanent impact on the landscape.

Works associated with the construction and reinstatement period will result in potential short-term impacts. Measures such as downward focussed lighting will be employed during the construction phase to reduce potential impact from lighting. The time span for vegetation to fully recover in disturbed areas will be short-term in duration (one to seven years) and will vary depending on the vegetation type.

The proposed Landfall Valve Installation (LVI) at Gleann an Ghad (Glengad) will contain above ground features. However, the careful siting of the installation at lower ground levels, results in low levels of change to the landscape. The landscape in which the facility is located is expansive, a fact that also helps to reduce the potential landscape impact of the new features. There will be no significant visual impacts for properties with a potential view across the location of the LVI.

8.7 MATERIAL ASSETS

The non - tunnelled section of the proposed pipeline route passes through grassland used for drystock grazing and peatland (considered rough grazing), which is of poor quality from an agricultural perspective and used for grazing of drystock. However, most of this section passes through forestry.

In the section of route through grassland there will be a 14m wide permanent wayleave and in peatland and forestry there will be a 20m wide permanent wayleave to accommodate the stone road.

The impact on agriculture will generally be limited to the construction and reinstatement period and the season or two thereafter. Once reinstated, there will be no restriction on agriculture activities such as grazing or tillage within the 14 metre wayleave in grassland, and the 20 metre wayleave in peatland.

Tree planting will not be permitted, and there will be localised permanent loss of areas for harvesting timber within the 20m permanent wayleave. Landowners will be compensated where there is loss. An Agricultural Liaison Officer will communicate with landowners/occupiers on agricultural issues that may arise during the construction phase.

The residual impact on agriculture will be a minor, long term impact at the lands associated with the LVI due to the loss of land for production. There will be a moderate, long term residual impact on forestry production within the permanent wayleave. The residual impact on the remaining lands used for grazing and grass production will be short term and minor.

An assessment of the development potential and land values in the area has also been carried out. The development potential is the potential for an area both to accommodate new development, primarily residential development, and also the potential to secure a Grant of Planning Permission for such proposed development. It is considered that development potential along the route of the proposed onshore pipeline is extremely limited and therefore, there will be no significant residual impact on development potential. Likewise, there will be no residual impact on the property market as it will gradually return to normal trends with house prices determined by demand and supply once construction is completed.

In terms of the assessment of natural and other resources required for the project it is intended to maximise the re-use of materials arising, including tunnel arisings. This will reduce the demand on local quarries for similar material and is in accordance with the principles of sustainable development. A number of re-use options have been identified for surplus materials and these will be pursued further with relevant third parties in accordance with waste management regulations. The aim will be to manage re-usable materials as locally as possible while minimising the quantities of re-usable materials that are disposed of to landfill.

The design of the proposed tunnelling compound at na hEachú (Aghoos) incorporates sustainability features to recover rainwater for use during the tunnelling process. The use of harvested rainwater will result in reduced traffic and reduced demand on sources of clean water.

Raw materials will be sourced locally where possible during the construction of the proposed pipeline, however, certain materials such as the pipeline and services will have to be imported.

There are no predicted significant residual impact of the proposed development on natural or other resources.

9 THE NATURAL ENVIRONMENT

9.1 TERRESTRIAL ENVIRONMENT

The main terrestrial habitats occurring along the proposed route are coniferous forestry and agriculturally improved grassland. The ecological value of habitats lying within the route is variable. Whilst the areas of agricultural grassland and coniferous plantations encountered are of relatively low ecological value, others such as the designated EU Annex I intertidal and saltmarsh habitats at the Leenamore River inlet are of international importance. Blanket bog habitats present do not form part or whole of any designated conservation sites. They range in ecological value from Low, Local /Moderate, to Nationally Important. Much of the route section at Gleann an Ghad (Glengad) is within the Glenamoy Bog Complex candidate Special Area of Conservation (cSAC), and the estuarine and intertidal habitats of Sruwaddacon Bay lie within both the cSAC and Blacksod Bay / Broadhaven proposed Special Protection Area (pSPA).

The vertebrate fauna of the area are typical of the various habitats, with a good representation of common and ubiquitous species including otter, badger, hedgehog, wood mouse, pygmy shrew and Irish stoat. Of the mammals, the otter is of particular note (an Annex II species under the EU Habitats Directive), and it is also listed in the Red Data Book. Otters are known to be present along all coastal habitats and also inland in the area. Otters and other mammals can be relatively tolerant of disturbance, but will be affected by the construction of the pipeline in the short term.

A total of 66 bird species have been recorded by aquatic studies of the Sruwaddacon Bay area. Only one species, Light-bellied Brent Goose, exceeded the threshold of nationally important numbers (i.e. 1% of the estimated National Population). A total of 47 species have been found by terrestrial based studies in the area of the proposed pipeline route. Overall, bird diversity and abundance is considered to be low. The lack of mature ‘woody’ vegetation – outside of the coniferous plantation - characterises the coastal nature of the terrestrial parts of the study area. It also explains the lack or scarcity of many nationally common terrestrial bird species.

A tunnel of approximately 4.9km will go underneath marsh, salt marsh, and the estuarine habitats of Sruwaddacon Bay. Most of the tunnel will be underneath the Blacksod Bay/Broadhaven pSPA and the Glenamoy Bog Complex cSAC. No surface construction works are proposed within Sruwaddacon Bay.

In order to avoid and minimise impacts on protected faunal species, specific mitigation measures will be incorporated into the design of the construction works – in particular, in relation to otters, badgers and frogs in the area. Measures to reduce noise and light emanating from the na hEachú (Aghoos) and Gleann an Ghad (Glengad) compounds will be implemented in order to minimise impacts on the adjacent pSPA, its bird species and otters.

Habitats will be impacted during construction of the pipeline but with successful reinstatement there will be no long-term impacts. Mitigation measures for habitats, including habitat reinstatement for the various habitat types will be implemented.

Vegetation clearance and reinstatement of working areas will be subject to method statements, implementation of which will be directed by the Project Ecologist and supervised by a full time Environmental Officer. Monitoring of habitats and species will be carried out during construction and after reinstatement.

Overall, given the localised nature of the temporary working area and the limited extent of the temporary construction compounds at na hEachú (Aghoos) and Gleann an Ghad (Glengad), the proposed mitigation measures, and the availability of similar habitats to those that will be directly affected, it is anticipated that there will be no residual or significant effects on the pSPA or on the wider local avian community.

There will be some loss of habitat on the footprint of the Landfall Valve Installation, but this will be located in an area of formerly improved agricultural grassland of low ecological value. There will be no other impacts on terrestrial ecology during the operational phase of the development.

In the long term there will be imperceptible to neutral impacts on terrestrial ecology.

9.2 FRESH WATER ENVIRONMENT

The study area for the proposed route is confined to Sruwaddacon Bay and the rivers and streams, which drain to the bay. The proposed route traverses two streams and one short estuarine crossing of a river known locally as the Leenamore River. These watercourses are of low to moderate ecological importance and low fisheries value. Sruwaddacon Bay is part of the Glenamoy Bog Complex cSAC and an important migratory route for the Atlantic Salmon, which is also an EU Annex II species (EU Habitats Directive).

During construction of these crossings, there is potential for temporary disruption to these habitats, and the release of suspended solids and contaminants. However, measures will be put in place to minimise these impacts.

Although the risk from suspended solids will be considerably reduced by mitigation, there is likely to be some silt deposition. However, such impacts will be temporary, lasting no more than one year or less in most cases. Mitigation measures will include the use of specialised construction methods and the implementation of measures to control sediment.

It is considered that any noise or vibration arising from the tunnel boring machine will have negligible adverse impact on salmon and trout in Sruwaddacon Bay.

There will be no impacts on freshwater ecology during the operational phase of the development, and no residual impacts on freshwater ecology as a result of the project as a whole.

9.3 MARINE/ESTUARINE ENVIRONMENT

Sruwaddacon Bay is a dynamic ecosystem providing a transitional zone between the freshwater flow and the fully marine environment of Broadhaven Bay.

It is proposed to tunnel underneath the bay thereby avoiding surface disturbance. It is considered that any noise or vibration arising from the tunnel boring machine will have negligible adverse impact on marine fauna in Sruwaddacon Bay.

There will be no impacts on the marine/estuarine environment during the operational phase of the development.

Provided that the tunnelling activities are employed successfully, there will be no residual environmental impact within the marine section of Sruwaddacon Bay.

View east/southeast of Sruwaddacon Bay from location on L1202 close to Gleann an Ghad (Glengad)

9.4 SOILS, GEOLOGY, HYDROLOGY AND HYDROGEOLOGY

This area of Mayo is underlain by the oldest sandstone rocks in Ireland and Europe. The dominant subsoil in the area is peat. A small amount of till derived from windblown sands is present, at the western edge of Sruwaddacon Bay and to the north of the bay, near the coast. Along the river valleys, alluvial deposits comprising mixed granular material (ranging from sands to boulders) are present.

During construction, potential impacts on soils, geology, hydrology and hydrogeology include accidental spillage of contaminants, weakening of peat structure and/or change in peat depth due to excavation and storage of peat material, disturbance of natural hydrology and increased silt content in water courses as a result of emplacement of road sub-base and site traffic.

Mitigation measures will be put in place to avoid or minimise these potential impacts. These include specialised construction methodologies, careful surface water management, removal of the top living layer of the bog prior to works and the careful reinstatement of the area once construction is completed.

The Geotechnical Risk Register, which has been compiled to address geotechnical hazards and risk control measures during the design and construction stages of the project, includes a description of the residual impacts (or risk) once mitigation measures have been implemented.

Following implementation of the proposed mitigation measures, minimal to no residual impacts on the existing hydrological/drainage regime are expected as a result of construction and operation of the proposed project.

There will be no residual impact on hydrogeology during the operation of the proposed development, except at the LVI, where there is potential for groundwater to reach the floor level of the LVI during extreme conditions (inclement weather, high ground water levels and tides).

Based on experience from peatland hydrology studies in blanket bogs, in terms of residual impact on peatland hydrology the proposed development will have an imperceptible residual impact on the peatland hydrology and non-designated Annex 1 habitats present, which in this case is recovering blanket bog.

Apart from the physical presence of the pipeline, the LVI, the tunnel and the stone road there will be no residual impacts on soils, geology, hydrology (including peatland hydrology) and hydrogeology, during the operational phase of the development.

10 ARCHAEOLOGY, ARCHITECTURAL AND CULTURAL HERITAGE

Four features of archaeological potential were identified, which will require specific mitigation measures during construction if deemed of archaeological interest. In addition, the proposed route passes through various landscapes that may possess a ‘hidden’ archaeological potential given the terrain. These include watercourse crossings such as Sruwaddacon Bay and the Leenamore River crossing. The pipeline will be constructed by tunnelling under the Bay, avoiding all known archaeological features, and no impact on marine archaeology is anticipated. However, there will be a programme of monitoring of the tunnelling arisings. This programme will be reviewed once the works are underway.

No recorded archaeological monuments or protected structures will be directly impacted by the proposed development.

A mitigation strategy using methods of probing, archaeological centreline testing, palaeo-environmental analysis and archaeological monitoring will ensure that any features of an archaeological, architectural or cultural heritage nature that may be revealed and impacted upon by construction are identified, recorded and fully resolved at the pre-construction and construction stage. Such methods will be subject to the approval of the Department of Environment, Heritage and Local Government.

There will be no residual impacts on archaeological, architectural or cultural heritage as it is anticipated that any issues associated with features and sites of archaeological, architectural or cultural heritage potential will be resolved in the pre-construction or construction stage of the proposed pipeline development.

11 CUMULATIVE IMPACTS AND IMPACT INTERACTION

Cumulative impacts can result from individually minor but collectively significant actions taking place over the same period of time, and/or within the same geographical area. The following elements, which have the potential to contribute to cumulative impacts, were addressed as part of the cumulative impact assessment for the proposed development:

1. Corrib Gas Field Development, which consists of the following elements in addition to the proposed Onshore Gas Pipeline and associated peat deposition site considered in this EIS:

    a. Offshore gas field development including seabed installations and offshore pipeline (offshore works and pipeline completed in 2009 and umbilical expected to be installed in Summer 2011);

    b. Gas Terminal at Béal an Átha Buí (Bellanaboy)(construction ongoing 2006 - 2010); and

    c. An Srath Mór (Srahmore) Peat Deposition Site (deposition from Terminal in 2005 and 2007).

2. BGÉ Mayo to Galway pipeline (Constructed 2005 – 2006 and final tie-in to Gas Terminal 2009)

Cumulative impacts were then assessed on a national and local/regional scale.

From a local perspective construction activities associated with the Corrib Gas Field Development have been ongoing since 2004 including:

- Construction of the Gas Terminal and associated peat removal since 2004;
- Preparatory works in 2005 and 2008 for the offshore pipeline and landfall installation; and
- Laying of the offshore pipeline and associated landfall works at Gleann an Ghad (Glengad) in 2009.

It is proposed that construction of the onshore pipeline, including associated peat disposal will begin in 2011 and continue to 2013. The activities will give rise to cumulative positive impact in terms of direct and indirect employment. They will result in increased traffic, noise, dust and visual disturbance in the immediate area of the works. The continuous nature of construction works associated with these elements of the Corrib Gas Field Development has potential to result in significant cumulative impact on those living in the na hEachú (Aghoos), Gleann an Ghad (Glengad), Ros Dumhach (Rossport) and Poll an tSómais (Pollatomish) areas, and those living on the haul route to an Srath Mór (Srahmore). Given the delay to construction of the onshore pipeline relative to these other elements of the Corrib project, the absolute impact at any one time has been reduced, however the duration of ongoing impact has been extended. The potential impacts will be mitigated as outlined in the previous sections, and cumulative impacts on the local community and on the local environment will be minimised.

Once the onshore pipeline has been constructed and reinstated the Gas Terminal is the only element of the Corrib Field Development which requires significant operational activity. During operation, there will be minimal operational activities at the LVI which will be unmanned. Regular visits and periodic maintenance comprise the only operational activities associated with the LVI.

At a national level, the impacts of the Corrib Gas Field Development have been considered in the context of effects on the national economy and compliance with national policy.

The Goodbody Report (2007)[4] identifies that the Corrib Gas Field Development will contribute over €3bn to Ireland's GDP over its lifespan, supplying approximately 60% of the country's natural gas needs at peak production. The gas field is estimated to yield approximately one trillion cubic feet of natural gas over an operating life of 15 to 20 years.

The Corrib Gas Field Development supports Ireland's proposed national strategic fuel switch from solid fuel and oil to natural gas and renewables and so contributes to Ireland's target to limit national greenhouse gas emissions while ensuring security of energy supply. A national fuel switch from oil and coal towards gas is also likely to result in lower levels of oxides of nitrogen and sulphur (NO_x and SO_x) nationally.

The Corrib Gas Field Development will make a significant contribution to national energy policy by moderating Ireland's dependence on imported energy. It will also provide stable and economic energy supplies, enhancing the sustainability of existing industry in the Border Midlands Western Region.

[4] Economic Assessment of the Corrib Gas Project. Goodbody Economic Consultants. November 2007

12 SUMMARY

The Environmental Impact Statement has examined the proposal to construct the Corrib Onshore Pipeline from Gleann an Ghad (Glengad) to the Gas Terminal. The development also includes the construction of a Landfall Valve Installation at Gleann an Ghad (Glengad). This project is of national strategic importance.

Where environmental impacts are identified, mitigation measures have been proposed to minimise these wherever possible. The principal mitigation measures are:

- Identification of a modified route that satisfies the criteria informed by local consultation in terms of proximity to housing and environmental concerns and incorporates the modifications proposed by An Bord Pleanála in its letter of 2nd November, 2009;

- Minimising potential disturbance to environmentally sensitive habitats; and

- Implementation of mitigation and control measures during construction and operation to minimise the risk of environmental pollution and impact on local community.

Having conducted a detailed study of the effects of the onshore pipeline project on the environment, it has been concluded that the proposed Corrib Onshore Pipeline will not have a significant residual impact on the human, natural or cultural heritage of the area in the long term.

Furthermore, the modified development addresses the safety concerns raised and safety criteria established by An Bord Pleanála, and a complete and transparent demonstration has been provided that the proposed onshore pipeline development does not present an unacceptable risk to the public.

GLOSSARY

Explanations of some of the main terms used in this report are provided in the glossary below. The definitions herein are not to be taken as comprehensive, but solely as an aid to the non-technical reader.

Bar / Barg	A unit of pressure. Bar (pressure). Barg (gauge pressure). 1 Barg = Pressure measured above atmospheric pressure. Atmospheric pressure varies but is approximately 1Bar.
Compulsory Acquisition Order (CAO)	A means whereby authorised bodies can acquire a parcel of land, subject to a public enquiry if objections are lodged. This legislative instrument is provided for under Gas Act. Under the Strategic Infrastructure Act, the power to grant a Compulsory Acquisition Order was transferred to An Bord Pleanála.
Bentonite	A fine inert clay (natural product) widely used in an aqueous suspension in tunnelling construction projects. .
Ecosystem	A community of living things and the environment in which they live.
EMP	Environmental Management Plan.
Habitat	The dwelling place of a species or community, providing a particular set of environmental conditions (e.g. forest floor).
Landfall	The point on the coastline where an offshore pipeline comes ashore.
LVI	Landfall Valve Installation.
Migratory	Used of animals that move seasonally: migratory birds and fish.
Mitigation Measures	Mitigation measures suggest ways to avoid or lessen the negative impact/effects of a project on the environment.
NO_x	Oxides of Nitrogen.
Protected Views	The protected views are identified as “Highly Scenic or Scenic Views” in the County Development Plan.
Ramsar Site	An area designated under the internationally agreed Convention on Wetlands of International Importance, especially as waterfowl sites.
Reception Pit	Pit / shaft excavated on land to receive the TBM as a tunnel is completed. The reception pit will form a second access to the tunnel which may be used during the installation of services.
Salmonids	Members of the fish family ‘Salmonidae’, including salmon, trout and chars.
Scenic Route	Scenic routes indicate public roads from which views and prospects of areas of natural beauty and interest can be enjoyed. Sightseeing visitors are more likely to be concentrated along these routes.
Segment Lined Tunnel	A tunnelling technique using concrete segments to support the tunnel that has been excavated. These segments are assembled to form complete rings and when connected, act as the tunnel lining.
SO_x	Oxides of Sulphur.

Special Area of Conservation	Special Areas of Conservation (SAC) are protected under the European Union (EU) Habitats Directive (92/43/EEC), as implemented in Ireland by the European Communities (Natural Habitats) Regulations, 1997. Where an area is proposed for this status it is described as being a candidate SAC (cSAC).
Special Protection Area	Special Protection Areas (SPAs) are protected under the EU Habitats Directive, which complements EU Directive 79/409/EEC, The Directive on the Conservation of Wild Birds ('The Birds Directive'), under which the SPAs were initially established.
Stakeholder	Refers to any individual or organisation that has an interest in a project. Examples of stakeholders include landowners, members of the public, statutory bodies and non government organisations.
Statutory body	Government department or public / state company. For example An Bord Pleanála and the National Parks and Wildlife Service are statutory bodies.
Starting Pit	Pit / shaft excavated on land into which the TBM will be placed to begin the tunnelling process. The starting pit will form the access to the tunnel (tunnel portal) during the tunnelling process.
Terminal	The plant where the produced gas will be separated from any associated liquids to meet the transmission specifications of the national gas grid.
Temporary working area	The area along the pipeline which is temporarily used by the developer to facilitate construction. The temporary working area is larger than the permanent wayleave. Also referred to as (working / pipeline) spread.
Trenchless Construction	A method of pipeline construction that avoids surface excavation (open cut approach). Trenchless construction or tunnelling involves progressive sub-surface excavation within rock or soil layers and is typically used to install linear services beneath features such as rivers. Examples of trenchless construction methods include segment lined tunnelling and micro-tunnelling.
Tunnel Boring Machine (TBM)	Machine designed to excavate / bore a tunnel. A TBM comprises a rotary cutting head fitted with excavated and / or rock breaking tools. Material is excavated as the TBM pushes itself (or is pushed) forward hydraulically. TBMs can be designed for a wide range of ground conditions including rock.
Turves	Sections of vegetated surface layer of peat that are removed intact and placed to one side during construction.
Umbilical	A 'bundle' of electrical and hydraulic control lines and chemical transportation lines used to control and monitor the subsea facilities from the Gas Terminal and supply methanol and other chemicals to the manifold and wellheads. The bundle is encased in a protective sheath.
Vertebrates	Animals with backbones.
Wayleave	*Permanent Wayleave* The defined strip of land along the pipeline to which the developer needs access during the entire life of a pipeline for safe operation and maintenance purposes. Excavation or building within the permanent wayleave is not permitted. Deeds of Easement are agreed with relevant landowners to record this permanent wayleave.

Corrib
natural gas

Corrib Onshore Pipeline

Environmental Impact Statement

Volume 1 – Environmental Impact Statement

RPS

MAY 2010

PREFACE

The Environmental Impact Statement (EIS) for the Corrib Onshore Pipeline consists of three volumes as follows:

Volume 1:

This volume addresses the likely significant impacts of the proposed Corrib Onshore Pipeline, provides information on the design and construction methods as well as the alternatives considered. A Preamble outlining the background and history to the Corrib Gas Field Development is also provided along with a Non-Technical EIS Summary.

Volume 2:

This volume includes drawings and supplementary specialist technical and environmental information to Volume 1 (see List of Appendices).

Volume 3:

This volume addresses the likely significant impacts of the deposition of up to 75,000m^3 of surplus peat at the Srahmore Peat Deposition Site. This surplus peat will be removed during the construction of the Corrib Onshore Pipeline. This volume also includes a Non-Technical EIS Summary, technical appendices and drawings.

This EIS is printed on 100% recycled paper.

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PREAMBLE

INTRODUCTION

Shell E&P Ireland Ltd. (SEPIL) on behalf of the Corrib Gas Partners (SEPIL, Statoil Exploration (Ireland) Ltd. and Vermilion Energy Ireland Limited) is developing the Corrib Gas Field off the coast of County Mayo. The development of the Corrib Gas Field represents the largest natural gas development in Ireland for over 30 years.

The Corrib Gas Field Development is divided into five distinct but inter-related and inter-dependent elements (see Figure 1) as follows:

1. Offshore seabed installation (subsea wellheads and manifold at the Gas Field);
2. Offshore gas pipeline (between wellheads and landfall);
3. Onshore gas pipeline (between landfall and gas terminal at Béal an Átha Buí (Bellanaboy));
4. Bellanaboy Bridge Gas Terminal; and
5. Onshore 150km Mayo to Galway pipeline.

All elements of the proposed development have received regulatory approval

Following local concerns raised in 2005 about the proximity of the approved pipeline to houses, and the subsequent reviews undertaken on behalf of the Minister for Communications, Energy and Natural Resources, SEPIL undertook to modify the route of the onshore pipeline in the vicinity of Ros Dumhach (Rossport).

SEPIL applied for consents for a modified route for the onshore pipeline in February 2009 in applications to An Bord Pleanála, the Department of Communications, Energy and Natural Resources (DCENR) and to the Foreshore Unit of the Department of Agriculture, Fisheries and Food (DAFF) under the relevant statutory processes.

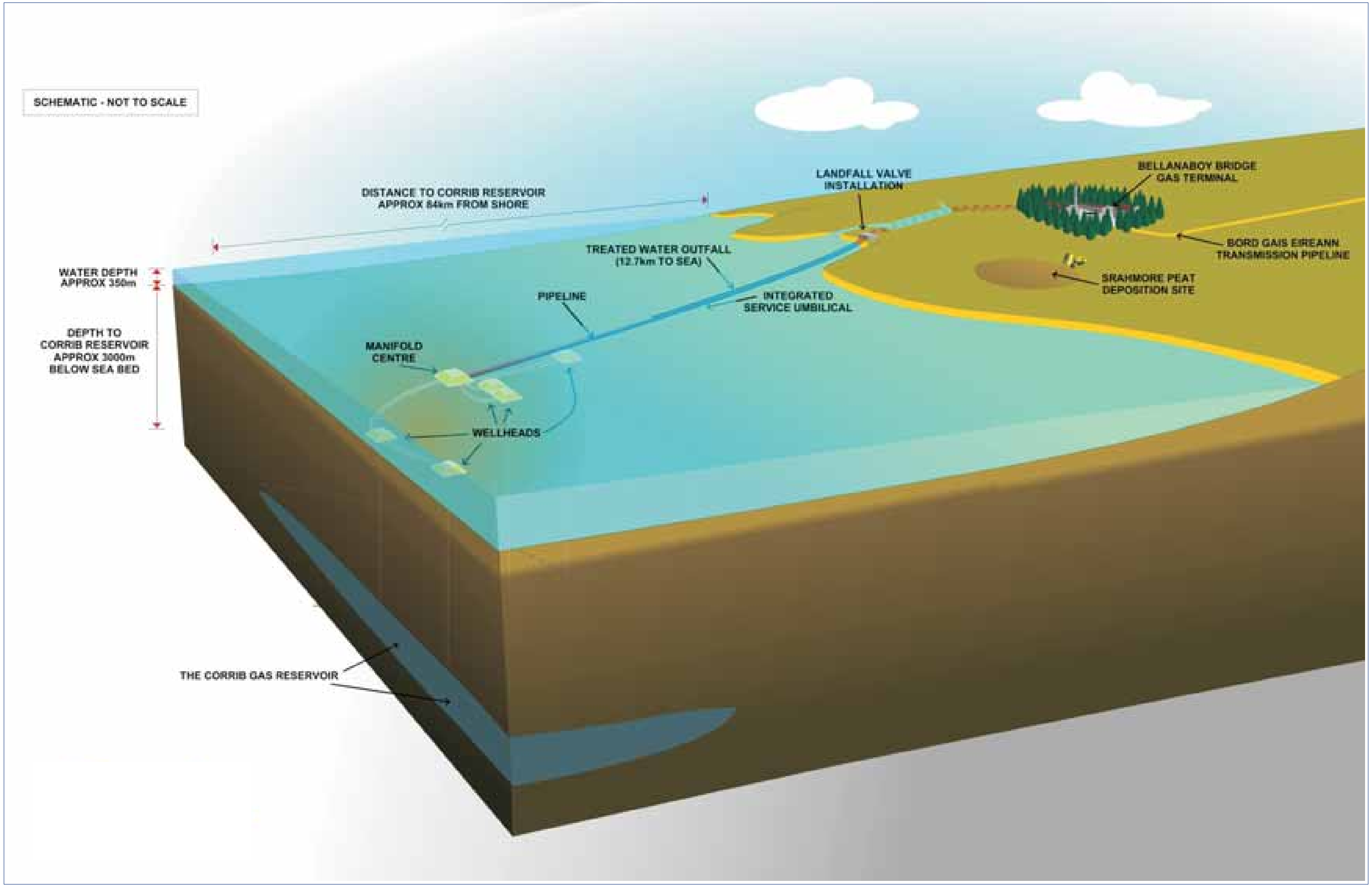
Following an Oral Hearing hosted by An Bord Pleanála in 2009, An Bord Pleanála in a letter dated 2nd November, 2009 requested that alterations be made to the proposed development as follows:-

> *“Modify the pipeline route between chainages 83+910 and 89+550 so that the route at this location would generally be in accordance with that indicated as Corridor C (that is, within Sruwaddacon Bay) in the route selection process which formed part of the Environmental Impact Statement (E.I.S.) and planning application”.*

This revised Corrib Onshore Pipeline EIS describes the modified onshore pipeline route in accordance with An Bord Pleanála’s request.

The modifications to the proposed onshore pipeline development requested by An Bord Pleanala has affected the applications made in February, 2009, and has necessitated the preparation of new/revised applications to the relevant statutory authorities, including a revised Environmental Impact Statement (EIS) for the onshore pipeline and other documentation as outlined below:

- This Preamble, which is common to the revised Corrib Onshore Pipeline EIS and the revised Supplementary Update Report to the 2001 Corrib Field Development Offshore Field to Terminal EIS (the ‘Offshore EIS’), outlines the background to the Corrib project and presents a profile of the developer, SEPIL. In addition, it summarises the regulatory approvals required for the proposed pipeline development and outlines the consents and processes associated with these.



Corrib Gas Field Development

Figure 1

File Ref: MDR0470GrEIS100 RevA03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

- The 2001 Offshore EIS (prepared by RSK Environment Ltd) described the pipeline system from the field to the Gas Terminal, with Section 19 covering the onshore pipeline. The new (revised) Corrib Onshore Pipeline EIS (prepared by RPS) for the development of the onshore pipeline between the landfall and the Gas Terminal replaces Section 19 of the 2001 Offshore EIS.

- As the consents processes under the under the Gas Act and the Foreshore Act apply to the pipeline in its entirety (both onshore and offshore), a revised (2010) supplementary update report in respect of the offshore section of the pipeline for the 2001 Offshore EIS has also been prepared (by RSK Environment Ltd).

BACKGROUND

The Corrib Gas Field is a small - to medium - sized offshore gas field, estimated to contain approximately 1 trillion cubic feet (tcf) of gas. It is equivalent to approximately two thirds the amount of gas originally contained in the Kinsale Head Gas Field. It is currently predicted that the Corrib Gas Field will supply up to 60% of Ireland's gas needs during peak supply and it is estimated to have a field life of between 15 and 20 years. The gas in the Corrib Gas Field is a pure form of natural gas, consisting of approximately 97% methane/ethane and small amounts of water and hydrocarbon condensate.

The Corrib Gas Field will be developed using subsea technology tied back to an onshore gas terminal. This means that once the wells are drilled, there will be no need for a permanent offshore platform structure, as the wells will be remotely controlled from land. This is best practice for a gas field of this type and size and is similar in design to some of the most modern gas field developments such as the Ormen Lange Field, Norway, the Snøhvit Field (Liquefied Natural Gas (LNG)), Norway, the Casino Field, south east Australia and the Scarab Saffron Gas Fields, East Mediterranean, Egypt.

THE DEVELOPER

SEPIL is a wholly-owned company within the global group of energy and petrochemical companies ("Shell Group"), operating in more than 140 countries and territories owned by Royal Dutch Shell plc. The Shell Group explores for, produces and trades in a range of energy resources.

The Shell Group is the largest international gas producer in Western Europe and one of the largest in the world. Currently, the Group operates in over 90 countries, employs approximately 100,000 staff, and operates more than 100 gas plants.

SEPIL is part of the Group's European organisation, which has extensive experience in operating gas plants and gas pipelines as well as subsea developments and offshore oil and gas fields in Europe since the 1960's (see Appendix D).

The Corrib Gas Field is being developed by three co-venture partners. These are SEPIL (the Operator) (45%), Statoil Exploration (Ireland) Limited (36.5%) and Vermilion Energy Ireland Limited (18.5%).

NEED FOR THE DEVELOPMENT

Since the application was submitted in 2001 to the then Department of the Marine & Natural Resources for approval of the Plan of Development for the Corrib Field, gas consumption in Ireland has continued to increase.

This rising demand for energy has outstripped Ireland's domestic production and infrastructure capacity. Consequently, Ireland has required additional imports of gas from abroad since the mid-

1990's (gas inter-connector pipelines with Scotland were constructed in 1993 and 2002) and currently more than 90% of the gas used in Ireland is imported. In 2009, approval was granted to Shannon LNG for the construction of a Liquified Natural Gas (LNG) terminal at Foynes and a high pressure pipeline connecting to the gas network by An Bord Pleanála under the Strategic Infrastructure Act. This facility will receive LNG (transported by ocean-going tankers) and will be connected to the Irish natural gas network. In addition, a new 'East–West electrical inter-connector' to facilitate greater exchange of electricity between Ireland and the UK will begin construction in 2010 (in addition to the existing Moyle (North-South) Inter-connector with Northern Ireland and electrical connections between Scotland and Northern Ireland).

This, combined with Ireland's peripheral location in Europe and its small market scale, leaves the country vulnerable to supply disruption and imported price volatility.

In 1999 Bord Gáis Éireann (BGE) commissioned consultants (Sofregaz, MCOS (now RPS) and JP Kenny) to evaluate the required strategic investment in gas transmission infrastructure throughout Ireland until the year 2025. The resulting expansion of the Irish Natural Gas Transmission Network has included:

- Gas Pipeline to the West (Dublin – Galway – Limerick), constructed 2002;
- Second Gas Interconnector (Ireland – Scotland), constructed 2002;
- South – North Pipeline (Dublin – Belfast), constructed 2006; and
- Mayo – Galway Pipeline, constructed 2005 – 2006 specifically for Corrib gas.

BGÉ also constructed the Belfast-Derry pipeline in Northern Ireland in 2005. The full extent of the Irish Natural Gas Network, including each of these recent developments and the proposed Corrib Pipeline, is shown on Figure 2 overleaf.

Declining gas reserves in the Kinsale Head and Ballycotton gas fields, and the lower-than-expected contributions from the Seven Heads field, means that indigenous gas forms a decreasing proportion of the gas used in the Irish market, supplying approximately 5% of the demand from domestic sources. Furthermore, the UK, from where Ireland imports over 90% of its gas, has itself become a net importer of gas. The development of the Corrib Gas Field will facilitate greater indigenous security of gas supply that will be available throughout the entire network. It has already stimulated expansion of the onshore gas transmission system, which in turn will result in increased possibilities for economic growth in the Mayo / Galway region.

Bord Gáis Éireann has been spending €40 million over three years on the Gaswest Project, under which the natural gas network from the Mayo-Galway Gas Pipeline is being expanded. Eleven towns in Co. Mayo and Co. Galway have been identified for this investment. The towns in Co. Mayo included in the Gaswest Project are Ballina, Ballinrobe, Ballyhaunis, Castlebar, Claremorris, Crossmolina, Knock and Westport. Progress for this expansion is already well under way, and Ballyhaunis and Knock are the only remaining towns in Mayo scheduled to receive gas (expected to be in 2010). Electricity generation and transport are the key sectors influencing energy demand in Ireland. In 2009 annual growth to 2020 was forecasted to be 1.7% (Energy Forecasts for Ireland 2020, *Sustainable Energy Ireland, 2009*).

Gas is also predicted to become a greater source of energy in Ireland due to its positive environmental profile compared with traditional energy sources such as peat and the Government's Kyoto Protocol commitments, which include targets for reduction of greenhouse gas emissions to no more than 13% above 1990 levels in 2008-2012. Ireland generates 55% of its electricity from natural gas. Natural gas thus facilitates reduced carbon emissions in Ireland while meeting increasing demands for energy at a time when renewable sources of energy are being developed but will only be capable of meeting a relatively small proportion of overall demand.

Gas Transmission Network in Ireland

Figure 2

CORRIB ONSHORE PIPELINE

File Ref: MDR0470GrEIS040 Rev A03
Date: May 2010

Corrib natural gas

RPS

EXISTING CONSENTS

The Corrib Gas Field Development has been subject to a long and complex regulatory approval process. The statutory approvals / licences / consents that are associated with the development and that have been granted are listed in Table 1 below.

Table 1: Existing Consents and Approvals for the Corrib Gas Field Development.

Licence/Consent	Status
Petroleum Lease by the Minister for the Marine and Natural Resources.	Granted 2001
Plan of Development for the Corrib Field by the Minister for the Marine and Natural Resources.	Approved 2002
Consent under Continental Shelf Act 1968 from the Minister for the Marine and Natural Resources.	Granted 2002
Foreshore Licence for pipeline, umbilical and outfall from the Minister for the Marine and Natural Resources.	Granted 2002
Consent to Construct a Pipeline (Section 40 of the Gas Act) from the Minister for the Marine and Natural Resources.	Granted 2002
Planning Permission – Bellanaboy Bridge Gas Terminal and associated peat deposition site from An Bord Pleanála.	Granted 2004
Waste licence from Environmental Protection Agency for peat deposition at An Srath Mór (Srahmore) (Bord na Móna).	Granted 2004
Integrated Pollution Prevention and Control Licence from the Environmental Protection Agency for Bellanaboy Bridge Gas Terminal.	Granted 2007
Green House Gas Emission Permit from Environmental Protection Agency, Bellanaboy Bridge Gas Terminal	Granted 2009

PROJECT HISTORY

The following provides an overview of the planning and development history of the Corrib Gas Field Development and rationale for the proposed modification of the route of the onshore section of the pipeline.

The Corrib Field was discovered in 1996 by Enterprise Energy Ireland Ltd, which was subsequently acquired by SEPIL in 2002. Application for planning permission for Bellanaboy Bridge Gas Terminal with associated Environmental Impact Statement (EIS) was lodged with Mayo County Council by Enterprise Energy Ireland Ltd in April 2001. Planning permission for the Terminal was received in August 2001 and subsequently appealed to An Bord Pleanála. Consent to Construct a Pipeline (under Section 40 of the Gas Act) from the Minister for the Marine and Natural Resources was granted in 2002. Enterprise Energy Ireland Ltd was acquired by Shell in May 2002.

In October 2004 An Bord Pleanála granted planning permission for the Gas Terminal and associated peat deposition site. Planning and construction of the Gas Terminal commenced in December 2004. Haulage of peat from Béal an Átha Buí (Bellanaboy) to An Srath Mór Srahmore (the peat deposition site) commenced under EPA Waste Licence in April 2005.

During preparation work for the onshore section of the pipeline in the summer of 2005 local concerns were raised about the proximity of the approved pipeline to houses between the landfall and the Gas Terminal. After opposition to these onshore works resulted in the imprisonment of five men for contempt of court, all onshore construction work associated with the Corrib Gas Field development was halted in July 2005.

The (then) Minister for Communications Marine and Natural Resources appointed international pipeline consultants, Advantica, to conduct an independent safety review of the onshore pipeline. They subsequently issued a report on their findings (Independent Safety Review of the Onshore Section of the Proposed Corrib Gas Pipeline, 2006). Offshore installation work was ongoing at this time. The Corrib Gas Partners accepted the recommendations arising from this review, which included limiting the pressure in the onshore section of the pipeline to 144 barg - less than half the original design pressure of the pipeline. Advantica concluded that, provided it could be demonstrated that the pressure in the onshore pipeline would be limited effectively and the recommendations of the report were followed, there would be a substantial safety margin in the pipeline design, and that the pipeline design and proposed route (originally proposed route) should be accepted as meeting or exceeding international standards in terms of the acceptability of risk and international best practice for high pressure pipelines. SEPIL and their engineering consultants carried out engineering and safety studies to ensure that all the recommendations made by Advantica in their Safety Review had been addressed and implemented in the design for the 2009 proposed development. Advantica's main findings and recommendations are detailed in Appendix Q8.

In 2006, a Government-appointed mediator (Peter Cassells) met with local residents from the Ros Dumhach (Rossport) area, including those who were opposed to the development, and with SEPIL in an attempt to resolve difficulties that arose there during 2005. Offshore subsea installation work at the Corrib Field was ongoing at this time and construction on the Gas Terminal recommenced in October 2006. In his report, Mr. Cassells recommended that the route of the onshore pipeline be modified in the vicinity of Ros Dumhach (Rossport). SEPIL took this recommendation and appointed consultants (RPS) in 2007 to identify and develop this modified route in consultation with the local community and other relevant stakeholders. Work on this began in January 2007 which also necessitated the preparation of a new Environmental Impact Statement for this section of pipeline. The outcome of the route selection process, which took place during 2007 and 2008 culminated in the various applications for consent for a modified onshore pipeline being submitted in February 2009.

As of May 2010, the offshore production facilities have been installed, the 83km offshore section of the Corrib pipeline has been laid, and the Gas Terminal is more than 90% complete. To allow the connection of the Corrib gas development with the national gas distribution network the 150km Galway to Mayo pipeline was completed in 2006 and is now connected to the Terminal. The onshore section of the Corrib Pipeline is the last major element of the project.

Following the application to An Bord Pleanala in February 2009 for consent for the onshore pipeline under the Strategic Infrastructure Act, the An Bord Pleanála requested further information in November 2009. This request included an invitation to SEPIL to modify the route of the onshore pipeline so that it would be generally in accordance with that indicated as 'Corridor C' in the February 2009 application (that is, within Sruwaddacon Bay). The revised Corrib Onshore Pipeline EIS reflects the requested route change.

STATUTORY APPROVALS ASSOCIATED WITH ONSHORE PIPELINE ROUTE MODIFICATION

The Planning and Development (Strategic Infrastructure) Act 2006 - the 'Strategic Infrastructure Act', was enacted on 6th July, 2006 and became fully operational on 31st January, 2007. This inserted a number of significant provisions into the Planning and Development Act, 2000 (the 'PDA'). In essence, these provide a streamlined procedure for planning applications for prescribed classes of infrastructure development, and require that applications for such development be made directly to An Bord Pleanála. The onshore pipeline development is declared under the 2006 Act to comprise strategic infrastructure. As such, the pipeline, which had previously constituted exempted development under the Planning Acts, is subject to an application for Approval for this development to An Bord Pleanála under the Strategic Infrastructure Act as a result of the route modification. This does not alter the requirement to submit separate applications under the Gas Act and Foreshore Act.

The entire pipeline between the Corrib Gas Field and the Gas Terminal received Ministerial Consent under Section 40 of the Gas Act in April 2002. However, a new consent will be required under the Gas Act for the entire pipeline in order to implement the proposed modifications to the onshore pipeline route. This is because there is no mechanism under the Gas Act to amend an existing consent.

The Foreshore Licence dated 17th May, 2002 to construct/install, operate and maintain the pipeline in the foreshore (from the high water mark to 12 nautical miles offshore), under the Foreshore Act, is specific to the exact route of the pipeline in the foreshore; therefore modifications to the route alignment in the areas of Sruwaddacon Bay below High Water Mark require additional consent.

Key consents for the revised route are therefore being sought as follows:

- Approval of the onshore pipeline and associated development within the functional area of the Planning Authority, by An Bord Pleanála under the provisions of the Planning and Development (Strategic Infrastructure) Act 2006;

- Consent for the overall pipeline development from the Minister of the Department of Communications Energy and Natural Resources (DCENR) under Section 40 of the Gas Act 1976 to 2002 (as amended); and

- A Foreshore Licence in respect of the works in the foreshore from the Department of Environment, Heritage and Local Government (DEHLG) under the Foreshore Acts 1933-2009 (as amended).

The inter-relationship of these three pieces of legislation is illustrated in Figure 3

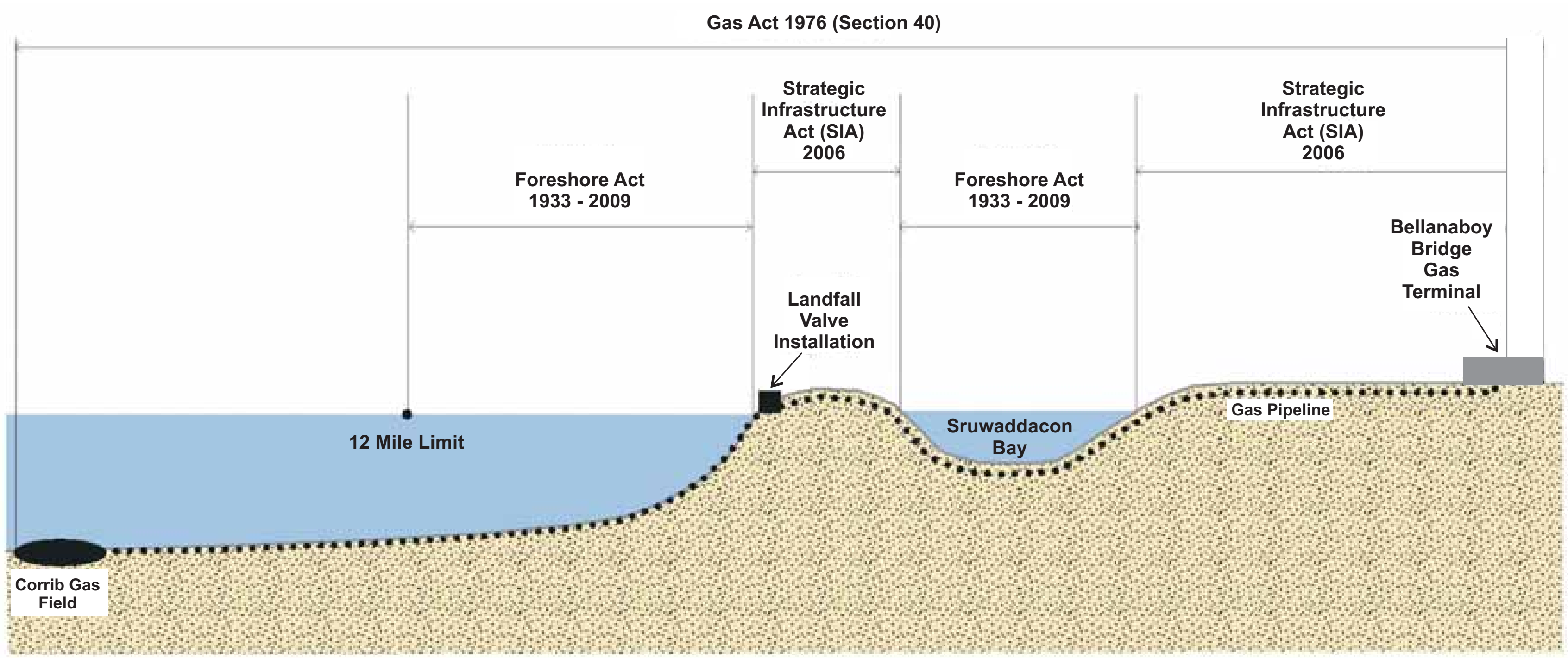
The following revised EIS documentation has been prepared:

- A revised Supplementary Update Report (by RSK) to the 2001 Offshore EIS, reflecting the current status of the offshore development; and

- A revised Environmental Impact Statement (EIS) for the proposed Corrib Onshore Pipeline (by RPS), which has been revised to reflect request for further information from An Bord Pleanála.

OFFSHORE EIS

The details of the development of the offshore section of the pipeline have not been materially altered since the publication of the 2001 Offshore EIS, nor indeed from that which has the benefit of previous regulatory consent. The Corrib Offshore Pipeline between the gas field and the landfall at Gleann an Ghad (Glengad) was installed in 2009 in accordance with the existing consents under the Gas Act and the Foreshore Act. The Supplementary Update Report for the 2001 Offshore EIS has been updated to reflect the current status of the offshore development, as well as up-to-date baseline survey data that have been acquired and the findings of monitoring carried out since the February 2009 applications were submitted.



Corrib Gas Field -

Statutory Approvals

Figure 3

File Ref: MDR0470GrEIS039 RevA03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

CORRIB ONSHORE PIPELINE EIS

The revised EIS for the modified onshore section of the pipeline has been prepared to meet the requirements of the European Communities (Environmental Impact Assessment) Regulations 1989-2001. The EIS includes:

- A summary of the route selection process and details on alternatives considered, including alternative construction methodologies;
- A detailed description of the proposed development;
- Pipeline design documentation presented in (revised) Appendix Q, in response to recommendations made by the DCENR, and to An Bord Pleanála's request (November 2009) for further information;
- An assessment of the environmental impacts associated with the revised route of the onshore section of the pipeline, including
  - o An assessment of the potential environmental impacts associated with constructing a 4.9 km tunnel, most of which is underneath Sruwaddacon Bay;
  - o An assessment of the potential impacts resulting from the deposition at the Srahmore Peat Deposition Site of up to 75,000m^3 of peat arising from the construction of the onshore pipeline. This assessment is provided in Volume 3 of the Corrib Onshore Pipeline EIS.

THE PLANNING AND DEVELOPMENT (STRATEGIC INFRASTRUCTURE) ACT 2006

Section 4 of the Strategic Infrastructure Act (SIA) relates to Provision of Electricity Transmission and Gas Infrastructure. Specifically Section 4 of the SIA inserts a new Section 182C into the Planning and Development Act 2000 (the 'PDA'), which now requires an application for approval of all strategic gas infrastructure projects to be made to An Bord Pleanála. Therefore the provisions of the SIA as inserted into the PDA apply to the proposed development. A "Strategic Gas Infrastructure Development" is defined in Section 2 of the PDA as amended by Section 6 of the SIA as:

> "*any proposed development comprising or for the purposes of a strategic downstream gas pipeline or a strategic upstream gas pipeline, and associated terminals, buildings and installations, whether above or below ground, including any associated discharge pipe*".

The Act further defines a strategic upstream gas pipeline as:

> "*so much of any gas pipeline proposed to be operated or constructed – (a) as part of a gas production project, or (b) for the purposes of conveying unprocessed natural gas from one or more than one such project to a processing plant or terminal or final coastal landing terminal, as will be situate in the functional area or areas of a planning authority or planning authorities*".

These definitions clearly incorporate all development within the functional area of Mayo County Council associated with the proposed upstream pipeline development, including the LVI and other associated infrastructure.

The SIA and PDA, as amended, provide that where the "undertaker" intends to carry out a Strategic Gas Infrastructure Development, the undertaker shall prepare an application and an Environmental Impact Statement, and shall apply to An Bord Pleanála for approval of the development. The powers to grant compulsory acquisition orders for land under the Gas Act have been transferred under the SIA to An Bord Pleanála.

Application

An application for consent under the PDA, as amended by the SIA and elsewhere, for the Corrib Onshore Pipeline was made to An Bord Pleanála in February 2009. The application consisted of:

- A cover letter, copy of draft statutory notices and other relevant particulars;
- Application drawings; and
- Environmental Impact Statement for the Corrib Onshore Pipeline.

Following a request for further information in November 2009, the application drawings and the Corrib Onshore Pipeline EIS have been revised. The changes to the EIS include the modification of the route, as well as a change of construction methodology for the modified route section. The EIS also includes further information on the design documentation for the pipeline (contained in a revised Appendix Q).

Copies of the response to An Bord Pleanala's request, including the revised application drawings and revised EIS will be provided to the prescribed bodies.

The additional information is likely to become available for public inspection during a statutory period for public consultation to be prescribed by An Bord Pleanála (some time after it has received the additional information). During this period any person may make a submission to An Bord Pleanála in relation to the additional information. The prescribed bodies would also be invited to provide submissions to An Bord Pleanála within this period.

An Bord Pleanála may reopen the oral hearing in respect of the additional information submitted.

An Bord Pleanála can approve applications made to it in whole or in part; it can require modifications to the proposal (as is the case with this application to An Bord Pleanála); or it may refuse approval. It may also attach conditions relating to the construction or financing of the project.

In making its decision, An Bord Pleanála must have regard to proper planning and sustainable development, environmental effects, national policies, the national interest, and relevant local development plans.

With the implementation of the SIA and the amendments of the PDA, no conventional Planning Permission is required under the Planning and Development Act 2000, i.e. from Mayo County Council, for any part of this proposed development.

THE GAS ACTS 1976 TO 2000 (AS AMENDED)

The Gas Act sets out in detail the powers and duties of the gas undertaker. Section 40 of the Gas Act applies to the proposed overall gas pipeline development. Section 40A requires that where relevant, an Environmental Impact Statement be included as part of an application to the Minister under Section 40 of the Act. Applications for Section 40 Approval must therefore be accompanied by comprehensive appraisal of possible environmental and other impacts, which may be brought about by the construction of the upstream pipeline.

The Gas Act as amended requires that when selecting a route for a pipeline that the developer have regard to any comments raised by any local authority within whose functional area the proposed pipeline route, or part of the route is situated, or any of the following on, in or over whose land such a route or part of the route would be situated, namely; a harbour authority, the Electricity Supply Board (ESB) or any other electricity undertaker, and Córas Iompair Éireann (CIE) or any other railway undertaker.

Consequently, SEPIL and their consultants, RPS, have consulted with the relevant prescribed bodies as well as with the DCENR prior to submitting the revised application for the proposed development. This has included pre-application consultation meetings with the DCENR, Mayo County Council, National Parks and Wildlife Service (NPWS) of DEHLG and North Western Regional Fisheries Board (NWRFB). Particulars of the concerns raised, and how these have been addressed are included in Chapter 2 of the Onshore Pipeline EIS.

Application

An application for Consent to Construct a Pipeline under Section 40 of the Gas Act, 1976, as amended, was made to the Minister of the DCENR in February 2009. As a result of the invitation from An Bord Pleanála for SEPIL to modify the onshore pipeline route, the February 2009 application to DCENR will be withdrawn and a revised (new) application will be resubmitted in parallel with the response to An Bord Pleanála. It will comprise:

- Application (Scope, Drawings and Design Premise)
- Offshore EIS comprising:
    - Corrib Field Development Offshore (Field to Terminal) Environmental Impact Statement, 2001 re-printed 2008.
    - Supplementary Update Report (Rev 03), 2010
- Corrib Onshore Pipeline EIS (Revised).

There is no statutory mechanism for making amendments to a Section 40 application. Therefore, in light of modifications requested by An Bord Pleanála under the Strategic Infrastructure Act, it is necessary for an entirely new Section 40 application to be made for the modified pipeline route now proposed.

THE FORESHORE ACTS 1933-2009 (AS AMENDED)

The Foreshore Acts 1933 to 2009 (as amended) provides for the protection and preservation of the Foreshore and the seashore.

The foreshore extends to the twelve-mile limit. Section 3(1) of the Act, as amended by the Foreshore (Amendment) Act 1992, and the Foreshore and Dumping At Sea Amendment Act 2009 provides that any works or placing structures or material on, or for the occupation of, or removal of material from the foreshore requires a lease or licence to be obtained from the Minister for Environment, Heritage and Local Government.

This type of development requires the preparation of an Environmental Impact Statement, which must be provided to the prescribed bodies specified in the Foreshore (Environmental Impact Assessment) Regulations, 1990 (S.I. No. 220).

SEPIL and their consultants, RPS, have consulted with the Foreshore Unit of the DEHLG and with relevant prescribed bodies prior to finalising the revised application for the proposed development.

Application

An application for a Foreshore Licence associated with the modifications to the Corrib Onshore Pipeline was submitted to the Coastal Zone Management Division of the DAFF in February 2009. As a result of the invitation from An Bord Pleanála for SEPIL to modify the onshore pipeline route, the February 2009 Foreshore Licence application will be withdrawn and a revised (new) application will be submitted to the Foreshore Unit of the DEHLG[1] in parallel with the response to An Bord Pleanála and the revised Gas Act application referenced above. It will comprise:

- Application Form;
- Offshore EIS comprising:
    - Corrib Field Development Offshore (Field to Terminal) Environmental Impact Statement, 2001 (re-printed 2008).
    - Supplementary Update Report (Rev 03), 2010.
- Corrib Onshore Pipeline EIS (revised).

[1] *Under the Foreshore and Dumping at Sea (Amendment) Act 2009, responsibility for all foreshore energy-related developments (including oil, gas, wind, wave and tidal energy) was transferred to the Minister for the Environment, Heritage and Local Government with effect from 15th January, 2010*

EXECUTIVE SUMMARY

Shell E&P Ireland Limited (SEPIL), on behalf of the Corrib Gas Partners (SEPIL, Statoil Exploration (Ireland) Ltd and Vermilion Energy Ireland Ltd) is developing the Corrib Gas Field off the coast of Mayo. The field will be produced via a subsea production facility with onshore processing. The overall development includes: the offshore wells, offshore subsea facilities and offshore pipeline as far as the Mayo coast, the onshore section of the pipeline and a gas terminal at Béal an Átha Buí (Bellanaboy), Co. Mayo. This Environmental Impact Statement (EIS) relates to the onshore section of the gas pipeline.

In January, 2007 SEPIL appointed RPS to implement a recommendation by the independent mediator, Mr Peter Cassells (appointed by the then Minister for Communications, Marine & Natural Resources), that SEPIL modify the route of a previously approved onshore gas pipeline '*in the vicinity of Rossport to address community concerns regarding proximity to housing*'. Since February, 2007, wide-ranging public consultation has taken place in parallel with the route selection process. Eight possible pipeline route corridors were published in June, 2007 and, after further assessment, these were shortlisted to three route corridors in September, 2007 using a combination of community, environmental and technical criteria. Throughout 2007, extensive technical and environmental assessments were undertaken to assess different aspects of each route option in parallel with community consultation. The ongoing assessment informed a decision to also investigate variations on the three shortlisted route corridors (A, B and C), and subsequently A1 and C1 were publicly announced in December 2007. The public consultation on these five corridor options, A, B, C, A1 and C1, closed in January 2008. RPS subsequently identified route C1 as the preferred route for the Corrib Onshore Pipeline in April 2008.

In February, 2009, an application for Statutory Approval of the proposed onshore pipeline development (based on the preferred Route C1) was submitted to An Bord Pleanála in accordance with the provisions of the Planning and Development (Strategic Infrastructure) Act 2006. Following a statutory period for the making of public submissions to An Bord Pleanála, an Oral Hearing, hosted by An Bord Pleanála, took place in Béal an Mhuirthead (Belmullet) during May and June, 2009.

In parallel, applications for consent to develop the Corrib pipeline under Section 40 of the Gas Act and the Foreshore Act were made to the Department of Communications, Energy and Natural Resources (DCENR) and Department of Agriculture, Fisheries and Food (DAFF) respectively.

In November, 2009, An Bord Pleanála invited SEPIL, the Applicant, to modify a specified portion of the proposed route (identified by chainage points in the Board's written correspondence) between Gleann an Ghad (Glengad) and na hEachú (Aghoos). Such modification was acknowledged in the Board's correspondence generally to comprise Corridor C as previously identified in the route selection process (that is, within Sruwaddacon Bay). An Bord Pleanála also requested further information on the proposed development, including a revised EIS, and a complete, transparent and adequate demonstration that the proposed pipeline does not pose an unacceptable risk to the public. In addition, An Bord Pleanála established both risk and consequence based safety criteria against which the proposed development will be assessed.

This revised EIS, which replaces the EIS previously submitted, describes the revised scheme in detail, including the pipeline route, construction methodologies and their associated aspects and potential impacts. The proposed route is approximately 8.3km long from the landfall at Gleann an Ghad (Glengad) to the Bellanaboy Bridge Gas Terminal. A Landfall Valve Installation (LVI) will be located approximately 50m from where the pipeline comes ashore at Gleann an Ghad (Glengad) and is designed to limit the pressure in the onshore pipeline to a maximum 100 barg. The design of the Corrib Onshore Pipeline is in accordance with recommendations made by the Independent Safety Review undertaken by Advantica, dated January 2006, and endorsed by the Technical Advisory Group (TAG) reporting to the Minister for Communications, Marine and Natural Resources. Furthermore, the design complies with the safety criteria established by An Bord Pleanála in its letter of 2nd November 2009.

In parallel with responding to An Bord Pleanála on the request for further information, applications under the Gas Act and Foreshore Act will be resubmitted to the DCENR and the Department of Environment Heritage and Local Government (DoEHLG) respectively.

The proposed onshore pipeline starts at the previously approved landfall in the townland of Gleann an Ghad/Dún Ceartáin (Glengad/Dooncarton) and crosses an area of improved grassland in the Glenamoy Bog Complex candidate Special Area of Conservation (cSAC). It then runs in a tunnel for approximately 4.9km in a south-easterly direction from Gleann an Ghad (Glengad) to na hEachú (Aghoos), whereupon it extends onto lands within the townland of na hEachú (Aghoos). It then turns in an easterly direction through peatland and forestry before rejoining the previously approved route to enter the Bellanaboy Bridge Gas Terminal site.

The principal challenges in arriving at the proposed scheme have been to address the concerns of people in the local community and to ensure that the potential for impact to the environment (especially in designated conservation sites) is minimised. The construction methodologies have been described and resulting potential environmental impacts assessed. Measures to prevent, limit, reduce and minimise environmental impact on the human and natural environments and cultural heritage have been considered and implemented in the revised design, as described. Alternative construction methods have also been considered and outlined.

The construction of the Corrib Onshore Pipeline requires the permanent removal of up to 75,000m^3 of surplus peat, which will be disposed of at a peat deposition site in An Srath Mór (Srahmore), located approximately 10km from the proposed route (see Appendix A4). A separate description of the peat deposition operations at An Srath Mór (Srahmore) is provided in Volume 3 of this EIS. There will also be a requirement to dispose of up to 68,000m^3 of tunnelling arisings. It is proposed to re-use a large amount of this material on the Corrib Onshore Pipeline Project. Any surplus material that can be classified as a by-product will be used on other identified construction sites as appropriate or processed at a local quarry. If this is not possible, the material will be sent for disposal offsite. A small proportion of the tunnelling material will be required to be disposed of to a licensed waste management facility.

The Corrib development will contribute significantly to ensuring Ireland's security of supply, meeting up to 60% of Ireland's gas requirements during the initial years of production and reducing Ireland's dependence on imported energy. Ireland is currently dependent on imports for more than 90% of its gas, and generates 55% of its electricity from gas. The Corrib development has supported the recent extension of the natural gas network in Co. Mayo and the North-West generally, which has brought regional and national economic benefit in terms of a clean and reliable energy source for both residential and industrial use. The project as a whole will have a net positive impact on the national, regional and local economy and on local employment during construction and during the lifetime of the operations.

Having conducted a detailed study of the effects of the onshore pipeline project on the environment, it has been concluded that the proposed Corrib Onshore Pipeline will not have a significant residual impact on the human, natural or cultural heritage of the area in the long term.

Furthermore, the modified development addresses the safety concerns raised and safety criteria established by An Bord Pleanála, and a complete and transparent demonstration has been provided that the proposed onshore pipeline development does not present an unacceptable risk to the public (see Appendix Q).

1 INTRODUCTION

As part of the Corrib Development, Shell E&P Ireland Ltd. (SEPIL) proposes to construct an Onshore Gas Pipeline to connect the permitted offshore pipeline and Corrib Gas Field off the west coast of Ireland to the gas terminal at Béal an Átha Buí (Bellanaboy).

This Environmental Impact Statement (EIS) addresses the Corrib Onshore Pipeline between the landfall at Gleann an Ghad (Glengad) and the gas terminal at Béal an Átha Buí (Bellanaboy). The proposed development consists of the following elements, which are considered in Volumes 1 & 2 of this EIS:

- 8.3km gas pipeline extending from a landfall located at Gleann an Ghad (Glengad) via a 4.9km tunnel, most of which is under Sruwaddacon Bay, to the permitted gas terminal at Béal an Átha Buí (Bellanaboy);

- Landfall Valve Installation (LVI) located approximately 50m from the landfall at Gleann an Ghad (Glengad) (Volumes 1 & 2);

- Associated services which extend from the Bellanaboy Bridge Gas Terminal to the landfall (and continues to the subsea manifold in the Corrib Field); and

- Outfall pipeline extending from the Gas Terminal to the landfall (and which continues to a discharge location approximately 12.7km from the landfall).

The proposed development includes the permanent deposition of up to 75,000m^3 of peat at the Srahmore Peat Deposition Site. This peat will be excavated during the construction of the onshore pipeline. The peat deposition operations at An Srath Mór (Srahmore) are described in Volume 3 of this EIS. A 4.9km segment lined tunnel will be constructed, which will account for over 60% of the pipeline route. There will therefore also be a requirement to dispose of up to 68,000m^3 of tunnel arisings. It is proposed to re-use as much as possible of this material for the construction of the Corrib Onshore Pipeline. Any surplus material that can be classified as a by-product will be used on other identified construction sites as appropriate or for landscaping / remediation at a local quarry. If this is not possible, the material disposed of at a suitable licensed waste facility. A small proportion of the tunnelling material will be required to be disposed of to a licensed waste management facility.

Figure 1.1 shows the proposed pipeline route and the location of the LVI. Further details of the proposed development are provided in Chapter 4.

This EIS, which has been prepared on behalf of SEPIL by RPS with input from a team of specialists, provides a source of information from which the local community, the competent authorities, prescribed bodies, and other stakeholders can gain an understanding of the proposed development, the route selection process and other alternatives considered. It also provides details on the existing environment, the potential impacts that may occur as a result of the development, their likely significance and the proposed mitigation measures to prevent or minimise these impacts.

The EIS will form an integral part of the applications for consent for the proposed development (Section 1.4). In this regard, it will also act as a basis for public consultation and informed comment.

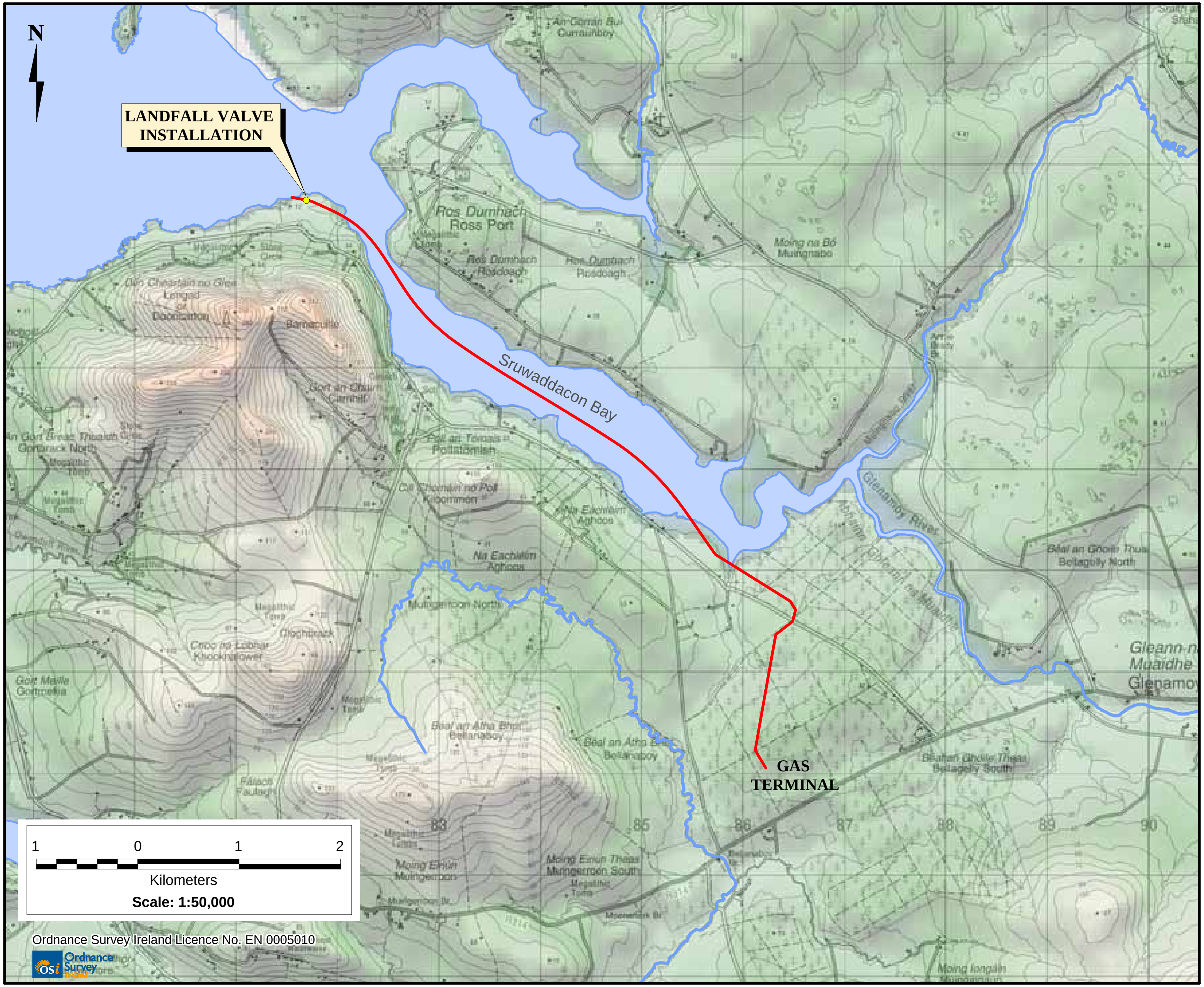
This chapter provides details on the overall structure of the EIS (Section 1.2), the EIS Study Team (Section 1.3), the applicable regulatory framework pertaining to the approval of the proposed development (Section 1.4 (also Preamble)), the Environmental Impact Assessment (EIA) process including project scoping (Section 1.5.1), as well as any difficulties encountered during the preparation of this EIS (Section 1.6).

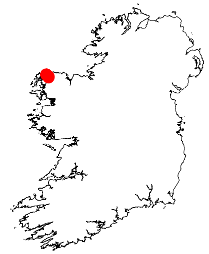
1.1 EIS SCOPE

This EIS has considered:

- Construction, commissioning, operation and decommissioning of the onshore gas pipeline, services, outfall pipe and LVI.

- Temporary works (e.g. compounds and access roads) required for the construction of these facilities.





Proposed Pipeline Route

Overall Layout of the Onshore Pipeline and Landfall Valve Installation

Figure 1.1

File Ref: COR25MDR0470Mi2145A03
Date: May 2010

CORRIB ONSHORE PIPELINE

1.2 EIS STRUCTURE

This EIS is contained within three volumes as follows:

Volume 1 Corrib Onshore Pipeline EIS:

1. **Preamble:** Provides background information in relation to the Corrib Gas Field Development including details on the SEPIL, need for the development, history of the project, the applications process and the relevant regulatory framework. It also addresses An Bord Pleanála's written Request for Further Information, dated 2nd November, 2009.

2. **Non-Technical Summary:** Provides a summary description of the project, the application process, and describes the main potential impacts associated with the proposed development and the proposed measures to mitigate against these impacts.

3. **EIS**: This report includes the following sections:

   Section A: Introduction and Project Description (Chapters 1- 5): Provides an introduction to the EIS, outlines the EIA and scoping process and describes the consultation process and other statutory processes. It also outlines the need for the onshore pipeline, the alternatives considered including the route selection process, and describes the proposed development including the associated construction activities and the decommissioning of the facilities.

   Sections B - F provide details on the existing environment prior to the development, describe the potential impacts (including residual, indirect and cumulative impacts) during the construction, commissioning and operational phases of the proposed development and the mitigation measures proposed in order to eliminate or reduce these impacts and any residual impacts. The content of these sections is outlined in the following:

   Section B: The Human Environment (Chapters 6-11): Community & Socio-Economic, Traffic, Air Quality and Climate, Noise and Vibration, Landscape and Visual Impact and Material Assets.

   Section C: The Natural Environment (Preface to Section C, Chapters 12-15): Preface, Ecology (terrestrial, freshwater and marine), Soils, Geology, Hydrogeology and Hydrology.

   Section D: Cultural Heritage (Chapter 16): Archaeology, Architectural and Cultural Heritage, including Underwater Archaeology.

   Section E (Chapter 17): Indirect, Cumulative Impacts & Impact Interactions

   Section F (Chapter 18): Summary of Potential Impacts & Mitigation

   Glossary of Terms

Volume 2 Corrib Onshore Pipeline EIS - Appendices:

Technical Appendices: Contains supplementary information to the above Sections A – D including reports on the specialist environmental studies. It also includes drawings of the proposed development, including alignment sheets for the proposed route and an integrated set of design documentation in the form of Appendix Q. An index of these reports and drawings is provided in the front of Volume 1.

Volume 3 Corrib Onshore Pipeline EIS – An Srath Mór (Srahmore) Peat Deposition Site EIS:

EIS, Non-technical Summary, Technical Appendices & Drawings: Volume 3 describes the proposed peat deposition site at An Srath Mór (Srahmore) and the proposed operations to dispose of up to 75,000m^3 of peat from the construction of the onshore pipeline.

1.3 EIS STUDY TEAM

This EIS has been prepared by RPS on behalf of SEPIL. Input was obtained from specialists who contributed to the EIS. Specialists who contributed to Volumes 1 & 2 of the EIS are outlined in Table 1.1. Volume 3 of the EIS, which addresses the Srahmore Peat Deposition Site, has been prepared by Tobin Consulting Engineers for Bord na Móna.

Table 1.1: EIS Study Team.

Section/Chapter	Topic:	Specialists:
A/ Chapter 2	Consultation	RPS
A/ Chapter 3	Alternatives, Route Selection,	RPS
A/ Chapter 4 and 5	Design and Construction	RPS (construction and civil design) JP Kenny (mechanical design) de la Motte (tunnelling)
B/ Chapter 6	Community and Socio Economics	RPS
B/ Chapter 7	Traffic Traffic Counts Traffic Management Plan	RPS Count on Us Tobins Environmental Services Ltd.
B/ Chapter 8	Air Quality and Climate	RPS
B/ Chapter 9	Noise and Vibration	RPS and Rupert Taylor Ltd
B/ Chapter 10	Landscape and Visual Assessment	RPS and Kevin Cleary and Associates Ltd.
B/ Chapter 11	Material Assets (agricultural/non-agricultural)	RPS
C/ Chapter 12	Flora and Fauna - Terrestrial Ecology Habitats and Vegetation Fauna Birds	Ecological Advisory & Consultancy Services (EACS): EACS and Enviroscope Environmental Consultancy Ecological Solutions and Associates Fehily Timoney and Company Ltd
C/ Chapter 13	Flora and Fauna - Freshwater Ecology	Aquatic Services Unit, UCC
C/ Chapter 14	Flora and Fauna - Marine Ecology Intertidal Sub-tidal Hydrodynamic Modelling	Benthic Solutions Ltd. RSK Environment Ltd EcoServe (Ecological Consultancy Services) HR Wallingford
C/ Chapter 15	Soils & Geology (including hydrogeology, hydrology and peat hydrology)	RPS AGEC Ltd Hydro - Environmental Services
D/ Chapter 16	Archaeology, Architectural & Cultural Heritage Terrestrial Underwater	Margaret Gowen & Co. Ltd. Archaeological Diving Company Ltd (ADCo)
E/ Chapter 17	Indirect, Cumulative Impacts & Impact Interactions	RPS
F / Chapter 18	Summary of Impacts and Mitigation Measures	RPS

A Natura Impact Statement (NIS), which is a report to inform the Appropriate Assessment with respect to the potential impact of the proposed onshore pipeline development on the Natura 2000 sites (Glenamoy Bog Complex cSAC 000500 and Blacksod Bay/Broadhaven pSPA 004037), was prepared by relevant specialists, who are as follows:

Table 1.2: Natura Impact Statement Study Team.

Topic:	Specialists:
Terrestrial Ecology (including otters and aquatic birds)	Ecological Advisory Consultancy Services (EACS):
Freshwater Ecology	Aquatic Services Unit, UCC
Marine Environment	Benthic Solutions Ltd.

The NIS was also prepared with the contribution from those listed in table 1.1 above. The NIS is provided in Appendix P of this EIS.

1.4 REGULATORY FRAMEWORK

This EIS supports the following applications for consents described in Figure 1.2.

1. Approval under the Planning and Development Act, 2000 as amended by the Planning and Development (Strategic Infrastructure) Act 2006, by An Bord Pleanála (development within the functional area of the Planning Authority);

2. Consent to construct a pipeline under Section 40 of the Gas Act 1976 to 2000, by the Minister for Communications, Energy and Natural Resources; and

3. A Foreshore Licence under the Foreshore Act 1933 to 2003 from the Minister for the Environment, Heritage and Local Government (for works in the foreshore).

Details on specific codes, standards, guidelines and legislation in the context of the proposed development are provided in the relevant chapters throughout sections A – F (Volume 1) of the EIS and Volume 3 of the EIS.

1.5 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS

The main purpose of the EIA process is to identify the likely significant impacts on the human environment, natural environment and on cultural heritage associated with the proposed development and to determine how to eliminate or minimise these. The EIS summarises the environmental information gathered during the impact assessments of the proposed development and, together with the ‘competent authority’ assessment, (which includes stakeholder consultation) and post construction monitoring, will make up the EIA process (see Figure 1.3). This EIS is based on all available information at the time of writing.

Several interacting steps typify the early stages of the EIA process, which include:

1. Screening – deciding whether an EIA is needed (see Preamble).

2. Scoping – identifying the issues likely to be important and the likely significant impacts of the development in the EIA process through consulting with various parties (see Section 1.5.1).

3. Assessment of Alternatives - outline of possible alternative approaches to the project, including route selection, design and construction (see Chapter 3).

4. Assessing & Evaluation - the central steps of the EIA process include baseline assessment (desk study and field surveys) to determine the status of the existing environment, impact

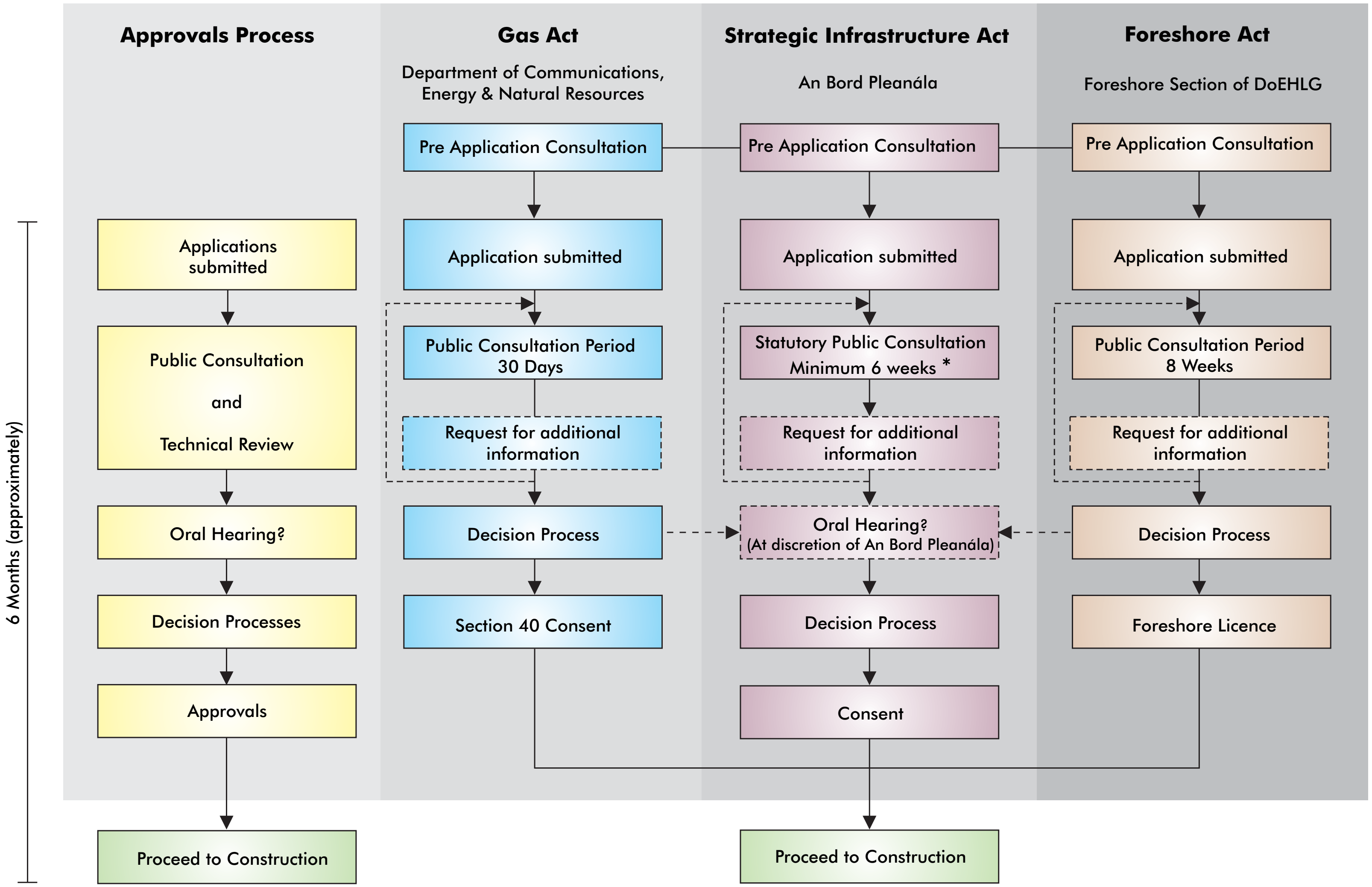
prediction and evaluation, and determining appropriate mitigation measures (see Sections B - F of this EIS).

This EIS, which is the cornerstone document in the EIA process, will aid in the development of the project's Environmental Management Plan (see Chapters 5 and 11) during the construction and operation of the proposed development.

1.5.1 Scoping

The scoping process for the Corrib Gas Field Development EIA commenced in 2000 and as a result, extensive information has been gathered through consultation with stakeholders. Stakeholders are those individuals, groups and communities who have a direct interest in the proposed development and the relevant governmental agencies concerned.

The scoping process for the proposed development of the modified route of the Corrib Onshore Pipeline began in early 2007 with the identification of individuals, communities, local authorities and statutory/non-statutory consultees likely to have an interest in, or that could be affected by, the proposed development or who could provide information on aspects relating to the project.



* For Initial Application
(as specified by ABP for Additional Information)

The Approvals Processes

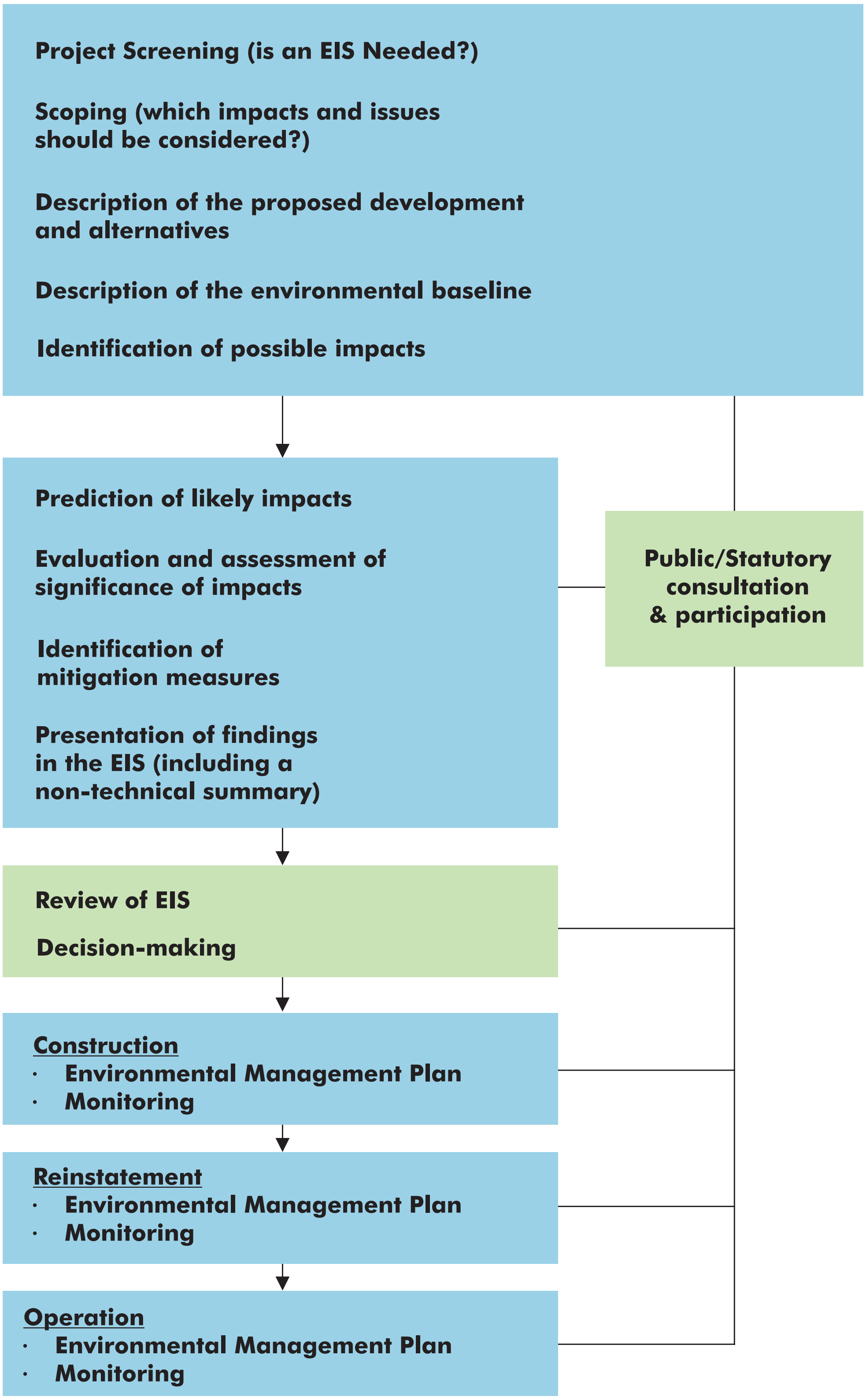
Figure 1.2

File Ref: MDR0470GrEIS003 RevA03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS



Important Steps in the EIA Process

Figure 1.3

CORRIB ONSHORE PIPELINE

File Ref: MDR0470GrEIS033 RevA03
Date: May 2010

Following the written request from An Bord Pleanála, received on 2nd November, 2009 for a modified route and revised EIS, the scoping and consultation process was revisited. One objective of the scoping process was to provide stakeholders with the opportunity to make known to the project team those issues pertaining to the route selection and proposed development that they considered important and warranted investigation and inclusion in the EIS. Chapter 2 provides further details on these consultations, including issues or concerns raised during the consultation process.

Scoping also involved consultations between the various specialists in the EIS Study Team (see Table 1.1), in particular to discuss proposed construction methods, interactions and to evaluate their likely significant impacts. Several workshop- type discussions were held to discuss the activities associated with the construction of the development and secondly to develop methods that would avoid or minimise environmental impacts. Through this process a thorough evaluation of potential impacts was undertaken and certain construction methodologies were eliminated from further consideration due to the likely significant impacts of their use.

In addition, RPS reviewed similar projects undertaken in Europe in order to gain a full understanding of potential impacts and suitable mitigation measures and to ascertain best practice, in particular in designated conservation sites.

The following main points were identified as a result of the scoping exercise:

- The majority of potential impacts will be temporary or short term and restricted to the construction stage.

- Further assessment of all baseline studies together with consultation with statutory and non-statutory bodies would be required to assist with identification of the potential impacts for the preferred route (see Chapter 5 and Sections B – F of Volume 1 of this EIS).

- The community had concerns regarding the proximity of the proposed development to dwellings (see Section B of Volume 1 of this EIS).

- Potential impacts on habitats, protected species, migratory species and feeding grounds would require further examination to ensure that potential impacts will be addressed adequately (see Section C of Volume 1 of this EIS).

1.5.2 Environmental Guidelines

This EIS has been prepared in accordance with the EPA documents ‘Guidelines on Information to be contained in Environmental Impact Statements’ (2002) and ‘Advice Notes on Current Practice in the Preparation of Environmental Impact Statements’ (2003) and having regard to the European Communities (Environmental Impact Assessment) Regulations 1989-2001. Other environmental guidelines have also been considered and have been referenced in Sections B – D of Volume 1 and Volume 3 where relevant.

1.6 DIFFICULTIES ENCOUNTERED

No specific constraints have limited the assessment of likely significant impacts detailed in Sections B – D (Volume 1) of the EIS.

1.7 SUMMARY OF CHANGES

Table 1.3 provides a summary of changes between the EIS which was submitted to the relevant authorities in 2009 and this revised EIS.

Table 1.3: Summary of Changes

Section / Chapter	Topic:	Description of Change:
Non Technical Summary	n/a	Pipeline route alignment Construction methodology Construction duration
A/ Preamble	n/a	Updated
A/ Chapter 1	n/a	Project description
A/ Chapter 2	Consultation	Public consultation in March/April 2010
A/ Chapter 3	Alternatives, Route Selection,	Selection of construction method between Gleann an Ghad (Glengad) and na hEachú (Aghoos) Selection of proposed tunnel alignment Mechanical configuration of LVI (straight pipe)
A/ Chapter 4	Design and Construction	Pipeline route description Tunnel description, including internal layout of tunnel Updated description of pipeline design and safety aspects
A/ Chapter 5	Construction	Construction of tunnel and associated works Construction activities at na hEachú (Aghoos) Construction of LVI surface water outfall Management of materials
B/ Chapter 6	Community and Socio Economics	Updated to reflect current status of project and proposed development
B/ Chapter 7	Traffic	Traffic numbers and durations Haulage roads
B/ Chapter 8	Air Quality and Climate	Reassessment of impacts of air emissions associated with change to pipeline route and construction methods
B/ Chapter 9	Noise and Vibration	Reassessment of noise and vibration impacts associated with change to pipeline route and construction methods
B/ Chapter 10	Landscape and Visual Assessment	Reassessment of landscape and visual impacts aspects associated with change to route and construction methods
B/ Chapter 11	Material Assets (agricultural/non-agricultural)	Management of tunnel arisings Resources and materials associated with tunnelling No longer impacts on Ros Dumhach (Rossport) Commonage
C/ Chapter 12	Flora and Fauna - Terrestrial Ecology Habitats and Vegetation	Reassessment of ecological aspects associated with change to pipeline route and construction methods Tunnelling noise and vibration Update surveys
C/ Chapter 13	Flora and Fauna - Freshwater Ecology	Reassessment of ecological aspects associated with change to pipeline route and construction methods Tunnelling noise and vibration
C/ Chapter 14	Flora and Fauna - Marine Ecology	Reassessment of ecological aspects associated with change to pipeline route and construction methods Tunnelling noise and vibration Updated surveys (benthic)

Section / Chapter	Topic:	Description of Change:
C/ Chapter 15	Soils & Geology (including hydrogeology, hydrology and peatland hydrology)	Peatland hydrology Reassessment of Geotechnical aspects associated with change to pipeline route and construction methods Reassessment of soils and geology aspects associated with change to pipeline route and construction methods Risk of landslides from tunnelling
D/ Chapter 16	Archaeology, Architectural & Cultural Heritage -Terrestrial -Underwater	Reassessment of archaeological impacts associated with change to pipeline route and construction methods Terrestrial archaeology survey at na hEachú (Aghoos) Marine archaeological surveys at na hEachú (Aghoos) and Gleann an Ghad (Glengad)
E/ Chapter 17	Indirect, Cumulative Impacts & Impact Interactions	Assessment of cumulative impacts in the context of revised route construction methods and current project schedule
F / Chapter 18	Summary of Impacts and Mitigation Measures	Updated

2 STAKEHOLDER CONSULTATION

The purpose of this chapter is to describe the consultation carried out in relation to the proposed development and to outline the key issues raised by stakeholders. Consultation began in early 2007 with the identification of key stakeholders with an interest in the proposed development. These include both statutory and non-statutory consultees as discussed in Section 2.1 and the general public (see Section 2.2). Proposed ongoing consultation activities associated with the development are also outlined in Section 2.2.5.

Consultation forms an essential part of the EIA process. In this case, the early involvement of the public and other stakeholders has helped to ensure that the views of various groups or individuals were taken into consideration from the preliminary route selection process through to the preparation of this EIS.

2.1 STATUTORY/NON-STATUTORY CONSULTATION

Consultations regarding route selection and the proposed development were conducted with a number of statutory and non-statutory bodies, as outlined in Appendix C, through either written correspondence or discussions. Initially, in April 2007, an EIS Scoping Report for the proposed development (see Appendix B) was circulated to consultees at the preliminary stage of the route selection process (see Chapter 3). The purpose of preparing the report was to inform consultees of the proposed development and to allow early input into the route selection process.

Community Update Brochures providing information updates (see Appendix D) at each stage of route selection were then issued to all consultees (see Appendix C) and circulated to householders in the Iorras (Erris) area. This provided a further opportunity for interested and potentially affected parties to comment on the proposed project. All consultees were requested to contact RPS if further information or a meeting was required to discuss the proposed development. The key issues raised by members of the public, through discussions or submissions, have been considered in the preparation of this EIS and are set out in Section 2.2.4.

Specifically, consultation with key statutory bodies has occurred in respect of the proposed onshore pipeline development, as modified in response to the written invitation of An Bord Pleanála. A summary of such consultation, and issues arising, is set out at Table 2.1.

Table 2.1: Key issues raised by statutory/non-statutory consultees on the proposed development.

Organisation	Issue	Chapter /Section /Appendix
Department of the Environment, Heritage & Local Government - National Parks & Wildlife Services	Construction related issues in designated conservation sites such as Special Areas of Conservation (SAC) and Special Protection Areas (SPA) and potential disturbance (e.g. lighting, noise and vibration) of species protected by the Wildlife Act.	Chapter 5 Section C Appendix J, K, L & M
North Western Regional Fisheries Board	Construction related issues including potential interaction with salmonid (including smolt) migration, including wastewater management at Aghoos tunnelling compound.	Chapters 5 & 13 Appendix K
Mayo County Council	Nature and extent of development proposed. Proposed surface water drainage system (including outfall) serving the proposed Landfall Valve Installation. Local Roads. Management of tunnelling spoil and tunnelling wastewater.	Appendix I Chapter 10 Chapter 7
Department of the Environment, Heritage & Local Government (including Underwater Archaeological Unit and National Monuments Service)	Route selection to consider routes, which would have least impact on archaeology. Potential impact of construction compounds in the close vicinity of site of archaeological potential.	Chapter 3 Chapter 16 Appendix N & O

Organisation	Issue	Chapter /Section /Appendix
Members of the Marine Licence Vetting Committee	Fish community assessment within Sruwaddacon Bay. Potential for physical impacts on Sruwaddacon Bay i.e. scour during construction works. Details on construction methods including footprint i.e. width, length, depth etc. Details on preferred construction method of choice and associated 'worst case scenario' impacts.	Chapter 13 & 14 Appendix K & L Chapter 5 & 14 Appendix L Chapter 5 Chapter 5 & Section C
Birdwatch Ireland	Potential adverse impacts on Sruwaddacon Bay which forms part of Blacksod Bay/Broadhaven (pSPA). An 'appropriate assessment' should be carried out and information provided to allow for scientific certainty. Significant site monitoring is required in order to inform this assessment process and ensure impacts on interests of the sites are assessed in a robust manner particularly given that Sruwaddacon Bay is an integral part of the pSPA designation. Significant monitoring of sites with Annex 1 birds (under the Birds Directive) outside designated sites in the wider countryside and appropriate measures to avoid impacts on these listed species & wildlife generally need to be identified. Potential disturbance to the pSPA (birds and their benthic fauna food source) - in particular from the tunnelling operation	Chapter 12, 13 & 14, Appendix J - L EIS & Appendix P Chapter 12, Appendix J Chapter 12, Appendix J Chapter 12, Appendix J
An Taisce	Concerns regarding potential leakage from the umbilical and the outfall pipeline. Management of excavated tunnelling material. Vibration from the tunnelling operation. Concerns about how the tunnel would be finished, e.g. grouted or not.	Chapter 4 Section C
Environmental Protection Agency	Options for disposal/recovery of tunnel arisings. Licensing/permitting.	Chapter 11 and Appendix S4
Irish Peatlands Conservation Council	Non-designated Annex 1 Blanket bog habitat.	Chapter 12 and Appendix J1

2.1.1 Pre-application Consultation

Prior to the submission of the application in February 2009, pre-application meetings were held with An Bord Pleanála, the Department of Communications, Energy and Natural Resources (DCENR), and the Foreshore Section of Coastal Zone Management Division (CZMD) of the Department of Agriculture, Fisheries and Food (now the Foreshore Unit of the Department of the Environment, Heritage and Local Government) on the scope of each of the three applications for the proposed development. An Bord Pleanála also requested that RPS give consideration, in the application under the Strategic Infrastructure Act, to the criteria used in the selection of the previously approved route and their comparison to those used in the route selection of the proposed route in this EIS (see Chapter 3).

Following An Bord Pleanála's request for further information dated 2nd November, 2009, SEPIL and their consultants has engaged in additional statutory consultation with statutory bodies including Mayo County Council, the Department of Communications, Energy and Natural Resources (DCENR), Department of Environment, Heritage and Local Government, National Parks and Wildlife Service and the North Western Regional Fisheries Board. In addition, further consultation with non-governmental organisations has taken place including An Taisce, Birdwatch and the Irish Peatland Conservation Council.

2.2 PUBLIC CONSULTATION

This section outlines both the approach to public consultation on the proposed development and the broader ongoing consultation activities on the project. This section also highlights the consultation process on the onshore pipeline including the key public stakeholders, and the key issues raised during consultation. Ongoing consultation activities associated with the proposed development are also discussed in Section 2.2.5.

Plate 2.1: Public Consultation during Open Day in February 2007

2.2.1 Approach to Consultation

The public consultation process on the onshore pipeline application as submitted in February 2009, which was developed and led by RPS, aimed to:

- Provide an open and transparent process for members of the public to participate in the route selection process;
- Seek input from the public on the criteria to be used in the route selection process;
- Provide a channel of open communication with landowners;
- Provide opportunities for the public to input into each phase of the route selection process and to raise issues or concerns with any of the corridor options presented; and
- Keep the public informed of the route selection process as it progressed.

2.2.2 Key Public Stakeholders

At the beginning of the consultation process, RPS set out to identify and contact as many public stakeholders and groups in Iorras (Erris) as possible. These include:

- People living and working in Iorras (Erris);
- Local landowners;
- Local community groups;
- Local business groups;
- Local public representatives;
- Locals who have shown an interest in the project; and
- Locals who supported and objected to the project.

2.2.3 Public Consultation Process

The consultation strategy developed and evolved as the project progressed and as RPS became more aware of public issues and concerns.

- A dedicated consultation team within RPS was assigned to assist and develop the consultation process.
- The first phase of consultation was devised to contribute to the route selection process.
- A local RPS Project Office was established in Béal an Mhuirthead (Belmullet), where a full-time RPS Consultation Team Manager and other full-time project staff were based to facilitate local and regional consultation. This service was advertised widely and the public were encouraged to visit the office during office hours (Monday to Friday, 9am-5pm) to discuss the project at their convenience. The service operated until June 2009 at which point the responsibility was transferred to SEPIL Community Liaison Officers (CLOs) and RPS's dedicated Landowner Liaison Officer.
- A dedicated RPS Landowner Liaison Officer was assigned to the project to assist various SEPIL Community Liaison Officers to consult directly with landowners within the identified route corridors.
- A number of consultation events were held to consult and inform the public with regard to the route selection process for the onshore pipeline. These included 'Open Days', a Community Workshop, 'Open House Week', meetings (face-to-face and small groups) and Public Displays.
- Community Update Brochures were published on a regular basis and at each project milestone to keep the public and other stakeholders updated on progress with regard to the route selection process. Nine of these were published during the route selection and public consultation process, seven prior to the February 2009 application submission, one was published after the 2009 application submission and an additional one in March 2010.
- A stand-alone website (www.corribgaspipeline.ie) dedicated to the Corrib Onshore Pipeline project was also set up as a virtual means of consultation with the public and to further assist the consultation process.
- Liaison with local residents on both sides of Sruwaddacon Bay has continued to-date. Since November 2009, RPS and SEPIL have had a large number of one-to-one meetings and

meetings with small groups to discuss all aspects of the project and to keep the local community up-to-date of developments.

- A series of meetings, focussed on the modified pipeline route requested by An Bord Pleanála, took place with members of the local community during April 2010. The views of local residents on various aspects of the project were ascertained through this engagement, the details of which are outlined in a report on these sessions contained in Appendix D.

A summary of each of the public consultation events is outlined in Table 2.2 and Figure 2.1. A brief summary is also given in the following sections, which are presented in chronological order of occurrence. Copies of Community Update Brochures and other literature provided to the public during these events can be found in Appendix D.

Table 2.2: Route Selection Phases and Public Consultation.

Phase	Date	Consultation
Introduction of RPS	February 2007	'Open Day 1' held in the Broadhaven Bay Hotel, Béal an Mhuirthead (Belmullet) outlined the role of RPS, the route selection process and predicted timelines. Community Update Brochure (dated February) distributed to approximately 3,500 households in Iorras (Erris).
Route selection criteria	March 2007	Facilitated Community Workshop in Teach Iorrais, Gaoth Sáile (Geesala) and discussion on the route selection criteria to be used in the selection process[1].
Route selection criteria	April 2007	Community Update Brochure (dated April) distributed to approximately 3,500 households in Iorras (Erris).
Finalisation of route selection criteria	April / May 2007	'Open House' held in RPS Project Office during the week April 30th to 4th May to provide a final opportunity for the public to comment and input into criteria for route selection.
Route selection criteria & identification of eight route corridor options	June 2007	'Open Day 2' held in (Broadhaven Bay Hotel, Béal an Mhuirthead (Belmullet)) to communicate the final route selection criteria. Identification of eight preliminary route corridor options. Community Update Brochure (dated June) distributed to approximately 3,500 households in Iorras (Erris).
Short-list of three route corridors	September 2007	Public Display in RPS Project Office to detail the emerging preferred route corridor options. Community Update Brochure (dated June) distributed to approximately 3,500 households in Iorras (Erris).
'Focus Week'	November 2007	'Focus Week' to provide a progress update to the public in relation to the route selection process. Held in the RPS Project Office during the week 12th –16th November 12th to 16th. Community Update Brochure (dated November) distributed to approximately 3,500 households in Iorras (Erris).
Variations of short-listed route corridors	December 2007	Announcement that further studies and feedback from the consultation process had led to the identification of two variations to the short-listed corridors. Corridor variations put on public display in the RPS Project Office. Community Update Brochure (dated December) distributed to approximately 3,500 households in Iorras (Erris).
End of consultation period regarding the route corridor options	January 2008	An additional public notice was put in all the local papers advising that the public consultation phase would close on 18th January, 2008.
Selection of preferred route	April 2008	Public announcement of preferred route, which was put on display in the RPS Project Office. Community Update Brochure (dated April, 2008) distributed to approximately 3,500 households in Iorras (Erris).
Applications made to An Bord Pleanála and DCENR	June 2008	Community Update Brochure summarising the EIS and the statutory approvals and submissions process was distributed to approximately 3,500 households in Iorras (Erris).
Withdrawal of applications made to An Bord Pleanála	December 2008	Public announcement stating that the applications have been withdrawn and the reasons for doing so. Letters were also sent to landowners and occupiers along the route advising that the application had been withdrawn but that a new application would be made in early 2009.
Key changes to new application	January 2009	A Community Update Brochure summarising the key changes in the EIS, details on the realignments to the proposed route, and the statutory approvals and submissions process was distributed locally in Iorras (Erris).

[1] A report on the workshop was issued to all participants for review and was available on Open Day 2.

Phase	Date	Consultation
ABP Oral Hearing	May and June 2009	Oral Hearing hosted by An Bord Pleanála in Béal an Mhuirthead (Belmullet) with participation by key statutory bodies, members of the local community and SEPIL.
Pipeline Route modification	March and April 2010	Community engagement was carried out to gather feedback in relation to the modified route. This involved a Community Update Brochure; an update to the web page; letters; face-to-face meetings, and small group meetings.

Consultation Process

- Mobilisation of Dedicated Local Consultation and Landowner Liaison Team
- Set up Local RPS Project Office
- Research the Project and Learn about Community Views
- Development of Consultation Strategy

Consultation Strategy

- Consultation Events with Local Community
- Community Update Brochures
- Project Website - www.corribgaspipeline.ie
- RPS/SEPIL Study Tour

Consultation Events

Open Day 1 "Introduction to RPS"	(Feb '07)
Community Workshop	(March '07)
Open House	(April / May '07)
Open Day 2 "Alternative Corridors Presented"	(June '07)
Public Viewing of Short Listed Corridors	(Sept / Dec '07)
Focus Week	(Nov / Nov '07)
Public Viewing of Route Corridor Variations	(Dec / Jan '08)
End of Consultation Period for Route Options	(Jan '08)
Selection of Preferred Route	(April '08)
Applications Made to ABP and DCENR	(May '08)
Withdrawal of Applications	(Dec '08)
Public Made Aware of Key Changes to New Applications	(Jan '09)
EIS 2010 Consultation	(Mar / Apr '10)

Public Consultation Process

Figure 2.1

2.2.3.1 Open Day 1

The first public Open Day was held in the Broadhaven Bay Hotel, Béal an Mhuirthead (Belmullet), on 27th February, 2007 from 3.00pm until 9.00pm. The objectives of this Open Day were to:

- Introduce RPS and outline their role;
- Introduce the importance of route selection criteria;
- Indicate parallel activities that would follow to obtain public and other stakeholder input on route selection criteria and the time frames for future events; and
- Promote and encourage participant involvement in the next phase of the consultation process.

Open Day 1 was widely advertised using local papers and radio. It was staffed by eleven RPS staff members with expertise in areas such as route selection, planning, environmental impact assessment, engineering and pipeline safety and consultation. It is estimated that the event was attended by approximately 100 local people. A Community Update Brochure (dated February 2007) introducing RPS and the project was available to participants on the day and was distributed to approximately 3,500 households in Iorras (Erris).

2.2.3.2 Community Workshop

On 31st March, 2007 a workshop was hosted by RPS in Gaoith Sáile (Geesala), County Mayo, from 10am until 4pm. It was facilitated by Pat Hayles Delbridge, an international expert in risk communications, commissioned by RPS. The purpose of the workshop was to understand and develop the criteria that the public considered important in the route selection process.

An open invitation to the workshop had been issued at Open Day 1 and by a Community Update Brochure distributed locally. Follow- up phone calls and letters were then sent to anyone who had expressed an interest as well as to all registered community groups.

The format of the workshop randomly divided participants into four working groups, with each group having the opportunity, in the course of the day, to provide insights into four topic areas:

- Technical
- Environmental
- Community and Planning
- Other, i.e. “What have we missed?”

Each workshop topic was allocated approximately 50 minutes and had a resource person from the project team, a facilitator, and a note taker. Participants were invited to give further insights in each of the key focus areas through further complementary processes, such as telephone calls, email and face-to-face meetings. Attendance at the workshop included 22 local people and fourteen RPS staff members. A report on the workshop was circulated to all attendees for further comment before being finalised. Copies of the final report were posted to all workshop attendees (see Appendix E). It was also made publicly available at Open Day 2 and at the RPS Project Office.

2.2.3.3 Open House

In addition to the Community Workshop, RPS hosted an ‘Open House’ week so that every opportunity could be made available to other interest groups and individuals to input into the final choice of route selection criteria. The ‘Open House’ week took place in the RPS Project Office from 30th April to 4th May, 2007 and was widely advertised using local papers, radio and parish newsletters.

Individuals and interest groups from all areas of the community ranging from sports groups, the GAA, angling clubs, women's groups, etc. were invited to come to the RPS Project Office and put forward their ideas and views on route selection criteria and the Onshore Pipeline Project. Members of the project team were also present and available to respond to queries over the course of the week.

2.2.3.4 Open Day 2

Open Day 2 for the Corrib Onshore Pipeline was held in the Broadhaven Bay Hotel, Béal an Mhuirthead (Belmullet) on Tuesday, 12th June, 2007, from 3pm until 9pm. The objectives of Open Day 2 were to:

- Provide feedback on public and other stakeholder input into route selection criteria;
- Outline the route selection criteria and the route selection process;
- Present eight indicative route corridor options;
- Seek feedback and comments in relation to the eight corridors presented;
- Promote and encourage public involvement in future phases of the route selection process; and
- To seek general input into the onshore pipeline project.

The format of the Open Day included a number of displays explaining how RPS had arrived at the different route corridor options. A Community Update Brochure (dated June 2007), which included maps and a description of the route corridor options, was made available to participants on the day. Members of the RPS project team (fourteen in total) were on hand to answer any queries. It is estimated that approximately 180 people attended the event. The event was widely advertised using local papers, radio and the project website and a public notice outlining the eight route corridors was published in the four local newspapers. The project website was also updated with relevant project information.

The Community Update Brochure was delivered to approximately 3,500 households in the local area and included a 'Tell Us Your Views' feedback form. The route corridor options were also publicly advertised in the four local newspapers.

After the Open Day, it was decided to host future public consultation events in the RPS Project Office where members of the public could visit and view future public displays in private at their convenience and discuss the project on a one-to-one basis and in a confidential manner with members of the RPS Project Team.

2.2.3.5 Public Event for Shortlisting

RPS short-listed three preferred route corridors (Corridors A, B and C) on 19th September, 2007. Approximately 165 landowners within or along the route corridor options were sent a letter advising that Corridors A, B and C had been short-listed and to invite these landowners to an advance viewing of the short-listed corridors, which were on public display in the RPS Project Office on 17th and 18th September. The public display was then open to the public from 19th September onwards. The RPS project team were on hand to answer any queries the public or landowners had in relation to the short-list of corridors. The event was widely advertised using local papers, radio and the project website. Maps of the short-listed corridors were also published in the four local newspapers.

The objectives of the public display of the short-listed corridors were to:

- Outline and describe the short-listed corridors options;
- Outline the route selection process and associated project timelines;

- Seek landowner and public feedback and comments in relation to the short-listed corridors presented;

- Promote and encourage public involvement in the next phase of the route selection process; and

- To seek general public input into the onshore pipeline project.

A Community Update Brochure (dated September 2007), which included maps and a description of the short-listed route corridors, was made available to participants on the day. The brochure outlined the reasons why these corridors had been short-listed and some of the identified constraints were also listed. The brochure was also delivered to approximately 3,500 households in the local area and included a 'Tell Us Your Views' feedback form. The shortlisted route corridors were also publicly advertised in all local newspapers.

2.2.3.6 Focus Week

RPS hosted a 'Focus Week' from Monday, 12th November to Friday, 16th November 2007, from 10am to 5pm in the RPS Project Office. This event aimed to update the public in relation to progress in the route selection process. Members of the RPS project team were available during the week to discuss the route selection process for the Corrib Onshore Pipeline and to answer any queries from landowners or the public.

The objectives of the Focus Week were to:

- Update the landowners and the public in relation to progress in the route selection process;

- Advise that RPS were investigating possible variations of Corridor A, B and C;

- Outline the route selection process and associated project timelines;

- Continue to seek landowner and public feedback and comments in relation to the short-listed corridors presented;

- Promote and encourage public involvement in the next phase of the route selection process, and

- Seek public input into the onshore pipeline project.

The event was widely advertised using local papers, radio and the project website. A Community Update Brochure (dated November, 2007) outlining progress made in the route selection process since September was also delivered to approximately 3,500 households in the local area and included a 'Tell Us Your Views' feedback form. Only three local individuals attended the Focus Week. There was no apparent reason as to why so few attended.

2.2.3.7 Variations of Corridors

RPS announced two further Corridor options (Corridors A1 and C1) on 7th December, 2007, which were variations of two of the previously short-listed corridors and were identified following feedback from the public consultation process and further environmental and technical considerations of the short-listed route corridors.

The corridor variations were put on public display in the RPS Project Office from 7th December, 2007 until 18th January, 2008 and potentially affected landowners were invited by letter to view the corridor variations in Seafield House (the RPS Project Office). Members of the RPS project team were available in the RPS Project Office to discuss all the route corridor options with landowners and the public during this last phase of consultation. The corridor variations were also publicly advertised in all four local newspapers.

It was advertised widely that the public consultation period around the route corridor options would end on 18th January, 2007. The public were again encouraged to make their views known to RPS by viewing the corridor variations on display in the RPS Project Office, by filling out one of the 'Tell Us Your Views' slips within the Community Update Brochure (dated December, 2007), or by sending their views online via the project website etc. In early January 2008, RPS again advertised that the public consultation process would officially close on 18th January, 2008.

Members of the RPS project team were available in Seafield House to discuss all the route corridor options with landowners and the public during this last phase of consultation.

The objectives of the public display of the short-listed corridor variations were to:

- Outline and describe the short-listed corridor variations and how they emerged;
- Outline the route selection process and associated project timelines;
- Seek landowner and public feedback and comments in relation to the corridor variations presented;
- Promote and encourage public involvement in the last phase of the public consultation process around the route corridor options; and
- Seek public input into the onshore pipeline project.

The Community Update Brochure, which included maps and a description of the corridor variations, was made available to anyone who visited to view the public display. The brochure was also delivered to approximately 3,500 households in the local area and included a 'Tell Us Your Views' feedback form. The brochure outlined the reasons why these corridor variations arose. The short-listed corridors and their variations were also publicly advertised in all local newspapers.

2.2.3.8 Announcement of Preferred Route

The selected modified route for the Corrib Onshore Pipeline was publicly announced by RPS in April 2008. Every effort was made to discuss the selected modified route with potentially affected landowners and commonage shareholders along the route prior to the public announcement. A letter was also sent to these landowners again advising of the choice of preferred route and inviting landowners to view the route on public display in the RPS project office. A Community Update Brochure (dated April 2008) and maps were enclosed. The selected route was publicly advertised in the local newspapers and the public were invited to view the display where the RPS project team would be available to answer any queries. The Community Update Brochure was also distributed to approximately 3,500 households in Iorras (Erris).

The objectives of the public display were to:

- Outline and describe the proposed route and the main reasons it was selected;
- Provide background information and details on the proposed development as a whole;
- Answer any queries that the public had in regard to the route selection process or any other aspect of the Project; and
- Outline the future steps in the project such as submission and determination of statutory applications.

2.2.3.9 Submission of Applications (May 2008)

Applications for consent in respect of the proposed onshore gas pipeline and associated development were originally submitted to An Bord Pleanála and the Department of Communications, Energy and Natural Resources in May 2008.

A Community Update Brochure, which summarised the key information provided in the EIS and the statutory approvals and submissions process was distributed to approximately 3,500 households in Iorras (Erris) in June, 2008. The EIS and its Non-Technical Summary were put on display in the RPS and SEPIL Project Offices in Belmullet, and on the project website (www.corribgaspipeline.ie). On request, a copy of the EIS was also made available on CD from the Project Offices.

2.2.3.10 Withdrawal of Applications in 2008

The applications to An Bord Pleanála were withdrawn in December 2008, and the details of this were publicly announced via the local and national media. The application was withdrawn to facilitate minor realignments to the route of the pipeline in order to avoid more sensitive habitats. Letters were also sent to all landowners and occupiers along the route advising of the withdrawal of the application.

The application under the Gas Act made to the Department of Communications, Energy and Natural Resources in May 2008 was withdrawn in January 2009.

2.2.3.11 Key Changes to Application (January 2009)

A Community Update Brochure summarising the key changes to the EIS and details on the realignments of the proposed route was distributed to approximately 3,500 houses in Iorras (Erris) in January, 2009, in advance of submitting the new application to which the 2009 EIS relate. The brochure also explained the statutory approvals process and detailed how the public could make submissions in relation to the application.

2.2.3.12 Modification of EIS

Following An Bord Pleanála's invitation to modify the pipeline route, direct engagement with members of the local community has been carried out by SEPIL Community Liaison Officers (CLOs) and by RPS staff. This focused on, but was not exclusive to, the areas of Gleann an Ghad (Glengad), Ros Dumhach (Rossport), na hEachú (Aghoos) and Poll an tSómais (Pollatomish). The purpose of this engagement, carried out in March and April 2010, was to inform stakeholders of the intended response to the letter issued by An Bord Pleanála in terms of modifications to the pipeline route and construction methodology, and to gather feedback on the proposals. This has involved:

- A letter outlining the project status and an invitation to meet with the project team was issued to approximately 600 homes in the Cill Chomáin (Kilcommon) area;
- A Community Update Brochure (distributed to approximately 3,500 houses in Iorras (Erris)) with a feedback form and an invitation to arrange a small group meeting;
- Every reasonable attempt was made to have contact with all those living in the immediate vicinity of the pipeline (approximately 1,000m from the mid-line in the bay (which was taken as an estimated location of the revised route)).
- A series of small group meetings;
- An online project update and feedback form;
- Project phoneline.

2.2.3.13 Brochures and Feedback Forms

Community Update Brochures (See Appendix D) were published to keep the public and other stakeholders updated with regard to the route selection progress. These were also used to inform the public about community, environmental and technical aspects of the project and to address issues or concerns raised during public consultation.

Each brochure included information on the various ways in which the community could get in contact with the project team. This allowed the public to return any comments or queries in relation to the relevant project milestones at that time, or in relation to the onshore pipeline in general. Each published brochure was delivered to approximately 3,500 local households in Iorras (Erris). The brochures were also sent to other stakeholders such as public representatives.

In parallel with this, SEPIL published regular newsletters updating the public on the Corrib project as a whole as well as updates on the onshore route selection process. Separately, SEPIL published a brochure in January 2008 outlining progress on implementing the recommendations made in by Advantica in their Independent Safety Review Report. The Brochure entitled 'Corrib Onshore Pipeline: Enhancing Safety' described the purpose and functions of the proposed Landfall Valve Installation (LVI) at Gleann an Ghad (Glengad).

2.2.3.14 Website

Access to up-to-date, accurate and reliable information about the Corrib Gas Pipeline is essential to ensuring good consultation can occur. To aid the consultation process, a stand-alone website was set up (www.corribgaspipeline.ie) dedicated to the Corrib Gas Pipeline. This enabled the public to access up-to-date information on the consultation, route selection and general onshore pipeline project at their convenience. The website also facilitated queries and public views to be submitted to RPS online. The website went live in September 2007. A designated email address (routeinfo@rpsgroup.com) was also set up and advertised locally to facilitate electronic communication with the public. All emails received were answered promptly.

This website was updated in March 2010, with an information update on the proposed modifications and an invitation to people to submit their views. The revised EIS, including a Non-Technical Summary, along with the original application, will be available on line. The project website will continue to be used as a method of virtual consultation where members of the public can access up-to-date information in relation to the onshore pipeline.

2.2.3.15 Promotion of Events

Public consultation events and project milestones were generally advertised using the following:

- Letters to potential landowners within and along route corridor options prior to public announcements of project developments;
- Face- to-face meetings with potential landowners within and along route corridor options;
- Local press and radio adverts;
- Small group meetings;
- Community Update Brochures which were distributed to approximately 3,500 households in Iorras (Erris);
- The Corrib Onshore Pipeline project website; and
- Press releases and media interviews.

2.2.4 Key Issues Raised

At all stages during the consultation process, the issues raised in returned feedback forms, at each public event, meeting, workshop etc. were recorded. As the consultation process progressed, the consultation strategy was reviewed and refined to ensure that the issues raised were taken into consideration. Public concerns were broadly grouped into community, safety, environmental and technical concerns. Every effort was made to address these issues through various consultation tools (Open Days, meetings, phone calls, Community Update Brochures, email and use of project website).

Table 2.3 provides a summary of key issues raised by members of the public in relation to the proposed development. The table includes a reference to where in the EIS these issues have been addressed.

Table 2.3 Key Issues

Issue	**Concern/Issue**	**EIS Chapter**
Community		
Proximity	The pipeline should be moved further from housing than the previously approved pipeline and avoid public buildings, road crossings, schools etc as much as possible.	Chapters 3 & 4
Impact of development on communities in Iorras (Erris)	Previous and future impact of the development on people living in close proximity to the proposed development and those living in Iorras (Erris).	Chapters 6 & 17
Benefits of the development in Iorras (Erris)	How will local people living in close proximity to the proposed development and living in Iorras (Erris) benefit from the proposed development?	Chapters 6 & 17
Value of local houses	Will the development impact on the value of houses along the proposed development? Will insurance premiums increase in the area because of the pipe?	Chapter 6 & 11
Landowner Consultation	Were all landowners consulted by SEPIL and RPS?	Chapters 2 & 6
Community consent for the development	100% community consent would be required for the proposed development – and this is the only way that the proposed development will gain acceptance within the local area.	Chapters 2 & 3
Safety		
Risk of injury	Concerns raised in relation to personal safety of the public or workers during protests against the development. Concerns were raised about the building burn distance.	Not addressed in EIS Appendix Q
Operating pressure in the onshore pipeline	Is it normal for gas pipelines to carry high-pressure gas that could cause a greater risk of ruptures and explosions in the pipeline?	Chapters 3 & 4 Appendix Q
Transportation of unprocessed 'raw gas'	Transportation of untreated 'raw gas'. Concern that it is unusual to transport gas in an untreated state on land. Concerns that the transportation of high pressure, 'raw gas', could cause a greater risk of ruptures and explosions in the pipeline.	Chapter 4 Appendix Q
Offshore gas processing	Why will SEPIL not process the gas offshore and avoid developing a terminal and onshore pipeline?	Not addressed in EIS
LVI - location	Concern expressed in relation to the location of the Landfall Valve Installation (LVI). Is there suitable access to the LVI to carry out maintenance works?	Chapter 4
LVI - safety	Concern about the safety of the LVI and the potential for explosions in Gleann an Ghad (Glengad).	Chapter 4 Appendix Q
Pipeline integrity and risk of explosions	Concerns in relation to the possibility of the onshore pipeline exploding. How would the integrity of the pipeline be maintained? Concerns were raised about the strength of the pipe, particularly the welds and its ability to withstand corrosion over time How do the bends in the pipe impact on safety? What happens in the event of an incident on the pipeline when it is underground? How is it maintained? What happens if the umbilical gets severed?	Appendix Q

Environment		
Designated Conservation Sites	Will the construction and operation of the development impact on designated conservation sites such as the Glenamoy Bog Complex cSAC and Blacksod / Broadhaven Bay pSPA within the area? What measures will be taken to avoid such impacts during construction and operation?	Chapter 5 & Sections B-F
Sand dune and Machair systems in Gleann an Ghad (Glengad)	Concerns in relation to the development of the LVI and potential impact on sand dune and Machair systems in Gleann an Ghad (Glengad), which is priority habitat.	Chapter 12
Permanent impacts to Sruwaddacon Bay	Concerns in relation to the construction of a pipeline in Sruwaddacon Bay and the potential for permanent impacts on its flora and fauna.	Chapter 5 & Sections B-F
Carrowmore Lake water quality	Concern about the potential for the proposed development to impact on the quality of water in Carrowmore Lake.	Chapter 3
Vibration from Tunnelling	Will there be significant impacts from tunnelling due to vibration on fauna or on people? Is there potential for tunnelling vibration to cause landslides? How will it affect the local environment (especially the graveyard and the school)?	Chapter 9 Chapter 12 Chapters 13 & 14 Appendix M1
Impacts on Shellfish	Will there be an impact on naturally occurring shell fish or aquaculture in Sruwaddacon Bay from the development?	Chapter 14
Technical		
Peat stability issues / landslides	Concern in relation to the construction of a pipeline in peat which coupled with the risk of landslides locally, could potentially impact on safety.	Chapters 5 & 15 Appendix M2
Future gas finds	Will the development be used to transport gas outside of that identified in the Corrib Gas Field?	Chapter 17
Tunnelling	How and where will material excavated from tunnelling be disposed of? Issues were raised about the possibility of hitting gas pockets (radon etc) during the tunnelling operation and what impact that might have on the local community. How much water is required for the operation and where will it come from and how will it be brought to the site? Concerns over the impact of possible 24 hour working were raised. There were also concerns about noise, light pollution and traffic on humans, particularly at the construction compounds.	Appendix S4 Not covered in EIS Chapter 5 Appendix M7 Chapters 7, 8, 9 & 12
Location of the pipe	There was concern about not being able to demonstrate exactly where the pipe is located for both the vertical and horizontal alignments.	Chapter 3, 5 and Appendix M1
Surface works in Sruwaddacon Bay	Will there be a need for surface intervention in Sruwaddacon Bay?	Chapter 5
Pipeline Safety	Concern regarding requirements of An Bord Pleanála to modify 2009 proposed pipeline route. Concerns regarding safety of sections of pipeline where modifications were not requested by An Bord Pleanála.	Appendix Q

2.2.5 Ongoing Consultation Activities

RPS will continue to address any issues or concerns that the public have throughout the statutory approvals and construction phases for the Corrib onshore pipeline, primarily via its own organisation which is based in both Mayo and Dublin. SEPIL's team of five full-time Community Liaison Officers will also continue to meet with people in the community and to respond to visits, phone calls, emails and letters from members of the public to the Corrib Natural Gas office in Belmullet.

The Community Liaison Officers (CLOs) are and will remain available during both the construction and operational phases of the proposed development to meet with the public, and provide any information necessary to address any questions, or issues and concerns in order to disseminate and circulate information to the community. There will also be regular newsletters circulated in the community to provide timely accurate information about the progress of the project - these will also be freely available online. There will also be regular public information notices in local newspapers detailing forthcoming construction activities – these will also be freely available online. The ongoing public information programme should be seen as comprising an integral element of the proposed development, and not a mitigation measure against a potential adverse impact.

Additionally, RPS and SEPIL will continue to update the public and other stakeholders in relation to the statutory approvals through the continued use of Community Update Brochures, public notices, the dedicated project website and by direct meetings with the public.

This EIS, including a Non-Technical Summary, will be available on public display in the Offices of Mayo County Council in Castlebar and Béal an Mhuirthead (Belmullet), as well as in the SEPIL Office in Béal an Mhuirthead (Belmullet). Copies will also be available for inspection at the local Garda station in Béal an Mhuirthead (Belmullet) during the public consultation period. The EIS will also be available to download from the dedicated application website, www.corribgaspipelineabpapplication.ie.

The consultation programme and strategy will continue to develop in relation to further queries and concerns raised by the public and other stakeholders during the statutory approvals and construction phases.

Ongoing Community Investment

In addition to the CLO team, SEPIL has also had a full-time Community Investment Advisor (CIA) working on the project since September 2007. The primary role of the CIA is the administration of SEPIL's three community investment programmes – the Local Grants Programme (LGP), the Third-Level Scholarship Programme and the Corrib Natural Gas Erris Development Fund (EDF). Through these three programmes, the Community Investment Advisor – who lives in the community – has built up relationships with some 127 community and voluntary groups within the Erris region.

The process of engagement around these programmes begins with initial contact from the group, by way of a telephone enquiry or personal call, or through the submission of a funding application. A face-to-face meeting is then arranged with a representative or representatives of the group to discuss funding applications, where appropriate, and this may lead to subsequent meetings. If funding is approved for an organisation (either through the LGP or the EDF), follow-up monitoring visits are conducted by the Community Investment Advisor to ensure the funding has been used appropriately and for the purpose for which it was given.

In 2008, the Community Investment Advisor had 139 meetings with various representatives within these voluntary and community groups. This was in addition to two public information open days held at the Belmullet office around the re-launch of the LGP in January 2008, which was attended by 52 people. In 2009, she had 209 meetings with various community representatives of funded voluntary and community groups, and several additional queries on funding from new contacts.

Whilst the meetings/visits associated with the community investment programmes are primarily linked to funding, updates on the Corrib project are also given by the Community Investment Advisor, and feedback on the project is freely given by these groups, which in turn helps to inform SEPIL's understanding of the community and thus it's decision-making in it.

3 PROJECT ALTERNATIVES

3.1 INTRODUCTION

The consideration of alternative routes and designs for the Corrib Onshore Pipeline has been the main focus for the planning of this project. The development of the various options has been approached by a multi-disciplinary team including environmental and technical specialists as well as stakeholder liaison personnel and has involved consultation with statutory bodies, non-governmental organisations and members of the public. The main objective in the consideration of alternatives was to find the best balance between community, environmental and technical criteria.

This process of considering alternatives resulted in the proposal set out in the statutory applications and accompanying EIS submitted to An Bord Pleanála, the Department of Communications, Energy and Natural Resources (DCENR) and the Department of Agriculture Fisheries and Food (DAFF) in February, 2009. The alternatives have now been revisited following an invitation from An Bord Pleanála, in a letter dated 2nd November, 2009, for SEPIL to modify the pipeline route between identified chainage points (Ch. 83.91 to Ch. 89.55) such that it '*would be generally in accordance with that indicated as Corridor C (that is, within Sruwaddacon Bay) in the route selection process*'.

This chapter summarises the alternative routes considered and presented in the February 2009 applications as outlined above, as well as the alternatives considered since the receipt of An Bord Pleanála's letter in November 2009, as follows:

- Alternative onshore pipeline routes;
- Alternative construction methods applicable to the route selected; and
- Alternative options for the design and configuration of the Landfall Valve Installation (LVI)

3.2 NEED FOR THE DEVELOPMENT

The evaluation of alternatives in the context of the EIA process has been carried out on the basis of the current status of the Corrib Gas Field Development project, having regard also to the considerations of An Bord Pleanála in respect of the pipeline route proposed in the 2009 EIS.

The project had received all principal consents for its development in 2002, and consequently the various route options and landfall valve designs were initially evaluated on the basis of the already approved project, supplemented by the reports issued by Advantica and the Technical Advisory Group (TAG) appointed by the (then) Minister for Communications, Marine and Natural Resources (see Preamble). The 'no development option' was also considered in this context. Following receipt of An Bord Pleanála's invitation to modify part of the 2009 proposed pipeline route, it has been necessary to carry out a further evaluation of the alternatives in respect of the modified route (including again considering the 'no development option').

The original pipeline route was approved and the pipeline granted consent under Section 40 of the Gas Act in 2002. Although the normal operating pressure of the pipeline as consented at that time was 110 barg or less, conditions of the consent stipulated that the pipeline should be routed a minimum of 70m from the nearest dwelling. This condition was associated with the design pressure of the pipeline, which had been set to 345 barg. This was then revised to 144 barg as a result of TAG's recommendations arising from the Independent Safety Review carried out by Advantica in 2005/2006.

The need to modify the permitted route of the onshore pipeline arose out of the project impasse in 2005, when a small number of landowners and local residents who did not accept the Compulsory Acquisition Orders issued for the development, prevented SEPIL from accessing lands for the construction of the onshore pipeline. Aspects associated with the characteristics of the Corrib Onshore Pipeline in this area had caused concern for sections of the local community. These concerns mainly related to the safety and integrity of the pipeline, and the risks it was perceived to pose for the community living near to it (see also Chapter 2). This led to local protests and the appointment of TAG, to manage an independent safety review of the Corrib Onshore Pipeline.

The route proposed in the statutory applications in 2009 was developed following a recommendation by independent mediator Peter Cassells, made in his report: 'Report and Recommendations from Mediation, (2006)', to "modify the route of the pipeline in the vicinity of Rossport to address community concerns regarding proximity to housing" (see Preamble). A modification to the route as recommended by Cassells could not be accommodated within the existing (2002) consents. Consequently, in 2009 SEPIL applied for the necessary consents for the modified route, including consents under the Gas Act, the Strategic Infrastructure Act and the Foreshore Act.

The mechanical design of the Corrib Onshore Pipeline is linked to the offshore pipeline design. The offshore design features have not changed materially since originally proposed in 2001. The diameter, wall thickness and grade of steel used for the Corrib Onshore Pipeline have been determined in the context of the overall project design, details of which are found in Appendix Q.

3.3 NO DEVELOPMENT OPTION

The implication of the 'no development' option (i.e. if the proposed Corrib Onshore Pipeline did not go ahead) is that the Corrib Field Development would not be realised. This option would ultimately result in decommissioning of the Gas Terminal at Béal an Átha Buí (Bellanaboy), which is under construction, the existing offshore pipeline extending to the Corrib Field from the established landfall at Gleann an Ghad (Glengad), and the seabed facilities in the Corrib Gas Field itself. The cumulative impacts of the project as set out in Chapter 17 would not occur.

In the context of the above, and having regard to national policy as well as regional and county development plans, the 'no development' scenario is not considered to be a realistic option.

3.4 ALTERNATIVE ROUTE OPTIONS

The main objective of the Corrib Onshore Pipeline route selection process which commenced in early 2007 was to find a suitable and feasible alternative to the originally consented route. As part of this process, a number of options were examined by a multi-disciplinary team. A qualitative route selection process was used, to identify a route considered to provide the best balance between the relevant community, environmental, and technical criteria. This resulted in the eventual selection of a proposed route as set out in the applications and associated Corrib Onshore Pipeline EIS submitted in 2009.

The route selection process for the 2009 EIS was carried out in the following main steps:

- Development of route selection criteria;
- Identification of study area;
- Identification of indicative route corridor options;
- Short-listing of route corridor options;
- Detailed corridor development including identification of variations;
- Development and selection of a preferred route.

3.4.1 Route Selection Criteria

The route selection criteria were established early in the route development process on the basis of community input in combination with relevant statutory, technical, environmental and project requirements. The route selection criteria used are listed below:

Community Criteria

- Maximise safety.
- Minimise impacts on people.
- Proximity to dwellings/public centres – (e.g. how close will the pipeline be to houses/schools, etc).
- Planning/land use – (e.g. will there be planning restrictions for houses close to a pipeline).
- Landowner consent and number of affected landowners / residents.

Environmental Criteria

- Minimise impacts on wildlife and habitats – (e.g. impacts to sensitive ecosystems and environmentally designated sites such as: Special Areas of Conservation (SAC), Special Protection Areas (SPA), Natural Heritage Areas (NHA).
- Avoid impacts on archaeology and cultural heritage.
- Minimise visual impact.

Technical Criteria and Project Requirements

- Pipeline construction and operation (e.g. access, complexity and hazards associated with both onshore and offshore construction of the pipeline).
- Optimise pipeline design and operation.
- Minimise pipeline length and distance to the offshore gas field.
- Location of and access to landfall valve installation.
- Impact on overall project programme and economic factors.

3.4.2 Identification of Route Corridor Options

In June 2007 a total of eight indicative route corridor options (see Figure 3.1) were identified on the basis of desk based studies (including flora and fauna, archaeology, geology and landscape) and vantage point surveys of the study area, in parallel with community and statutory consultation. The eight corridors extended from four different landfall points to the Bellanaboy Bridge Gas Terminal. Technical and environmental specialists examined the route corridor options, and subsequently short-listed three of the eight corridors – Corridors A, B and C.

3.4.3 Short-listed Route Corridor Options

Three route corridors (A, B and C) representing the corridors with the least environmental and technical constraints were short-listed in September 2007. These corridors all commenced at the previously approved landfall location at Gleann an Ghad (Glengad); the alternative landfalls having been found to be less attractive from an environmental and project schedule point of view than that already permitted. The reasons for not short-listing the other five corridors (D-H) were as follows:

Corridor D (An tInbhear (Inver Upland))

- Over 5km of this corridor was through areas of peat, and while the route was not entirely through designated conservation sites, some parts of the route contained intact blanket bog, and the requirement to protect such habitat added technical challenges particularly for reinstatement.

- The first 2km of the corridor were close to human habitation and raised issues associated with impact on development potential.

- There were a number of recorded archaeological features within this corridor.

Corridor E (An tInbhear (Inver) / Barr na Trá (Barnatra))

- As for Corridor D, a significant part of the route corridor (over 6km) went through areas of peat, some of which were intact blanket bog.

- Parts of the corridor were closer than the short-listed route corridors to human habitation and areas with development potential.

- There were a number of recorded archaeological features within this corridor.

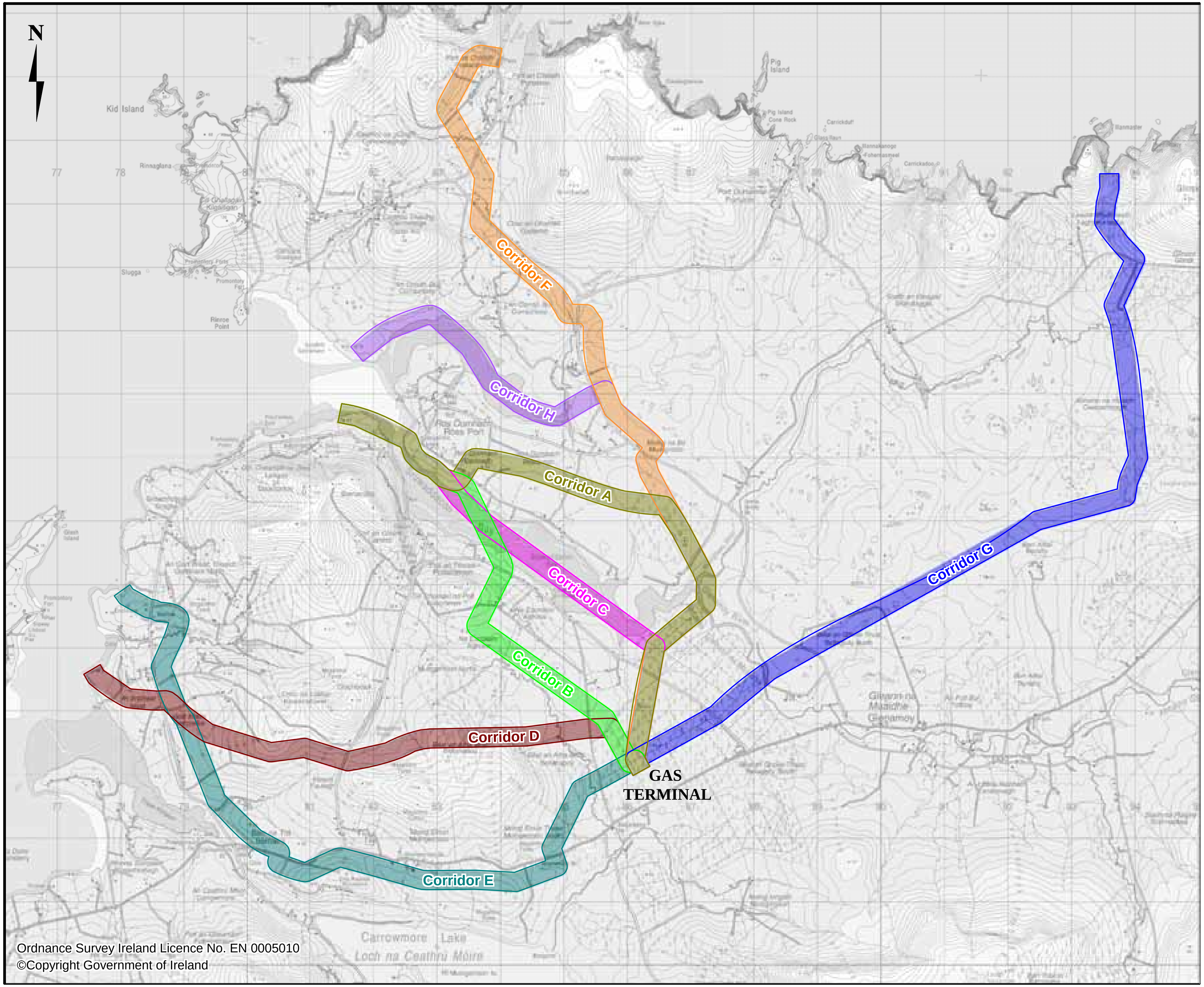
Corridor F (Port an Chlóidh (Portacloy))

- As for Corridor D, a significant part of the route (over 9km) went through areas of peat, some of which was intact blanket bog.

- The associated landfall was narrow and steep, with a rocky approach, which meant the possibility of difficulties with pulling-in the offshore pipeline.

- It added over 19km to the overall offshore and onshore pipeline route, with associated flow and pressure disadvantages.

- It was difficult to find a suitable location for the landfall valve installation.



LEGEND:

Preliminary Route Corridors

- **Corridor A** **Rossport**
- **Corridor B** **Aghoos**
- **Corridor C** **Sruwaddacon Bay**
- **Corridor D** **Inver Upland**
- **Corridor E** **Inver / Barnatra**
- **Corridor F** **Portacloy**
- **Corridor G** **Glinsk - Glenamoy Bog**
- **Corridor H** **North Bay**

Preliminary Route Corridors

Figure 3.1

File Ref: COR25MDR0470Mi2146A03
Date: May 2010

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Corridor G (Glinsce (Glinsk))

- The corridor traversed approximately 6km of the Glenamoy Bog Complex cSAC, through some of the more intact and significant parts of the lowland blanket bog (EU Annex 1 Habitat)

- It was considered that it would not be possible to reinstate the route of the pipeline without impinging on the integrity of the Glenamoy Bog Complex cSAC.

- This corridor represented major technical and logistical challenges to construction. There was deep peat in these areas and limited access. These issues were predicted to pose difficulties during construction.

- The associated landfall was narrow and steep with a rocky approach, which increased the possibility of difficulties with pulling-in the offshore pipeline.

- Tunnel construction and landfall installation on the steep and exposed beach at the landfall associated with this corridor would have represented very high-risk operations and could have involved significant technical difficulties.

- The potential amount of rock excavation across the beach and through the near shore would have represented additional environmental risks.

- This corridor added over 20km to the overall offshore and onshore pipeline route, with associated flow and pressure disadvantages.

Corridor H (North Bay)

- Machair habitat (EU Habitats Directive Annex 1 Habitat) was present at the associated landfall site.

- The intertidal approach ran through the Rinroe Brent Goose feeding area. This is one of two main feeding areas for this species, numbers of which in this area are considered to be internationally significant.

- Pipelay through the offshore approach to the landfall had potential to cause changes to the sand formations at the mouth of Sruwaddacon Bay where tidal flows are very strong.

- Access for machinery to the area would be difficult. It would require the construction of temporary and permanent roads, which could have had lasting impacts on the local habitat.

Subsequent to the short-listing, studies and surveys continued for the three identified corridors, and the various possible construction methods were evaluated.

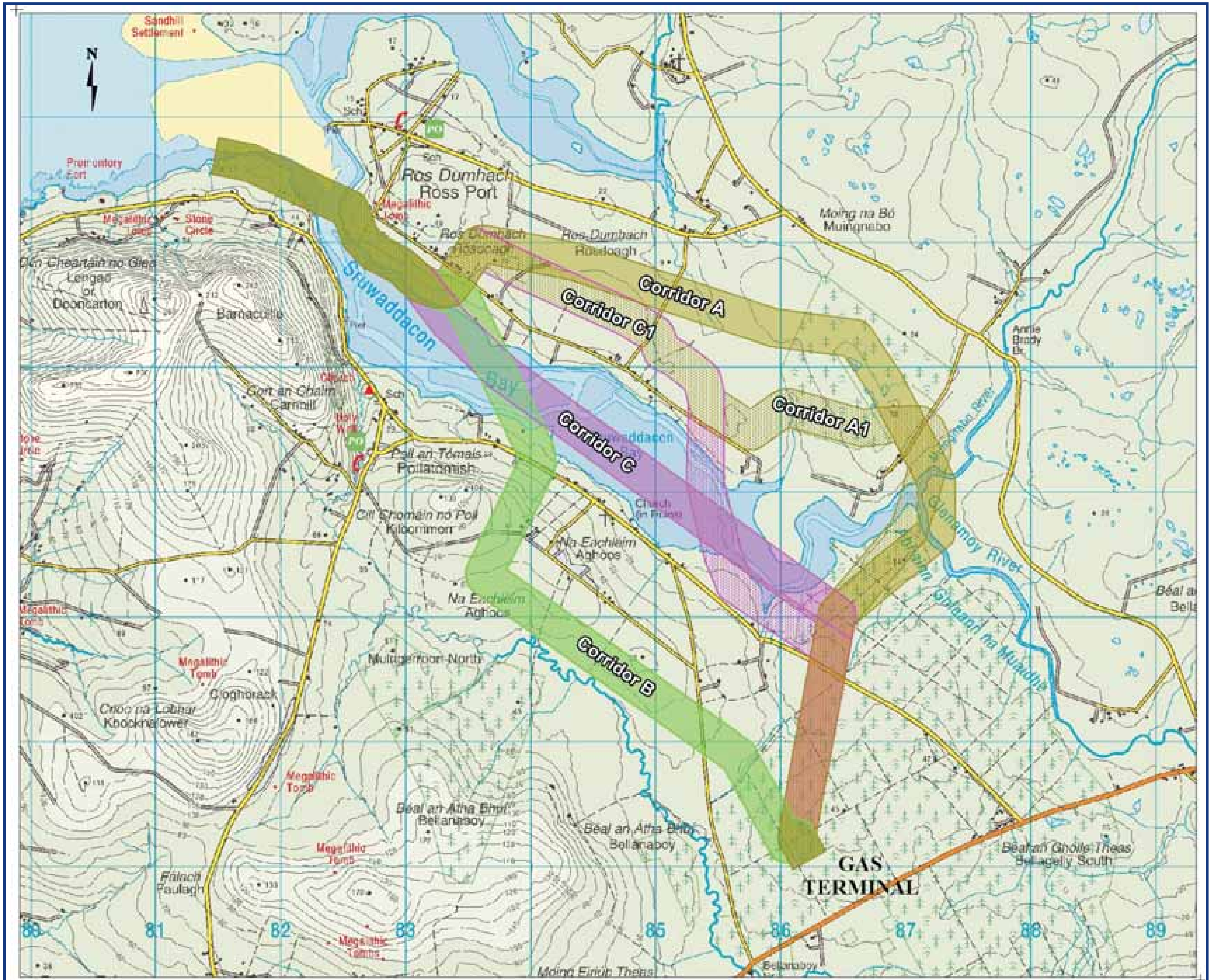
3.4.4 Variations to Short-listed Route Corridor Options

As significant parts of Corridor A traversed the Glenamoy Bog Complex cSAC, a variation to Corridor A was developed to minimise impact on this designated site. This alternative corridor was termed Corridor A1 (see Figures 3.2a and 3.2b).

A variation to Corridor C was developed after additional marine ecology surveys were carried out to identify habitats or species likely to be of commercial, scientific or conservation value. In addition, detailed consideration by the project engineers and environmental specialists was also undertaken for open cut and trenchless construction methodologies for traversing Sruwaddacon Bay. This included a geophysical survey and modelling of the hydrodynamics of the bay to understand the potential impacts of the different construction methodologies being considered at that time.

These assessments indicated that open cut construction methods for longer crossings of the bay would result in greater environmental and technical risks. It also concluded that the trenchless construction methods considered at that time (Horizontal Directional Drilling (HDD) or Direct Pipe micro-tunnelling) for bay crossings greater than one kilometre would be more difficult to achieve without surface intervention, and that conventional construction using open cut methods would probably take more than one season to complete. Consequently, Corridor C1 emerged as variation to Corridor C with a shorter crossing of Sruwaddacon Bay (see Figures 3.2a and 3.2b).

These, five corridor options, namely A, A1, B, C and C1 were then assessed



Detailed Route Corridor Development - Variations

Figure 3.2a

File Ref: MDR0470GrEIS101 RevA03
Date: May 2010

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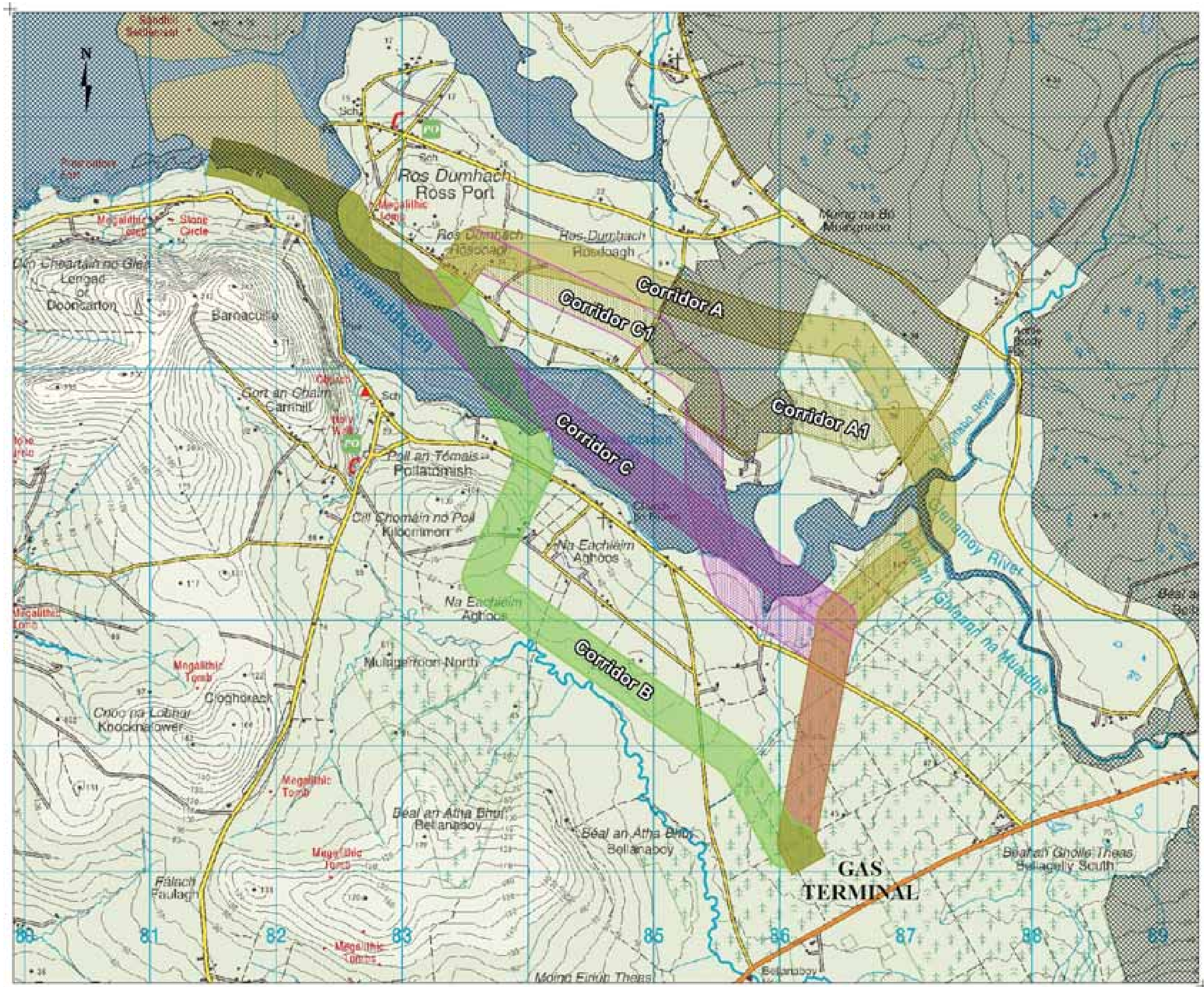

Detailed Route Corridor Development - Variations showing Conservation Designated Sites

Figure 3.2b

File Ref: MDR0470GrEIS102 RevA03
Date: May 2010

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3.4.5 Comparison of Alternative Routes and Final Route Selection

At the final stage of the route selection process the actual routes within the corridors were identified and evaluated. This evaluation involved consultation with the local community, as well as with statutory and non-statutory bodies.

After further assessment of the short-listed corridors and their variations, Route C1 was selected on the basis that it represented the route with the best balance of community, environmental and technical constraints whilst being acceptable from an environmental point of view. The main reasons for choosing C1 were as follows:

- Routes in **Corridor A** traversed longer and more sensitive areas of intact blanket bog, including bog pools, in the Glenamoy Bog Complex cSAC than Route C1.

- **Route A1** crossed a longer section of bog within the Glenamoy Bog Complex cSAC than Route C1 although it avoided the more sensitive intact bog (which includes bog pools) to the north. There was also documented landowner opposition along this route.

- The bay crossing associated with **Route B** was approximately 40% longer than the longest crossing associated with Route C1, with greater risk of technical difficulties of trenchless works due to the additional length. Also this route did not completely avoid those intertidal areas of the bay that are more favoured by over-wintering and resident bird species. A section of Route B lay within the catchment of the na hEachú (Aghoos) branch of the Bellanaboy River which flows into Carrowmore Lake (the main source of local drinking water and a designated conservation site (cSAC and pSPA). There would therefore be some risk of impact to these during the construction period from surface water run-off. In addition, there was documented landowner opposition along this route.

- Route C (from Ros Dumhach (Rossport) to na hEachú (Aghoos)) was approximately 3.6 times longer than the upper crossing on Route C1. Alternative specialised construction methods including HDD and Direct Pipe micro-tunnelling had been examined for this length of crossing. It was found that these trenchless construction options would require a combination of technologies and a number of intermediate pits within the bay, and that this would greatly increase the complexity and risk associated with the operation (see Section 3.5 below). An open cut crossing would have a higher risk of interfering with the hydrodynamics of the bay. The duration of construction of this route was also more likely to impinge on periods of seasonal environmental sensitivity, as it was estimated that it would extend over two construction seasons. It was therefore concluded (on the basis of the alternatives considered at that time) that choosing Route C would be untenable in terms of the EU Habitats and Birds Directives on a project where alternatives clearly existed.

Route C1 had a number of advantages over the alternative routes as follows:

- The crossings of Sruwaddacon Bay associated with Route C1 were shorter (compared to Routes B and C), and were within the range considered feasible for ‘Direct Pipe micro-tunnelling’, the proposed construction methodology, which would minimise impact on the bay and the pSPA/cSAC;

- The upper (approximately 1km) crossing of the bay largely avoided the intertidal areas of the Bay most favoured by over wintering and resident bird species; For the shorter upper crossing, the works could be completed in less time, which would reduce the potential for impacting on seasonal environmental sensitivities such as the movement of salmonids and presence of over-wintering birds; and

- Although the route traversed a short section of the Glenamoy Bog Complex cSAC, it was routed at the very edge of the cSAC to minimise potential impact on the bog.

3.4.6 Corridor C and the Proposed Route

Following receipt of An Bord Pleanála's invitation to modify the pipeline route between identified chainage points (Ch. 83.91 to Ch. 89.55) such that it '*would be generally in accordance with that indicated as Corridor C (that is, within Sruwaddacon Bay) in the route selection process*' (see Figure 3.3), the considerations relating to Corridor C as described above have been re-examined by technical and environmental specialists.

A key consideration was to identify a construction methodology which would minimise impact on Sruwaddacon Bay and in particular the species and habitats associated with the pSPA and cSAC. A number of alternative construction methods were examined, including some which were not considered previously, in parallel with developing a route which would satisfy An Bord Pleanála's requirements in terms of proximity to housing, traffic impact and residential amenity.

As described in Section 5.5 it is now proposed to install the onshore pipeline in a segment lined tunnel between Gleann an Ghad (Glengad) and na hEachú (Aghoos). As these points represent the locations of the previously proposed micro-tunnelling compounds (western end of lower crossing at Gleann an Ghad (Glengad) and southern end of upper crossing at na hEachú (Aghoos), these points were used to represent the end points for the route modification. The actual pipeline chainages have been up-dated as a consequence of the design of the modified pipeline route, which is shorter than the 2009 proposed pipeline route.

The proposed tunnel alignment as shown on Figure 3.4 was then developed. The following constraints have been applied to the routing:

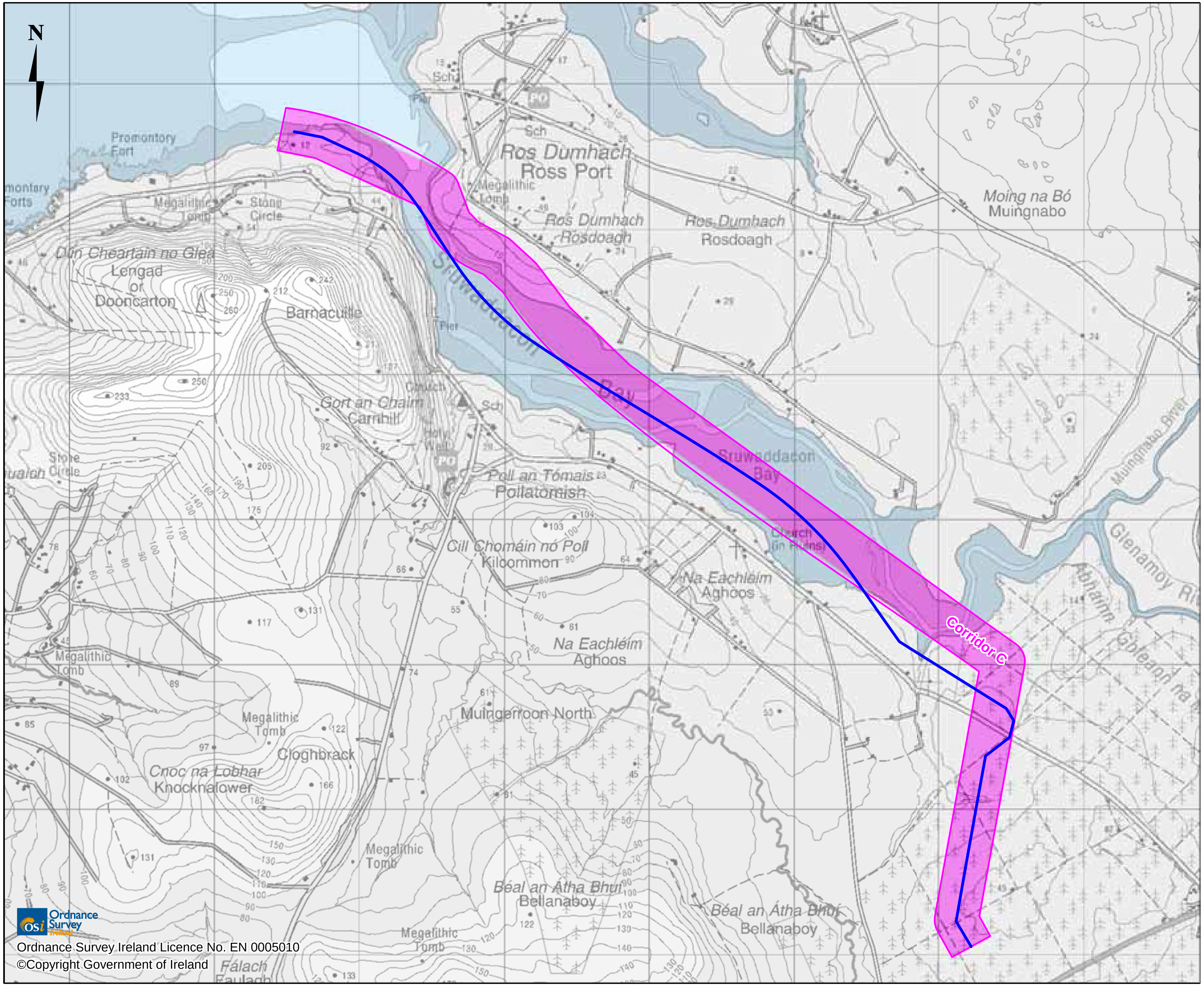
- The route between Poll an tSómais (Pollatomish) and Ros Dumhach (Rossport) is aligned to generally maximise distance to housing on each side of the bay;

- The route alignment seeks to minimise tunnelling duration as:

    - It represents a feasible trajectory for tunnel construction and pipeline installation. (The minimum bending radius of the gas pipeline is the principal constraint in this regard).

    - It avoids a rocky area east of the channel at the narrow section of the bay.

The trajectory of the proposed tunnel has also resulted in a minor route realignment within the proposed tunnelling compound at hEachú (Aghoos). This is a direct consequence of the requirement to tunnel from na hEachú (Aghoos) to Gleann an Ghad (Glengad) rather than to the northern side of Sruwaddacon Bay due to the different tunnel trajectories.



LEGEND:

Corridor C

Proposed Pipeline Route 2010

Corridor C and Proposed Pipeline Route

Figure 3.3

File Ref: COR25MDR0470Mi2470A02
Date: May 2010

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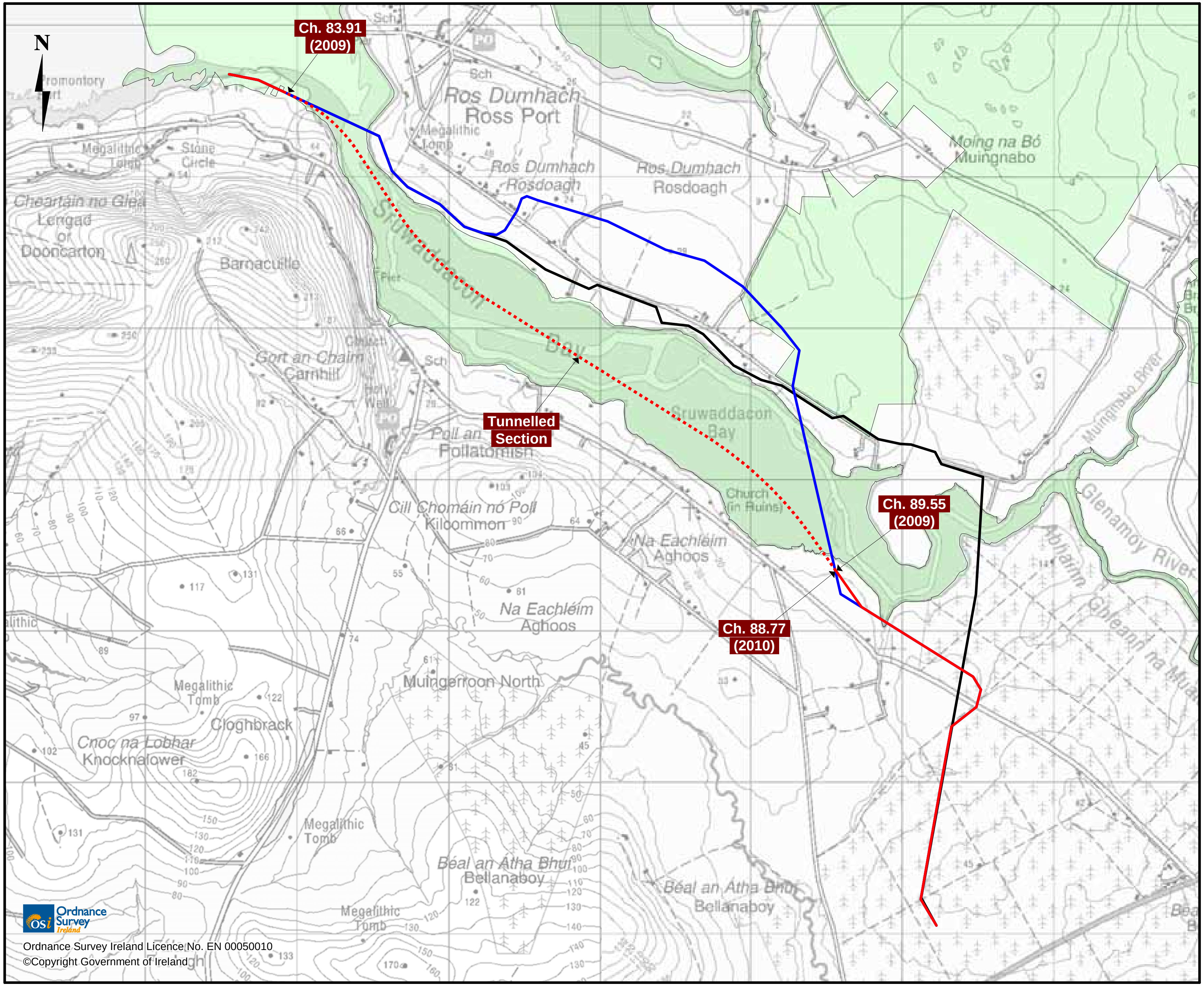
Corrib natural gas

RPS



LEGEND:

- Proposed Route 2010
- Proposed Route 2009
- Previously Approved Route
- Glenamoy Bog Complex (SAC) (Indicative)

Note:
Approximate Chainage Points Shown

Proposed Pipeline Route Showing Tunnelled Section

Figure 3.4

File Ref: COR25MDR0470Mi2107A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

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3.5 ALTERNATIVE CONSTRUCTION METHODOLOGIES

Onshore pipelines on land (including minor watercourse crossings) are typically constructed using a standard open cut 'spread' technique (see Chapter 5). No alternatives to conventional on land construction were considered outside of peatland areas as this approach already represents the minimum environmental impact for pipeline construction.

Alternative pipeline construction techniques have been considered for that portion of the route within Sruwaddacon Bay, and for areas of peatlands. The consideration of alternative techniques for both these parts of the proposed pipeline route is outlined below, taking into account the potential environmental impact of each of the techniques.

3.5.1 Sruwaddacon Bay

Approximately 4.6km of the proposed modified route is through Sruwaddacon Bay. This presents significant technical and environmental challenges which are summarised in Table 3.1 below.

Table 3.1: Construction and Environmental Considerations in Estuarine Environments.

Technical Considerations	Environmental Considerations
Construction difficulties in the wet environment.	Minimise disturbance to wildlife and habitat.
Tidal effects including impact on access for plant and personnel leading to longer construction period.	Impact on wildlife and habitat during periods of increased sensitivity.
Potential for scour as a result of high tidal flow velocities.	Impact to habitat – changes to flow pattern.
Length of crossing and duration of works.	Impact on wildlife and habitat during periods of increased sensitivity.
Excavations/disturbance of seabed.	Release of sediment with potential impact on fish and benthos.
Accidental spills.	Impact on benthos and wildlife.
Use of stone in construction.	Residual impact of importation of non-indigenous material.
Reinstatement of trench / surface works (where applicable).	Minimise residual impact on wildlife and habitat.

A number of alternative construction options, and combinations of methods, were considered for this section of the onshore pipeline route. Table 3.2 summarises the main environmental and technical aspects associated with each of the alternative construction methods. This includes construction methods which have been used in intertidal areas on other projects including open cut methods, but which for various reasons do not meet the requirements of the Corrib Onshore Pipeline project. Among the main construction options considered were:

- Conventional open cut construction;
- Specialised open cut method;
- Trenchless methods conventionally used for pipeline construction (Micro-tunnelling (Direct Pipe/Pipe Jacking) and Horizontal Directional Drilling (HDD); and
- Segment lined tunnelling.

Conventional open cut construction (pre-trenching followed by pull-in of assembled pipeline into open trench) would require extensive plant to be located in the bay for a significant duration. The subsequent reinstatement and consolidation of the seabed/river bed would take some time to be achieved, and therefore would result in temporary habitat loss relevant to the pSPA and cSAC. This construction option was therefore ruled out at an early stage.

A study was also undertaken to identify a more effective specialised open cut technique for this project (sheet piling in sections) which could achieve construction within a reduced programme and thereby minimise the overall impact of the construction of the pipeline. This study concluded that such methods would be technically feasible, but on detailed examination it was concluded that the time required for reinstatement and consolidation of the trench could result in temporary habitat loss relevant to the pSPA and cSAC. Therefore, this open cut method was also ruled out.

Trenchless construction methods normally used in pipeline construction include micro-tunnelling (Direct Pipe/Pipe Jacking) and Horizontal Directional Drilling (HDD). These methods had previously been considered for crossings of Sruwaddacon Bay. A construction option involving both methods and a minimum of 3 intermediate pits in Sruwaddacon Bay was developed for Corridor C. This comprised:

- Micro-tunnelling (Direct Pipe / Pipe Jack): 2 x 300m long drives from land at either side of crossing to intermediate pits located within Sruwaddacon Bay.

- HDD method: 2 x ‘twin bore’ parallel 1,750m long drives from an intermediate pit within Sruwaddacon Bay at the middle of the crossing. HDD activities would take place from a barge in Sruwaddacon Bay (located at the middle pit). Two HDD drives would be bored in each direction (total of 4 HDD drives) to intermediate pits within Sruwaddacon Bay; connections would be made at these intermediate pits to the micro-tunnelling tunnels described above. For this (middle) section of the crossing, the gas pipeline would be installed in parallel with a services conduit for carrying the umbilicals etc. Within the micro-tunnel sections at each end of the crossing, the gas pipeline and associated services would be bundled.

The complexity of the combined micro-tunnelling / HDD approach, including significant works within Sruwaddacon Bay and an anticipated duration of at least 2 construction seasons, had contributed to ruling out Route C during the previous route selection process. The HDD method would require the use of large volumes of bentonite under pressure with which to maintain a tunnel bore open until the gas pipeline (and for the parallel services conduit) could be inserted. It was therefore considered that it would represent an unacceptable risk of bentonite escape into Sruwaddacon Bay given that the ground conditions within the bay consist of gravel layers and highly fractured and layered rock. Overall, it was considered that the impacts associated with the intermediate pits/stations and the logistics surrounding these gave rise to impacts including temporary habitat loss and disturbance, relevant to the pSPA and cSAC. The combined micro-tunnelling / HDD approach was therefore ruled out.

The remaining option was segment lined tunnelling, which had not previously been considered as an alternative construction method. This method which is described in further detail in Chapter 5 involves building a larger tunnel (4.2m outer diameter) than that associated with HDD or micro-tunnelling, and can be constructed without intermediate pits, thereby avoiding surface disturbance within the cSAC / pSPA.

However, segment lined tunnelling requires manned tunnelling, i.e. the tunnelling workforce works at the front end of the tunnel bore, assembling the tunnel’s concrete lining in segments just behind the tunnel boring machine. This methodology represents tried and tested technology, has a high degree of accuracy, but requires significant support systems and logistics. It is also slow when compared to more conventional pipeline installation techniques.

A 3.5m internal diameter (4.2m outer diameter) segment lined tunnel has been proposed for the onshore pipeline and services. It was selected for the following reasons:

- It is suitable for a wide range of soil conditions, and can be used for a tunnel trajectory with varying soil conditions;

- It minimises the risk of bentonite releases as bentonite is only used at the tunnel face;

- It minimises the potential impact on the seabed and overall disturbance to the bay (it is extremely unlikely to require surface intervention – see Section 5.5.1.3); and

- It is the only trenchless construction method that can be used for such long crossings without intermediate pits/stations in conditions such as those found in Sruwaddacon Bay.

The reasons segment lined tunnelling had not previously been considered as an alternative include:

- Segment lined tunnelling would significantly extend the construction programme, and would delay the start of gas production from the Corrib Field. The construction programme associated with the previously proposed route was 12 months, whereas the tunnelling project is estimated to take approximately twice as long to complete.

- Segment lined tunnelling would add significantly to the extent of the temporary works, as well as overall project capital cost

- The 2009 proposed development complied with all relevant gas industry codes and standards Therefore, segment lined tunnelling would not have been justified.

- The 2009 proposed development was considered to represent a technically feasible construction project, both in terms of the Sruwaddacon Bay crossings and on land.

3.5.1.1 Tunnelling from One Side or Two Sides

The overall average rate of tunnelling estimated for the proposed tunnel is 11m per day. The options of tunnelling from one or two sides were examined in order to determine if overall tunnelling programme and thereby construction phase duration could be reduced. The options studied were:

A. **Tunnelling from One Side na hEachú (Aghoos)**: Segment lined tunnel (4.9km long x 4.2m outer diameter) starting at na hEachú (Aghoos) and ending at Gleann an Ghad (Glengad). This option comprises one tunnelling operation based at na hEachú (Aghoos) and a reception pit at Gleann an Ghad (Glengad). (For reasons outlined below, tunnelling from the Gleann an Ghad (Glengad) side only was not considered to be an acceptable option).

B. **Tunnelling from Both Sides (na hEachú (Aghoos) and Gleann an Ghad (Glengad)**: Segment lined tunnel constructed in two sections, meeting at a point beneath Sruwaddacon Bay, without the requirement for an intermediate pit. This option comprises a tunnel from na hEachú (Aghoos) (1.9km x 4.2m O.D.) and a tunnel from Gleann an Ghad (Glengad) (3.0km x 3.5m O.D.).

It is estimated that by tunnelling from one side only, the duration of tunnelling operation itself (not including mobilisation and pipeline installation) for the 4.9km tunnel would be approximately 14.5 months.

When tunnelling from both sides both tunnels need to connect, a process called “docking”. Several docking techniques have been used in the past, which include “drive by”, where the tunnels meet side by side after which the tunnels are joined sideways, “face to face”, where the tunnels of equal diameter meet head on, and “drive in”, where one tunnel with a smaller diameter enters a larger diameter tunnel head on. The “drive in” method has been considered, as this would carry the smallest risk for the need of an intermediate pit in the bay.

In order to prepare the larger tunnel for the arrival of the smaller tunnel, the larger TBM needs to be removed and the tunnel prepared, which takes approximately 2 months. The full advantage, in terms of overall project programme, of tunnelling from both sides (from Gleann an Ghad (Glengad) and from na hEachú (Aghoos)) would be realised if the smaller diameter tunnel would arrive at the prepared larger diameter tunnel “just in time”.

Therefore, the different lengths of tunnel considered for this option were chosen on the basis of optimising the construction programme. It is estimated that the overall duration of tunnelling for this option would be approximately 9 months, i.e. a reduction of approximately 5.5 months. Tunnelling from one side (from na hEachú (Aghoos)) was selected for the following reasons:

- The proposed site for the tunnelling compound at na hEachú (Aghoos) is located approximately 400m from the nearest occupied house and it is well serviced by the improved section of the L1202. In this location, the potential for traffic, visual, lighting and noise impacts from the tunnelling operation on the local community are minimised.

- By tunnelling from na hEachú (Aghoos) only, potential impacts on local residents in the areas of Gleann an Ghad (Glengad) and Poll an tSómais (Pollatomish) in terms of traffic, visual, lighting and noise are reduced as far as possible. The presence of a tunnelling compound at Gleann an Ghad (Glengad) has been reduced in duration from approximately 15 months to approximately 12 months.

- The volumes of construction traffic accessing Gleann an Ghad (Glengad) via Poll an tSómais (Pollatomish) are minimised. Excavated materials from the tunnel will be removed from na hEachú (Aghoos) and transported from the site via the L1202 which has been widened and improved.

3.5.1.2 Tunnel Grouting

The following options were considered in respect of the final finish of the tunnel:

- Fully grouted tunnel. This would entail filling the remaining void spaces in the tunnel with grout (typically cement) once the pipeline and services here been installed

- Partially grouted tunnel. This would mean partially grouting the tunnel with cement to ensure encasing the installed pipeline with cement grout in the lower section of the tunnel, but leaving the remaining upper void space within the tunnel to be filled with water.

- An open tunnel. This would mean that the tunnel would remain permanently accessible and fitted with necessary lighting, ventilation and permanent access points.

The primary considerations in deciding how to finish the tunnel were:

- Safety of the gas pipeline and associated services;

- Compliance with relevant codes and standards;

- Potential for using the tunnel for other services in the future; and

- Potential requirement for maintenance of the services within the tunnel.

It is proposed to grout and seal the completed tunnel once the gas pipeline and associated services have been installed. This option has the following advantages:

- The pipeline will be completely protected within the grouted tunnel. As described in Chapter 4 and Appendix Q, the pipeline will be inspected internally on a periodic basis using an intelligent pipeline inspection gauge (PIG) and possible corrosion will be monitored by the cathodic protection system.

- A fully grouted tunnel is preferable from a maintenance point of view in that there is no manned entry required.

- The fully grouted configuration will ensure the long term integrity of the tunnel structure.

3.5.1.3 Vertical Alignment of Tunnel

The following options were considered regarding the vertical alignment of the tunnel:

A. Tunnelling mainly through sands and gravels i.e. the superficial deposits; and

B. Tunnelling through rock i.e. below the superficial deposits

The main aspects considered were as follows:

- Duration of tunnelling activities: Tunnelling in soft sediment (sands and gravels) is normally faster than tunnelling in rock. The average tunnelling speed has been estimated (for a 4.2m diameter tunnel boring machine) to be 14m per day for sands and gravels, and 6-8m per day for rock.

- Construction safety: drilling in rock will increase the number of times that TBM cutting tools need to be inspected / changed. The inspection and replacement of these tools requires personnel to work under an air lock system at the head of TBM. Reduction of such intervention/operations will minimise safety risks.

It is proposed to route the tunnel mainly through sands and gravels. The proposed tunnel alignment is shown in Appendix M1-A (Drawings Dg0401 – Dg0404). The horizontal alignment of the tunnel may deviate by up to 8m on each side. The vertical alignment of the tunnel may vary between a minimum cover of 5.5m and a maximum depth of 10m below the indicated centreline. On the basis of geophysical data acquired for the proposed route, it is estimated that approximately 80% of the tunnel will be through sands and gravels, whereas approximately 20% of the tunnel will be bored through the relatively short sections of rock at na hEachú (Aghoos) and at Gleann an Ghad (Glengad). This option has the following advantages:

- It is estimated that the average tunnelling speed for the proposed tunnel alignment will be 11m per day. This is significantly faster than tunnelling through rock only which is estimated to add approximately 5 - 6 months to the duration of tunnelling.

- Tunnelling mainly through sands and gravels is expected to minimise the need for equipment change-out and intervention.

Table 3.2: Evaluation of Construction Methods considered for Sruwaddacon Bay (Tunnel from na hEachú (Aghoos) to Gleann an Ghad (Glengad))

Methods	Brief Description	Environmental Considerations	Technical Issues
Open cut	Excavation of trench across the bay from the surface. The pipeline is welded onshore and pulled into the open trench and subsequently back-filled. (Open cut methods are similar to standard pipeline construction on land.)	Seabed disturbance resulting from excavation and replacement. Disturbance to lower layers of bottom sediment. Sedimentation effects. Scour effects. Reinstatement difficulties.	Difficulty in keeping trench open. Large amount of excavation required. Access problems. Stockpiling requirements of excavated material. Tidal constraints. Management of suspended materials and sediments. Management of scour. Effectiveness of reinstatement i.e. pipeline must not become exposed.
Dredging	Open cut method using floating plant e.g. cutter suction dredger, hydraulic excavator mounted on floating barge. The pipeline is welded onshore and pulled into the dredged trench.	Seabed disturbance resulting from excavation and replacement. Sedimentation effects. Requires removal of excavated material to a deposition location removed from the excavation. Disturbance to lower layers of bottom sediment. Potential for long-term alteration to the bottom profile of the watercourse. Potential loss of bottom sediments to watercourse due to scour effects. Reinstatement difficulties.	Large amount of excavation required. Storage / loss of material required for backfill. Access problems. Tidal constraints. Management of suspended materials and sediments. Management of scour. Effectiveness of reinstatement i.e. pipeline must not become exposed. Likely requirement for foreign material (rock fill) as permanent backfill above pipeline.
Both sides trenching	Specialist Open Cut method. Both sides trenching involves assembling a pipeline on the foreshore and securing its alignment with piles. Excavations are made along both sides of the pipeline resulting in the pipeline gradually sinking into position. The pipeline is subsequently backfilled with excavated material.	Seabed disturbance resulting from excavation and replacement. Disturbance to lower layers of bottom sediment. Sedimentation effects. Scour effects. Reinstatement difficulties.	Difficulty in achieving desired minimum pipe cover of 1.6m (depends on ground conditions). Access problems. Stockpiling of excavated material. Tidal constraints. Management of suspended materials and sediments. Management of scour. Effectiveness of reinstatement i.e. pipeline must not become exposed.

Methods	Brief Description	Environmental Considerations	Technical Issues
Plough Method	Progressive installation of a pipeline (and/or umbilical) behind a moving plough. The plough is lowered to the desired depth of trench as it moves forward. As the foreshore is ploughed, a space is created into which the pipeline can be laid. As the plough proceeds, the pipeline remains in place and the foreshore closes naturally behind it.	Minimal disturbance to the bed of the watercourse. Low risk of generating suspended solids. Low risk of scour. Reinstatement takes place naturally during construction. Reinstatement is likely to be very effective. Potential surface disturbance from heavy equipment with large traction forces i.e. to pull the plough.	This method would not be suitable for the Corrib Onshore Pipeline, which is made from high tensile steel. At 508mm in diameter and with a wall thickness of 27.1mm, the gas pipeline is very stiff and could not realistically be installed using this method. Required depth of installation (minimum 1.6m cover) could not be achieved. This method could potentially be used for the umbilicals and other services.
Jetting	Jetting uses water to fluidise the sand beneath an assembled pipeline. Applying the jet of water therefore allows the pipeline (or services umbilical) to be sunk into position gradually and effectively	Potential for high levels of sediment disturbance. Disturbance to lower layers of bottom sediment. Sedimentation effects. Scour effects. Reinstatement difficulties.	With a minimum cover requirement of 1.6m, this method was not deemed reliable for installation of the pipeline. Storage / loss of material required for backfill. Effectiveness of reinstatement i.e. pipeline must not become exposed. Likely requirement for foreign material (rock fill) as permanent backfill above pipeline.
Sheet piling in sections	This methodology was developed for consideration for this project. It uses floating plant to install parallel rows of sheet piles within the estuary. The area between the sheetpiles is then excavated and an assembled section of sleeve pipe is brought into position. The operation is carried out in sections >100m long. The gas pipeline and services umbilical can then be pulled into position within the sleeve pipe. This method was considered further since November 2009, incorporating specialised experience in land based and marine based construction. The method was developed along the lines of a moving pipeline spread (approximately 300m long) using land based equipment on a series of connected floating platforms.	This method has the potential for seabed and water column disturbance but because it is undertaken in sections, measures can be incorporated to minimise these impacts. Scour effects. Sedimentation effects. Reinstatement difficulties.	Access. This method uses a number of floating pontoons connected together to form a self contained pipeline spread which generally lies on the seabed. Only for limited periods during spring tides will the pipeline spread float or need to work in deeper water. The pipeline spread advances by floating pontoon sections from the rear of the spread to the front. This must be carried out at suitable periods of tide. Materials will be transported to the pipeline spread on floating plant and lifted into position by crane. The risk of generating suspended materials and sediments is minimised by using suction equipment which pumps excavated material from the trenched area at the front of the spread to the backfilling area at the rear of the spread. All of this activity is confined within the sheet piled area. Management of scour. Proper alignment of sleeve pipe sections.

Methods	Brief Description	Environmental Considerations	Technical Issues
Stone road / embankment method	This methodology uses land- based plant to gradually construct a working platform in the form of a stone embankment that will be above the level of the tide for most of the time. A sleeve pipe is installed in the foreshore from this platform, in a similar way to the one used for the sheet piling option. This method can be used where there is insufficient draft for floating plant.	Importation of large amounts of foreign material (rock) into the watercourse. Significant scour effects. Significant sedimentation effects. Likely duration of this method of construction and potential conflict with environmental constraints (migrating fish and wildfowl). Effectiveness of reinstatement i.e. removal of all foreign material from the watercourse.	Logistics. Large amounts of material movements. Tidal effects and management of water. Access is independent of tide. Potential for significant scour effects that will be difficult to control
Trenchless construction - Horizontal Directional Drill (HDD)	Trenchless method using initial small diameter pilot hole followed by progressively larger reamed holes until pipeline or sleeve pipe (for umbilicals) can be pulled into place below the bottom of the watercourse.	Minimal surface disturbance. Potentially no disturbance. Intervention pit(s) would be required for Sruwaddacon Bay. Use of relatively large volumes of bentonite. Potential for bentonite break out.	The success of this method depends on there being suitable ground conditions. The ground conditions within Sruwaddacon bay are not suitable for HDD. The potential for failure over long crossings is higher than for the Direct Pipe method (see below). The maximum limit of this method in terms of length is approximately 1.75km.
Trenchless - Direct Pipe **(micro-tunnelling)**	Trenchless construction method using a 'full bore' (normally up to approximately 2m in diameter) micro-tunnelling machine (Tunnel Boring Machine – TBM) to install a pipeline underground. The cutting head is attached to the pipeline and driven forward using hydraulic force applied to the advancing pipeline. The pipeline ensures that the bore is kept open as it is being installed. Excavated material is removed through the rear of the pipeline.	Intervention pit(s) would be required for Sruwaddacon Bay. Use of bentonite. Quantities of material generated by the tunnelling process depend on length and diameter of tunnel. For a 2m diameter tunnel, approximately $3.1m^3$ of material needs to be excavated per linear meter.	The method can be applied in a range of soil conditions. In the event of subsurface obstructions not being detected by site investigation, these can be potentially avoided by changing direction/trajectory or removed from the surface (an intervention pit may be required in this event). It may also be possible to remove an obstruction from within the pipeline depending on its diameter (no surface disturbance required). This method has been successfully used in the crossing of the River Rhine (454m), near Worms in Germany. The technology is relatively new and there is no industry experience with longer length tunnels. The limit of the technology currently would be approximately 1km.
Trenchless – Pipe Jacking **(micro-tunnelling)**	Trenchless construction method using 'full bore' (normally up to approximately 2m in diameter) micro-tunnelling machine (Tunnel Boring Machine – TBM) to install a pipeline underground. The cutting head	Intervention pit(s) would be required for Sruwaddacon Bay. Use of bentonite. Quantities of material generated by the tunnelling process depend on length and diameter of tunnel.	The method can be applied in a range of soil conditions. In the event of subsurface obstructions, these can be potentially avoided by changing direction/trajectory or by removing the obstruction from the surface (an intervention pit may be required

Methods	Brief Description	Environmental Considerations	Technical Issues
	is driven forward using hydraulic force applied to the TBM. Concrete pipe sections are added one by one behind the TBM; the growing number of pipe sections are pressed together by hydraulic force and form a sleeve pipe. This keeps the tunnel bore open as it is being installed. Excavated material is removed through the rear of the TBM and sleeve pipe.	For a 2m diameter tunnel, approximately $3.1m^3$ of material needs to be excavated per linear meter.	in this event). It may also be possible to remove an obstruction from within the pipeline depending on its diameter (no surface disturbance required). The application of this technology is in practice generally limited to approximately 1.2km when working in varied soil conditions. Longer pipe-jacking tunnels would require intermediate pits. However, the longest pipe jack is 2.5km, from land in North Germany to a shaft in the Waddenzee.
Trenchless – Segment Lined Tunnelling	Tunnelling using a large TBM (>3m I.D.). The cutting head is driven forward using hydraulic force applied by the TBM to the end of the tunnel already completed. Concrete segments are used to construct the tunnel in rings / sections to the rear of the TBM. These concrete segments are brought through the advancing tunnel for placement behind the TBM. The minimum diameter of segment lined tunnels over longer lengths is approximately 3.5m due to construction personnel access requirements. The tunnel so formed is lined with segments. These keep the tunnel bore open as the pipeline is being constructed. Excavated material is removed through the rear of the TBM and the segment lined tunnel. This method is usually used for large bore tunnels e.g. Dublin Port Tunnel. Has been used successfully for 4km pipeline crossing in Ems, Germany.	The bentonite used for segment lined tunnelling operations is utilised at a low pressure and carefully managed. The risks of any bentonite breakout into the environment are very small. Quantities of material generated by the tunnelling process depend on length and diameter of tunnel. Due to the larger tunnel diameter with segment lined tunnelling, the quantities of materials arising from the tunnelling process are correspondingly large. For a 4.2m diameter tunnel, approximately $13.85m^3$ of material excavated per linear meter, however reuse of some excavated material on site is possible. An intervention pit would only be required in exceptional circumstances. The possibility of there being a requirement for an intervention pit with segment lining is remote.	The method can be applied in a range of soil conditions. . This method can also be used for very long tunnels. This method requires personnel to work full-time (24 hour basis) within the tunnel as work progresses. Relatively slow tunnelling method due to large size and length of time to assemble segments in place (typically 15 - 20 minutes tunnelling / 40 - 45 minutes segment assembly each hour)

3.5.2 Peatlands

Approximately 2.7km of the proposed pipeline route crosses peatlands of varying environmental sensitivity (see Chapter 12). Aspects and potential impacts associated with construction in peatland are summarised in Table 3.3 below.

Table 3.3: Construction and Environmental Considerations in Sensitive Peatland

Technical Considerations	Environmental Considerations
Stability of the pipeline.	Minimise risk of peat instability.
Machinery access. Pipeline construction requires heavy plant and equipment and a stable surface is essential.	Minimise risk of compression of the upper vegetated layers of the bog.
Trench construction.	Avoid creating artificial drainage channels, which would impact on hydrology and natural drainage within the bog.
Working area requirements.	Minimise footprint of working area.
Trench reinstatement.	Minimise residual impact on bog.

Alternative construction methods that were considered for peatland areas included:

- Pipe pull into open trench;
- Trenchless methods (micro-tunnelling, horizontal directional drilling); and
- Specialist open cut techniques.

The three methods and their suitability for use in peatlands are discussed below. Specialist open cut techniques have been selected for the works (see Section 3.5.2.3).

3.5.2.1 Pipe Pull (into open trench)

Construction in peat can be done by excavating a trench and allowing it to fill with water (where this can be achieved naturally). A section of pre-assembled pipeline can then be pulled and floated into position (in stages if necessary) using winches and cables. This method is only suitable for short and straight sections of bog where there is good access to either side for plant and machinery. It has been used successfully on other projects in Ireland in the past. It was considered that this method would not be suitable for the Corrib Onshore Pipeline because of the need to keep the working area narrow in order to protect the bog, and due to the length of sections in bog on the southern side of Sruwaddacon Bay. The method was considered not to offer any environmental or technical advantages for this project. It was also not recommended for the installation of the umbilicals and services because of the limited allowable maximum pull force for these.

3.5.2.2 Trenchless Methods (Micro-tunnelling, Horizontal Directional Drilling)

The use of two trenchless methods, namely micro- tunnelling and horizontal directional drilling, were considered to minimise impact on potentially sensitive areas of peatland (particularly in respect of the blanket bog habitats in Ros Dumhach (Rossport)).

Micro-tunnelling can work well for a range of ground conditions, but is not suitable within peat. Micro-tunnelling could potentially be used to tunnel beneath an area of peat where more suitable ground conditions may exist. However, for a given length of micro-tunnel crossing, the same length would ideally be available above ground to assemble the gas pipeline and services for pull in. Approximately 2.7km of the preferred route is through peatland.

Horizontal directional drilling (HDD) was also considered for construction through peat. This technology is fully developed and can be used successfully over significant distances (depending on pipeline diameter and ground conditions). HDD would have the same disadvantages as those outlined for micro-tunnelling above, but it was also rejected due to the high volumes of bentonite fluid that would be required using this method. Bentonite, which is chemically inert clay used to cool and lubricate the drilling operation, is an essential working fluid for the HDD process. Bentonite is also important to prevent the bore from collapsing (by holding the hole open by virtue of hydro-static pressure) before the pipeline is inserted into place. The characteristics of peatlands are such that there would be significant risk of loss of containment of bentonite fluid during a HDD operation.

It was considered that neither of these two methods would be suitable for this development in areas of peatland.

3.5.2.3 Specialist Open Cut Techniques

The following two alternative open cut methods were considered for construction in areas of peat in addition to the proposed ‘stone road’ method (see Section 5.4):

- Construction of the pipeline trench from a ‘floating’ stone road; and
- Construction of the pipeline trench from a road consisting of bog mats.

The suitability of these methods depends on ground conditions (peat depth, stability, type and environmental sensitivity).

A ‘floating road’ can be constructed in soft ground using a combination of geotextiles, geogrids and stone. These materials are laid on courses to form a composite layer that floats on top of soft ground while providing a stable platform for construction. This system has been used on construction projects in Ireland with good success. However, the ‘floating road’ concept requires some strength in the ground below. In areas that are particularly soft along the proposed route, the floating road would not be as successful especially if the vegetated surface of the bog is removed. Therefore this is not the preferred approach for the proposed development.

Bog mats are commonly used for construction in soft ground including areas of peatland. This approach was used successfully on the Gas Pipeline to the West for Bord Gáis Éireann in 2002 in extensive areas of peatland in Connacht. However, the successful use of bog mats depends on keeping the vegetated surface layer of the bog in place. Although wooden bog mats could be used for short sections of peatland if ground conditions are suitable, it is not the preferred approach for the proposed development.

The ‘Stone Road’ method has been used successfully on the Mayo-Galway Pipeline at Upper Glencullin in the Carrowmore Lake Complex cSAC. When used in designated or intact peatlands, the method involves removing and preserving the upper vegetated surface layer of the bog in sections before construction and subsequently putting this back on the surface of the disturbed bog during reinstatement. The pipeline and services are installed within the stone road. The Stone Road method is preferred as it will provide a stable working platform for construction as well as securing the long term stability for the pipeline within the bog. The route of the Mayo-Galway pipeline at Upper Glencullin is showing good signs of recovery. This method therefore offers technical and environmental advantages despite logistical challenges.

3.6 ALTERNATIVE DESIGNS

3.6.1 Landfall Valve Installation – Alternative Pressure Limiting System Designs

SEPIL committed, in accordance with Advantica’s recommendations, to redesign the landfall valve installation, previously proposed to be a manual shut-off valve, to provide additional safety features and to provide assurance to the local community of the safety of the overall onshore pipeline design.

The Advantica report also recommended that the UK Offshore Operators Association (UKOOA) risk-based decision-making framework be used as guidance for decisions that have safety implications. For an overpressure protection (in this EIS termed pressure limitation) system, the UKOOA guidance requires that non-technical issues be given due attention and consideration. Consequently, the concept selection of a pressure limiting system was conducted, taking into account technical, environmental and community aspects.

The Corrib pipeline was originally designed for 345 barg, which represented the maximum pressure that could occur in the system plus a safety margin. This pressure (320 barg) is the 'closed in tubing head pressure (CITHP)', which could occur if the pipeline was shut off at the Gas Terminal without the valves at the wellheads closing. In practice, the risk of this happening would be minimal. Figure 3.5 illustrates the predicted decline in CITHP over time for the Corrib Field.

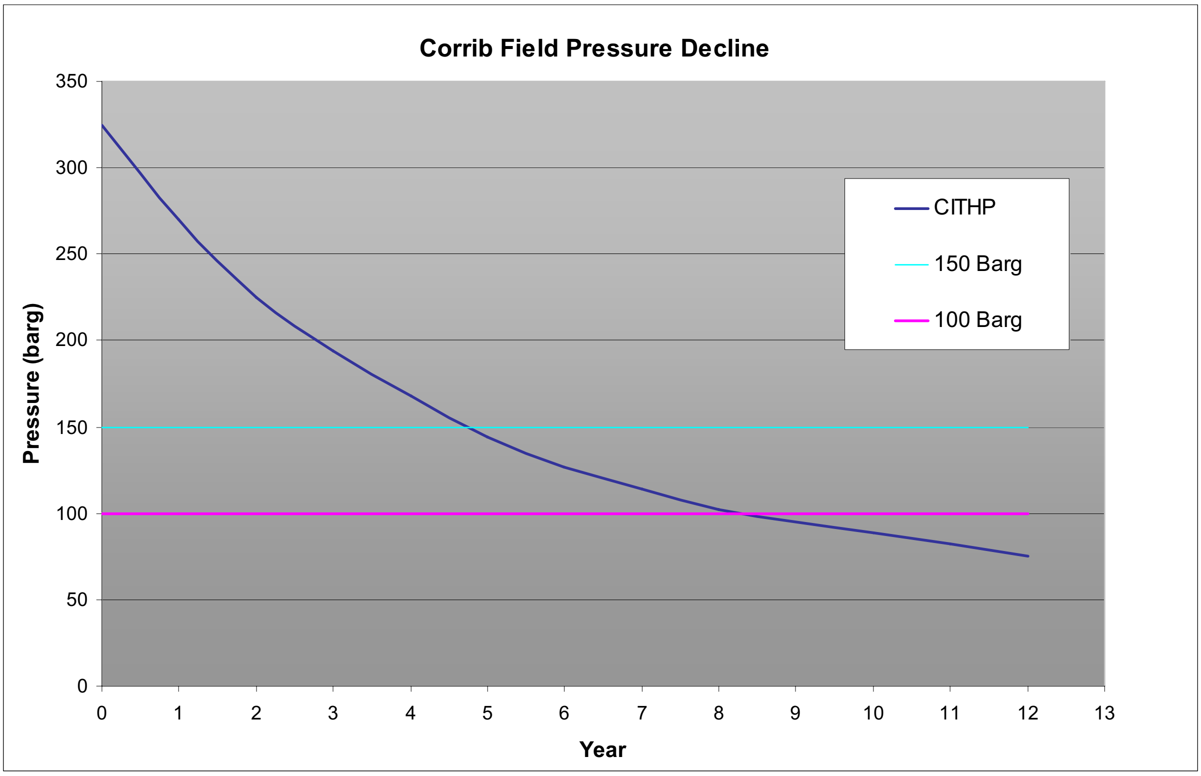


Figure 3.5: Projected Pressure Decline in the Corrib Gas Field.

As set out in the 2009 EIS, the pressure concept adopted for the pipeline system was to limit pressure in the onshore pipeline to 144 barg in line with the recommendations made by Advantica and TAG (DCENR) in 2006.

In order to satisfy elements of An Bord Pleanála's request for additional information of November, 2009, SEPIL has re-evaluated the pressure regime in the pipeline system and has made changes to the pipeline safeguarding system and to the normal pipeline operating pressure. An important change has been to lower the Maximum Allowable Operating Pressure (MAOP) in the onshore pipeline to the lowest practicable pressure without impacting on terminal operations (100 barg). An MAOP of 100 barg is a similar pressure level to a recently permitted gas pipeline in Ireland. The offshore pipeline MAOP has now been set to 150barg and the reliability of the offshore safeguarding system has been significantly increased by hardware changes in the control system.

The normal pipeline operating pressure at the inlet to the Bellanaboy Bridge Gas Terminal for the maximum plant throughput of 350 mmscfd has been reduced to 85 barg.

During the initial years, the flow into the pipeline is controlled by the subsea choke valves, which act to reduce the flowing wellhead pressure to approximately 122 barg at the subsea manifold. Due to pressure losses along the 83km long 20 inch pipeline this means that normal arrival pressure at the landfall will be 90 barg or less.

Figure 3.5 above illustrates that the function of the LVI to limit the downstream pressure to a maximum of 100 barg MAOP is relevant only while the reservoir pressure is above 100 barg, estimated to be approximately eight years from start of production.

Flow is planned to be continuous in the pipeline with actual flow rate depending on gas offtake (sales) and any other restriction or requirements imposed by the downstream pipeline operator. Normal operating procedures will ensure that the pressure in the system is such that there is sufficient time to allow operator intervention to maintain pressure within the normal operating envelope. The maximum operating pressure limit at the inlet to the Gas Terminal has been set to 92 barg. If the pressure at the Gas Terminal rises to 93 barg the inlet valve to the Gas Terminal will close automatically and a signal is automatically sent to close the choke, wing and master valves on all sub-sea wells.

Should the pressure continue to rise, the landfall valve installation, which is independent of the Gas Terminal, will automatically close two high integrity isolation valves to shut the onshore pipeline off from the offshore pipeline. This overpressure protection measure will be activated at 99 barg and will ensure the pressure in the onshore pipeline is limited to less than 100 barg. The Maximum Allowable Operating Pressure (MAOP) is therefore set at 100 barg.

Closure of the landfall valve installation will result in a signal being sent to close all master and wing valves on the sub-sea wells. Additionally a signal will be sent to vent, at the Gas Terminal, the hydraulic pressure to all sub-sea valves. This will result in the closure of the subsurface safety, master and wing valves on all wells and the manifold inlet valves for each well. The purpose of these actions is to limit the pressure in the offshore pipeline to below the MAOP of 150 barg. Additionally the sub-sea manifold is fitted with a high-pressure trip, set at 145 barg, which will cause the choke, master and wing valves to close on all sub-sea wells.

The system described above is fully automated and does not rely on operator intervention. Operator intervention is possible and the Control Room Operator can command closed all sub-sea actuated valves.

Detailed descriptions of the pipeline safeguarding system and the assessment of reliability of the system are given in Appendix Q2.1, Q4.5 and Q4.6.

The alternatives considered in respect of the landfall valve design are outlined below.

Two principal methods of overpressure protection at the landfall were considered; mechanical and instrumented. Combinations of the two means of protection were also studied. Pressure Safety Valves connected to the pipeline and a plant relief system are commonly used mechanical means, whereas the instrumented option incorporates an instrumented sensing device that ultimately acts to stop over pressurisation by closing a set of valves and isolating the source of overpressure from the low-pressure systems.

An instrumented system incorporating a High Integrity Safety Shutdown System was selected.

The main options considered for the pressure protection of the onshore pipeline at the landfall were:

- Single Actuated Beach Valve.
- Single Actuated Beach Valve + Pressure Safety Valve.
- High Integrity Safety Shutdown System.

These options were all considered to satisfy TAG and Advantica's recommendations.

The High Integrity Safety Shutdown System was chosen for the following reasons:

- Although the first option of wellhead valve closure with a Single Actuated Beach Valve would satisfy the minimum requirements, it was felt that this solution did not have sufficient redundancy (e.g. it provided a third level of protection but with a reduced level of reliability) to significantly address concerns about high pressure in the pipeline.

- Although the second option of wellhead valve closure with a Single Actuated Beach Valve and additional Pressure Safety Valve provided a third level of protection and reliability, the design of a pressure relief system would require additional flaring capacity in the system, either in a dedicated flare or through the Gas Terminal. This overpressure protection system was considered inferior to the selected option which provided a higher integrity third level of overpressure protection within the valve installation itself, and which did not require venting or flaring.

The selected design option valve installation system utilises a High Integrity Safety Shutdown System located at the landfall. The High Integrity Safety Shutdown System is described further in Chapter 4 and Appendix Q.

3.6.2 Landfall Valve Installation – Alternative Mechanical Designs

The original pipeline design included an onshore isolation valve located below ground level at the landfall. This was intended to allow the onshore section of the pipeline to be isolated manually from the offshore section – for instance, if maintenance was needed. As outlined above, it is now proposed to enhance the design of this valve installation to satisfy the recommendations made by TAG and Advantica. An evaluation of two alternative configuration of the pressure limiting valves was carried out. The alternatives considered were:

A. Pressure Limiting Valves located on bypass pipework; or

B. Pressure Limiting Valves located on mainline (the ‘straight pipe’ option)

The principal considerations in evaluating these alternatives were:

- System reliability and safety;
- Operations and maintenance considerations;
- Track record of mechanical equipment required to provide the pressure limiting function;
- Compliance with relevant industry codes and standards; and
- Compliance with Shell design standards.

It is proposed to configure the Pressure Limiting Valves in a ‘bypass’ of the 20 inch pipeline. This configuration comprises:

- 20 inch / 508mm mainline section with a full bore ball valve which is locked in the closed position during normal operation.
- 16 inch / 406mm bypass section comprising two Pressure Limiting Valves, bypass isolation valves (upstream and downstream of Pressure Limiting Valves) and small bore valves and fittings required for commissioning and maintenance.
- Monitoring and control systems

This configuration has the advantage that it allows the offshore and onshore pipelines to be pigged as described in Chapter 5. The design of the proposed Pressure Limiting Valves does not permit pigging and therefore these cannot be incorporated into the system on the mainline. (Pigging of the pipeline will be carried out infrequently and in strict accordance with a Permit to Work System. During pigging operations, the 20 inch mainline valve will be moved to the open position. Because the LVI bypass pipework including the Pressure Limiting Valves cannot be pigged, it will be fabricated from duplex stainless steel and Iconel clad steel which has high resistance to corrosion).

The alternative mechanical configuration for the LVI without the bypass pipework i.e. the ‘straight pipe’ option has the following disadvantages:

- There is little or no industry experience with 20 inch full bore valves in High Pressure Protection Systems. Industry experience and track-record are important criteria when assessing the safety of oil and gas systems.
- This concept does not meet Shell’s standards of design and cannot be considered as best industry practice.
- It is considered that ‘piggable’ High Pressure Protection Valves are not best practice as the integrity of the highly reliable valves could be compromised due to mechanical damage of the valve seals by the passing Intelligent Pig.

The proposed LVI design is detailed in Appendix Q. A design evaluation of the alternative straight pipe layout is also provided in Appendix Q4.4.

3.6.3 Landfall Valve Installation – Alternative Civil Designs

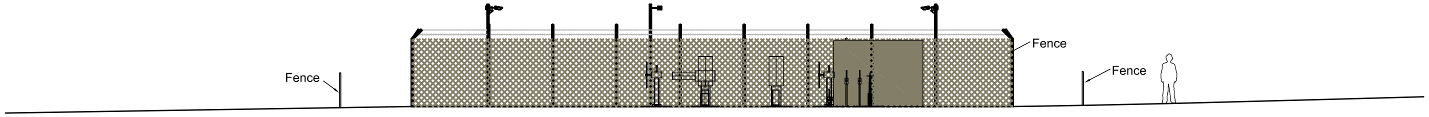
The proposed Landfall Valve Installation (LVI) is larger and more complex than the previously approved underground block valve. In order to accommodate the necessary changes, and at the same time take into account the sensitivity of the landscape at the landfall location, a number of different design options were considered (as shown on Figure 3.6). The primary factors influencing the design were:

- Compliance with all relevant codes and standards in the facility design and construction;
- Location of the LVI as close as possible to the actual landfall;
- Minimise visual impact of the facility; and
- Minimise impacts on flora and fauna.
- Security

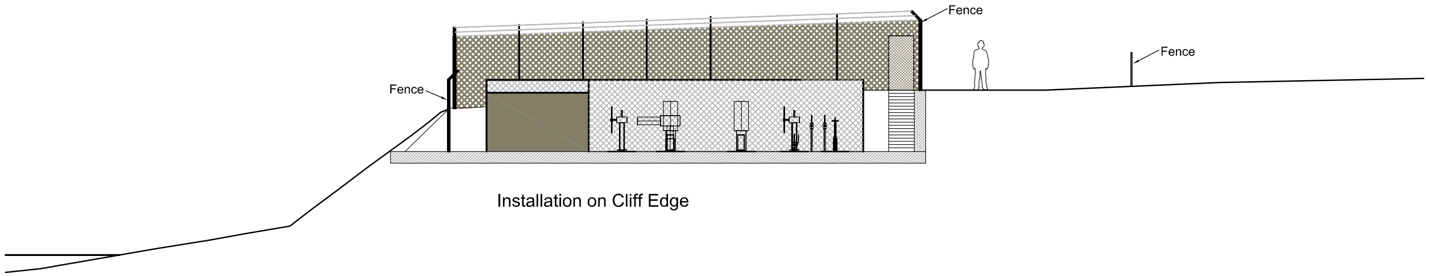
The following four alternative design arrangements were considered:

- Conventional above ground facility;
- Facility on cliff edge;
- Underground and enclosed facility; and
- Facility in excavated lower terrain position (dished).

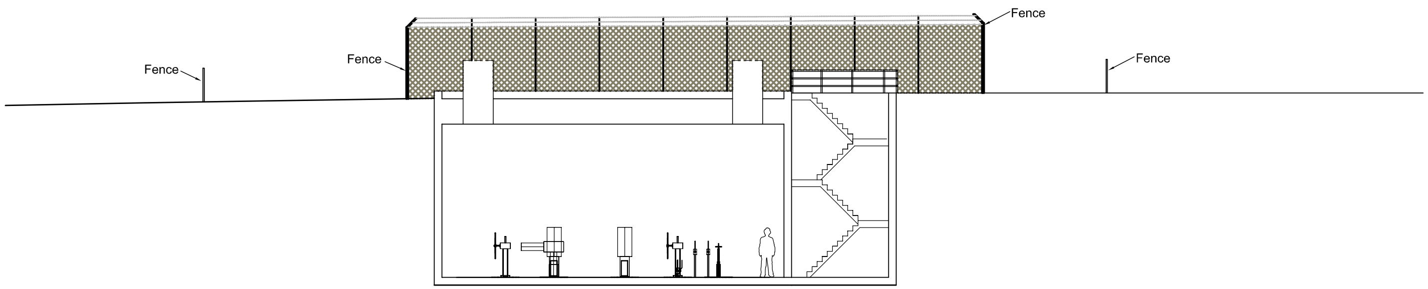
The selected design consists of underground valves with above ground actuators and instrumentation (conventional arrangement), located in an excavated lower terrain position (dished). The main reasons for selecting this option are listed in Sections 3.6.3.1-3.6.3.4.



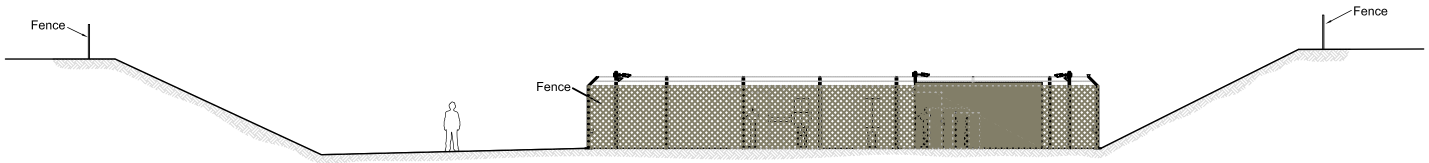
Conventional Above Ground Installation



Installation on Cliff Edge



Underground and Enclosed Installation



Installation in Excavated Lower Terrain Position (Dished)

Landfall Valve Installation
Alternative Civil Designs

Figure 3.6

File Ref: COR25MDR0470Fg3.6A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

3.6.3.1 Conventional Above Ground Installation

This option, which is the gas industry standard facility layout, built at existing ground level along the route of gas pipelines, consists of underground valves with above ground actuators and instrumentation. In this case, the location of the facility is set back 27m from the cliff edge to avoid a sand martin colony (see Chapter 12). The plan area of the installation in this format would be approximately 25m x 23.5m with an adjoining hard standing area of 25m x 10m for maintenance access and works. The facility is surrounded by a 1.35m high outer concrete post and rail boundary fence. Inside this outer fence, there is an inner security fence 2.8m high. The inner fence is chainlink, which is set at the bottom in a concrete sill.

Access is via a 4.5m wide double gate. Lighting and security columns of 6m height are located within the compound. Access to the facility is by an access road with a hammerhead (tee- shaped) turning area. The above ground features within the compound include green coloured instrumentation cabin (approximately 3m in height), valve actuators and control panels.

This conventional above ground installation was considered to be unacceptable due to its high visual impact.

3.6.3.2 Installation on Cliff Edge

The facility considered is a variation on the conventional above ground facility and would be located at the cliff edge and set lower down by 3m. There is a 2.5m high reinforced concrete retaining wall on three sides, with a 2.8m high security fence on top of the wall. A pedestrian access, including concrete stairs and security gate, is required. Hard standing and turning area is provided on the east side. An access road is required. The plan area of this layout is approximately 15m x 15m.

This option was not considered acceptable on the grounds of its high visual impact on the coastline, the potential disturbance to an established sand martin colony, the requirement for substantial concrete structures, questions in relation to long-term stability of the cliff face and the exposure of equipment to the exposed saline environment.

3.6.3.3 Underground and Enclosed Installation

The facility considered is a variation on the conventional above ground facility but contained in a concrete structure and set below ground level. The location of the facility is set back 27m from the cliff. The facility is enclosed within a reinforced concrete structure with three adjacent sides sloped away from the bottom of the structure, while on the fourth side, a retaining wall is used to allow a hard standing area close to the structure. The interior of the structure will require forced ventilation in accordance with gas safety industry standards; this would add complexity in the form of additional requirements for power and mechanical equipment. To ensure maintainability of valves and equipment, the roof of the underground compartment will contain removable pre-cast roof sections to allow mobile crane access from the hard standing. The internal plan area of the facility is approximately 12m x 12m. A 2.8m fence would also be required around this installation.

This option was not considered any further due to the enclosed nature of the facility, its potential impact on the safe operation and maintenance of the facility and the substantial concrete structures required. The fact that a 2.8m high perimeter fence would be required for this configuration of facility significantly reduces the advantages of placing it below ground.

3.6.3.4 Installation in Excavated Lower Terrain Position (Dished)

The selected option is a variation on the conventional above ground facility but the facility is set down 3m below existing ground level. The actuators and instrumentation are located above ground, while the valves are underground. The plan location of the installation is set back 27m from the cliff. The main features are:

- The installation footprint is 20m x 22m;
- It is located at the bottom of a ‘dished area’ with four sloping sides and an access ramp;

- The compound fence is a single 2.8m high fence; and
- The top of slopes will have a 1.35m high sheep wire fence.

This option was considered to be the most suitable as it has the following advantages:

- It complies with all relevant gas industry standards (good natural ventilation);
- It minimises the visual impact of the facility (see Chapter 10); and
- It minimises potential disturbance to the sand martin colony in the cliff area (see Chapter 12).

A number of alternative options have also been considered for the preliminary design of this installation including colour scheme, drainage (soak away or outfall), and alignment of the access road. The selection of these options has been informed by the visual impact assessment (see Chapter 10) to ensure that the potential visual impact of the installation is minimised.

4 PROJECT DESCRIPTION

4.1 INTRODUCTION

The purpose of this chapter is to describe the main features of the Corrib Onshore Pipeline, including the pipeline route, relevant design codes and standards, operation, maintenance and decommissioning.

The proposed Corrib Onshore Pipeline system extends for a length of approximately 8.3km from a landfall at Gleann an Ghad (Glengad) via a 4.9km tunnel (4.6km of which is underneath Sruwaddacon Bay) to the permitted Gas Terminal at Béal an Átha Buí (Bellanaboy) and consists of the following elements:

- Onshore gas pipeline;
- Services (umbilicals, fibre optic cable and signal cable);
- Water outfall pipeline; and
- Landfall Valve Installation (LVI) located approximately 50m east of the landfall at Gleann an Ghad (Glengad).

The onshore gas pipeline system and the LVI are described further in Sections 4.3.1- 4.3.4 below.

The proposed development is expected to be operational for approximately 15-20 years, and has a design life of 30 years.

The construction of the proposed development, including the tunnel, is described in Chapter 5. A description of the peat deposition operations at An Srath Mór (Srahmore) is provided in Volume 3 of the EIS.

In addition to the information contained in this Chapter, more detailed Technical and Safety documentation can be found in Appendix Q including:

- Appendix Q1: An introduction to the technical and safety documentation contained in Appendix Q
- Appendix Q2: An integrated design description of the proposed development
- Appendix Q3: Application of relevant pipeline Codes of Practice
- Appendix Q4: Technical details of the design of the onshore pipeline, offshore pipeline and LVI
- Appendix Q5: Integrity Management of the Corrib Pipeline
- Appendix Q6: Reports on Safety Management including a Qualitative Risk Assessment and a Quantitative Risk Assessment

4.2 ROUTE DESCRIPTION

The proposed route is approximately 8.3km long and follows the line of the previously approved onshore route (see Preamble) for approximately 25% of its length (see Figure 3.4 in Chapter 3). The proposed route is described below, and is also shown in Figures 1 to 6 in Appendix A1 in Volume 2 of the EIS.

Plate 4.1: Aerial view (looking north west) showing na hEachú (Aghoos), Sruwaddacon Bay, Dún Ceartáin (Dooncarton) and Gleann an Ghad (Glengad)

The offshore pipeline comes onshore in the townland of Gleann an Ghad (Glengad) 1.5km west of Ros Dumhach (Rossport). The proposed onshore pipeline route traverses this headland, in an east-south-easterly direction, for approximately 640m. From here, the pipeline route traverses Sruwaddacon Bay in a south-easterly direction towards Na hEachú (Aghoos). The section of the pipeline route from Gleann an Ghad (Glengad) to Na hEachú (Aghoos) is approximately 4.9km long and will be tunnelled. Approximately 4.6km of the tunnel will be beneath Sruwaddacon Bay.

At Na hEachú (Aghoos), the pipeline route turns in an easterly direction for approximately 0.9km, traversing an area of blanket bog within which it crosses an approximately 40m wide estuarine river channel. The route then enters an area of forested bog (approximately 2.2km long) where it turns in a southerly direction, rejoins the previously approved route and enters the Bellanaboy Bridge Gas Terminal site.

Plate 4.2: View of Sruwaddacon Bay (looking south east) from a location on the L1202 between Gleann an Ghad (Glengad) and Poll an tSómais (Pollatomish).

4.3 CORRIB ONSHORE PIPELINE

4.3.1 Onshore Gas Pipeline

The onshore pipeline will carry hydrocarbon gas (mainly methane), a small amount of associated water (which will contain methanol), small amounts of production chemicals injected at the wellheads, as well as hydrocarbon condensate.

In accordance with the previously published recommendations of the Technical Advisory Group (TAG) and the Advantica Safety Review (see Preamble), the design pressure of the onshore gas pipeline will be 144barg. At this design pressure, the design factor for the gas pipeline will be 0.3, the factor which is normally used for areas of high population density i.e. built-up urban areas. In rural areas, design factors are normally significantly less conservative than 0.3.

In recognition of the criterion that An Bord Pleanála has stated it intends to apply in respect of an appropriate hazard distance, the maximum allowable operating pressure (MAOP) of the onshore pipeline has been set at 100barg. This lowered MAOP will reduce the hazard distance as requested by An Bord Pleanála. Under normal operating conditions, the pressure in the Corrib Onshore Pipeline will be controlled so that it will not exceed 92 barg (at the outlet of the onshore pipeline). A dedicated overpressure protection system, the Landfall Valve Installation (LVI) (see Section 4.3.4), has been designed to prevent exceedance of the onshore pipeline MAOP and hence prevent overpressure of the onshore pipeline. This is located at Gleann an Ghad (Glengad).

The gas pipeline is made of high-grade carbon steel. It has an outside diameter of 508mm / 20 inches and a wall thickness of 27.1mm. The external surface of the pipe will be protected from corrosion by a 3-layer polypropylene coating. Additional protection against corrosion will be provided by an impressed current cathodic protection system. The pipeline will be protected from internal corrosion, through the injection of inhibitor chemicals from the Gas Terminal into the gas conveyed in the pipeline via the services umbilical. Various monitoring tools will be used to gather data on the internal condition of the pipe and to confirm its integrity along its length. Methanol, which acts as a hydrate inhibitor, will be injected at the gas wells via the services umbilical to prevent the formation of hydrates, which could cause a blockage in the pipeline.

Additional design details on the Corrib Onshore Pipeline are provided in Appendix Q4.

4.3.1.1 Tunnel Section

Approximately 4.9km of the pipeline and associated services will be installed within a tunnel between Gleann an Ghad (Glengad) and Na hEachú (Aghoos), mostly beneath Sruwaddacon Bay. The tunnel will be lined with concrete sections and will be constructed mainly within sands and gravels. It will have an outside diameter of 4.2m and an inside diameter of 3.5.

The gas pipeline and services will be arranged inside the tunnel in a manner that will facilitate installation of each service.

A 250mm / 10” ‘spare duct’ made from High Density Polyethylene (HDPE) will be installed in the tunnel. A spare umbilical, spare electrical signal cable and a spare fibre optic cable will also be installed. These spare elements can be used as spare control elements of the pipeline system (electrical, fibre optic or umbilical lines) and water discharge pipeline in the tunnel (should this ever be required).

Once the gas pipeline, and the associated services and spares have been installed, the tunnel will be grouted with a cement grout. There will be no permanent access to the tunnel after construction is completed and the compounds have been reinstated.

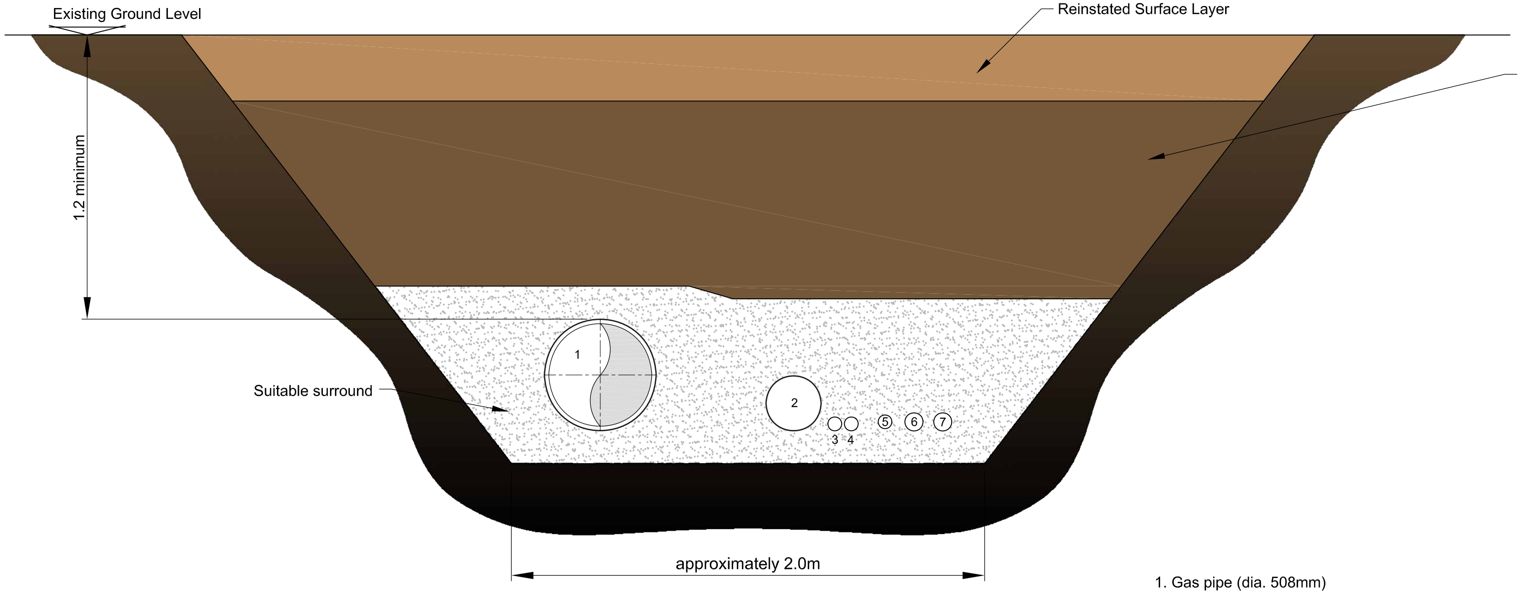
4.3.1.2 Land Sections

On land, the pipeline will be buried within a trench approximately 2-3m wide, to a minimum depth of cover of 1.2m below ground level (see Figure 4.1). In peatland areas, the pipeline and associated services will be laid within a stone road (see Chapter 5) to the same depth of cover. A section of this stone road (approximately 970m long) has already been constructed within the Gas Terminal site under the 2002, Gas Act consent. This is detailed in Appendix M3. In areas where the pipeline crosses watercourses, it will be installed at a minimum depth of cover of 1.6m.

Marker tape made from brightly coloured and sturdy plastic film will be used to alert parties to the location of buried services. It will typically be installed during backfilling of the trench some distance (minimum 300mm / 1ft) above the pipeline and umbilicals. If digging were to take place above the buried pipeline or services umbilical, the marker tape would be encountered and alert third parties well before there was a possibility for accidental damage to either pipe or services. In addition, impact protection in the form of pre-cast concrete slabs will be placed over the pipeline where it crosses under streams/ditches as well as at road crossings. Marker posts indicating the location and direction of the installed pipeline and services will be located at field boundaries, road or river crossing points and at changes in direction of the pipeline.

Upon completion of construction and reinstatement, a 14m wide permanent wayleave will remain in place for the lifetime of the pipeline. A 20m wide permanent wayleave will remain in peatland to accommodate the stone road (see Chapter 5). This wayleave will effectively be a defined strip of unfenced land which will allow SEPIL the right of access along the pipeline for monitoring and maintenance purposes, as required. In general, normal agricultural practices can continue within the wayleave, but deep ploughing, turf cutting, tree planting and building restrictions will apply. Chapter 11 addresses further details on the land use aspects of the permanent wayleave.

During the operational phase of the project, the presence of the pipeline will not impose any restrictions on use of Sruwaddacon Bay, such as boating, fishing or walking in the intertidal areas.



TYPICAL TRENCH DETAIL

1. Gas pipe (dia. 508mm)
2. Outfall pipeline (dia. 250mm)
3. Fibre Optic cable (dia. 63mm)
4. Signal cable (dia. 63mm)
5. Umbilical #1 (dia. 62mm)
6. Umbilical #2 (dia. 82mm)
7. Umbilical #3 (dia. 82mm)

Note: Positions of gas pipeline, outfall pipeline and services are indicative

Typical Trench Detail

Figure 4.1

File Ref: COR25MDR0470Fg4.1A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

4.3.2 Services

A services umbilical link between the Gas Terminal and the offshore subsea facilities will be installed with the onshore and offshore pipelines. The umbilical will contain the following lines (see Figure 4.2):

- Hydraulic fluid supply lines. The hydraulic fluid supply lines provide hydraulic power to the Christmas Tree valves on the seabed and the subsurface valve in each well (see Section 4.4.3.4). The hydraulic fluid is a water / glycol mixture which will operate at maximum pressures of 210 barg and 610 barg.

- Chemical supply lines (corrosion inhibitor and methanol). The chemical supply lines are required for the continuous operation of the Corrib Pipeline System as they carry both a corrosion inhibitor that prevents internal corrosion of the pipeline, and methanol which forms a completely miscible mixture with condensed water from the gas. Methanol inhibits the formation of hydrates, which are crystalline solids consisting of water and hydrate forming components such as methane, ethane, propane and small quantities of carbon dioxide. A sufficient volume of chemicals will be injected to ensure that corrosion is inhibited and hydrate formation prevented. The chemicals are injected continuously at various wells and, if required, at the subsea manifold. The chemicals will be transported back to shore, mostly in the liquid phase, which flows back with the natural gas from the wells. When these fluids enter the Gas Terminal, the liquid phase is separated from the gas phase, and the liquid is taken through a comprehensive treatment process. The methanol is recovered within the Gas Terminal for re-use, whereas components of the other injected chemicals are removed in the various stages of the water treatment plant, before the treated water is discharged.

- Water discharge lines to transport treated produced water from the Gas Terminal to the subsea manifold.

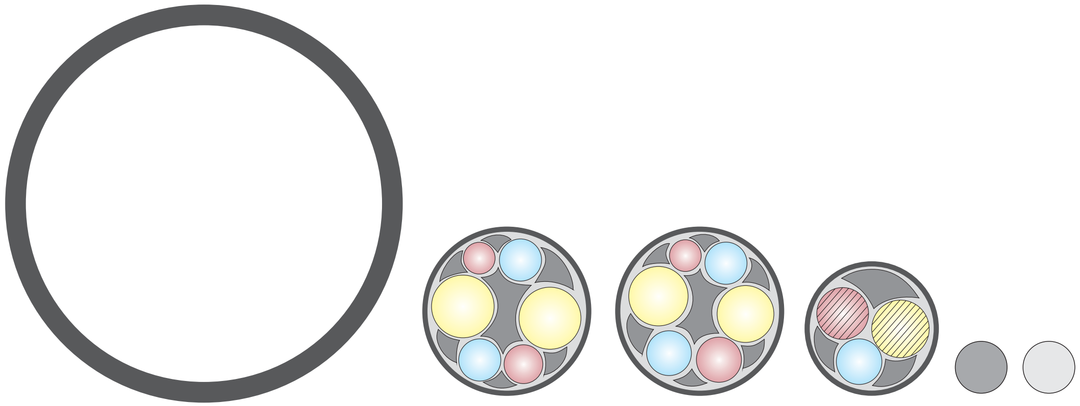
- Data communication, electrical control and power cables.

For the onshore section of the pipeline route, the services umbilical comprises three bundles of conduits, each contained within an outer sheath made from Medium Density Polyethylene (MDPE) (See Figure 4.2). The outer MDPE sheath (approximately 80mm in diameter for two lines and approximately 60mm for the third line) contains steel tubing and electrical cables. These services are arranged within the MDPE outer sheath using spacers / fillers. These services extend for the full length of the pipeline (onshore and offshore) as three discrete umbilicals onshore and combined in a single umbilical offshore. A spare umbilical will be installed in the tunnelled section of the onshore pipeline.

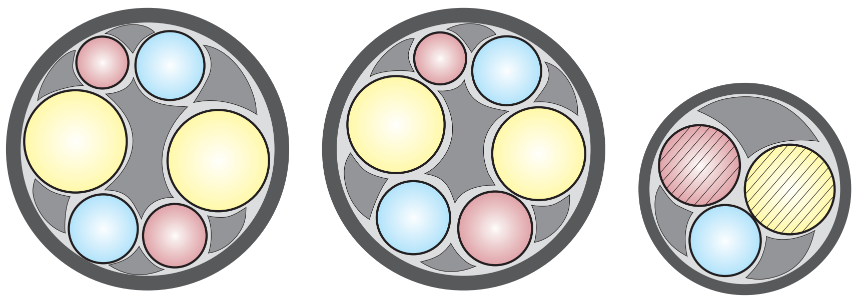
On land, the services umbilicals will be laid below ground approximately 1m from the gas pipeline within the same trench and at a similar depth. Services within the tunnel will be arranged in a manner similar to that shown in Chapter 5 Figure 5.5.

A fibre optic control cable and an electrical control cable between the Gas Terminal and the Landfall Valve Installation will also be laid in the same trench and alongside the umbilicals.

Further technical design details regarding the services associated with the Corrib Onshore Pipeline are provided in Appendix Q4.



	HDPE Outfall Pipeline (254mm)
	Umbilical No. 1 (81mm)
	Umbilical No. 2 (81mm)
	Umbilical No. 3 (62 mm)
	Fibre Optic (<25mm)
	Electrical Cable (<25mm)



	Spacer
	Outer MDPE Sheath
	Stainless Steel Tubing - Hydraulic Line
	Stainless Steel Tubing - Methanol Line
	Electrical Cable
	Produced Water

Services Umbilicals & Outfall Pipeline -

Typical Details

Figure 4.2

File Ref: MDR0470GrEIS038 RevA03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

4.3.2.1 Leakage Prevention

The features incorporated into the design and operational stages to prevent leakage from the services umbilicals are outlined as follows:

Design Features

- The fluid supply cores within the umbilical will be constructed of super duplex stainless steel, which is a high-grade non-corroding form of stainless steel (see Appendix Q).

- The external sheath of the umbilical will be constructed of polyethylene to provide mechanical protection during handling, installation and operational use.

- The umbilical is factory tested to a proof pressure at least one-and-a-half times its design pressure. Burst tests of samples of the umbilical cores have been completed, confirming that a pressure of a minimum of two times design pressure has been achieved. It will also be further tested to 1.1 times the design pressure after installation, prior to operation.

- The services umbilical will be trenched offshore and buried to a minimum of 1.2m below ground, approximately 1m from the gas pipeline for land-based sections onshore to minimise potential for third party interference causing damage to the lines. Additional impact protection in the form of concrete slabs will be provided at road crossings and stream, ditch and drain crossings.

Operational Features

- Both the on land and subsea portions of the pipeline route will be subject to regular inspection (such as visual surveys, cathodic protection measurement and intelligent pigging) as set out in the Pipeline Integrity Monitoring Scheme (PIMS) (see Section 4.4.3.1).

- On land, marker posts will be installed above the pipeline at field boundaries and where the pipeline route changes direction. In this way, landowners can be sure of the location of the pipeline using these visible waypoints. This will minimise any accidental external interference with the installation.

- A leak detection system will be operated on the methanol supply lines. By balancing the inlet and outlet flow and pressure, leakage can be detected by the Control Room Operator at an early stage.

- The hydraulic supply lines, which transport a water / glycol mix, are not provided with a specific leak detection system but any significant leak would be detected by either continuous running of the hydraulic pumps or low pressure in the hydraulic system.

4.3.3 Outfall Pipeline

A 250mm / 10 inch diameter water outfall pipeline made of High Density Polyethylene (HDPE) will be installed with the onshore gas pipeline and services umbilical. The purpose of this pipeline is to transport treated surface water run-off from the process area of the Gas Terminal to a discharge location approximately 12.7km offshore from the landfall in accordance with the terms of the Integrated Pollution Prevention and Control Licence for the Gas Terminal. Further details on the water outfall pipe are provided in Appendix Q4.

4.3.4 Landfall Valve Installation (LVI)

The LVI will be located at the landfall at Gleann an Ghad (Glengad). The main features of the LVI are outlined below and illustrated in Figures 4.3 to 4.5.

4.3.4.1 LVI Mechanical Design

The purpose of the LVI is to limit the pressure in the onshore pipeline to a maximum allowable operating pressure (MAOP) of 100 barg. In the event that the pressure rises in the onshore pipeline, the valves will close and the onshore pipeline will be isolated from the offshore pipeline to prevent overpressure of the onshore pipeline occuring.

The LVI will consist of valves, pipework, instrumentation and supporting equipment. The main elements (isolation valves, pressure limiting system and associated pipe work) will be below ground, with valve actuators (used to open and close the valves) and instrumentation/control cabinets located above ground.

The LVI will function as follows;

- Three independent pressure sensors, located at the facility, will continuously measure the pressure in the onshore pipeline.

- If the measured pipeline pressure rises, a dedicated control unit will initiate closure of the two shutdown valves located at the LVI to ensure pipeline pressure remains below the onshore pipeline MAOP of 100 barg. The configuration of the system is shown in Figure 4.5. This function is automatic.

- The closed shutdown valves isolate the onshore pipeline from the offshore pipeline, thereby preventing any further pressure increase in the onshore pipeline.

- If the LVI shutdown valves are closed, production at the wells will also be shut, such that offshore pipeline pressures will remain below 150 barg (the offshore pipeline MAOP).

An operating envelope has been defined and the production system from the wells to the Gas Terminal will be controlled, such that this safeguarding system would operate on a very infrequent basis.

The system will be constantly monitored and regularly tested, in accordance with relevant test procedures for pipeline safety shut-off valves.

Further technical details on the LVI, including a design justification and an assessment of alternative mechanical design layouts, are provided in Appendix Q4.

4.3.4.2 LVI Civil Design

In order to minimise the landscape and visual impact of the facility, the LVI has been set down in a 'dished' area approximately 3m below existing ground level (See Figure 3.6 in Chapter 3). A general plan layout of the proposed facility is shown in Figure 4.4.

The footprint of the facility within the compound will be approximately 22m x 20m. The following facilities will be associated with the compound:

- A cabin will contain instrumentation associated with the operation of the LVI. The instrumentation cabin will be approximately 5.3m x 3.3m and 2.6m high. This cabin will be made from steel and finished in a neutral colour. Other cabinets associated with the valve actuators will be lower than 1m high.

- Above ground valve actuators will be protected with metal mesh covers. These will be approximately 2.5m high.

- The pipeline and valves will be located below ground and will be buried. The service umbilicals will be combined in a below ground reinforced concrete chamber within the LVI compound. An air valve chamber and a control valve chamber for the water outfall pipeline will also be located below ground within the LVI. All chambers will be fitted with covers, flush with ground level.

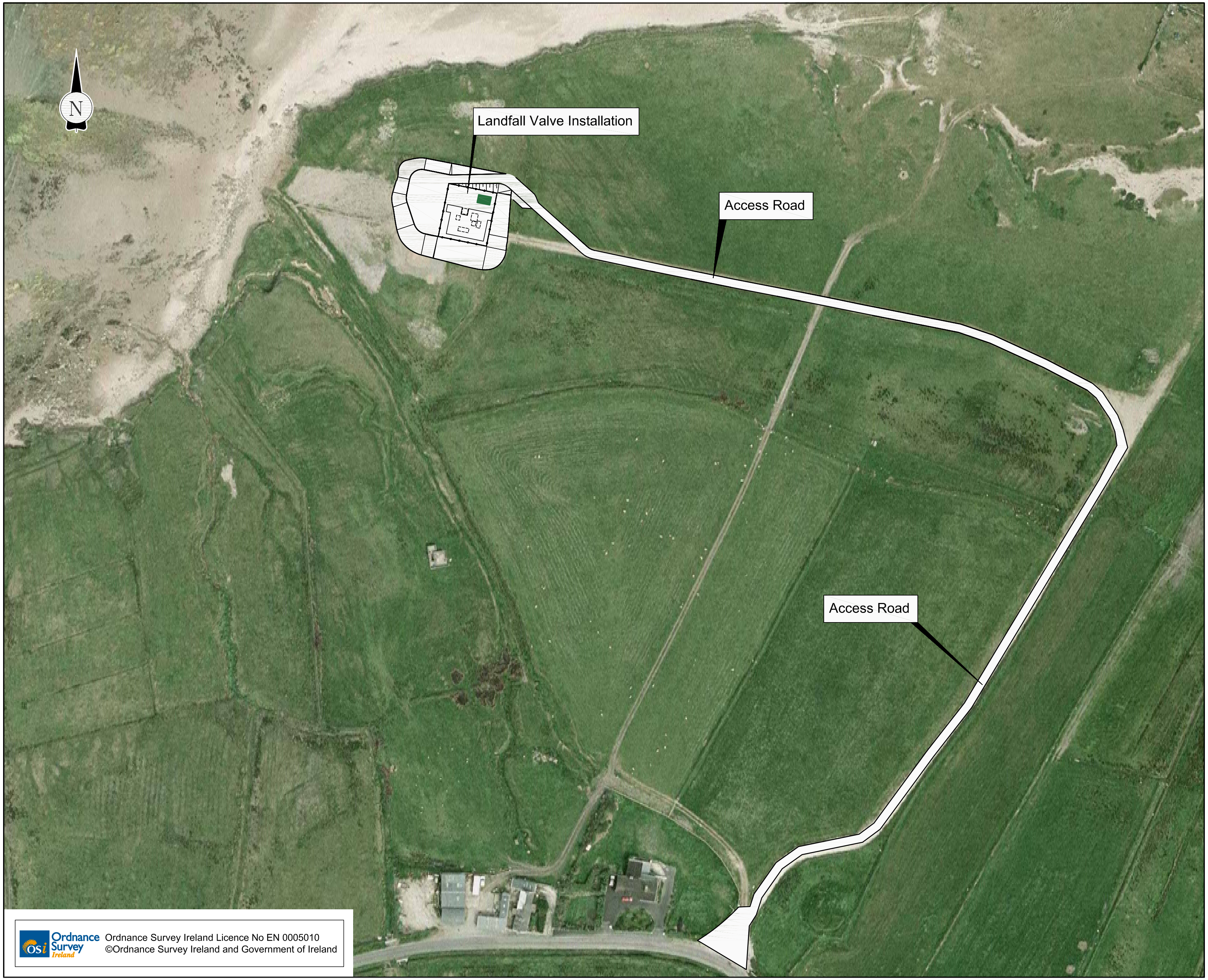
The immediate area around the facility will be surfaced with gravel. The remaining hard standing will be finished with locally sourced topsoil and allowed to vegetate naturally. The side slopes will be constructed to a 1:2 slope and will be reinstated with 200mm depth of topsoil, sourced from within the working area. To aid topsoil stability and grass growth, a geotextile membrane will be laid from the toe of the slope to 1m beyond the top of slope. The resulting overall area within which the LVI compound will be located (including side slopes) will be approximately 40m x 50m.

The compound is fenced off with a single 2.8m high security fence. A stock proof fence (1.35m high) will be erected around the top of the slopes. Permanent access to the LVI will be provided via a 3.5m wide access road from the L1202 (Local Road) to the facility and through manually operated gates (vehicular and pedestrian).

The access road to the LVI will be surfaced with topsoil sourced from within the temporary working area, which will encourage regeneration of grasses along the ramp and road.

A surface water drainage system for the LVI compound will be provided. This will consist of a low level network for the perimeter of the valve area and a high level network for the toe (bottom) of the slopes. Both networks will meet at a chamber upstream of an interceptor, which will retain any oils or solids in the highly unlikely case that these are present in the drainage water. Surface water will drain from the site to an outfall in the cliff face.

Security lighting and CCTV cameras will be provided. The lighting will be used in the event that access is required during hours of darkness. It will be possible to operate the lighting and CCTV cameras remotely from the Gas Terminal as well as locally. During normal operations no lighting will be required. The LVI will also be visited and inspected on a regular basis by operations personnel.



Landfall Valve Installation
General Layout

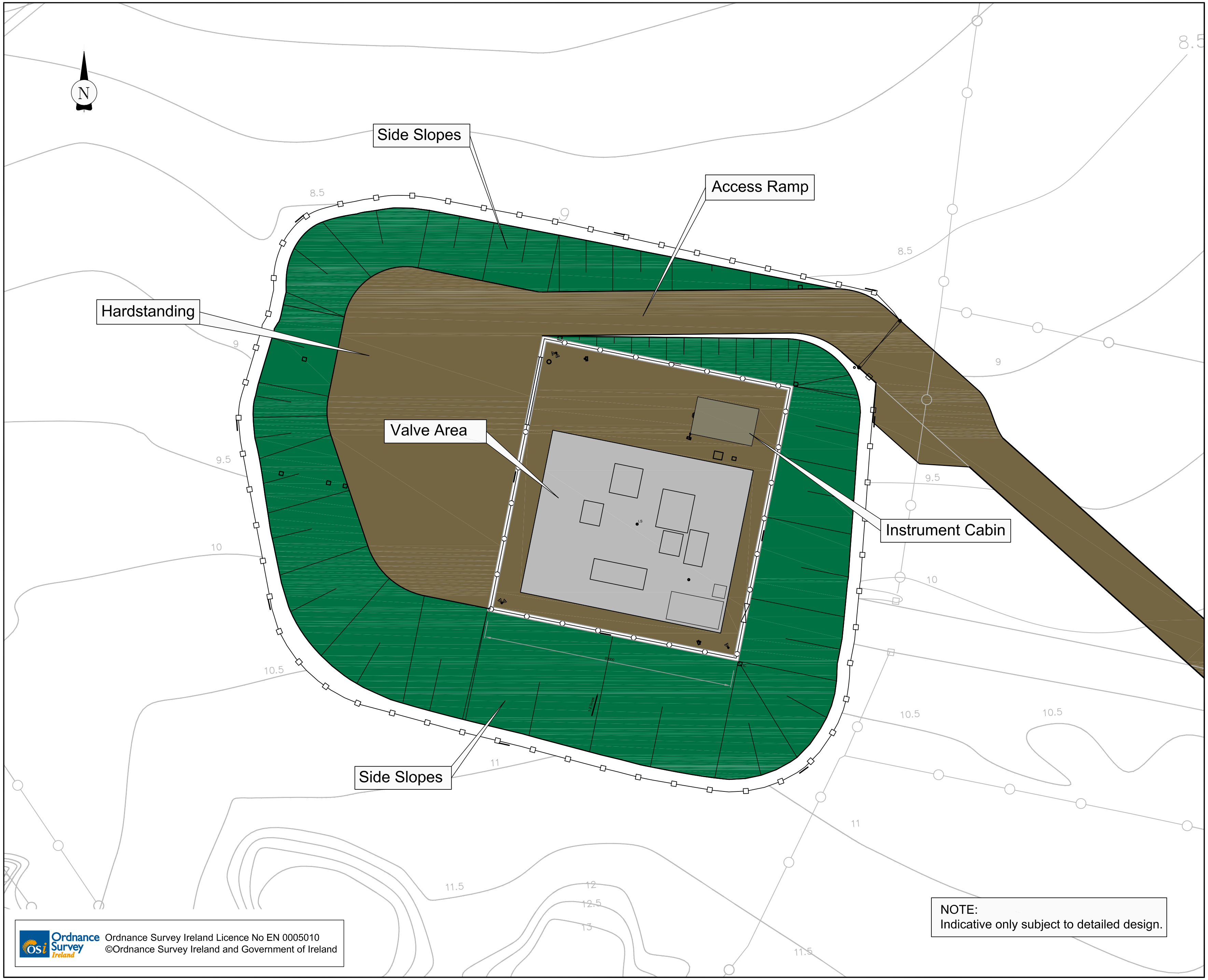
Figure 4.3

File Ref: COR25MDR0470Fg4.3A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

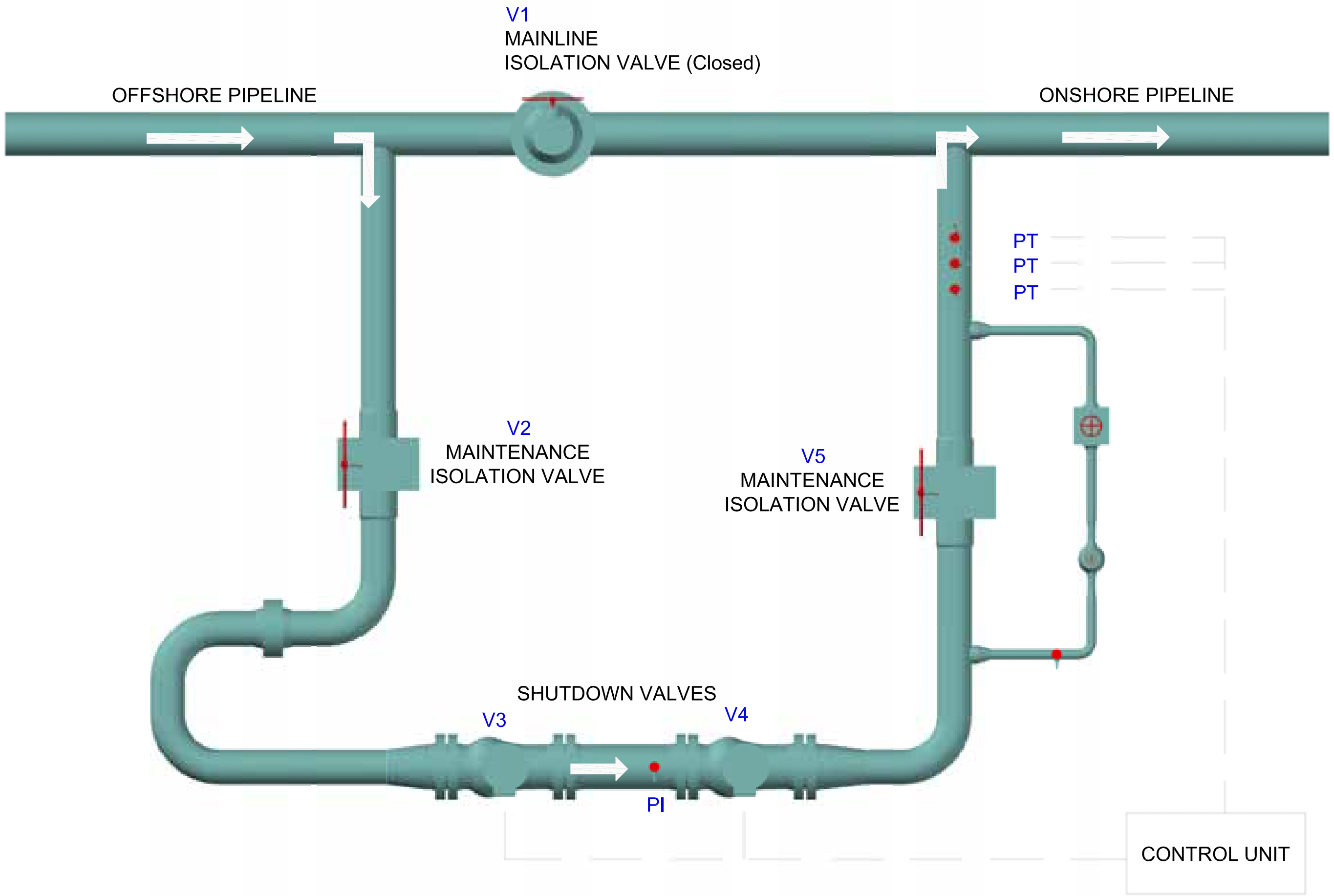


Landfall Valve Installation
Detailed Layout

Figure 4.4

File Ref: COR25MDR0470Fg4.4A03
Date: May 2010

CORRIB ONSHORE PIPELINE



PT
Pressure Sensors. measure the pressure in the pipeline.

CONTROL UNIT
The control unit sends signals to shutdown valves to close them when pressure approaches 100 bar.

V1
Mainline Isolation Valve. Closed during normal operation.

V3 & V4
Shutdown Valves. Will close automatically when pressure approaches 100 bar.

V2 & V5
Maintenance Isolation Valve. Open during normal operation, closed when maintenance of the shutdown valves is required.

PI
Pressure indicator

Landfall Valve Installation
Valve Configuration

Figure 4.5

File Ref: COR25MDR0470Fg4.5A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

4.4 PIPELINE SAFETY AND INTEGRITY

SEPIL is committed to ensuring the safety of the Corrib Onshore Pipeline and has given safety full consideration in every stage of the project development from preliminary design right through to decommissioning. The following sections outline some of the basic safety features of the Corrib Onshore Pipeline considered at each stage of development. These aspects of the proposed pipeline are covered in detail in Appendix Q.

4.4.1 Design Stage

The Corrib Onshore Pipeline has been designed in accordance with relevant nationally and internationally accepted design codes and standards, which were also agreed with TAG as being appropriate. These design codes and standards include:

- I.S. EN 14161:2004 (Petroleum and Natural Gas Industries – Pipeline Transportation Systems) (ISO 13623:2000 Modified);
- I.S. 328: 2003 (Code of Practice for Gas Transmission Pipelines and Pipeline Installations (Edition 3.1)); and
- BS PD 8010-1: 2004 (Code of Practice for Pipelines – Part 1: Steel Pipelines on Land).
- BS PD 8010-3: 2009 Code of Practice for Pipelines - Part 3: Steel Pipelines on Land. Guide to the application of pipeline risk assessment to proposed developments in the vicinity of major accident hazard pipelines containing flammables. Supplement to PD 8010-1:2004

The LVI has been designed in accordance with:

- Offshore Standard DNV-OS-F101 Submarine Pipeline Systems January, 2007.

The short section of offshore pipeline upstream of the LVI to the high water mark has been designed in accordance with:

- Offshore Standard DNV-OS-F101 Submarine Pipeline Systems January, 2000.

The primary standards for the umbilical system are:

- ISO/CD 13628 – 5 Design and operation of subsea production systems – subsea control umbilicals; and
- ISO/CD 13628 – 6 Design and operation of subsea production systems – subsea production control umbilicals.

The primary standards for the outfall pipeline are:

- I.S. EN 14161 2004 Petroleum and Natural Gas Industries - Pipeline Transportation Systems (ISO 13623:2000 Modified)

The following standard shall also apply:

- ISO. 4427-2007 Plastic piping systems - Polyethylene (PE) pipes and fittings for water supply.

The primary code for the design of the tunnel is:

- Code of Practice for Safety and Tunnelling in the Construction Industry BS 6164- 2001

The design process has included hazard identification reviews and hazard and operability reviews. The objective of these reviews is to challenge the system design and to identify practical solutions to potential risks. Additional precautionary measures have been implemented following Advantica's independent safety review. These measures are outlined below.

Further details of the relevant codes and standards are provided in Appendices Q3 and Q4.

4.4.1.1 Qualitative Risk Assessment

Unlike Quantitative Risk Assessment (QRA), a qualitative risk assessment describes risks in non-numerical terms. Appendix Q6 describes how qualitative risk assessments have been carried out during design of the pipeline and will continue to be applied through its operation.

One output from the qualitative risk assessment process is an inventory of all the hazards identified for the operation of the Corrib pipeline facilities. This Risk Register is also presented in Appendix Q6.

Shell standards require the use of 'bowtie analysis', which is a form of qualitative risk assessment. Section Q6 explains the bowtie method in detail and how it has been applied for the Corrib pipeline.

4.4.1.2 Quantitative Risk Assessment (QRA)

A quantitative risk assessment (QRA) for the proposed Corrib Onshore Pipeline has been carried out by Det Norske Veritas (DNV). This assessment has analysed potential accident scenarios in terms of their likelihood and possible consequences. The following failure modes were studied:

- Third party interference;
- Construction defect/material failure;
- Internal and External Corrosion;
- Ground movement; and
- Other failure modes.

The QRA (see Appendix Q6) has concluded that the risk posed to the safety of the general public from the Corrib Onshore Pipeline will be extremely low. It will be much lower than the risks posed by other gas pipelines which have been permitted in Ireland. The QRA shows that the pipeline, along with the measures in place to prevent or mitigate against hazards, will operate with risk levels that are well below the levels required by the codes specified for the design of the pipeline.

4.4.1.3 Safety Case

In accordance with the newly enacted Petroleum (Exploration and Extraction) Safety Act (No. 4/2010), SEPIL will be required to submit a Safety Case for approval by the Commission for Energy Regulation (CER) and will apply to the CER for a safety permit to operate the Corrib Gas Field development, including the onshore pipeline. This Safety Case will provide a demonstration that risks have been and continue to be managed to As Low As Reasonably Practicable ('ALARP') levels.

4.4.1.4 Independent Safety Review

In 2005, the Minister for Communications, Marine and Natural Resources appointed independent consultants, Advantica, to undertake a safety review of the Corrib Onshore Pipeline. SEPIL has accepted and will implement all Advantica and TAG (DCENR) recommendations. Details are provided in Appendix Q3.

4.4.1.5 Mechanical Specification of Pipeline

The Corrib Onshore Pipeline is designed to a very high specification, and its wall thickness is 27.1mm. This conservative specification was originally selected to ensure that the pipeline could safely contain the maximum possible pressure in the system i.e. wellhead pressure during the initial phase of operation. The Corrib Onshore Pipeline will be pressure tested to 504 barg before it is brought into service.

Within the natural gas industry, a pipeline wall thickness of 19mm (typically specified ‘Heavy Wall’) for transmission pipelines is generally accepted to be impervious to a strike from an excavator and pipelines with wall thickness greater than 19mm, as in the case of the Corrib Onshore Pipeline, would give an even higher level of protection. Further details regarding the strength of the pipeline are provided in Appendix Q4.

4.4.1.6 Corrosion Protection - Internal

Acidic components such as Carbon Dioxide (CO_2) and Hydrogen Sulphide (H_2S) are known to cause corrosion in gas pipelines. Detailed studies of the potential for CO_2 corrosion in the pipeline have been carried out for the Corrib reservoir fluids at pipeline operating conditions using the Shell proprietary ‘HydroCor’ computer programme and are described in Appendix Q4. These studies show that corrosion rates in the onshore pipeline will be very low even without the addition of corrosion inhibitors. A chemical corrosion inhibitor will be injected with the methanol to further mitigate the corrosion. A corrosion allowance of 1mm has been included in the onshore pipeline design. A number of additional features have been incorporated in the system design in order to minimise the potential for internal corrosion to impact upon the integrity of the pipeline. The pipeline wall thickness will be measured during the initial pipeline inspection pigging run. This will provide a clear outline of pipe wall thickness at the start of service. Similar runs will take place according to the requirements of the Pipeline Integrity Management Scheme (Appendix Q5).

The wall thickness in above ground sections of the pipeline can also be measured using specialised equipment. This can be extended to buried sections during periods of maintenance at the LVI.

H_2S has not been detected in the well fluids. Nevertheless a system for monitoring this possible H_2S concentration in the future is included in the system design. Further information on this is provided in the PIMS (Appendix Q5). Due to the characteristics of the Corrib Gas Field, it is highly unlikely that H_2S will occur in the future in the gas from the field.

The corrosion inhibitor and methanol will be injected into the gas at the wellheads. The methanol pumps, which pump the chemicals through the umbilical, have 100 per cent redundancy, i.e. there is a spare (third) pump available should one fail. The injection system is also fitted with low flow alarms.

4.4.1.7 Corrosion Protection - External

The external surface of the pipeline will be protected with a 3-layer polypropylene coating. This is a tough and durable waterproof material that will adhere strongly to the steel pipe. It will provide the main line of defence from external corrosion. To prevent corrosion where the pipe sections have been welded together, high quality shrink sleeves will be fitted.

In addition to the external pipeline coating, the pipeline will be protected from corrosion by an impressed current system. This is termed cathodic protection and works by neutralising corrosive effects, which are electro-chemical. The protection potential generated by the cathodic protection system is measured at cathodic protection posts installed at accessible locations above the pipeline and by regular surveys. Data gathered during operation provides information on the condition of the pipeline and potential corrosion issues.

Details of the applied corrosion protection systems can be found in Appendix Q4 (Materials and Corrosion Management Premises).

4.4.1.8 Methanol Injection

Methanol will be injected into the gas at the wells to ensure that components in the gas do not form hydrates in the production system. The methanol acts as a hydrate inhibitor by lowering the point at which hydrates will form. Methanol will be recovered from the production fluids at the Gas Terminal and reinjected subsea.

4.4.2 Construction Stage

4.4.2.1 Materials Check

All materials used in the construction of the Corrib Gas Pipeline system will be certified to relevant industry specifications. This means that manufacturers must meet stringent quality control requirements and produce relevant quality certification for all materials.

In addition to the manufacturers' quality assurance systems, all critical materials used on the Corrib Onshore Pipeline will also be inspected by independent third party inspectors at the point of manufacture. Finally, all materials arriving on-site will be inspected before being assembled and associated documentation will be examined for correctness and completeness.

Stored line pipe which will be used on the onshore pipeline has been preserved. Further detail of preservation of this line pipe is provided in Appendix Q5.

4.4.2.2 Welding

Pipeline welding will be carried out in strict accordance with detailed approved welding procedures executed by qualified welders. Qualified Pipeline Welding Inspectors will inspect every weld completed. Comprehensive records will be kept of all test results. Testing will include non-destructive ultrasonic examination of the weld and other possible tests including radiographic examination or magnetic particle inspection (MPI). Welds will also be inspected visually. If anomalies are discovered that could affect pipeline integrity, these will be repaired and retested.

Each length of pipe used will be fully traceable to the pipe mill where it was manufactured. Each length of pipe has a unique number that identifies the pipe length and its batch number. Where two pipes are welded together, their unique reference numbers will be recorded with the number of the weld and the identity of the welder who made the weld. If problems are discovered on one welded joint, it will be possible to locate other welds where pipes from the same batch number were used, or where the same welder was involved.

Welding will be carried out in accordance with a welding procedure designed specifically for the project based on the project materials. Each welder will be required to qualify for welding on the project by carrying out a number of test welds in accordance with the project specific welding procedure. These test welds will be subject to non-destructive examination and also mechanical testing to prove that each welder can meet the specification.

4.4.2.3 Depth of Burial

Approximately 4.9km of the proposed onshore pipeline will be installed within a 4.2m outer diameter concrete lined tunnel. The pipeline and associated services will not be at risk from normal activities within Sruwaddacon Bay, including boating, fishing and leisure activities, due to the minimum burial depth of 5.5m and the structural strength of the concrete tunnel.

On land, the Corrib Onshore Pipeline will be laid with a minimum depth of cover of 1.2m in accordance with industry codes of practice (I.S. 328). At this depth, the pipeline will not be at risk from agricultural practices including ploughing. Hundreds of kilometres of natural gas transmission pipelines have been in operation in Ireland for almost 30 years. These are installed in areas ranging from intensive tillage areas in north Co. Dublin to peatlands in Co. Roscommon. Gas transmission pipelines have also been installed through many urban centres. Visual markings (e.g. marker posts at field boundaries and buried marker tape) will also make it clear to landowners where the pipeline is buried after reinstatement has been completed.

Regular visual surveys of the pipeline as per the PIMS (Appendix Q5) will ensure that any accidental interference by third parties e.g. digging or construction in proximity to the pipeline will be identified quickly.

On land, the services umbilical, which includes conduits for the essential control services (hydraulics, corrosion inhibitor, methanol, electrical), will be laid in the same trench approximately 1m from the gas pipeline. These services together with the signal cable and fibre optic cable will also be laid with a minimum depth of cover of 1.2m in areas where the route is on land.

At watercourses, the minimum depth of cover will be 1.6m in accordance with industry codes of practice (I.S. 328). Impact protection in the form of concrete slabs will also be placed above the buried pipeline where it crosses beneath streams, drains or ditches. This is to ensure that any future possible drain clearance will not result in accidental damage to the pipeline. Concrete slabs will also be used to protect the pipeline where it crosses beneath tracks and roads. This will ensure that it will not become damaged by traffic (especially from heavy vehicles).

For the Leenamore River crossing, the gas pipeline will be concrete coated. A spare duct (steel pipe with concrete coating) will be laid parallel to the gas pipeline at the Leenamore River crossing. The umbilicals and water discharge pipeline will be installed within this duct. Installation of this duct will allow the duration of the construction of the Leenamore River crossing to be minimised.

4.4.2.4 Stability

The pipeline and stone road have been designed having regard to maximising the stability of the pipeline. The stone road and pipeline will not be at risk from landslides or peat slides.

The pipeline route avoids any areas of steep slopes where there may be potential for such risks of landslides or peat slides.

The stone road construction methodology is described in Chapter 5 and Chapter 15. Detailed analysis of the stability of the stone road and pipeline within it are included in Appendices M2 and Q6.

4.4.2.5 Testing and Commissioning

The pipeline system will be subject to detailed testing prior to being put into operation. An outline of these tests is provided in Chapter 5. This will include pressure testing of the pipeline in sections or as a whole at 504 barg for a period of 24 hours. Once the pipeline has been fully tested and certified as complying with relevant codes and standards, commissioning can commence.

A high-level commissioning procedure for the pipeline has been developed by SEPIL and will be carried out using specialised qualified staff. The pre-commissioning and commissioning stages are outlined briefly in Chapter 5.

SEPIL has engaged an independent verification body to provide independent verification of all Corrib Gas Pipeline safety critical facilities. In addition, prior to commencement of Corrib gas production, a Letter of Acceptance is required from the Department of Communications, Energy and Natural Resources confirming that independent third-party verification has been carried out and completed satisfactorily for the development.

4.4.3 Operation and Maintenance

No further disturbance to land is likely to be required during the operational phase except for access as part of routine visual inspection and monitoring purposes. Safe operation of the pipeline system is achieved through its design, and through operating the system within the set parameters. In addition, SEPIL will operate a comprehensive scheme for monitoring and maintaining the pipeline system integrity. During the operation and maintenance stage of the project, the factors outlined below also enhance project safety.

4.4.3.1 Pipeline Integrity Management Scheme (PIMS)

The stated aim of the PIMS (see Appendix Q5) is to provide a management scheme for safeguarding the integrity of the Corrib Gas Pipeline system and the associated services to ensure its availability for safe operations in line with SEPIL's operational, societal and environmental objectives. The guiding principle of the scheme is to ensure that any risk of failure, which has the potential to endanger the safety of people or the environment, is reduced to a level as low as reasonably practicable ('ALARP'). Risk 'barriers' such as the design features mentioned above, or the injection of corrosion inhibitor, represent one part of the PIMS. The other essential part, is the ongoing verification of the effectiveness of such risk barriers through monitoring and measurement. The PIMS considers:

- Process safety e.g. operating procedures, overpressure protection, emergency procedures and leak detection;
- Mechanical Integrity, including fatigue, overstress, mechanical damage and threats from peat instability and other geotechnical instability, Corrosion Management and Flow Assurance; and
- Management of change, e.g. design change, modifications and set points.

4.4.3.2 Leak Detection

The risk of leaks in the onshore pipeline system is extremely low due to its design in combination with the quality assurance process applied to its fabrication, construction and installation. Nevertheless, two systems of leak detection will be operated for the pipeline.

The first system will be computerised and covers the offshore pipeline as well as the onshore pipeline. It will utilise flow, pressure and temperature data. Its essential objective will be to provide an early warning if a pipeline leak should occur, so that appropriate remedial action can be undertaken.

A second and independent, system will be in installed, which is based on monitoring along the onshore pipeline route by means of very sensitive vibration detection using a fibre optic cable.

The main functions of the leak detection systems are:

- To provide the operator with alarm signal levels on occurrence of a detectable leak anywhere within the system;
- To identify the area where the leak is situated (second system only); and
- To evaluate the leak rate, and the total gas lost, due to the leak.

4.4.3.3 Landfall Valve Installation

Regular inspection, maintenance and testing of the LVI will ensure that it is ready to operate in the infrequent event that it is required. However, since the normal operating pressure for the Corrib Onshore Pipeline at the Terminal inlet will be approximately 85barg (equivalent to approximately 90 barg at the LVI) and given the relative simplicity of the Corrib production and processing system in comparison to other highly complex production and processing facilities, the operating frequency of the LVI safety shutdown system is expected to be very low. The LVI is part of the automated pipeline protection system and will close without operator intervention at 99 barg. The landfall valve can be closed manually by remote signal from the Gas Terminal if required. Therefore if, for any reason, qualified personnel see the need to take this action, they can do so immediately. If such action were to be taken, it will only be possible to re-open the LVI valves manually at the LVI.

The LVI will be a secure facility similar to many Above Ground Installations (AGIs) in the Irish gas transmission network.

Further information on the LVI, including a design justification and an assessment of alternative layouts, is provided in Appendix Q4.

4.4.3.4 Wellhead Control

On the seabed, at the top of each Corrib well, a valve assembly (or ‘Christmas Tree’) is installed. This is made up of a series of valves and instruments that are used to safely manage gas production. The main function of the tree is to direct the gas from the well into the flow line and to provide the means to safely and reliably shut in (stop), gas production.

The primary valves on the tree are the master valve and flow wing valve. These two valves are used to ensure that gas production can be safely shut in either by the operator or, automatically by the control system, should an unexpected event occur. The tree also contains valves to allow methanol and other chemicals to be injected into the well if required. Finally, each tree, has a choke valve that the control room operator can use to accurately control the rate and pressure at which the gas flows from the wells into the subsea pipeline.

In addition to the master and flow wing valves, each well also has a surface controlled subsurface safety valve installed approximately 900m below the seabed. This valve is designed to be an independent back up for the primary tree valves.

Additional information on wellhead control and process safeguarding systems is provided in Appendix Q4.

4.4.3.5 Qualified Personnel

Operations and maintenance staff who will work at the Gas Terminal and who may need to operate the LVI will be fully qualified and competent to fulfil their roles. Maintenance will be carried out in accordance with detailed procedures. Works to take place will be planned in advance and will operate according to a Permit to Work system. Where necessary, specialist personnel (e.g. manufacturer technicians) will be used for specialised work. Safety training briefings (toolbox talks) will also cover the key safety issues prior to any works or maintenance taking place.

4.4.3.6 Risk Assessment

The risk assessments initiated during the design phase will be carried through into operations in a number of ways. For example, qualitative risk assessment studies identify the controls in place to prevent accidents and, during operations, such controls will be maintained and tested through a system of safety critical activities, performance assurance of safety critical elements, etc.

4.4.3.7 Emergency Response Plan

An Emergency Response Plan will be prepared and put in place before commissioning of the pipeline. The plan will be administered by the staff at the Gas Terminal in close co-ordination with the principal response agencies. The main objectives and elements of the emergency response plan will be communicated to the local community and to the local and regional emergency services. It will contain actions to be taken in the event of an emergency and will include:

- Responsibilities and organisation;
- Notification procedures and communications in the event of an incident;
- Alerting and communication procedures;
- Procedures for shutting down the pipeline;
- Emergency actions to be taken; and
- Reporting.

Further details on the principles of emergency response provisions are provided in Appendix Q6.

4.4.4 Liaison with Landowners

SEPIL will liaise with landowners regarding the onshore pipeline system, its position and normal safety requirements typical for such developments. Information about the project and its location is a simple but important element of the safe operation of the pipeline.

Marker posts will be installed above the pipeline at field boundaries. In this way, landowners can be sure of the location of the pipeline using these visible waypoints.

4.5 OPERATION AND MAINTENANCE

The pipeline will be operated from the Bellanaboy Bridge Gas Terminal. Normal operation of the pipeline will involve periodic inspection of the pipeline route and visits to the LVI by maintenance personnel.

Checks of the LVI will include periodic testing and maintenance in line with the manufacturers' recommendations, or on the basis of inspection results. The frequency and detail of inspection and maintenance activities will be carried out according to the principles of the PIMS (see Section 4.4.3.1), manufacturer recommendations and relevant codes and standards.

4.5.1 Permanent Wayleave

The details of the permanent wayleave are defined in respect of each landholding through which the pipeline passes. The Deeds of Easement sought herein with landowners/occupiers will permit SEPIL access to this wayleave at any time for normal operation, routine inspection and maintenance. Some restrictions will apply to the use of land within the permanent wayleave (building of structures, tree planting, deep ploughing etc.) but otherwise the land in this area will return to normal use once construction and reinstatement have been completed.

Revisions to the pipeline route have resulted in a smaller wayleave footprint meaning that access requirements to private lands for inspection and maintenance has been minimised.

4.6 DECOMMISSIONING

Decommissioning of the pipeline after its useful life will involve the removal of any above ground facilities at the LVI and any remaining gas and hydrocarbon residues from the pipeline and services. Decommissioning may involve reinstating the dished LVI compound to previous ground level. This would involve importing material to the area in consultation with the relevant authorities at the time, particularly having regard to the relevant designation status.

Decommissioned pipelines are typically left in place, cleaned and monitored according to an agreed programme. The umbilicals will be flushed to remove all traces of chemicals and all electrical lines isolated and disconnected. The outfall pipe will be flushed with clean water. The umbilical and outfall pipe, once isolated, flushed and capped could be left in-situ.

A decommissioning plan will be prepared to ensure that the activities will comply with relevant EU and national legislation relevant to decommissioning at that time. The plan will incorporate best practice for decommissioning at the relevant time period, and will include an environmental appraisal of the proposed decommissioning methods. Decommissioning plans will be subject to further regulatory approval at the relevant time.

5 CONSTRUCTION AND COMMISSIONING

5.1 INTRODUCTION

This chapter describes the activities associated with the construction and commissioning of the Corrib Onshore Pipeline. Mitigation measures have been developed to ensure that any potential negative effects of the construction activities on the environment have been minimised.

The activities described below include pre-construction, construction and reinstatement as well as the necessary testing and commissioning of the pipeline system before the pipeline is put into operation.

Construction will be carried out using two methods, namely segment lined tunnelling from Na hEachú (Aghoos) to Gleann an Ghad (Glengad) for approximately 4.9km (approximately 60% of the pipeline route), most of which is underneath Sruwaddacon Bay (see Section 5.5) and conventional 'open-cut' technique ('Spread Technique') (see Section 5.4) for approximately 3.4km of the pipeline which is on land (approximately 40% of the route). Contingency measures to deal with potential geotechnical hazards are considered and outlined in the Geotechnical Risk Register (see Appendix M).

Tunnelling activities will be carried out from a temporary compound located in Na hEachú (Aghoos) (see Section 5.5.2). The tunnel will be bored mainly through the sands and gravels overlying bedrock within Sruwaddacon Bay and will terminate at a temporary reception pit at Gleann an Ghad (Glengad). It is not anticipated that any surface construction work will be required within Sruwaddacon Bay

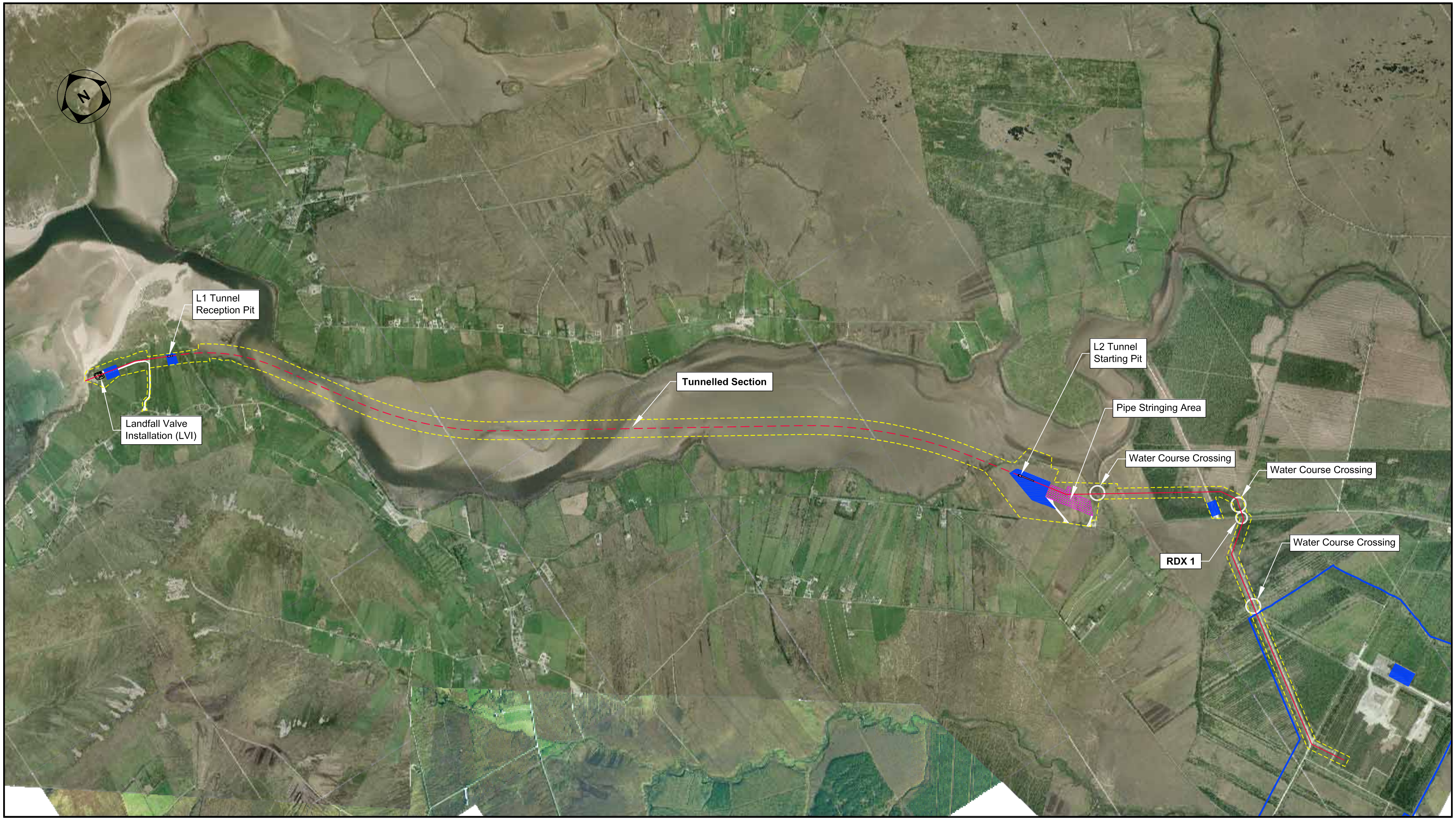
Where reference is made to the construction of the onshore pipeline this should be taken as also including the water outfall pipeline and services (umbilicals and cables) as described in Chapter 4 unless they are addressed or referenced separately.

A typical construction layout plan is provided in Figure 5.1 (a & b), which provides details on the proposed location of the temporary and permanent works.

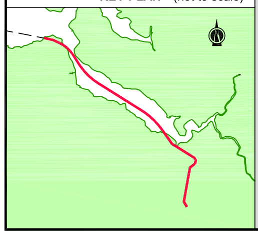
5.2 CONSTRUCTION PROGRAMME

It is estimated that it will take approximately 26 months to complete the construction of the Corrib Onshore Pipeline. The main elements of the project programme are outlined below and illustrated in Figure 5.2.

- Mobilisation;
- Pre-construction activities including setting up of temporary construction compounds and facilities;
- Preparation of temporary working areas;
- Construction of the Landfall Valve Installation;
- Tunnelling;
- Construction of stone road in peatland areas;
- Installation of the Onshore Gas Pipeline (and associated services);
- Testing;
- Grouting of tunnel;
- Commissioning; and
- Reinstatement.



KEY PLAN (not to scale)



LEGEND

	PROPOSED PIPELINE ROUTE
	TUNNELLED SECTION
	TERMINAL PLANNING BOUNDARY
	TEMPORARY WORKING AREA
	SITE COMPOUNDS
	TEMPORARY ACCESS ROAD (6m wide)
RDX	ROAD CROSSING

NOTE:

TEMPORARY WORKING AREA SHOWN INCLUDES POSSIBLE DEVIATION OF THE PIPELINE AND THE PIPELINE CONSTRUCTION SPREAD. THE PIPELINE CONSTRUCTION SPREAD WILL TYPICALLY BE 40M. WIDE. THE TEMPORARY WORKING AREA ALSO INCLUDES ALL COMPOUNDS AND ANCILLARY AREAS.

PROPOSED CONSTRUCTION PLAN

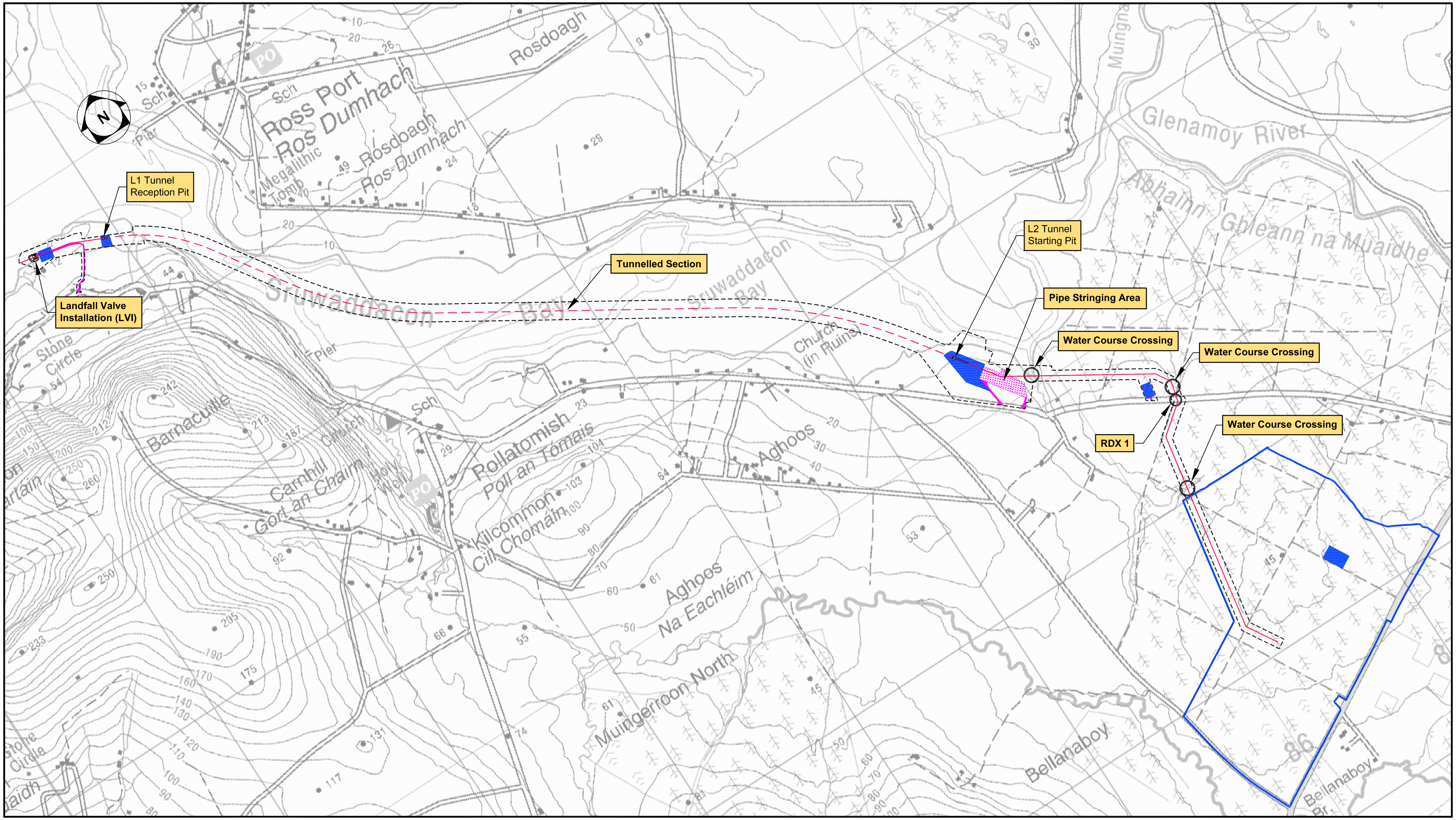
Figure 5.1a

CORRIB ONSHORE PIPELINE

File Ref: COR25MDR0470Fg5. 1aA03
Date: May 2010

Corrib natural gas

RPS



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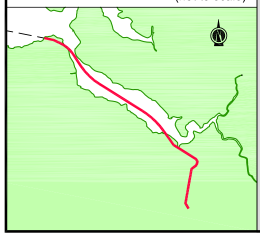


LEGEND

- PROPOSED PIPELINE ROUTE
- TUNNELLED SECTION
- TERMINAL PLANNING BOUNDARY
- TEMPORARY WORKING AREA
- SITE COMPOUNDS
- TEMPORARY ACCESS ROAD (6m wide)
- RDX ROAD CROSSING

NOTE:

TEMPORARY WORKING AREA SHOWN INCLUDES POSSIBLE DEVIATION OF THE PIPELINE AND THE PIPELINE CONSTRUCTION SPREAD. THE PIPELINE CONSTRUCTION SPREAD WILL TYPICALLY BE 40M. WIDE. THE TEMPORARY WORKING AREA ALSO INCLUDES ALL COMPOUNDS AND ANCILLARY AREAS.

PROPOSED CONSTRUCTION PLAN

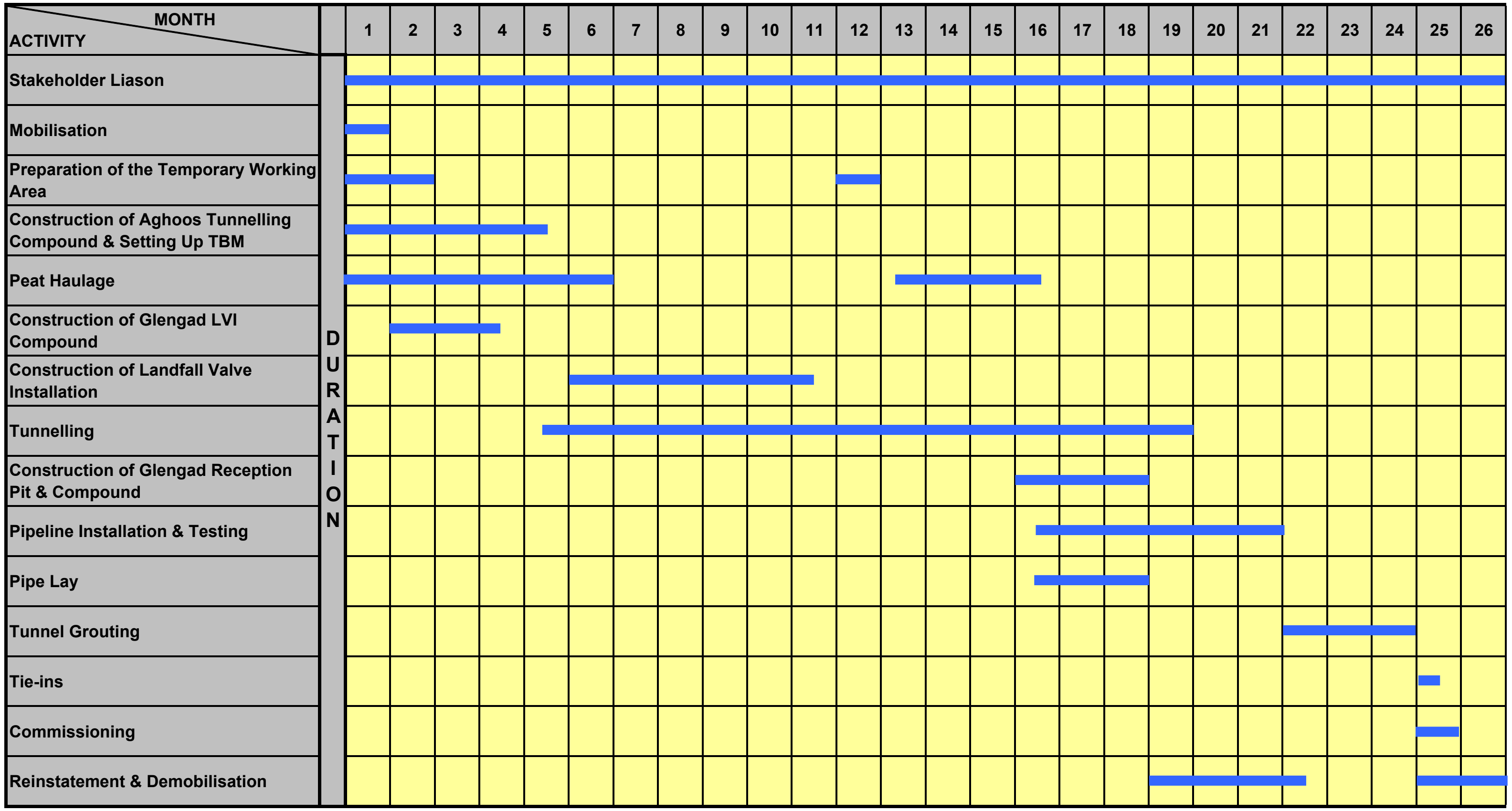
Figure 5.1b

CORRIB ONSHORE PIPELINE

File Ref: COR25MDR0470Fg5.1bA03
Date: May 2010

Corrib natural gas

RPS



Notes:

Stakeholder Liaison includes ongoing liaison with Landowners, Community, Local Authorities and Statutory Bodies such as NPWS and NWRFB
Preconstruction activities includes the setting up of temporary construction facilities
Construction of Pipeline timeframe includes all general pipe laying, road/river/track crossings and peatlands construction
Durations shown are indicative only and activities may occur at any time during the construction period

Typical Construction Programme

Figure 5.2

File Ref: MDR0470GrEIS051 RevA03
Date: May 2010

CORRIB ONSHORE PIPELINE

5.3 PRE-CONSTRUCTION ACTIVITIES

Before construction can commence, a number of preparatory activities will be carried out. These activities, which are outlined below, involve detailed surveys and consultation with landowners, statutory bodies and the public.

5.3.1 Consultation and Liaison

5.3.1.1 Landowners

Prior to construction a Landowner Liaison Officer (LLO) will liaise with landowners and occupiers and, where possible, agree certain items such as temporary fencing, security, temporary relocation of water supplies and access requirements.

A survey and assessment of wells and field drains will be carried out to ensure that field drainage patterns and water supplies are not adversely affected by the works. Boundaries, dwellings and roads (public & private) in the vicinity of the works will also be surveyed to provide an accurate record for reinstatement purposes.

5.3.1.2 Statutory Bodies

Consultation on the detailed aspects of the construction and reinstatement activities will be carried out prior to and during construction. Bodies to be consulted include the relevant divisions of Mayo County Council, the National Parks and Wildlife Service (NPWS) and the North Western Regional Fisheries Board (NWRFB).

5.3.1.3 Public

In parallel with direct landowner liaison, regular community updates will be published to provide relevant information to the local community and stakeholders prior to and during the construction phase of the project. In addition, local Community Liaison Officers (CLOs) will carry out liaison duties throughout the duration of the construction period for the onshore pipeline. It is also proposed that a Project Monitoring Committee will be established to monitor the project, including environmental, geotechnical, and road traffic and maintenance issues. The committee would include representatives from SEPIL, Mayo County Council, the Department of Communications, Energy and Natural Resources (DCENR), the NWRFB, the Department of the Environment, Heritage and Local Government (DoEHLG), and representatives from the local community, selected in accordance with procedures to be agreed with Mayo County Council.

5.3.2 Pre-Construction Surveys (Investigation, Surveying and Testing)

Detailed ground investigations, environmental surveys and archaeological testing required to support the construction process would be carried out and finalised at this stage. Sections B-F of this EIS include further details on pre-construction survey requirements. The proposed route will also be surveyed to identify any safety hazards along the route, including any that have arisen since the preparation of this EIS.

5.4 PIPELINE CONSTRUCTION ACTIVITIES ON LAND (NON TUNNELLED)

Conventional ‘open-cut’ technique (‘spread technique’) will be used for approximately 3.4km of the pipeline which is on land. Approximately 0.7km will be in grasslands, while 2.7km will be constructed through peatlands using the stone road construction method.

The spread technique uses a temporary working area to carry out construction (Figure 5.3). This provides access for construction machinery along the route of the pipeline. All general pipe-laying activities will be carried out within the temporary working area and follow the sequence outlined in Section 5.4.6 unless otherwise stated.

The spread technique will be adapted in areas of peatland (see Section 5.4.5) and in other habitats, e.g. salt marsh, to minimise environmental impact and aid successful reinstatement (see Chapter 12).

In general, the temporary working area will be 40m wide and follow the route of the onshore pipeline. Increased working space will be required at road and watercourse crossings and where temporary construction compounds are required. Upon completion of construction, a 14m wide permanent wayleave will remain in place for the lifetime of the pipeline, except in peatland and forestry where a 20m wide permanent wayleave will be required to accommodate the stone road.

5.4.1 Mobilisation

Mobilisation will include the putting in place of staff, temporary facilities, plant and equipment, materials and systems for construction. Training in health, safety and environmental issues will be provided for staff during the mobilisation period, which is estimated to take some four to six weeks.

5.4.2 Preparation of the Temporary Working Area on Land

The pipeline centreline and the temporary working area boundaries will be marked out using wooden pegs. This process is known as ‘setting out’ and will be carried out in accordance with co-ordinates detailed on project drawings and agreed in advance with landowners/occupiers and the relevant authorities. The location of all field drains and services will be identified at this stage, where possible. Likewise any drains/services discovered during the subsequent excavation works will be marked out and recorded. Where necessary, crops, ditches, sod banks, walls and trees will be removed from within the temporary working area.

All identified construction safety hazards will also be marked and fenced. In particular, protection will be provided against all overhead and buried cables and warning signs will be erected. This activity will be carried out in accordance with the Construction Health and Safety Plan developed by the Contractor nominated as the Project Supervisor for the Construction Stage (PSCS) in accordance with the requirements of the Safety, Health and Welfare at Work (Construction Regulations) (2006). See Section 5.13.3 for more details.

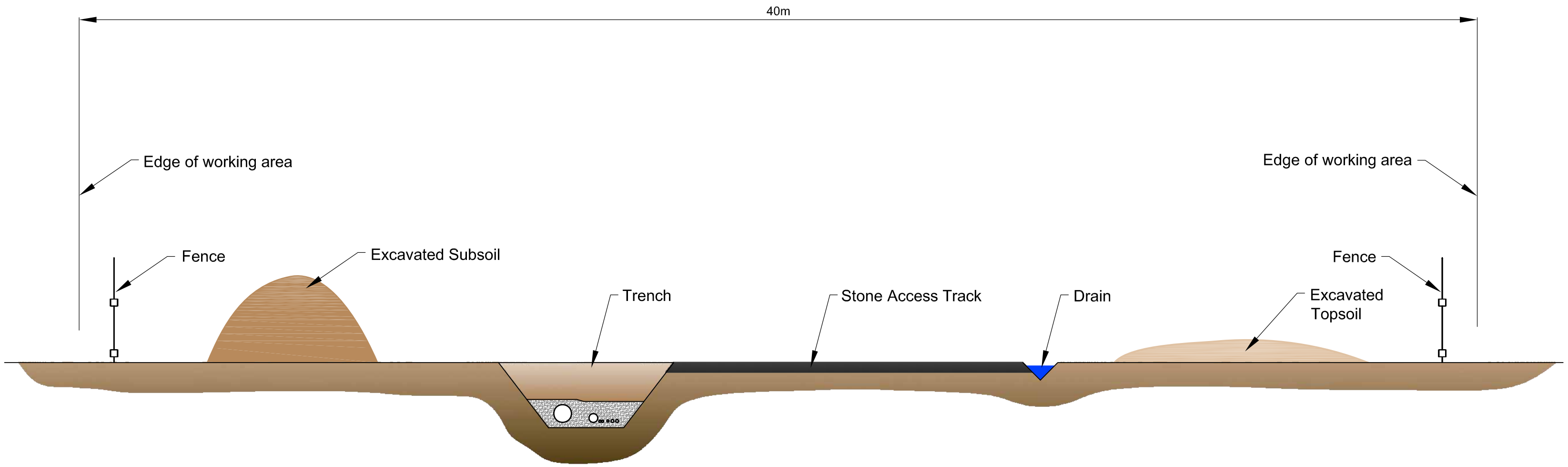
The setting out process is generally carried out ahead of the main construction activities on an area-by-area basis.

5.4.3 Fencing

Following the setting out process the temporary working area will be fenced off. Linked palisade fence sections will form a continuous, 3m high fenced boundary to the temporary working area. In some areas (e.g. the tunnelling compound at na hEachú (Aghoos)), temporary fencing will be specially designed to attenuate construction noise and reduce light spillage and visual impact.

Access requirements identified through landowner/occupier liaison (e.g. livestock movement) across the temporary working area will be identified and suitable arrangements put in place. Provisions for sensitive wildlife or protected species will also be made as agreed with the relevant authorities/bodies (see Chapter 12 for further details).

Fenced boundaries will be inspected regularly and maintained throughout the construction process.



Note: Positions of gas pipeline, outfall pipeline and services are indicative

Typical Temporary Working Area in Grassland

Figure 5.3

File Ref: COR25MDR0470Fg5.3A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

5.4.4 Wayleave Preparation — Grasslands (Chainage 83.40 to 83.88 and Chainage 89.10 to 89.35)

At Gleann an Ghad (Glengad) and a short section at the Leenamore river, topsoil will be stripped by appropriate earth moving equipment and stored carefully in stockpiles within the temporary working area for use in the subsequent reinstatement of the lands. The stored topsoil will be kept separate from subsoil excavated at the trenching stage (see Section 5.4.6.5). Topsoil will also be stripped from the LVI site, LVI construction compound and the tunnelling reception pit compound. A layer of stone will be laid to form a running track and provide a firm, all-weather surface for construction plant and materials. This will be removed after construction and before the topsoil is reinstated.

Temporary drainage will be installed, where necessary, and ditches will be kept open using flume pipes or alternative techniques.

The layout of the temporary working area for general pipeline construction is shown in Figure 5.3.

A licensed archaeologist will be present on site to monitor all topsoil stripping activities.

5.4.5 Wayleave Preparation — Peatlands (Chainage 88.77 to 89.10 and Chainage 89.35 to 91.72)

Construction in peatlands presents technical challenges mainly as a result of soft ground. The principal factor influencing construction methods is peat depth; however, other important factors include the shear strength of the peat and the local hydrology.

Bog mats will provide a temporary surface for construction plant movements during setting out and fencing operations in peatlands and during reinstatement (Plate 5.1).

Plate 5.1: Installation of Bog Mat track within peatland.
(Mayo – Galway Pipeline, 2006) (Note use of low ground pressure machinery to deliver bog mats.)

In the peatland sections of the route it is proposed to construct a stone road, which will form a stable working platform for the works. It is then proposed to lay the pipeline in a trench within the stone road. This method of construction will require a similar temporary working area to that used for grasslands. The key benefits of the stone road method are listed below:

- The stone road provides a stable running track, capable of carrying construction traffic;
- It reduces the area affected by construction (compared to conventional open cut methods in peatland); and
- It provides long term stability and protection of the pipeline.

Peat will typically be excavated to within approximately 0.5m of the base of the peat and the excavation backfilled with stone. The process of installing the stone road will be a combination of excavation and displacement of peat with stone (see Plate 5.2 below). The depth of stone will vary depending on the depth of peat. A licensed archaeologist will be present on site to monitor all peat excavation activities.

The proposed stone road is approximately 12m wide at its upper surface.

Plate 5.2: Placement of stone road at Upper Glencullin
(Mayo - Galway Pipeline, 2006)

The stone for constructing the stone road will be locally sourced and carefully selected to ensure that it is appropriate for the local environment within the peat. Where possible, tunnel arisings will also be used in combination with quarry stone for the construction of the stone road. As the stone road is constructed, peat plugs will be placed at approximately 50m intervals to prevent the road acting as a preferential drainage channel. This will minimise the potential impact on the local hydrology (see Chapter 15).

The stone road method of construction was used in areas of peatland during the construction of the Mayo-Galway pipeline (see Plate 5.2), where the pipeline was laid next to the stone road. For the

Corrib Onshore Pipeline, it is proposed to install the pipeline and associated services within the stone road. Once the stone road is in place, a trench will be excavated in the stone road, within which the onshore gas pipeline and services will be laid. The trench will then be backfilled using pipe bedding material and the excavated stone.

A section of stone road (approximately 0.97km long) from chainage 90.725 to 91.692 within the Gas Terminal site boundary has already been constructed (see Appendix M3). This is further detailed in Appendix M3. It is proposed to use this stone road for the construction of the Corrib Onshore Pipeline.

5.4.5.1 Area of Peatland east of Leenamore River (Chainage 89.35 to Chainage 89.54)

It is proposed to remove and preserve the top vegetated layer of peat in sections (turves) in an area of peatland, east of the Leenamore River crossing (see Chapter 12). In this area (approximately 190m along the pipeline route), it is also proposed to limit the width of the stone road to 9m to minimise impact on the peatland.

The turves to be removed will be approximately 2m x 1m x 0.5m deep (see Plate 5.3). A specially designed excavator bucket will be used to lift and place turves carefully onto wooden bog mats so that they do not break up. These bog mats are located alongside the stone road within the temporary working area. The storing of turves on bog mats will facilitate their later removal and reinstatement of the wayleave without damaging the underlying bog. The general layout of the pipeline spread in this area is shown on Figure 5.4.

Plate 5.3: Removal of turves from bog using excavator equipped with specialised bucket
(Mayo-Galway Pipeline, 2006) (Note storage of turves and low ground pressure (wide tracked) excavator)

Turves will be stored in a single layer in order to minimise the potential damage to the turves, and to minimise compaction of the peat beneath the bog mats. The turves will be monitored during storage and they will be watered when required to keep them moist. Water used for this purpose will be collected rainwater or water diverted from local watercourses sourced from a suitable location.

In this section of peatland, no excavated peat apart from the turves will be stored within the temporary working area. The required temporary working width will be approximately 40m to allow sufficient spacing for storage of turves.

5.4.5.2 Other Areas of Peatland (Chainage 88.77 to 89.10 and Chainage 89.54 to 91.72)

In areas of peatland, where it is not possible to turve, the top surface of peat including the vegetation will be removed by excavator and kept separate from peat excavated from lower layers (in the same way that top soil is kept separate from subsoil in grasslands). This material will be retained and used during the reinstatement process.

The quantities of peat removed will depend on the depth of peat in any given area. It is proposed to store excavated peat separately within the temporary working area by ‘side casting’ and spreading where necessary (as agreed with the geotechnical engineer) (see Figure 5.4). All surplus peat will be removed and deposited at the Srahmore Peat Deposition Site.

5.4.6 Pipeline Assembly and Installation

Once the pipeline wayleave has been prepared (in grasslands or in peatland areas), pipe laying activities (and installation of associated services) can begin.

5.4.6.1 Pipe Stringing

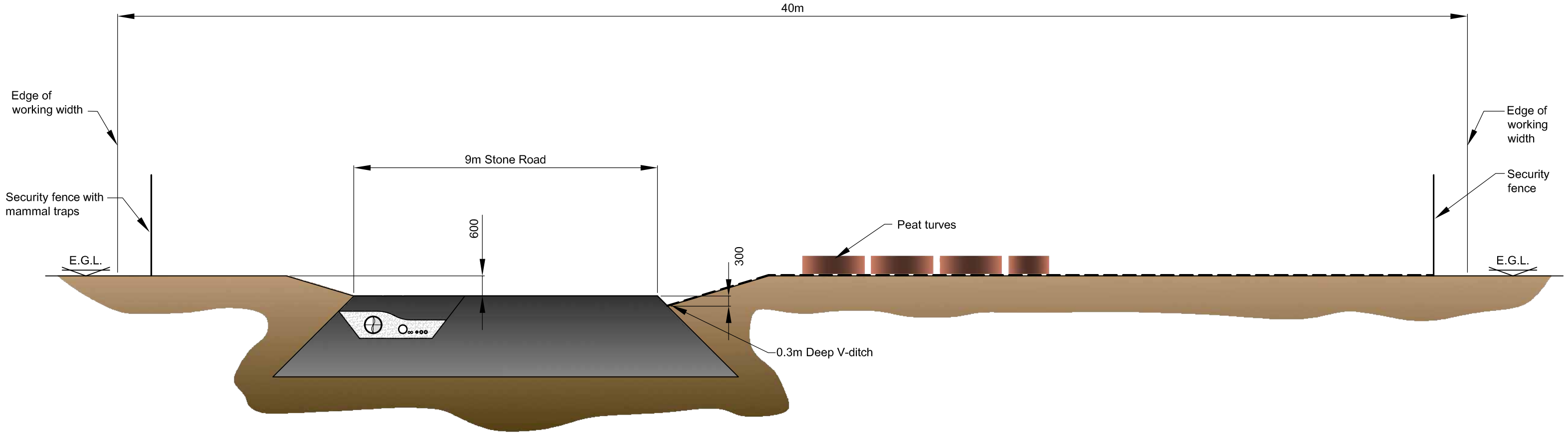
The term ‘pipe stringing’ refers to the delivery and laying out of individual pipe lengths (each approximately 12m long) along the pipeline route. Lengths of pipe will be transported along the temporary working area or by public road from a local storage point (the Terminal) or directly from its storage location in Co. Donegal in accordance with the Traffic Management Plan (TMP). The water outfall pipeline, umbilicals and services will be strung out and laid in the same trench as the gas pipeline.

5.4.6.2 Pipe Bending

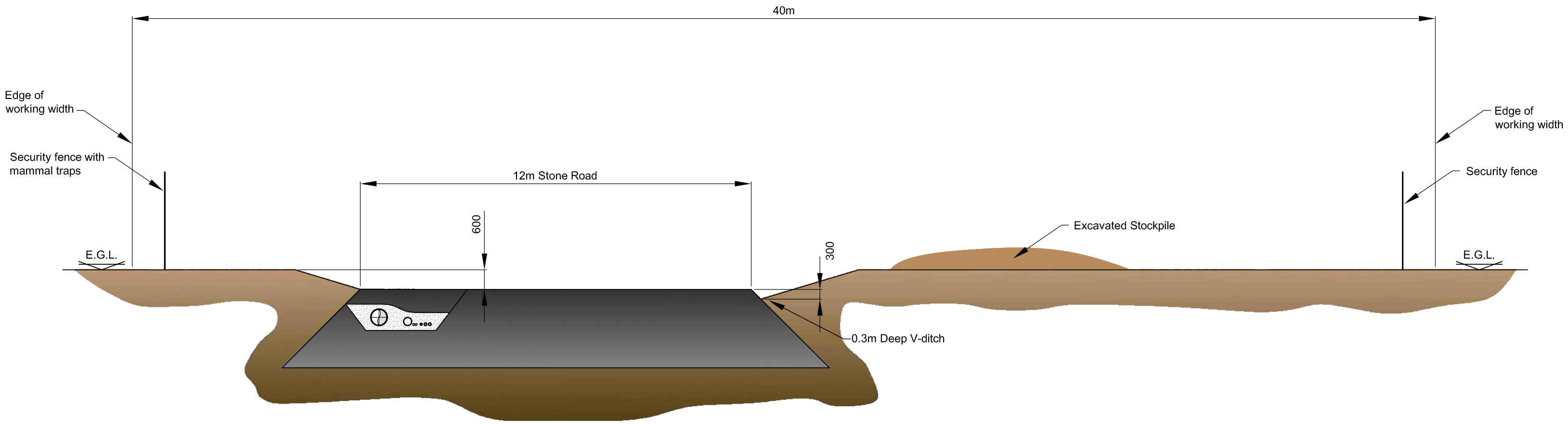
Pipe lengths will be bent on site where changes in elevation or direction occur along the pipeline route. Special hydraulic bending machines will be used for this purpose. Pre-formed or forged bends may also be used.

5.4.6.3 Pipe Welding

Lengths of pipe will be mounted on timber skids to allow access under the pipe for the welding process. The pipeline will be welded together in sections along the side of the trench prior to lifting the pipe string into the trench. Welding will be carried out manually by suitably qualified welders or automatically by using welding machines. The welding process will be carried out in accordance with approved procedures.



9m STONE ROAD



12m STONE ROAD

Note: Positions of gas pipeline, outfall pipeline and services are indicative

Typical Layout of Temporary Working Area in Peatlands

Figure 5.4

File Ref: COR25MDR0470Fg5.4A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Welders will work in crews. Two pipe lengths will be clamped end-to-end to form a butt weld. The welding crew at the “front-end” will weld the pipes together depositing the first two passes (root pass and hot pass). Welders working on the “back-end” will follow behind and fill in the weld left by the front-end welders. When work is not carried being out on welded lengths of pipe, any open ends will be capped off.

Plate 5.4: Manual Welding
(Gas Pipeline to the West, 2002)

5.4.6.4 Weld Testing and Coating

Weld quality is essential to pipeline integrity and the quality of all welds will be checked using non-destructive inspection techniques. Strict acceptance criteria will be applied in accordance with relevant standards. Any unacceptable defect detected will either be repaired or the joint cut out and re-welded. The repair weld is subject to the same testing and inspection requirements as the original weld. Additional tests may be required.

Following welding, coatings will be applied to the field joints and other areas where metal is exposed. These coatings are electrical insulators and are resistant to the action of corrosion or soil bacteria. Following application, the coating quality will be checked against strict acceptance criteria.

5.4.6.5 Trenching

The trench in which the pipeline will be installed will be excavated using mechanical excavators or a specialised trenching machine. The depth of the trench may vary but will allow a minimum reinstated cover of 1.2m over the top of the pipeline on land, with 1.6m provided below the clean bed of any watercourse (i.e. rivers, streams and ditches) and 1.6m below the lowest point at road crossings (i.e. roadside drains).

Where rock occurs, and ground conditions are not suitable for normal excavation, it may be necessary to break the rock using rock breakers.

An even layer of pipe bedding material will be placed in the excavated trench. This bedding must be free of any object/material that could cause damage to the pipe coating and compromise the integrity of the onshore pipeline. Materials excavated from the tunnelling process may be suitable for this purpose. If suitable material is not available, it will be necessary to import material such as sand or pea gravel. The pipe may also be specially coated with fibrous material (geotextile) to offer additional protection, particularly in rocky sections.

A licensed archaeologist will be present on site to monitor all trenching activities.

5.4.6.6 Ditching

Before a length of the welded pipeline is lowered into the trench the complete section will be inspected for adequacy of pipe coating. This will be carried out using a piece of equipment called a holiday detector, which detects flaws in the external coating using an electric / magnetic discharge. Any flaws identified will be rectified and re-tested.

Once a section of trench has been prepared, the relevant section of pipeline will be lowered into the trench using a series of side-boom crawler tractors (see Plate 5.5). These units are designed to safely lower the completed pipe string into the trench. At various locations along the pipeline route it may be necessary to tie the pipeline into a pre-installed section of pipe contained within a sleeve pipe (e.g. at road and watercourse crossings).

The water outfall pipeline and other services will be laid within the same trench as the gas pipeline. These will also be inspected prior to installation to ensure that they have not been damaged and once laid are ready for commissioning. These services will also be bedded and surrounded in suitable material such as sand or pea gravel. In some locations, it may be necessary to use a conduit to facilitate the subsequent installation of the umbilical and services. The minimum separation distance between the gas pipeline and the umbilicals (on land) will be 1m.

Plate 5.5: Ditching assembled pipeline.
(Gas Pipeline to the West, 2002)

5.4.6.7 Backfilling

The gas pipeline will typically be given a 150mm bedding and surround to protect its coating and the trench will then be backfilled in suitable layers will be compacted at regular intervals. This method prevents excessive settlement of the backfill at a later date. Care will be taken not to over-consolidate the backfill, particularly on sloping ground, as this can act as a sub-surface dam against natural drainage. Marker posts will be placed at field boundaries, road crossings, etc. to indicate the route of the onshore pipeline. Marker tape made from brightly coloured and sturdy plastic film, to alert parties to the location of buried services, will be placed some distance (minimum 300mm) above the buried service.

5.4.7 Reinstatement

5.4.7.1 Grassland

Once the pipeline installation has been completed, the temporary working area will be levelled and graded. In grasslands, the stone in the running track will be removed, where required, and the track mechanically ripped / ploughed to a depth of 500mm to remove any compaction of soft strata. The topsoil will then be put back and the land boundaries reinstated. The topsoil from each area will be replaced in its original location.

Timing of reinstatement of agricultural areas will depend on progress, requirements for access and weather conditions. It is intended that reinstatement will take place shortly after construction; however, reinstatement of agricultural areas could take place during the following season subject to landowner agreement.

Plate 5.6: Reinstatement taking place on section of pipeline in Co. Galway.
(Gas Pipeline to the West, 2002)

5.4.7.2 Peatland

In areas of peatland, the stone road will be covered with up to 0.6m of peat stockpiled within the temporary working area for this purpose. The area will be finished off, levelled and graded with vegetated peat as described in Section 5.4.5.2.

In the area of peatland to the east of the Leenamore River, once the gas pipeline and associated services have been installed, a regulation layer of peat will be spread upon the stone road. The peat used for this process will be the original peat excavated from the area. Stored turves will then be put back to cover the reinstated peat layer on top of the stone road. Each of the turves will be positioned carefully next to the previous section of turf and in this way the surface of the bog will be reinstated (see also Appendix M). Care will be taken to avoid compaction during reinstatement and the turves will be reinstated to a slightly higher level than the surrounding bog in order to allow for settlement post construction.

5.4.7.3 General

Reinstatement will include the re-erection of fences or walls between fields and properties, including where they cross the reinstated trench.

Following reinstatement, temporary fencing and bogmats will be removed and the lands returned to normal use. Restrictions on development within the permanent wayleave will remain in place as described in Chapter 4.

5.4.8 Road and Track Crossings

The proposed route includes one road crossing as shown on Figure 5.2. This will be a short crossing, which will be constructed using standard open-cut techniques. The pipeline will be installed with a minimum depth of cover 1.6m in accordance with the relevant standards and local authority requirements.

The road crossing will be discussed and agreed with Mayo County Council prior to construction. The construction contractor will also liaise with the relevant utility providers concerning the presence of services at the road crossing location. A minimum clearance of 300mm will be maintained between the onshore pipeline and any existing services. In addition impact protection in the form of precast concrete slabs may be placed over the pipeline and under the road / track.

It is proposed that works will be undertaken in accordance with a Traffic Management Plan (See Appendix E). Road surfaces will be returned to a standard equal or better to that prior to construction of the pipeline, in agreement with Mayo County Council.

5.4.9 Watercourse Crossings

In addition to the 4.9 km tunnel, of which 4.6km is under Sruwaddacon Bay (see Section 5.5), the proposed route includes two small stream crossings and one short estuarine river crossing at Leenamore. Watercourse crossings and details of their proposed construction activities will be discussed and agreed with NPWS and NWRFB prior to commencement of construction, and liaison with these agencies will continue throughout the construction period.

The construction of the two stream crossings and the estuarine Leenamore River crossing will be carried out using an open-cut trench. Mitigation measures for construction in these watercourses are outlined below. Further details are provided in Chapter 13.

A flume pipe will be laid on the bed of the stream to direct flow through the temporary working area. The flume pipe will isolate stream flow from construction activities and will allow installation of the onshore pipeline without significant disturbance of the river flow. Temporary barriers made up of sand bags or other materials will direct the stream flow into the flume pipe and prevent water from escaping onto the temporary working area. It is proposed that this method will be used for the two small stream crossings as shown on Figure 13.1 (sites 4 & 5) (see Chapter 13).

The trench will be excavated so that the cover above the pipeline to the riverbed will be a minimum of 1.6m. Following laying of the pipeline, the trench will be backfilled initially with a 150mm sand or pea gravel surround followed by coarse, silt free material or, depending on quality, the excavated material. In addition, impact protection in the form of precast concrete slabs will be placed over the pipeline and under streams /ditches.

The estuarine Leenamore River crossing will be constructed using an open cut trench similar to that outlined above. A concrete coated section of pipeline will be used for the crossing. A spare duct will be laid parallel to the gas pipeline at the Leenamore River crossing. The umbilicals and water discharge pipeline will be installed within this duct. Installation of this duct will allow the duration of the construction of the Leenamore River crossing to be minimised. A flume pipe type arrangement, or similar, will be used to carry stream flow through the temporary working area and out into the estuary.

Consideration will be given to the tidal nature of this inlet when developing a detailed method statement for construction.

An area of salt marsh also exists at this location. It is proposed to turve the relevant area of salt marsh prior to the excavation of the pipeline trench. The salt marsh turves will be stored locally on the foreshore and used for reinstatement upon completion of the pipeline installation and subsequent backfilling of the trench.

The bed and banks of all watercourse crossings will be reinstated to their original profile, using previously excavated material, where possible. Furthermore, the mitigation measures listed below will be applied.

- Disturbance of bankside soils and instream sediments will be kept to the minimum required for the pipe laying process to avoid unnecessary impact on the stream habitat.
- Operation of machinery within the river/streams and in the immediate vicinity will be kept to a minimum to avoid unnecessary disturbance.
- No refuelling of machinery or vehicles whilst located in the stream/river.
- Vehicles or machinery will be cleaned prior to entering the watercourse.
- Disturbance of bankside vegetation will be kept to a minimum to preserve the stream habitat.
- If pumps are utilised, care will be taken to screen pump inflows to protect fish and to ensure that the watercourse upstream of the barriers is not pumped dry.
- Splash plates will be placed at the outflow of pumps to ensure that scouring and suspension of fine sediments does not take place.
- Containment, settlement and/or filtration methods will be used where necessary.
- Locally sourced quarry stone will be used adjacent to streams and river crossings (approximately 10m each side).
- Upon completion of the instream work, the stream/river will be restored to its original configuration and stabilised to prevent bank erosion.

It is estimated that it will take approximately one day to complete each stream crossing and approximately two days to complete in-stream works at the Leenamore River crossing.

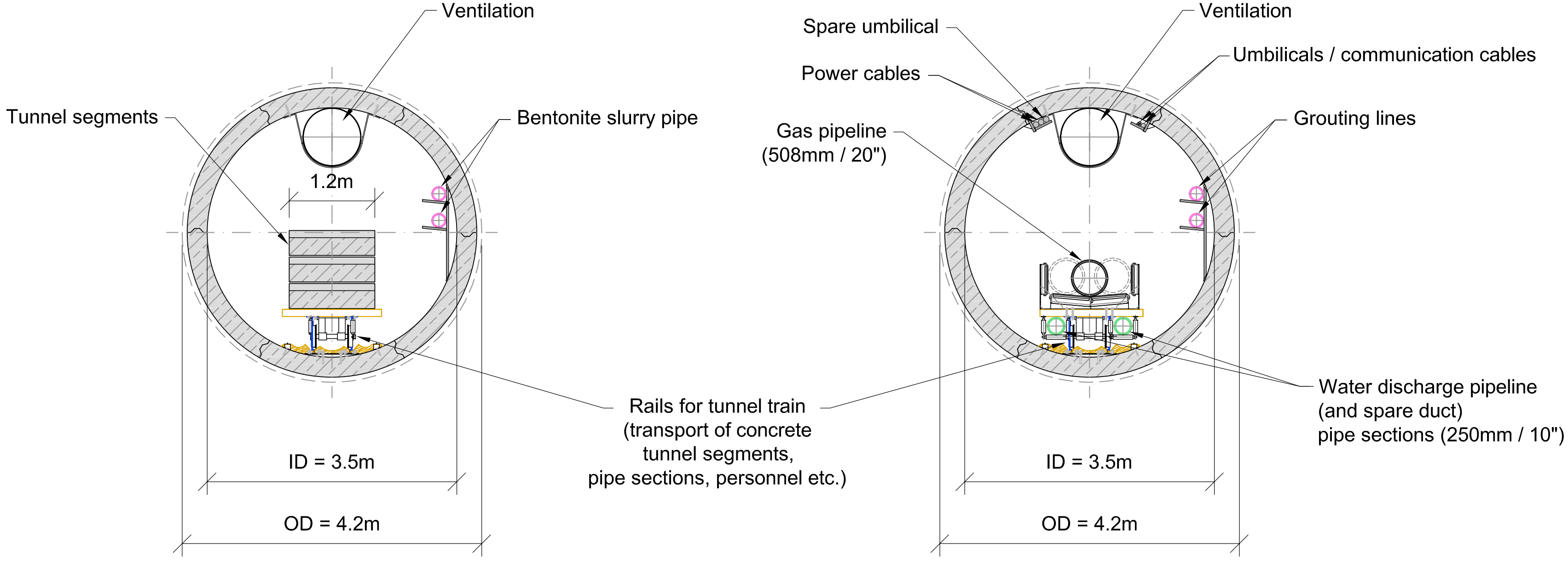
5.5 TUNNEL CONSTRUCTION

Construction of the Corrib Onshore Pipeline in Sruwaddacon Bay will involve tunnelling, also referred to as segment lined tunnelling. This entails the construction of a concrete lined tunnel into which the pipeline and associated services are subsequently installed. The tunnel is bored using a Tunnel Boring Machine (TBM) without disturbing the surface of the bay. The tunnelling operation will be carried out from a tunnel start pit at Na hEachú (Aghoos) and will follow a predetermined trajectory to a reception pit at Gleann an Ghad (Glengad).

The proposed tunnel will be approximately 4.9km long and the TBM will have an outside diameter of approximately 4.2m. The internal diameter of the tunnel will be approximately 3.5m. This size of tunnel is required to allow staff to work within the tunnel during construction and to facilitate the installation of the onshore pipeline and associated services once the tunnel is completed. Refer to Figure 5.5 for details of the tunnel cross section.

The geology along the proposed route between Gleann an Ghad (Glengad) and na hEachú (Aghoos) is described in Chapter 15 and in Appendix M. The geology within the bay consists mainly of sands and gravels with occasional cobbles and small boulders to depths of up to 25m, below which there is bedrock.

The proposed tunnel alignment is shown in Appendix M1-A (Drawings Dg0401 – Dg0404). The tunnel will be bored mainly through sands and gravels. The vertical alignment of the tunnel may vary between a minimum cover of 5.5m and a maximum depth of 10m below the indicated centreline.



Transport of Tunnel Segments
during Tunnel Construction

Installation of Pipeline and Associated Services
after tunnel is completed

ID: Inner Diameter
OD: Outer Diamter

Cross Section of Tunnel showing Installation of Pipe Sections

Figure 5.5

File Ref: COR25MDR0470Fg5.5A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Tunnelling Operations

An overview of the tunnelling process is shown on Figure 5.6. The tunnelling operation will commence at the starting pit at Na hEachú (Aghoos) and proceed towards the reception pit at Gleann an Ghad (Glengad). The tunnelling operation involves the use of a standard guidance/control system to ensure that the tunnel can be excavated along a predetermined path to within very small tolerances. During the tunnelling operation, there will typically be eight personnel working within the tunnel at any given time.

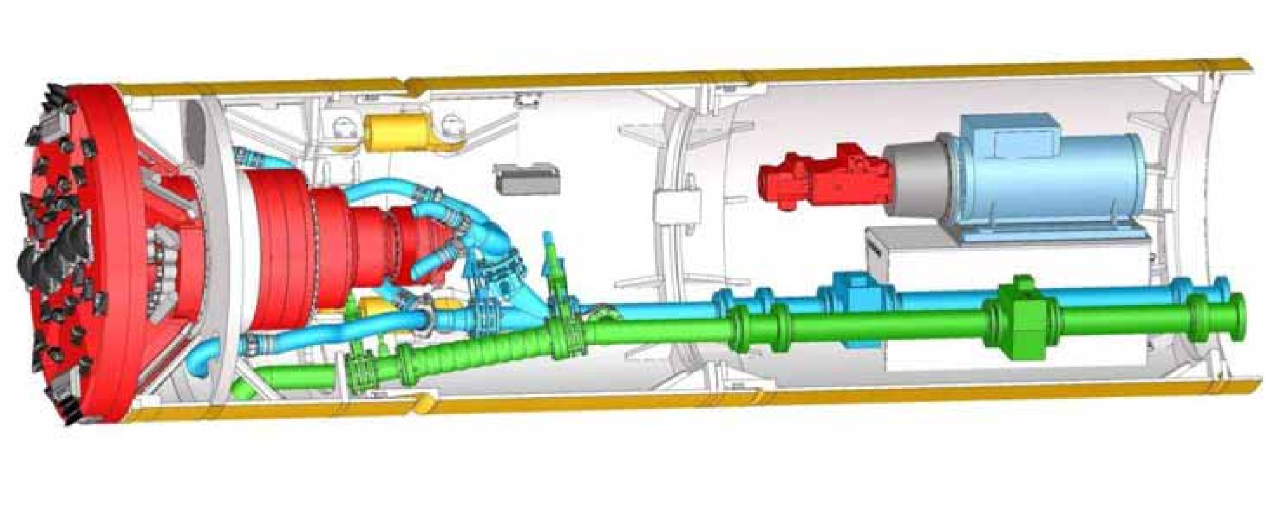
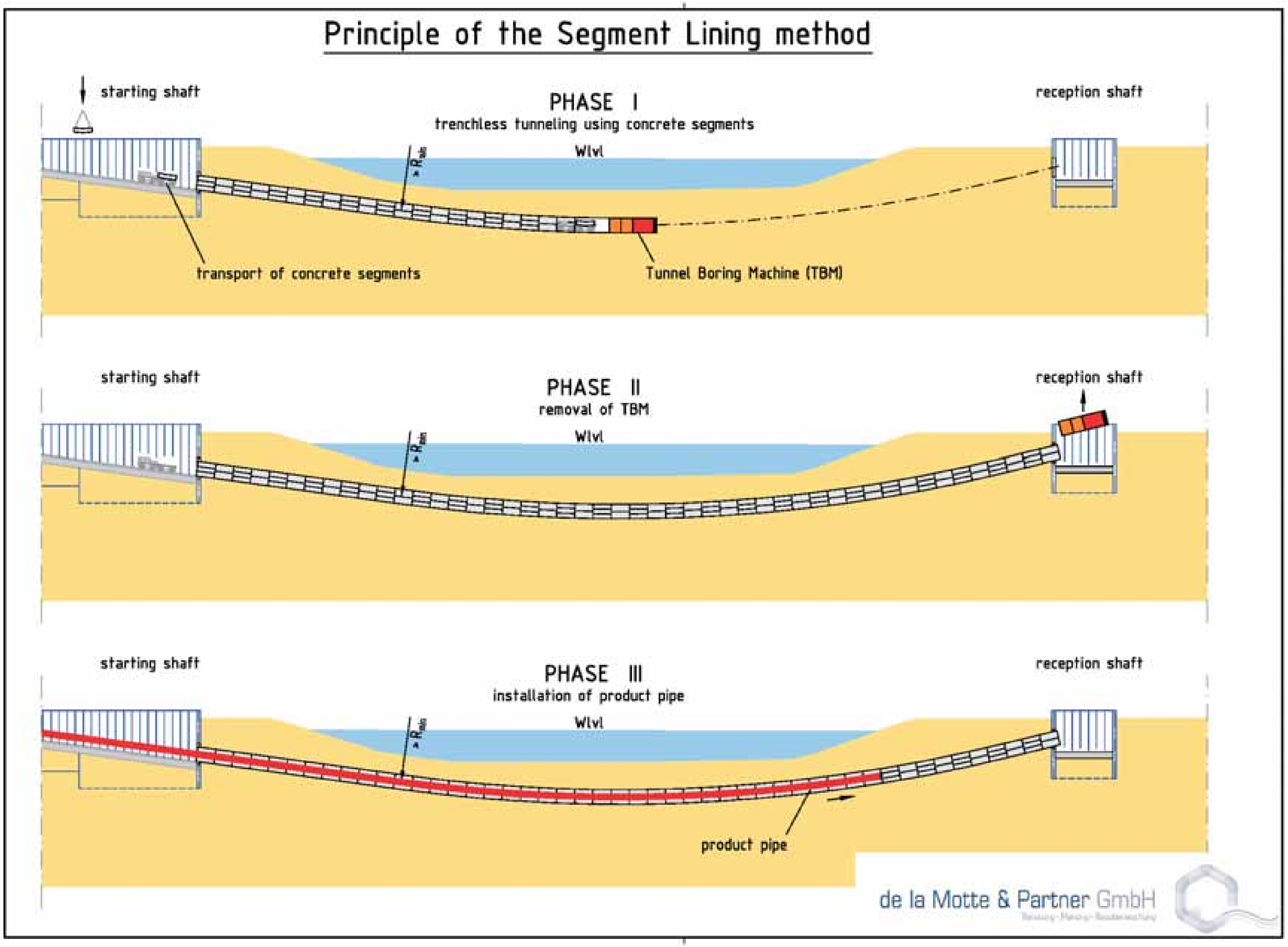


Plate 5.7: Illustration of Tunnel Boring Machine (TBM)
Note cutter head (red), drilling fluid lines (blue) and material recovery lines (green) (*Source: Herrenknecht)*

As the TBM excavates its way forward, the tunnel will be lined (from within) using concrete rings. Each ring will typically comprise six segments. The concrete segments, each approximately 1.2m long, which make up each concrete ring, will be small enough to be brought from the tunnelling compound through the tunnel to where the next concrete ring needs to be assembled. The segments for each additional concrete ring will be stacked on a trolley and brought to their final location on a small railway track running within the tunnel. As each ring is assembled it will add approximately 1.2m to the length of the tunnel lining.



Outline of Segment Lined Tunnelling

Figure 5.6

File Ref: MDR0470GrEIS098 RevA03
Date: May 2010

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Corrib natural gas

RPS

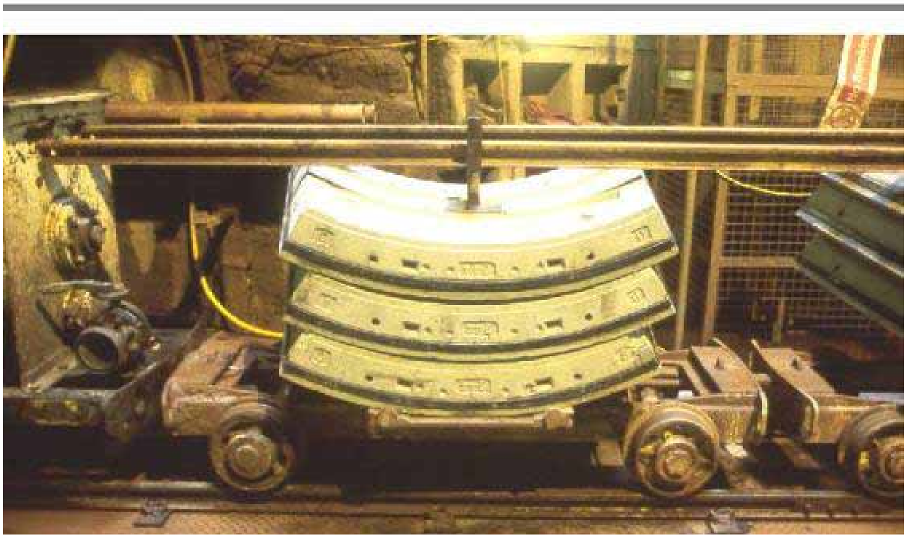


Plate 5.8: Tunnel segments being transported through tunnel on tunnel railway

The TBM uses the front edge of the concrete lined tunnel as an abutment to push against during the tunnelling process. Material is gradually cut away by the head of the TBM which rotates at approximately six revolutions per minute. Drilling fluid (bentonite slurry) is used for lubrication and cooling of the cutting head, removal of cuttings and stabilisation of the cut. As material is excavated, it passes through a crusher at the rear of the TBM cutting head. This ensures that all material is crushed to a maximum size of approximately 40mm and can therefore be hydraulically transported to the surface via bentonite slurry lines (see also below).

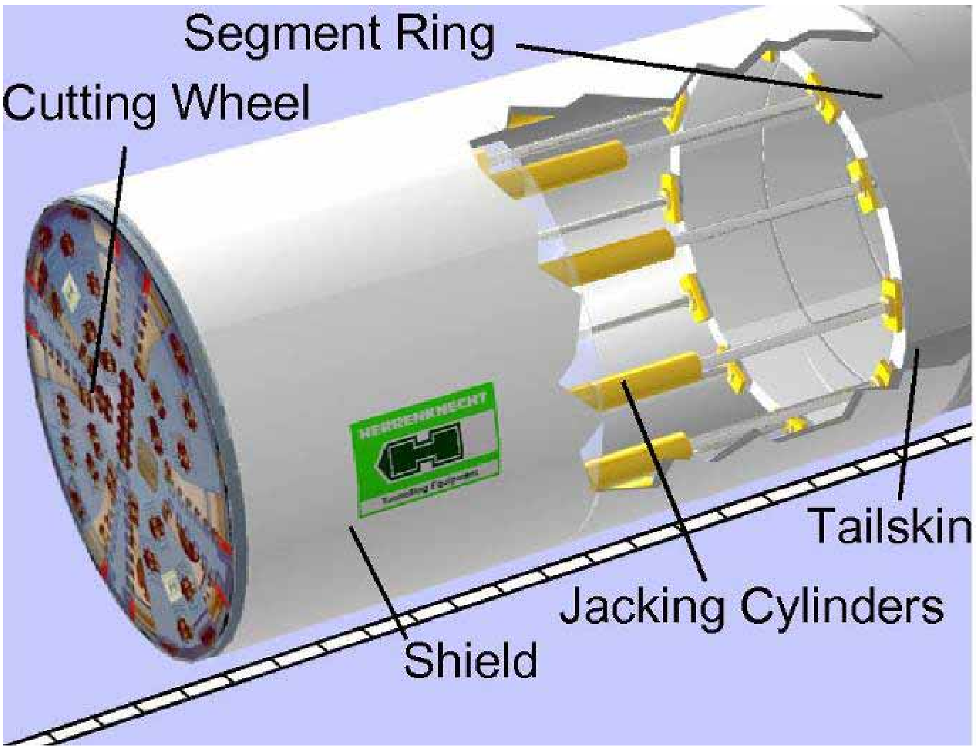


Plate 5.9: Cut–away of Tunnel Boring Machine (TBM) showing concrete rings and hydraulic jacking cylinders

The TBM will excavate material for typically 15 - 20 minutes at a time, pushing forward all the time with hydraulic jacking cylinders positioned around the circumference of the inside of the TBM. The jacking cylinders push against the assembled tunnel. When the hydraulic jacking cylinders reach the end of their travel, they are retracted to allow a new tunnel segment to be installed. This will include the installation of a new ring (comprising six segments) and extension of supply services and maintenance typically taking 40 – 45 minutes. The bentonite system will be operated on a 24 hour basis to prevent the bentonite slurry hoses from becoming clogged.

During each advance of the TBM, the annulus between the outside wall of the tunnel and the excavated surface of the surrounding ground will be sealed with cement grout. The cement grout will be transported in a mobile container to the TBM (using the tunnel railway) where it will be injected into the annulus from the back of the cutting shield of the TBM as the tunnel progresses. This operation is a controlled operation where the injection pressure and volume injected are recorded. The completed tunnel is therefore rigidly installed without any annular void space thereby avoiding the risk of subsidence.

Plate 5.10: Illustration of Tunnel Boring Machine cutter head showing drilling fluid recirculation
Source: Herrenknecht

Progress of a TBM through sands and gravels is predicted to be faster than through bedrock. The volume of tunnel arisings generated and the volume of freshwater drilling fluid (bentonite and freshwater) required during the tunnelling process have been estimated on the basis of an average rate of progress of approximately 11m per day. The tunnelling arisings will be temporarily stored within the tunnelling compound in a dedicated storage area. Should the rate of tunnelling increase, daily water requirements and volume of excavated materials may increase. To cater for such an increase in tunnelling progress, a dedicated temporary stockpiling area will also be available in the Aghoos stringing area. Any excess tunnel arisings which cannot be accommodated in the storage area at the main tunnelling compound will be transferred to the temporary stockpiling area in the stringing area where it will be stored for re-use on the project or export off site.

To cater for the potential for increases in freshwater consumption, storage will be provided on site in storage tanks with an additional reserve in the settlement lagoon (pond). Any additional freshwater required for construction will be delivered to the site in tankers.

When the tunnel has been completed, the TBM will be removed from the reception pit at Gleann an Ghad (Glengad). The gas pipeline and associated services will then be installed within the tunnel (see below).

Once the onshore pipeline and associated services have been installed the pipeline will be hydrotested before the tunnel is fully grouted with a cement grout. It is currently assumed that tunnel arisings will not be suitable for use in grouting the tunnel, as they may cause clogging of the grout pumping system. The grouting material will therefore be imported from an external source. The liquid grout fills all remaining void space within the tunnel and over a period of time it will cure / solidify. The onshore pipeline and services within the tunnel will be surrounded and supported permanently by this grouting and the tunnel will be permanently sealed.

5.5.1.1 Tunnel Arisings

Excavated cuttings will be crushed within the TBM and mixed with the drilling fluid (bentonite slurry). The drilling fluid containing this material is pumped back to the bentonite handling plant located at the tunnelling compound in na hEachú (Aghoos) via dedicated hoses through the advancing tunnel bore.

Excavated materials from tunnelling (tunnel arisings) will be separated from the drilling fluid/bentonite slurry mixture and stock-piled temporarily on the site in an area reserved for this purpose (tunnel arisings storage area). Depending on the geology of the section tunnelled, tunnel arisings will comprise varying amounts of crushed rock, sands and gravels.

The majority of these materials (maximum aggregate size approximately 40mm) will have re-use potential and it is proposed to re-use a significant proportion of the material excavated by the TBM. This material will be sorted by the separation plant into various fractions which may be recombined after the separation process depending on the re-use potential of the material.

Tunnel arisings are estimated to contain a very small quantity of bentonite (approximately 0.4% by weight) (see below). This will not affect its geotechnical properties or re-use potential.

Options for re-use of the tunnel arisings (and other surplus materials arising from construction including demobilisation) are described in Chapter 11 and Appendix S4. It should be noted that the traffic volumes used in the Traffic Impact Assessment, contained in Appendix F, allow for the worst case scenario of the unlikely event that none of the tunnel arisings will be suitable for re-use on the Corrib Onshore Pipeline project. This is both in terms of materials export (i.e. the arisings themselves) and import (i.e. additional quarry materials that will be required in the event that the tunnelling arisings are unsuitable).

5.5.1.2 Drilling Fluid

As set out above, it is proposed to use bentonite mixed with water as a drilling fluid during the tunnelling process. However, it should be noted that suitable alternative drilling fluids, such as water mixed with polymer additives, may also be used.

Bentonite is a natural product comprised of very fine inert clay which is widely used in construction projects. Dry bentonite will be added at a rate of approximately 35kg per cubic meter of water (approximately 3.5% by weight) to make up the bentonite slurry. Mixing will take place at the na Aghoos Tunnelling Compound. Depending on the tunnel length, a maximum of approximately 250m^3 of bentonite slurry will be present in the circulation system.

The use and consumption of drilling fluid in the tunnelling process will be monitored throughout the works by material balance calculations and pressure control. In the unlikely event of loss of drilling fluid, the volume imbalance or the reduction in pressure would alert the operator and mitigation measures would quickly be put in place to control any localised breakout.

Bentonite slurry will be managed at a bentonite handling unit, which will be located within the tunnelling compound at Na hEachú (Aghoos). This facility will circulate and recycle the drilling fluid/bentonite slurry throughout the tunnelling process via dedicated hoses to and from the TBM and includes areas for settlement and filtration. The bentonite handling unit will be used to separate tunnel arisings from the drilling fluid. The separation plant will include a number of stages of treatment using plant such as shakers and cyclones, and will be designed to efficiently recover bentonite slurry for re-use in the tunnelling process.

During the tunnelling process, some drilling fluid will remain in the void spaces of the surrounding ground as the tunnel is excavated. Small quantities of drilling fluid will also remain in the excavated material arisings. The composition of the bentonite drilling fluid will be optimised to suit the geology of the section being tunnelled. It will be monitored constantly and fresh bentonite will be added as required to ensure that the system is working optimally at all times.

It is estimated that approximately $1m^3$ of bentonite slurry will be used for every $1m^3$ of material excavated. This amounts to an estimated average consumption rate of $150m^3$ of slurry per day. Of this daily average, it is estimated that $66m^3$ will be used in the ground interface immediately surrounding the TBM cutting head. A further quantity of $34m^3$ of bentonite slurry is estimated to remain in the tunnelling spoil after it has been passed through the separation plant (approximately 0.4% by weight). In addition, an average of $50m^3$ of bentonite slurry is expected to be removed from the system each day and replaced with fresh bentonite as described above.

Drilling fluid removed from the system each day as slurry will be passed through a centrifuge and filter press. The resulting sludge cake will be disposed of at a licenced waste facility. The remaining liquid (approximately $50m^3$ per day of water with a total suspended solids content of less than 0.001% by weight) will be treated at the tunnelling compound water treatment system and will be disposed of at an authorised facility.

Rainwater will be collected at the Aghoos Tunnelling Compound and stringing area and will be used to mix the drilling fluid. Where insufficient quantities of rainwater are available, fresh water will be imported to the site in road tankers. Surface water from the stockpiling areas for tunnelling spoil will also be collected and reused in the drilling fluid, as far as possible.

5.5.1.3 Intervention Pit Tunnelling Contingency

The tunnelling methodology selected, including the size and power of the tunnel boring machine (TBM), in combination with segment lining is not expected to require any form of surface intervention. The need for surface intervention would only arise in exceptional circumstances. The potential environmental impacts associated with the construction of an intervention pit have been assessed for completeness only.

An intervention pit would be constructed using sheet piles or other such methods from a pontoon/barge accessed using other support vessels. A typical intervention pit will have a footprint of approximately 25m x 15m ($375m^2$). The intervention pit would provide access to the problem area from the surface and ensure that an excavation can be kept open. A temporary jetty would be required as a marine access/egress point to handle construction traffic/materials to and from the pontoon/barge. The temporary jetty would be located at an area near the construction compound at Na hEachú (Aghoos), at a point where the working area meets the shoreline of Sruwaddacon Bay. Plant and equipment on a floating pontoon would access the area where surface intervention is required.

5.5.2 Aghoos Tunnelling Compound

The tunnelling operations will be carried out from a compound at Na hEachú (Aghoos) the ‘Aghoos Tunnelling Compound’, (see Figure 5.7). The proposed location for this compound is in an area of undesignated peatland.

The main equipment and facilities required for a typical tunnelling compound are described below. The details presented have been derived from information provided by tunnelling advisors. However, the final details of plant, dimensions and capacities may vary depending on the contractor selected for the works. The compound described (see Figure 5.6) is considered to represent a most likely case for the purpose of assessing the associated environmental impacts.

- **Tunnel Starting Pit & Ramp** – A reinforced wall and base excavation for insertion of the TBM to start the tunnel process. The ramp slopes from surface level down into the starting pit. Railway tracks will be installed on the ramp for transporting equipment in and out of the tunnel using a small train. The starting pit also includes a sealing body. This is a large block of low strength mortar and its purpose is to seal the annular space at the end of the tunnel.

- **Gantry Crane** – 12m high gantry crane, erected over the starting pit and ramp, used to lower concrete segments into position on the railway for delivery to the cutting face.

- **Storage Area for Concrete Segments** – Located adjacent to the starting ramp beneath the gantry crane. Concrete segments (for lining the tunnel) will be stored here.

- **Power Generation Plant** – Consists of 2 x 1MW diesel generators, 1 x 0.5MW diesel generator, 1 x 0.5MW reserve diesel generator, diesel storage tank and switching station. As there will be no connection to the local ESB network, the generators will be required to provide power to the tunnelling operations including the TBM, bentonite handling plant, gantry crane, lighting, pumps, offices and other miscellaneous items.

- **Storage Tanks** –

    - Two water storage tanks (750m^3 each);

    - Fresh bentonite storage tank (500m^3); and

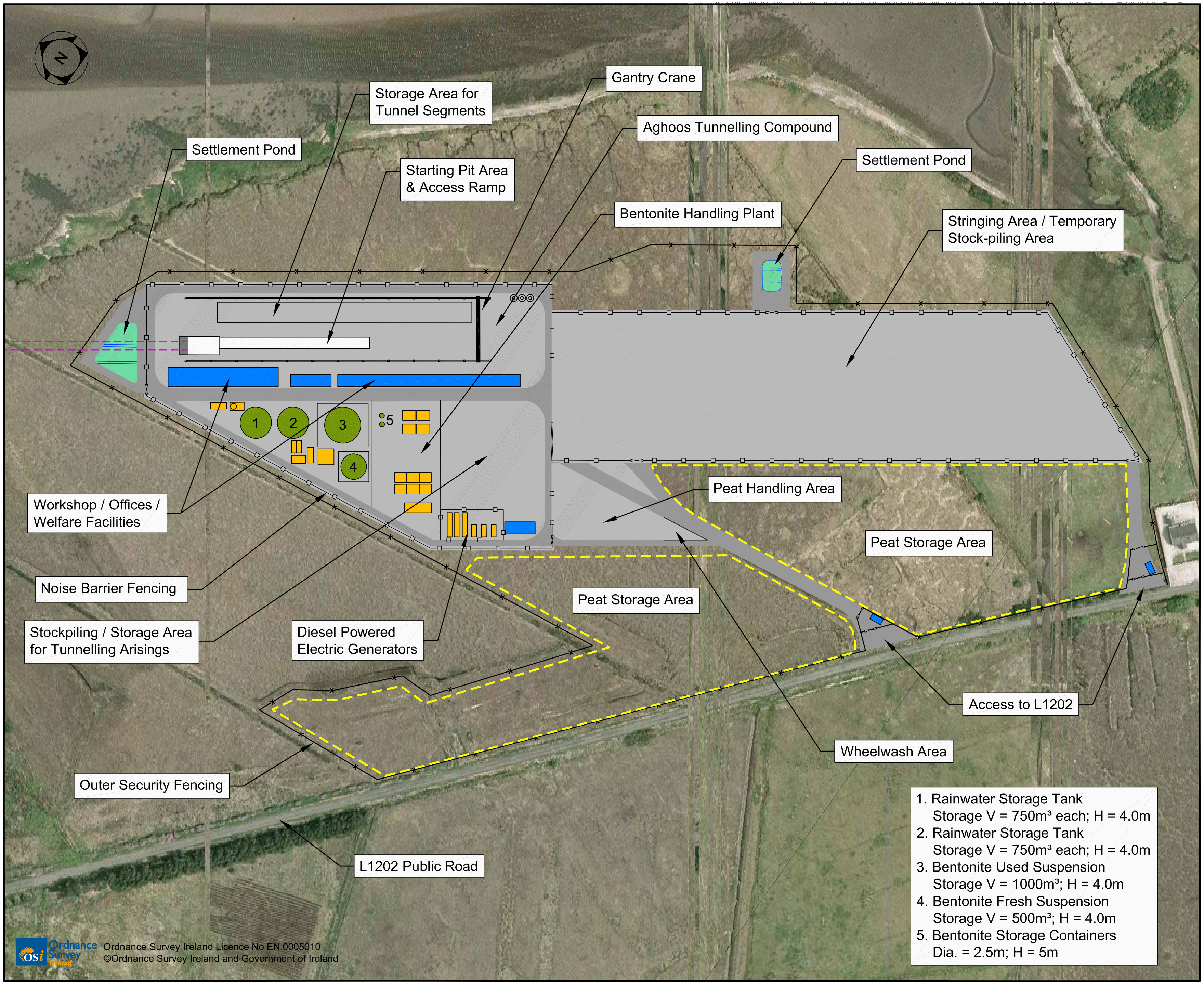
    - Used bentonite storage tank (1,000m^3).

  Rainwater falling on the site will be collected, treated and then pumped into storage tanks for use during the tunnelling process. Bentonite will be mixed with water and used as a lubricant and cutting fluid for drilling and will be stored on site in a separate tank. Used bentonite suspension arising from the bentonite treatment process will be collected and stored in a separate tank where it will await collection for licensed disposal off site.

- **Settlement Lagoon** – This feature is designed to provide final treatment of surface water run-off from the compound by slowing down water flow and allowing suspended solids to settle out. This feature will be in place at an early stage of site construction and will remain in place until full reinstatement is almost complete. The volume of the proposed settlement lagoon is approximately 1,000m^3. The settlement lagoon can be used as an additional reserve volume of fresh water for use in the tunnelling process, if required.

- **Bentonite Handling Plant** – Treatment system for the removal of bentonite from the tunnel arisings. The system consists of a shaker system for removal of larger particles, a series of 3 hydrocyclones for removal of solids and a centrifuge and a filter press for removal of finer particles.

- **Grout Silos** – Used for storage of mortar on site. It is proposed to mix grout on site for grouting the annulus of the tunnel and for filling the tunnel following the installation of the pipeline and services. Mixing of grout will take place in a controlled and contained environment using automated mixing tanks located in an area within the tunnelling compound designated for this purpose. Grout silos, located adjacent to the mixing tanks, will be filled with dry cement brought in by container truck. The cement will be ‘blown’ into the storage silos from the container truck using a sealed unit and stored there for mixing as required during the works. The mixing operation will involve mixing the cement with sand and water in the mixing tanks and filling containers which are transferred to the tunnel using the tunnel railway. The mixing/batching system is a contained system which includes a bunded wash down area. A separate drainage system will be constructed where these operations take place which will direct any run off water from rainfall & wash down into a sump for disposal off site or for storage in a tank for reuse.



Aghoos Tunnelling Compound

Typical Arrangement

Figure 5.7

File Ref: COR25MDR0470Fg5.7A03
Date: May 2010

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- **Bentonite Silos** – 2 no. silos, volume (approximately $25m^3$) each used for storage of bentonite (in powder form).

- **Storage area for tunnel arisings** – Located adjacent to the bentonite handling plant. This area will be designated for the storage of tunnel arisings following the treatment process. Approximately $2,250m^2$ has currently been allocated for the storage of tunnel arisings within the Aghoos Tunnelling Compound itself. A further $4,800m^2$ has been allocated at the adjacent stringing area. These two areas combined will be capable of storing over 100 days of arisings at a tunnelling progress rate of 11m per day (estimated to be the average progression rate for the tunnel).

- **Lighting** – The Tunnelling Compound and Stringing Area will be provided with artificial lighting for carrying out operations at night. The lighting system will consist of lanterns mounted on 8m high poles located to provide an adequate standard of lighting to facilitate the necessary construction operations both safely and effectively. The lighting system will be designed to minimise spill of lighting outside of the compound.

- **Workshop** – General storage, testing and workshop.

- **Offices and welfare facilities** – Required for staff working at the site.

Given the site's proximity to Sruwaddacon Bay (Glenamoy Bog Complex cSAC / Blacksod Broadhaven pSPA), the compound incorporates features to mitigate potential impacts on the cSAC / pSPA (see Section 5.15).

It is estimated that the Aghoos Tunnelling Compound (SC3) will be in place for approximately 26 months. Figure 5.7 shows a typical arrangement of the tunnelling compound and stringing area (see below).

5.5.2.1 Aghoos Stringing Area

A pipeline stringing area (the 'Aghoos Stringing Area') will be constructed adjacent to the Aghoos Tunnelling Compound. This compound will be used for welding sections of pipe together and preparing associated services for installation within the completed tunnel. This site will consist of:

- Temporary storage areas for sections of gas pipeline, water discharge pipeline, umbilicals, etc;

- Pipe supports and rollers, which will be used to move assembled pipe sections into the tunnel;

- Ancillary equipment including cranes / side-booms with which to lift and move sections of pipe; and

- Mobile welding equipment and other plant required to assemble the pipeline sections.

Once the tunnel has been successfully constructed, the umbilicals and other services will be installed. These will be mounted on the inside wall of the tunnel, allowing space for the installation of the gas pipeline, water discharge pipeline and spare HDPE duct. The tunnel railway system will be used for this installation process.

The onshore pipeline will be welded together in the stringing area in sections approximately 80m long. These sections will be mounted on rollers for insertion into the tunnel. Sections of the water discharge pipeline and a spare HDPE duct (identical to the water discharge pipeline) will also be assembled in lengths of 80m and bundled (one each side) with the onshore pipeline. Each 80m bundle will be mounted on trolleys and transported inside the tunnel using the tunnel railway system.

It is estimated that the Aghoos Stringing Area will be in place for approximately 21 months.

5.5.2.2 Glengad Reception Pit and Compound

The reception pit at Gleann an Ghad (Glengad) (the ‘Glengad Reception Pit’) will be located within a compound (SC2) approximately 65m x 55m in size. Part of this compound will be located within the boundaries of the Glenamoy Bog Complex (cSAC).

The reception pit will consist of a sheet-piled excavation approximately 8m deep x 7.5m wide x 15m long. The pit will have a concrete base anchored with soil anchors. A sealing body, located next to the reception pit (to the east) will consist of a second sheet-piled excavation similar in size to the reception pit, which will be backfilled with a low strength mortar.

As tunnelling nears completion, the TBM will pass through the sealing body to emerge at the reception pit where it will be dismantled and removed over a period of approximately one month. Due to the large size of the TBM, a crane will be required at this site.

It is estimated that the Glengad Reception Pit will be in place for approximately 12 months.

5.5.3 Construction of Aghoos Tunnelling Compound, Aghoos Stringing Area and Glengad Reception Pit and Compound

The following sections describe how each of the compounds associated with the tunnelling process will be established and constructed, as listed below.

- Aghoos Tunnelling Compound - Site Set Up;
- Aghoos Tunnelling Compound – Construction;
- Aghoos Stringing Area – Site set-up & Construction; and
- Glengad Reception Pit and Compound – Construction.

5.5.3.1 Aghoos Tunnelling Compound - Site Set Up

The tunnelling operation will be carried out from the tunnelling compound located in peatland in Na hEachú (Aghoos).

Temporary access roads to facilitate the installation of the fencing will be constructed using bogmats. Approximately 2,500m of 3m high steel palisade fencing will be erected around the perimeter of the site. The fencing will be fastened to bogmats for support and stability.

Once the site is established, construction of the surface water management system will take place. Access will be provided by bogmat roads. The surface water treatment system will comprise a bypass separator for removal of hydrocarbons followed by a settlement lagoon for removal of suspended solids and the installation of a filtration system for removal of finer particles. The surface water treatment system will be located at a low elevation on the site to enable surface water run off to gravitate towards it, thereby avoiding the requirement for pumping during the works. The overflow outfall from this system will be to an existing surface water ditch that flows into Sruwaddacon Bay. Connecting pipe work will be installed for future tie-ins to the compound drainage network.

The development and construction of the tunnelling compound will require the temporary storage of peat for use in the reinstatement of the site following completion of tunnelling operations. It is proposed to provide peat storage areas south of the tunnelling compound between the compound and the public road. These areas will be serviced by bogmat access roads. V-ditches will be installed both up slope and down slope of these areas to intercept and collect surface water run-off and direct it to the surface water treatment system. Culverts will be placed at locations where access roads must cross existing drains and ditches.

5.5.3.2 Aghoos Tunnelling Compound - Construction

Following completion of the works described above, construction of the tunnelling compound will commence. This will be a bulk earthworks operation involving the importation of quarry stone and the removal of peat to the Srahmore Peat Deposition Site.

The works will begin with the construction of the main stone access road to the site. This 6m wide access road as well as the main compound will be constructed in a similar manner to the stone road construction method described in Section 5.4.5. The surface layer of peat including vegetation will be removed and stored at the designated peat storage area on site for use in future reinstatement activities. Below this layer, peat to a depth of up to 1.0m above mineral soil will be excavated and removed off site to the peat deposition site at An Srath Mór (Srahmore).

Stone will be delivered in tipper lorries from local quarries and placed over the excavated peat surface. The stone will displace peat and will also be pushed into the remaining layer of peat using excavators (see Appendix M2). The access road will be constructed progressively in this way, with machinery always working from on top of the stone structure.

Peat plugs will be installed at suitable intervals to prevent the longitudinal flow of water within the road. The surface of the road will be finished with capping material. This will consist of small well graded quarry stone that can be compacted to provide an even surface for trafficking. V-ditches constructed alongside the access road will be used to collect surface water run off and direct it towards the treatment system via gravity flow.

It is intended to construct the access road as far as the settlement lagoon, a distance of approximately 400m from the public road. In order to avoid the requirement for tipper lorries to drive long distances into the area of peat, a peat handling area will be constructed at the location where the access road meets the compound. This area is approximately 2,500m^2 in size and will be used to transfer the excavated peat from site dumpers to road-going tipper lorries. A wheelwash system will be set up in this area and trucks leaving the site will be cleaned before they exit onto the public road.

The tunnelling compound covers an area of approximately 24,000m^2. It will be built in the same manner as the access road, with construction beginning at the lower end of the site in order to facilitate the connecting of the initial drainage network, and progressing up hill. The drainage system will be installed as the construction of the compound progresses.

A starting pit and ramp will be excavated for the tunnelling operation. These works will commence once sufficient working space has been provided within the compound area. The starting pit will be approximately 8m long x 10m wide x 12m deep. The ramp for accessing the pit will be approximately 75m long x 5m wide and increase in depth from 0m to 10m below ground level. Construction of the starting pit and ramp will entail the installation of sheet piles (and bracing where necessary), excavation of stone, installation of soil anchors and the placement of reinforced concrete.

A 3m high non-transparent noise barrier (fence) will be installed around the perimeter of the compound and inside the palisade fencing, following completion of the stone placement works. This barrier will be designed to mitigate the potential noise emissions from the works in the compound. It will also serve to visually screen the works.

The surface of the tunnelling compound will be finished with 100mm – 150mm of surface dressing (tarmacadam). The surface dressing will provide a clean impermeable surface facilitating rainwater harvesting and contributing to general site tidiness.

5.5.3.3 Aghoos Stringing Area - Site Set Up and Construction

Once tunnelling operations are underway the stringing area will be constructed. The stringing area will only be required during the assembly and installation of the onshore pipeline and associated services within the tunnel.

The stringing area will be constructed in the same manner as the tunnelling compound; however, it is proposed to combine tunnel arisings with quarry stone to complete the construction of this area. It is estimated that approximately 11,000m^3, or half of the fill used for this compound, will be tunnel arisings. The surface of the stringing area will be finished with 100mm – 150mm of surface dressing (tarmacadam).

V-ditches and linear drainage channels will be installed and connected to the surface water treatment system at the compound where ground levels permit. Where required, water pumps will be used to address height differences in the terrain. The drainage system is designed for a 1 in 20 year rainfall event. Where ground levels are unsuitable, a second surface water treatment system, similar to the system at the compound will be constructed. The overflow outfall from this system will be to an existing surface water ditch that flows into Sruwaddacon Bay.

A stone road access from the public road will be constructed at the eastern end of the stringing area and a one way system will be adopted on the site.

A 3m high non-transparent noise barrier will be installed around the perimeter of the stringing area following completion of the stone placement works (see above).

A temporary stockpiling area for tunnel arisings will be provided in the eastern end of the stringing area, as described above.

5.5.3.4 Glengad Reception Pit and Compound - Construction

Before the completion of the tunnel a reception pit will be constructed in Gleann an Ghad (Glengad). A temporary access road and site compound will be required. These will be constructed using material recovered from the excavation of the LVI dished area, and they will be surfaced with stone capping material from a local quarry.

Topsoil will be stripped from the area of the compound and stockpiled for use during reinstatement. Sheet piles for the reception pit will then be installed over a period of approximately two weeks. Once these have been installed, the pit will be excavated. Materials excavated will be stockpiled locally, separately from topsoil.

The base of the reception pit will be lined with concrete to provide a level surface and to seal the pit. Approximately half of the reception pit will be filled with low strength mortar. This part of the reception pit is referred to as the sealing body. The purpose of the sealing body is to seal the annular space at the end of the tunnel.

5.5.4 Reinstatement of Na hEachú (Aghoos) and Gleann an Ghad (Glengad) Compounds

5.5.4.1 Aghoos Tunnelling Compound and Stringing Area

On completion of the installation of the onshore pipeline, umbilicals and services, reinstatement of the compound and stringing area at Na hEachú (Aghoos) can commence. Equipment and machinery will be disconnected and disassembled and removed from the site. Tanks will be emptied in a controlled manner and removed, bund walls will be demolished and offices and welfare facilities will be removed. Ducting and pipework will be decommissioned and removed. Once the onshore pipeline and associated services have been installed in the tunnel and the tunnel fully grouted, the starting pit and ramp will be back filled with tunnel arisings stored at the temporary stockpiling area and the sheet piles will be cut to a depth of 1m below finished ground level.

Once the site has been cleared, the operation to remove the surface dressing from the compound and the stringing area can begin. A road planer will excavate and gather the tarmacadam, which will be removed off site to an authorised facility. This material can be recycled. The site drainage system will be maintained throughout the period of surface dressing removal.

Once the surface dressing has been removed, the noise barrier fencing will be taken down and removed from site. Following removal of this fence, the top 300 – 600mm of stone will be removed from the tunnelling compound and stringing area.

The placement of up to 600mm of peat over the surface of the tunnelling compound will then be sequenced to maximise the availability of the drainage network before it too is eventually removed.

The access road will be maintained to the surface water settlement lagoon area(s) up until the end of the reinstatement works. At this stage the surface water treatment system will no longer be required. The bypass separator, filtration unit and settlement lagoon will be removed and the ground will be reinstated and surface water drains and ditches will be restored throughout the site.

Following the completion of the peat reinstatement works the bogmats in the peat storage areas will be removed along with any culverts that were installed. V-ditches will be filled in and surface water drains and ditches will be restored throughout the site. Finally the perimeter fencing will be taken down and the bogmats removed.

5.5.4.2 Glengad Reception Pit and Compound

Once the TBM has been removed from the site and onshore pipeline and associated services have been installed, the site of the reception pit can be reinstated. This will involve cutting the sheetpiles to a depth of 1m below finished ground level and backfilling the pit with stockpiled subsoil. The compound will be removed and stockpiled subsoil will be placed. Topsoil stripped from the area and stockpiled nearby will be used to complete reinstatement of the area. This will be graded and levelled. The area will be allowed to revegetate naturally.

5.6 CONSTRUCTION OF LANDFALL VALVE INSTALLATION

The area of the Landfall Valve Installation (LVI) will be set out and fenced off prior to construction. A separate compound (SC1) will also be established from which construction activities in this area will be based. The compound will be constructed in a similar manner to the Glengad Reception Pit and compound.

Access to the LVI will be via the access road from local road L1202.

The first stage of the construction of the LVI will be to excavate the site to the required levels. Topsoil will be stored separately to preserve the local seed bank and facilitate reinstatement. After removal of the topsoil and overburden layers, some excavation, in the rock layers will be required.

After completion of the excavation, various civil works will be undertaken. These include the construction of foundations, fencing and the surface water drainage system.

Most of the LVI pipework and associated equipment will be fabricated in sections off site. These sections will be brought to the site and assembled in situ and then connected with the onshore and offshore pipeline, as appropriate.

Upon completion of the construction works, the area surrounding the LVI will be reinstated using temporarily stored topsoil. Within the LVI site, a geosynthetic mat (e.g. ‘geo-jute’) will be used on the slopes surrounding the LVI to stabilise topsoil against erosion.

5.6.1 LVI Surface Water Outfall

Surface water collected in the LVI dished area will pass through a separator prior to discharging onto the foreshore via the surface water outfall pipe. In order to install the surface water outfall pipe a section of the foreshore will be fenced off. Construction will require the excavation of a trench of up to 5.5m depth in places and up to 15m wide from the LVI through the cliff face. A geotextile separation layer will be placed at the base of the cliff face, on top of which a headwall will be constructed using gabion mattresses and baskets. These will be hand filled with locally sourced stone in order to ensure that the headwall will not be visible when the construction is completed. The outfall pipe will terminate at the headwall. The area in front of the headwall will be reinstated with locally sourced stone that will be hand picked, such that the outfall will not be visually obtrusive and will blend into the local surroundings. The proposed approach to construction of the surface water outfall will be subject to further optimisation to reduce potential impacts where possible.

5.7 TEMPORARY WORKS

5.7.1 Site Compounds

In addition to the tunnelling compounds already described (SC2 and SC3) and the LVI construction compound (SC1), two other site compounds will be located along the pipeline route. These compounds will be located as follows:

- SC4:In the vicinity of where the proposed pipeline route crosses the L1202 (RDX 1); and
- SC5: Within the Gas Terminal site;

These compounds will normally contain site offices/cabins, welfare facilities, vehicle parking and material storage and stockpiling areas. The proposed locations of these site compounds are shown in Figure 5.2. All stockpiling will be contained within the site compounds and temporary working areas. Hard standing will be used, where necessary, and the area will be secured by fencing for safety. Where pipe stringing will take place adjoining the pipeline, an additional working area will be required as shown on Figure 5.2. In some of these locations preparatory geotechnical works may be required.

5.7.2 Energy Requirements

Most construction plant and machinery will be powered by diesel engines, including plant and equipment associated with the tunnelling works. Many items of plant will need to be refuelled on the temporary working areas from mobile diesel bowsers. Diesel fuel will be stored and handled carefully to ensure that spillage is avoided. The storage and handling of diesel will be managed through procedures to be established in the Environmental Management Plan (EMP).

Electrical requirements for construction, e.g. for site lighting, etc, will be met either with diesel powered generators or by local temporary electricity connections procured through ESB Networks. Heating requirements, e.g. for site cabins will be met by electrical heaters powered by diesel generators.

Diesel generators will be enclosed in sound proofed containers to minimise the potential for noise impacts.

Construction energy requirements are covered in detail in Chapter 11.

5.7.3 Lighting

Lighting of temporary working areas and tunnelling and site compounds during periods of darkness will be minimised to that necessary for security and safety reasons. The tunnelling operations will require continuous working (on a 24 hour basis, 7 days per week) and therefore night-time lighting will be a feature of the Aghoos Tunnelling Compound. The lighting will be designed to minimise local disturbance and glare; only essential lighting will be used. Local residents will be notified in advance. The Aghoos Tunnelling Compound will be enclosed by 3m high, non-transparent noise barriers that will largely contain the light within the compound perimeter.

In general, lighting (where required and including lighting that may be required for security staff) will be powered by generators in a central location on each work area.

5.8 TESTING AND COMMISSIONING

Testing of the Onshore Gas Pipeline and LVI is an integral part of the commissioning activities.

Testing of the water outfall pipeline and services will also be carried out in accordance with SEPIL and relevant industry standards.

All test methodologies and acceptance criteria will be specified prior to the carrying out of any test. Strict safety precautions will be imposed during all testing and only suitably qualified and experienced personnel will be involved. All test results and test parameters will be documented. Where test results fall outside the agreed acceptance criteria, repair work or modifications will be carried out. Subsequently, the appropriate acceptance test will be repeated.

The equipment in the LVI will be tested in accordance with the required standard and the manufacturer's recommendations. This will include full function testing of the valves and the control system.

Further details on testing the integrity of the onshore pipeline and services are contained in Chapter 4.

5.8.1 Testing of all Materials Prior to Construction

SEPIL will carry out quality assurance inspection during manufacturing and prior to and following shipping of all materials to the site. Any materials that fail the quality inspection will be marked and isolated to ensure that they are not used as part of the project.

5.8.2 Testing of Welds

All welds will be tested in accordance with strict industry standards using visual inspection and non-destructive inspection techniques.

5.8.3 External Testing

The external pipe coating will be inspected for defects during the installation procedure. This will include all joints where field coating is applied over welds. A holiday test will be carried out prior to ditching operations. Any flaws or defects discovered will be repaired immediately and re-inspected upon completion.

The excavated trench will also be inspected for correct depth, width and proximity to utilities, where relevant. Ditching operations and installation of services within the tunnel will be monitored to ensure that the onshore pipeline, water outfall pipeline and services are installed correctly and not damaged in the process.

5.8.4 Hydrostatic Pressure Testing

Once all sections of the onshore pipeline have been installed, ditched, tied-in and backfilled, the pipeline will be filled with water for a hydrostatic pressure test. This operation proves the assembled pipeline's pressure integrity and is a requirement of the relevant design codes. Testing involves pressurising the water in the pipeline for a set period of time using an approved test pressure.

The water to be used for the hydrostatic pressure testing will be sourced from the Gas Terminal and also from the rainwater storage tanks at the tunnelling compound at na hEachú (Aghoos). It is proposed that hydrostatic test water be disposed of at sea via the water outfall pipeline, which terminates in a diffuser on the sea bed approximately 2km north of Erris Head.

The total quantity of water to be disposed of from the hydrostatic testing of the onshore pipeline is approximately 2,500m^3. This water will be treated at the Gas Terminal and will not contain any additives or chemicals. It will be sampled and analysed for a range of parameters prior to disposal to ensure that it does not contaminate the receiving environment.

5.8.5 Pre-Commissioning of Onshore Pipeline

After the hydrostatic testing is complete, the pipeline will be inspected internally by pigging. A temporary pig receiver will be installed at the LVI for this purpose. Several types of pigs will be used to test the pipeline, including the following:

- A gauging pig is made up of a soft metal (e.g. aluminium) ring that is slightly smaller than the internal diameter of the pipeline. It will test for any internal obstructions in the pipeline. The soft metal ring will be damaged if the internal diameter of the pipeline is, for some reason (e.g. a dent), smaller than what is permitted by the pipeline design specification.

- Water filling / dewatering pigs will be used to fill the pipeline with water for hydrostatic testing and to dewater the pipeline after hydrostatic testing. These pigs fit snugly inside the pipeline.and can be made of foam or metal with rubber gaskets.

- An intelligent pig is used to measure the pipeline wall thickness, relating this to location. Intelligent pigs use electronic measurements to obtain the required data. Intelligent pigs will be run during pipeline pre-commissioning and during operations as part of the pipeline integrity monitoring regime.

After the pigging operations and inspections have been completed, the temporary pig traps will be removed. The pipeline will then be tied in to the LVI by welding.

It may also be necessary to use temporary pumps and tanks at Gleann an Ghad (Glengad) and at the terminal site for a short period during the pre-commissioning /commissioning phase for the pipeline. Nitrogen generating equipment at the terminal site may also be required.

Once the pipeline is fully tied in, the onshore pipeline will be purged of air using nitrogen gas from the Offshore Pipeline. It will then be ready for gas commissioning.

5.8.6 Commissioning

Commissioning involves the introduction of natural gas into the pipeline and the testing of all safety and emergency systems associated with the overall system. The first stage in the process will be to purge nitrogen gas from the entire pipeline (offshore and onshore). Gas from the Corrib Field will be introduced to the pipeline system by opening gas wells one at a time. Nitrogen gas in the pipeline will be vented at the Gas Terminal. When the composition of the gas reaching the Terminal is of sufficient quality (composition of nitrogen is below required specification), the Terminal will be ready to export gas to the gas transmission network.

5.9 CONSTRUCTION TRAFFIC AND ACCESS

The mobilisation and demobilisation of construction plant and the delivery of materials along with vehicular movements from construction personnel will generate the majority of traffic associated with the proposed development. Where possible, the temporary working area will be used for transportation of plant and equipment thus minimising movement on public roads. As pipeline construction proceeds, associated traffic will move in tandem with construction activities along the temporary working area.

Plant and equipment will normally be contained within the temporary working area, site compounds or at the Terminal site.

In certain locations, temporary access roads will be required to allow the movement of construction traffic between the public road and the temporary working area. The locations of proposed temporary access roads are shown on Figure 5.2.

At points where construction related vehicles travel from the works area onto the public road network these will be inspected and cleaned as necessary. Wastewater from cleaning will be recovered and discharged at locations agreed with Mayo County Council. Where the intensity of the construction traffic demands it, wheel washes may be used. The public road network in the vicinity of the works will be inspected daily and will be cleaned, using road sweepers, as required

Residents in the vicinity of the works will be made aware of construction activities. Special arrangements may be required to ensure that residents have necessary access to their properties at all times. The Traffic Management Plan (Appendix E) will be agreed with Mayo County Council and will be updated from time to time, as required, in consultation with the relevant authorities.

Generally, the construction of temporary access roads will involve the excavation of topsoil and the application of crushed stone or wooden bog mats and a geotextile membrane. All temporary access roads will be removed once construction is complete and the land will be reinstated.

5.10 WORKFORCE

It is estimated that some 120 to 140 workers will be employed during the construction of the Corrib Onshore Pipeline. These will include construction operatives and construction management personnel. Where possible, staff resources and services will be sourced locally, however, specialist pipeline workers will be required in particular for welding and for the tunnel construction under Sruwaddacon Bay.

5.10.1 Working Hours

Normal working hours for the non tunnelling activities are proposed to be between 07:00hrs and 19:00hrs, Monday to Friday, and between 08:00hrs and 16:00hrs on Saturdays. Tunnelling at Na hEachú (Aghoos) and certain inspection and commissioning activities will need to be undertaken on a continuous (24 hour, 7 days per week) basis.

Apart from tunnelling operations, Sunday working will be avoided, where possible, but cannot be entirely excluded. If extended working hours are required, these will be discussed in advance with local residents and with Mayo County Council.

Road haulage activities will generally be restricted to between 07:00hrs and 19:00hrs Monday to Friday and between 07:00hrs and 16:00hrs on Saturdays as set out in the Traffic Management plan (Appendix E).

Night-time security will be present at the temporary compounds and working areas.

5.11 CONSTRUCTION PLANT AND EQUIPMENT

The typical plant and equipment required for construction of the Corrib Onshore Pipeline are listed in Table 5.1.

Table 5.1: Typical Plant proposed for general construction activities.

Description	Purpose	Notes	Number Required (approximate)
Dozer	Topsoil stripping and reinstatement in areas of improved agricultural land.	Tracked. Diesel engine powered.	5
Excavator	Excavating trench. Management of materials. May also be employed for breaking fractured rock for excavation. General purposes.	General purpose machines. Small and large machines will be used. Diesel engine powered.	5 Large 5 Small
Side Boom	Lifting and 'ditching' assembled pipeline into trench.	Heavy Plant (up to 70 tonnes in weight). Tracked. Diesel engine powered.	5
Mobile Welding Unit	Provide mobile power and equipment for welding of pipeline.	Wheeled or tracked. Relatively light equipment (<15 tonnes). Diesel engine powered.	10
Crawler Crane	Lifting plant and equipment into position.	Heavy Plant. Tracked. Diesel engine powered. Likely to be used at LVI, Aghoos Tunnelling Compound and Glengad Reception Pit.	4
Dumpers	Transport of stone / excavated peat at site works. Generally used within compound areas and along the pipeline spread, but may be used on public road for short distances.	Typically wheeled (6 wheel drive) on low ground pressure wheels. Capacity 25 – 40 tonnes. Diesel engine powered.	10
Tracked Loader or Pipe Carrier	Transport of pipe lengths to the pipeline spread.	Tracked. Diesel engine powered.	5 - 10
Generator	Provide electricity in remote locations.	Stationary (or mounted on mobile plant). Diesel engine powered.	10 - 15
Piling Rig	Installing piles.	Tracked. Diesel engine powered.	1 - 4
Tunnel Boring Machine (TBM) and associated power packs.	Tunnelling. Power packs provide power for: • TBM • Pumping of cuttings from tunnel face • Air handling and lighting within tunnel	Power packs are Diesel engine powered (remotely) and contained within acoustic enclosures.	1
Bentonite Handling Plant	Separates tunnelling arisings from bentonite slurry.	Stationary plant. Electric / Diesel engine powered.	1
Road Going Trucks (HGVs)	Movement of construction materials, cabins, plant and water	Road going tipper trucks (articulated or rigid) Capacity 20 – 30 tonnes. Diesel engine powered.	10 - 20

Other plant and machinery used during construction include tractors and trailers, trucks, rock breakers (provisional) mounted on excavators, site vehicles (4x4), pumps and road dressing equipment.

5.12 CONSTRUCTION MATERIALS

The construction process will require efficient management of materials. The main materials that will require management throughout the construction of the onshore pipeline are listed in Table 5.2

Table 5.2: Construction Materials

Item	Description
Line Pipe	Pipe lengths will be transported to a temporary storage location or they will be delivered direct to the works, as required, using suitable transportation (HGVs on road sections and off-road vehicles along the temporary working area). Any ‘off cuts’ will be returned to the Gas Terminal site for appropriate disposal or re-use.
Auxiliary Services	Sections of the water outfall pipeline and services will initially be stored at the Gas Terminal. These will be transported to the temporary working area and assembled there.
Stone (and other granular fill)	In many locations stone is used for the provision of a stable, all weather access to the works and for long sections of the temporary working area. Locally sourced stone will be used for these purposes. In the case of the construction of the stringing area, pipeline trench, and the stone road, tunnel arisings combined with locally sourced quarry stone will be used where appropriate. Stone used for construction may be left in situ or removed depending on local requirements. For example, stone roads are proposed to be left in-situ in areas of peatland.
Peat	Peat excavated during construction will either be used for reinstatement or disposed of off site or both. Surplus peat will be transported to the An Srath Mór (Srahmore) peat deposition site.
Concrete	Ready-mix concrete will be used at the LVI, for construction of the tunnelling start and reception pits for the tunnel, and for the foundations of tanks and heavy equipment at the tunnelling compound. Pre-cast concrete slabs may be used at certain locations, e.g. road crossings.
Bentonite	Bentonite used for the tunnelling will be imported and mixed to the required consistency on site. Bentonite will be recycled and reused, where possible, throughout the operation and surplus quantities will be removed upon completion. Bentonite requiring disposal will be sent to a licensed disposal facility.
Engineered Materials	Engineered materials (including bog mats, geotextiles, geogrids, steel sheet piles and other piling systems) will be used.
Water	Water required by the construction process will either be harvested from rainfall, sourced locally, brought in in tankers or sourced from the Terminal site or a combination of these. Water will be required for a number of purposes including tunnelling, cleaning plant and machinery and for hydrostatic testing of the onshore pipeline. The sourcing of additional water to be used for hydrostatic testing (if required) and disposal points for hydrostatic test water will be agreed with the relevant authorities.

Sustainable management principles will be used in the management of all materials proposed for the construction of the project in accordance with the EMP which will be drawn up for the works (see Section 5.14.2).

5.13 PROJECT MANAGEMENT

5.13.1 Construction Management

SEPIL will oversee the construction activities to make sure all the commitments given during the planning stages are implemented throughout the execution of the project. The proposed project management structure for the construction phase is outlined as follows:

- Construction Manager on site, who will oversee the entire project and who will ensure that the works are undertaken in accordance with the Contract Documents, the measures outlined in this EIS, the Environmental Management Plan (EMP) and detailed Method Statements agreed with the relevant authorities. The Construction Manager will also have responsibility for the Health and Safety Plan.
- Senior Pipeline Engineers who will take field responsibility for construction activities.
- Geotechnical Engineer who will monitor and supervise civil works in peatland areas.
- Field Surveyors who will survey and prepare 'as laid records'.
- Transport Manager who will manage transport activities.
- A Community Liaison Officer, who will communicate with the local community and landowners during the works (see Chapter 2).
- A Landowner Liaison Officer, who will communicate with landowners on agricultural issues as they arise during the construction phase.
- An Environmental Officer, who will supervise the works from an environmental perspective, ensuring compliance with commitments made in the EIS and the EMP (see Section 5.13.2). The Environmental Officer will have the power to stop any works not following agreed method statements and EIS commitments. The Environmental Officer will also ensure that all construction personnel receive appropriate induction training on environmental issues, including pollution awareness and control associated with the project prior to commencing work. The Environmental Officer will coordinate and be the site focal point for communication with the relevant statutory bodies, e.g. NPWS and NWRFB.
- Environmental Specialists who will supervise and advise on all relevant ecological and archaeological features.
- Specialist Inspectors reporting to the Construction Manager and who will supervise the construction according to design and engineering aspects of the project.
- Safety Officer.
- Contract Administration Staff.

5.13.2 Environmental Management Plan (EMP)

Preventative and management measures will be applied throughout the construction phase to ensure that all environmental effects associated with the proposed development are minimised, mitigated or avoided as outlined in Chapter 18. Various tools will be implemented to ensure sound environmental management. These include the preparation of an EMP.

The EMP will be used as an management tool to ensure compliance with all relevant environmental regulations and standards and to minimise the potential impacts associated with the development. This EIS will form the basis for many of the environmental procedures that will be fully developed within the EMP.

The EMP will be drawn up in accordance with the schedule of commitments presented in Chapter 18 of this EIS. It will detail measures to minimise actual and potential impacts associated with the construction phase, describing or referencing the procedures and equipment proposed to prevent, monitor and manage possible effects. The EMP will serve as a compliance document recording the progress of commitments and their conformity with the requirements set by the relevant authorities and the expectations of the public.

Typically the EMP will address topics as shown below.

- Vegetation clearing
- Audits and review
- Environmental Liaison and Consultation
- Pollution Control
- Waste Management
- Traffic Management
- Hazardous Substance management
- Environmental Supervision & Training (all personnel)
- Environmental Health and Safety (EHS) performance
- Spill Contingency
- Dust Management
- Noise Management
- Reinstatement Management/Monitoring
- Disease Prevention
- Community Liaison
- Surface Water Management
- Landowner Liaison

Construction method statements will be developed to manage the construction activities in accordance with the EMP and EIS committments. The EMP will also establish monitoring protocols for ecology, archaeology, water, dust, noise and sediment control. The monitoring programmes will be outlined in detail within the EMP and will include the timing and frequency of monitoring and policies for evaluating and amending the monitoring programme.

Once detailed design information is available, the EMP will be finalised. Upon the commencement of construction, the EMP will be reviewed according to a regular timeframe and updated, if necessary. These updates will be made in consultation with relevant regulatory authorities.

The EMP will provide systems for the effective environmental management of the construction process covering important items such as waste management and pollution control. Environmental auditing will be carried out to ensure compliance with the EMP.

Environmental liaison and consultation with statutory bodies, local authorities and non-statutory organisations, where required, will continue throughout the construction of the onshore pipeline system.

SEPIL is committed to achieving a level of environmental management and performance consistent with national and international standards and in compliance with all relevant statutory obligations. It will seek to incorporate the most environmentally sound technology and procedures into the design of the project in order to ensure optimal management of all activities. These environmental commitments are summarised in Chapter 18.

5.13.3 Construction Health & Safety Plan

A Risk Assessment for the construction phase of the Corrib Onshore Pipeline will be developed by SEPIL. This Risk Assessment will form the basis for the Preliminary Health & Safety Plan required under the Health, Safety and Welfare at Work (Construction) Regulations 2006. The Preliminary Health & Safety Plan will be produced by the appointed Project Supervisor Design Process (PSDP).

The Preliminary Health & Safety Plan will in turn be further developed by the appointed Project Supervisor for the Construction Stage (PSCS) to produce the Health & Safety Plan for the construction phase of the project. The Plan will help to ensure that construction risks are minimised, and will include the following typical requirements:

- Responsibilities and organisation;
- Relevant drawings and specifications;
- Information on relevant adjoining land uses;
- Site constraints;
- Known existing services;

- Safety and health hazards and associated risk assessment;
- Risk reduction measures;
- Emergency procedures; and
- Communication and liaison requirements.

The appointed Project Supervisor for the Construction Stage (PSCS) will coordinate with the Project Supervisor Design Process (PSDP) for all design work during construction.

The selection of competent contractors who will apply safety management systems under the supervision of a strong project construction management team will minimise risks to an acceptable level.

5.14 ENVIRONMENTAL CONSIDERATIONS

Table 5.3 outlines the key environmental constraints along the route of the proposed pipeline and describes the mitigation measures proposed to avoid and or minimise the environmental impact of the proposed construction activities.

During the mobilisation of the project all staff will receive inductions and training relevant to their role during construction. This will include training on environmental aspects outlined in the EMP and will indicate sensitive areas, environmental precautions and good environmental practice on site.

The design of the tunnelling compound in na hEachú (Aghoos) incorporates environmental mitigation such as:

- Fencing to attenuate construction noise and reduce lighting and visual impact;
- Reuse of excavated materials where possible;
- Rainwater harvesting on site and reuse of water and drilling fluid where possible;
- A detailed surface water drainage system including specialist treatment facilities;
- A lighting system designed to minimise visual impact;
- Application of surface dressing to the compound which will provide a clean impermeable surface contributing to rainwater harvesting and general site tidiness;
- Set up of a wheelwash system in this area, allowing trucks leaving the site to be cleaned before they exit onto the public road; and
- Use of sound proofing on plant, such as generators and pumps, to reduce the levels of noise generated on site.

Care will also be exercised at all watercourse crossings traversed by the onshore pipeline. Watercourse crossings will be carried out in isolation of stream flow in order to avoid disturbance and to prevent water escaping onto the temporary working area. Construction methods at watercourses will be discussed with NPWS and NWRFB prior to commencement of construction, and liaison with these agencies will continue throughout the construction period.

Particular restrictions associated with issues such as disturbance of bankside vegetation and operation of plant and machinery will be required at watercourse crossings.

An EMP will be developed to ensure that construction of the onshore pipeline is carried out in accordance with the EIS commitments, all relevant legislation, regulations and standards and in line with current environmental best practice. Furthermore, the construction of the onshore pipeline will be supervised and closely monitored by an Environmental Officer to ensure that construction is carried out in compliance with the EMP. Specialists such as the Project Archaeologist and the Project Ecologist will also monitor and supervise the works.

Table 5.3: Key Environmental Constraints and Mitigation.

Environmental Constraint	Mitigation
Sruwaddacon Bay is an important habitat for birds and wildlife and is designated as a cSAC and pSPA. Sruwaddacon Bay is also a Ramsar site.	Tunnelling – The proposed construction method for installation of the pipeline through Sruwaddacon Bay is via segment lined tunnelling. Trenchless methods provide a means of pipeline installation that cause minimal disturbance to the surface of the area traversed. In this way, the construction of the proposed Corrib Onshore Pipeline in Sruwaddacon Bay can be carried out with minimal impact on the estuary. The tunnelling compounds located onshore will be subject to noise attenuation and appropriate lighting design to minimise the impact of the construction activities on local residents and wildlife.
The onshore pipeline route passes through an area of sensitive peatland in a non-designated area. It also passes through salt marsh.	'Stone Road' Method – The preferred construction method that will be used in areas of peatland will be the 'Stone Road' method. This method will provide a stable platform on which construction plant and machinery can operate and provide added stability and support to the installed pipeline. The same approach will be used to build the tunnelling compound at na hEachú (Aghoos). Conservation of vegetated layer of peat – Turving will be carried out in one location (approximately 190m long) to the east of the Leenamore River. In this area, the width of the stone road will be 9m to minimise impact. This approach will preserve the active surface layer of peatland in this area and assist the reinstatement of the area affected by construction. In other areas of peatland where it is not possible to turve, the upper vegetated layer will be stripped and stockpiled for use during reinstatement (as for topsoil in grasslands). Plugs – peat plugs will be placed at 50m intervals within the stone road to maintain the hydrology of the area and prevent the stone road acting as a preferential drainage channel within the bog. Salt Marsh - Turving will also be applied in the area of salt marsh near the Leenamore river crossing.
Environmental management of construction.	The Environmental Management Plan (EMP) will set out key measures to ensure compliance with all relevant commitments set out in this EIS, environmental regulations and standards and to minimise the potential impacts associated with construction. The EMP will include plans and procedures for the effective environmental management of construction.
Environmental policing of construction.	The Environmental Officer, Project Ecologist and Project Archaeologist will provide supervision, monitoring and inspection of the works to ensure that construction is carried out in an environmentally sound manner.

6 COMMUNITY AND SOCIO-ECONOMICS

6.1 INTRODUCTION

Human beings comprise one of the most important elements of the 'environment', and any potential impact upon human beings by a development proposal must therefore be comprehensively addressed. The principal concern in this respect is that people experience no significant unacceptable diminution in their 'quality of life' as a consequence of the construction and operation of a proposed development. The components of 'quality of life' addressed in this community and socio-economic impact assessment include both demographic and employment patterns, and wider community issues, including tourism, cultural identity, and language. Other community-related issues such as land use, material assets, and cultural heritage are addressed in other Chapters of this EIS.

6.1.1 What is Community?

It is essential at the outset of this assessment to set out what is understood by the term *'community'*. Certainly community includes the residential and working population of the receiving environment, and this is addressed in terms of demographic analysis – studying patterns of population change, age profile, socio-economic profile, employment patterns, etc. Community also includes the physical land area of a development; this is addressed in terms of land use, property (see Chapter 11) and cultural heritage (see Chapter 16). Community also includes the visiting community who come to the area to observe or otherwise enjoy the physical land and landscape of the area.

The primary basis for the proposed development – a revised alignment of the onshore pipeline element of the overall Corrib Gas Field Development – derives from a key recommendation made in Peter Cassells' Report to *"modify the route of the pipeline in the vicinity of Rossport to address community concerns regarding proximity to housing"* (see Preamble). Whilst this recommendation clearly places human beings at the forefront of the project, the Cassells Report does not define what is understood by its author to comprise '*community'.* It is considered that the Report has used the term '*community'* generally to refer to persons in the local vicinity of the proposed pipeline, who expressed concerns with, or opposition to, the project. The difficulty with such use of a general term like '*community'* as a collective substitute for a number of individuals is that, by its very generality, all residents of a local area appear to share a uniform concern with, or opposition to, the project. In contrast, following extensive consultation in respect of the proposed modified pipeline, it is considered by RPS that such blanket collective opposition to the project does not actually occur in the local and wider vicinities of the Study Area. There is in fact significant support for the project, with people having regard in particular to the significant economic and employment benefits arising from such a large infrastructural project. This is not in any way to lessen the degree of concern or opposition that an individual or group may have to the project – such concern also arises from persons who support the project in principle.

The publication, '*The Environmental Movement In Ireland'*, by Liam Leonard (2007), seeks to provide some clarity, in sociological terms, as to what defines a rural community. The author, from the Social Sciences Research Centre (SSRC) of NUI Galway, addresses the rise of local environmental activism, including the experience of the Corrib Gas project, and defines the rural community as representing "*an articulation of defence of space, lifestyle and environment by a social group who are concerned about the degradation of all that they hold dear"* (p69). He notes that this perceived risk to a local population or environment can form the basis of resistance to industrial or infrastructural projects, even though such projects may be intended to modernise an area, or otherwise have the potential consequence of stemming the tide of emigration, economic stagnation and historical depopulation, through spreading of an industrialised wealth base across the country.

In this context, *'community'* is not restricted to the people who live in, or work in a particular locality. It also includes persons who share ties to the people and landscape of that area. It also includes shared values, and a sense of place and belonging, whether or not an individual actually resides or works in that particular locality. In respect of the Corrib Gas Field Development therefore, the community cannot be simply seen as the local population within the immediate vicinity of the project. It must also include the residential, working and visiting populations of the wider vicinity, region, and State, who share in the sense of place, or who otherwise feel a connection to the area, or to the proposed development, whether in support or opposition to the project.

This community and socio-economic assessment of the impact of the proposed onshore pipeline development cannot occur in isolation from the considerable and extensively documented history of conflict that has occurred between proponents of the Corrib Gas Field Development, and objectors to that project. Consistent with Leonard's definition above, such persons are not restricted to residing in the local vicinity of the project, but rather are spread through the wider locality, region, county and State. It is the case that stated concerns in respect of the overall Corrib Gas Field Development have been made by persons not necessarily resident in the local vicinity of the project, but who may share similar values as local persons who have raised concerns with, or opposition to, the project. Equally, it is the case that local support for the project is replicated throughout the region, and State as a whole.

This assessment has been prepared in the context of all the above that serves to make up the local and wider communities of the overall Corrib Gas Field Development in general, and the specific proposed onshore pipeline that comprises the subject of this EIS.

Whilst acknowledging the wider regional, national and international communities both in support of, and opposition to, the overall project, it is considered appropriate generally to restrict this assessment to the impact of the proposed pipeline development, and in cumulative terms, the overall Corrib Gas Field Development on the local and wider resident, working and visiting populations of the Study Area, as identified below.

6.1.2 Characteristics of the Proposed Development

The characteristics of the proposed development, for the purposes of this assessment of community and socio-economic issues, cannot isolate the proposed construction and operation of the onshore gas pipeline from the other elements of the Corrib Gas Field Development, including the current construction and planned future operation of the permitted Bellanaboy Bridge Gas Terminal, as well as construction of the offshore element of the gas pipeline (see Chapter 4).

The existing settlements in closest proximity to the proposed Corrib gas pipeline and associated development are Gleann an Ghad / Poll an tSómais (Glengad / Pollatomish), Béal an Átha Buí (Bellanaboy) and Na hEachú (Aghoos). In addition, dwellings are scattered along the coast roads that occur on both sides of Sruwaddacon Bay and on other sites within the vicinity of the pipeline, including Ros Dumhach (Rossport). Construction of the proposed pipeline development will result in the removal from use of one habitable house on the coast road (L1202) in the townland of Na hEachú (Aghoos), in close proximity to the area of the proposed Na hEachú (Aghoos) tunnelling compound, for as long as the pipeline is operational. This property is in the ownership of SEPIL. Otherwise, the minimum separation of the proposed pipeline from existing dwellings will be approximately 240m.

The proposed onshore pipeline runs through the Electoral Divisions (EDs) of Cnoc na Lobhar (Knocknalower) and Gleann Na Muaidhe (Glenamoy) as defined by the Central Statistics Office (CSO). In addition, Cnoic na Daimh (Knockadaff), Muing na Bó (Muingnabo) and Barr Rúscaí (Barroosky) Electoral Divisions (EDs) have also been included in this demographic analysis, with all these identified EDs taken to comprise an overall Study Area of the subject development. It is considered important to include these additional EDs as part of this demographic assessment, having regard to the pattern of dispersed settlement across the vicinity of the pipeline development, and the wider Iorras (Erris) area, which together comprise the local and wider vicinities of the proposed pipeline project.

The proposed onshore gas pipeline, and the overall Corrib Gas Field Development, is envisaged to have an operational life of some fifteen to twenty years. Total employment associated with the overall project will include installation of the offshore subsea facilities, the laying of the offshore and onshore elements of the overall gas pipeline, construction of associated structures and facilities, construction and operation of the Gas Terminal, and ongoing maintenance of the various elements of the project.

6.2 METHODOLOGY

The current EPA Advice Notes on Current Practice in the preparation of Environmental Impact Statements (September 2003) sets out a useful framework methodology, which has been followed in preparing this assessment. Issues under the general heading of Human Beings are stated to include:

- Economic Activity – will the development stimulate additional development and/or reduce economic activity, and if either, what type, how much and where?
- Social Consideration – will the development change patterns and types of activity and land use?
- Land Use – will there be severance, loss of rights of way or amenities, conflicts, or other changes likely to ultimately alter the character and use of the surroundings?
- Health and Safety – will there be risks of death, disease, discomfort or nuisance?

The issue of land use is addressed separately in this EIS. The issue of health and safety is a crucial element in the overall pipeline design, and is primarily addressed in Chapter 4, and in associated Appendices of this EIS. This chapter therefore primarily addresses the community issues of the proposed development in terms of its social and economic aspects.

In order to ensure a robust assessment of Community and Socio-economic issues, this chapter separately addresses both matters of demography and employment, and other community issues. In terms of demography and employment, the primary official record and analysis of demographic trends is the CSO Census of Population. The Census records demographic information at State, County, and local levels. In this regard, the smallest geographical unit distinguished by the 2006 Census is the Electoral Division (previously termed District Electoral Division or Ward). The most recent Census was taken on the 23rd April 2006. Analysis of demographic trends has occurred in reference to the most recent Census statistics, which are then compared with similar data recorded in the Census publications of 1996 and 2002. This gives a ten-year profile of population and population change, including population numbers, age profile, household numbers, employment, and social class for the State, County, and defined Study Area. In addition, this analysis of official CSO statistics is compared with the population analysis contained in the Cill Chomáin Development Plan 2006-2010[1], the development plan prepared for Cill Chomáin (Kilcommon) Parish on behalf of Comhar Dún Chaocháin Teo. The demographic analysis of this Development Plan is based upon the official statistics of the 2002 Census of Population (the 2006 Census had not been published at the time of writing this Plan), but also offers a qualitative explanation for the trends in population and employment that lie behind those statistics.

In terms of understanding of community issues, the Cill Chomáin Development Plan is a useful reference for understanding the receiving community environment of the overall planned Corrib Gas Field Development. The Plan, whilst not a Statutory document, has been prepared by a community development co-operative with the stated mission *“to work in a proactive way to promote the linguistic/cultural, infrastructural, economic, educational and social development of the parish of Cill Chomáin and to develop in an integrated and sustainable manner the material and human resources of the area”* (p1). The Plan records that the organisation co-ordinates development at local level, provides information and assistance to voluntary groups in relation to developing and managing projects, sourcing funding, etc. and has worked in partnership with a number of state and semi-state agencies in its efforts to further develop the parish.

[1] Cill Chomáin Development Plan 2006-2010, Comhar Dún Chaocháin Teo, 2006

In addition to this desktop work, in June, September and November 2007, February, April and September 2008, April and May 2009, and April 2010, RPS undertook driving surveys of the local and wider vicinity of the proposed pipeline development, across the Iorras (Erris) area and Cill Chomáin (Kilcommon) Parish, and including Béal an Mhuirthead (Belmullet), being the largest settlement in this wider area. The purpose of these surveys was to note the general form and function of the local settlements of this area, and their potential as community nodes. It should be noted that these surveys are not intended to comprise an in-depth analysis of these settlements, their populations and facilities, but rather are intended to inform a qualitative consideration of the local and wider vicinity of the proposed development, including the scale and function of settlements, the general distribution of resident and employment populations, and the various communities within this Gaeltacht area.

The methodology for the assessment also includes significant reference to ongoing statutory and non-statutory consultation and public engagement (see Chapter 2). Public consultation has identified issues and concerns from individuals and groups throughout the local and wider vicinities of the proposed pipeline route. Of particular note, the key issues of the proposed onshore pipeline project, and the wider Corrib Gas Field development, were addressed in significant detail in May and June 2009 at a public Oral Hearing held by An Bord Pleanála in respect of the application for Approval of the proposed pipeline development submitted in February 2009. This Statutory forum facilitated extensive input in respect of the pipeline development by the Applicant, Prescribed and non-Prescribed Bodies, and the general public.

Perhaps the greatest ongoing source of information in relation to the communities of the local and wider vicinity of the Corrib gas pipeline development, of Cill Chomáin (Kilcommon), and the wider Iorras (Erris) region, derives from the work of the SEPIL's Community Liaison Officers (CLOs), with a presence in the area since 2001. At present, there are five full-time CLOs working in the area of the proposed development, and through which messages related to the project and its progress – both positive and negative - are communicated. In excess of 150 households are covered by the CLO team. The CLO team also deals with any specific complaints in respect of the project that are made through the Corrib Natural Gas office in Belmullet.

It is acknowledged that, notwithstanding the extensive public consultation and engagement process that has occurred, in particular since February 2007, and the various opportunities for local input and dialogue arising, there has been little positive engagement with persons who are actively opposed to the overall Corrib Gas Field Development. Such inability to consult regularly with these people, many of whom reside in the local vicinity of the proposed route, could potentially have resulted in an information deficit in terms of understanding the significance of the landscape and hinterland, and indeed the causes of such opposition to the project. However, it is fortunate that, in addition to the limited extent of consultation that has occurred with these persons, two books have been published which record the sentiments and concerns held by these local opponents of the project, and which articulate this in a detail that was not forthcoming during the public consultation process.

The first book – '*Our Story – the Rossport 5'* (Small World Media, 2007), edited by Dr. Mark Garavan, details the circumstances of the overall Corrib Gas Field Development from the perspective of the 'Rossport 5'. The second book – '*The Price of Our Souls – Gas, Shell and Ireland'* (AFRI, 2008), written by Michael McCaughan, gives an insight into elements of the ongoing project and opposition strategy, including the 'Rossport 5', the Rossport Solidarity Camp, and the nature of activism in general. In addition, as referred to above, *"The Environmental Movement in Ireland"* by Liam Leonard (2007) provides a more academic articulation of the issues surrounding contemporary environmental activism, including specific reference to the experience of the Corrib Gas Project. These books provide an extremely useful resource for undertaking this community impact assessment of the proposed pipeline development as, taken from the viewpoint of local opponents and activists, it provides a clear and unambiguous detail of the grounds of opposition to the project, providing an articulation to those who have chosen, for the main part, to distance themselves from the significant public consultation process carried out by RPS in respect of the modified onshore pipeline route.

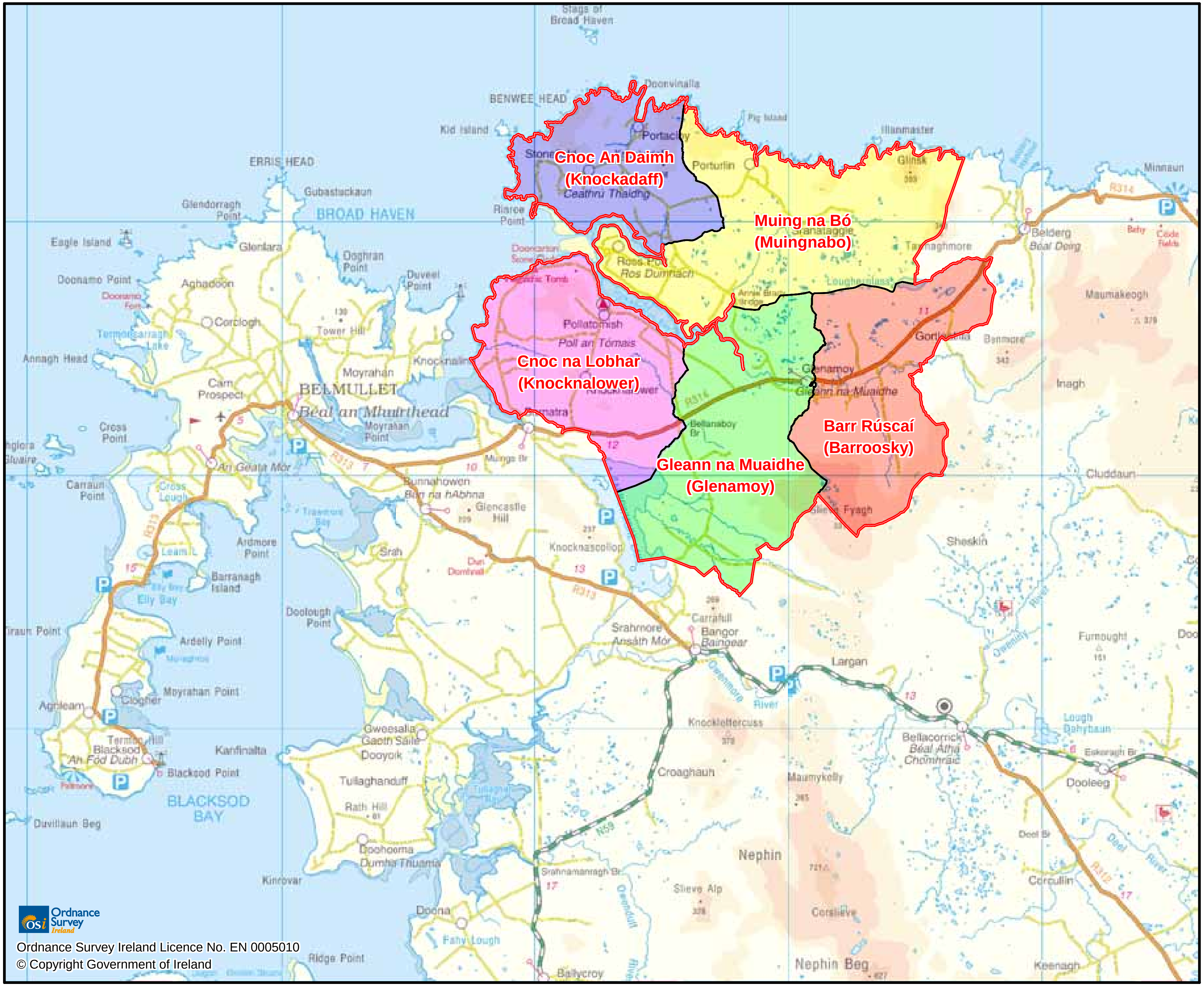
6.3 EXISTING ENVIRONMENT

6.3.1 General

The Study Area, as described above, is consistent with the demographic analysis of the Cill Chomáin Development Plan 2006-2010 in identifying the area of Cill Chomáin (Kilcommon) Parish. Table 6.1 below lists the EDs included in the Study Area. The location of these EDs are illustrated in Figure 6.1.

Table 6.1: List of Electoral Divisions and Townlands comprising the defined Study Area

ED No.	ED Name 2002	ED name 1996	Townland
061	Cnoc na Lobhar	Knocknalower	Baile na nAchadh; Barr na Coille; Béal an Atha Buí; Cnoc an Chairn; Cnoc na Lobhar; Gleann an Ghad / Gleann na nGad (Dún Ceartáin); Gort Breac; Gort Milleadha; Greanphoill; Inbhear; Fálach; Moing Eiriún; Poll an tSómais (Cill Chomáin)
056	Gleann Na Muaidhe	Glenamoy	Baile Géimhe Theas; Baile Géimhle Thuaidh; Gleann Chuilinn Íochtarrach; Gleann Toirc Beag; Gleann Toirc Mór; Muing Iongáin.
054	Barr Rúscaí	Barr Rúscaí	Barr Altaí, Barr Rúscaí, Creagán Mór, Bun Altaí, Gort Liatuile, An Léana Riabhach, Poll Buí, Sraith na Pláighe
062	Muing na Bó	Muingnabo	Abhainn na nIorrach; Glinsc; Leacht Murrach; Muing na Bó; Port Durlainne; Ros Dumhach; Sraith an tSeagail.
060	Cnoc An Daimh	Knockadaff	Cill Ghallagáin; Ceathrú na gCloch; Ceathrú Thaidhg; Corrán Buí; Cnoc an Ghairtéil; Port an Chlóidh



LEGEND:

Overall Study Area

Mayo EDs

Study Area EDs

Barr Rúscaí Barroosky

Gleann na Muaidhe Glenmoy

Cnoc An Daimh Knockadaff

Cnoc na Lobhar Knocknalower

Muing na Bó Muingnabo

Electoral Divisions (EDs)

Figure 6.1

File Ref: COR25MDR0470Mi2109A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

6.3.2 Population Change

The 2006 Census records that the population of the State grew from 3,917,203 persons to 4,239,828 persons between 2002 and 2006, representing an increase of 8.2% in four years. The average annual rate of population increase in this period was 2%, which is the highest on record, and compares with 1.3% for the previous inter-Censal period 1996 - 2002. The 2006 population is the highest recorded population in Ireland since 1861, with 16.9% growth over the ten-year period.

In a similar trend, the population of County Mayo experienced an increase of 5.4% between 2002 and 2006, building on that population increase of 8% in the previous inter-Censal period. This amounts to an 11.1% increase in the county over the ten- year period. In contrast, the Study Area recorded a fall in population of -1.5% over the period 2002 – 2006. However, this is a significant improvement on the population decline experienced during the previous inter-Censal period of -9.5%. Overall for the ten-year period 1996-2006, the population decline experienced in the Study Area of -10.8% is in stark contrast to the comparative significant population growth experienced at State and County level.

Comparative population growth rates for the State, County and Study Area between 1996 and 2006 are detailed in Table 6.2.

Table 6.2: Population at State, County and Local Level, 1996-2006*

Area	Total Population			% Change	% Change	% Change
	1996	**2002**	**2006**	**96-02**	**02-06**	**96-06**
State	3,626,087	3,917,203	4,239,848	+8.0%	+8.2%	16.9%
County Mayo	111,524	117,446	123,839	+8.0%	+5.4%	11.1%
Study Area	2,129	1,927	1,899	-9.5%	-1.5%	-10.8%

**Source: Census of Population 1996, 2002 and 2006 (Central Statistics Office).*

The reasons stated in the Cill Chomáin Development Plan 2006-2010 for this recorded decline in population in the Study Area are *"a decline in the birth rate, emigration, lack of local employment opportunities, out-migration of young adults to attend third level institutions, many of whom do not return because of a shortage of job opportunities to match their qualifications".*

The population density of the Study Area of one person per 13 hectares is in sharp contrast to the national average of one person per 1.6 hectares. The respective figure for County Mayo, of one person per 4.5 hectares, reflects the primarily scattered rural population that occurs within the county. In this context, the Cill Chomáin Development Plan gives a practical example of the consequence of such low population density – that of educational provision - recording that *"The low population density and the difficulty in attracting sufficient numbers for specific courses limits the range and number of adult educational opportunities which can be offered".*

6.3.3 Age Profile

The age profile for the State, County Mayo, and the Study Area over the period 2002 - 2006 is set out in Table 6.3. The results indicate that the percentage of population within the dependent age cohort (0-14 and 65+) in all these areas is in decline. However, it also indicates that this dependent age cohort figure is greater in County Mayo (34.9% in 2006) than that experienced in the State as a whole. Moreover, this dependency is even more pronounced in the Study Area, at 36.6% for the same period.

The working age population of the Study Area increased by 2.9% from 2002 to 2006 – a percentage growth greater than that for the State or County. However, although the working age population in the Study Area has increased over this inter-Censal period, compared with the previous 6-year inter-Censal period 1996-2002, it is, nevertheless, still below the State and County working age profile. Therefore, proportionally, the working age population of the Study Area supports a greater number of younger and older people than County Mayo, and the State as a whole.

Moreover, Table 6.3 confirms that the population age cohort 25-44 is significantly lower in the Study Area than the average for the County or State as a whole. This cohort marginally decreased in the Study Area over the inter-Censal period 2002 – 2006, whereas it marginally increased nationally and in Mayo County.

Table 6.3: Age Profile at State, County and Local Level: 2002 – 2006*

Age Cohort	0-14	15-24	25-44	45-64	65+	Dependent 0-14 & 65+	Working Age Population 15-64
State 2002	21.1%	16.4%	30.1%	21.2%	11.1%	32.2%	67.7%
State 2006	20.4%	14.9%	31.8%	21.9%	11%	31.4%	68.6%
County Mayo 2002	21.5%	14.2%	26.4%	23.2%	14.7%	36.2%	63.8%
County Mayo 2006	20.5%	13.3%	26.9%	24.9%	14.4%	34.9%	65.1%
Study Area 2002	22.1%	14%	23.1%	23.4%	17.4%	39.5%	60.5%
Study Area 2006	20.1%	14.4%	22.2%	26.8%	16.4%	36.6%	63.4%

**Source: Census of Population 2002 & 2006 (Central Statistics Office).*

Of note, the Cill Chomáin Development Plan 2006-2010 refers to this higher than national average dependency ratio in the Study Area, and concludes that *“These and other factors such as the reduction of attendance numbers in schools raise concerns about the future sustainability of this community”*.

6.3.4 Household Size

The average household size for the Study Area in 2006 was three persons. This is only marginally higher than that recorded for County Mayo (2.75 persons) and the State (2.81 persons).

Table 6.4: Average Number of Persons Per Household 2006*

Area	2006
State	2.81
County Mayo	2.75
Study Area	3.0

**Source: Census of Population 2006 (Central Statistics Office).*

6.3.5 Persons at Work

The total number of people at work in the State increased by 26% between 1996 and 2002. Employment levels in County Mayo also increased significantly, recording an increase of 22% over this period. Both the State and County continued to experience growth in the number of people at work for the subsequent inter-Censal period 2002-2006, albeit at a more reduced level of 18% and 17% respectively. Overall, the percentage of the population of the State and Mayo County recorded as at work by the CSO for the ten-year period 1996-2006 increased by 48% and 43% respectively.

In contrast, the number of persons at work within the Study Area experienced a significant decline (-13%) between 1996 and 2002. However, the number of people at work increased from 395 people to 545 people in the Study Area over the period 2002-2006, representing an increase of 38%, and an overall increase of 20% for the ten-year period 1996-2006. This level of employment growth is still well below the national and county experience, over a period that has, up until recently, been viewed by many economic commentators as one of significant economic and employment growth.

Table 6.5: Employment Levels 1996, 2002 & 2006*

	Population in Employment			% Change		
	1996	**2002**	**2006**	**1996 - 2002**	**2002 - 2006**	**1996 - 2006**
State	1,307,236	1,641,587	1,930,042	+26%	+18%	+48%
Mayo County	36,583	44,764	52,277	+22%	+17%	+43%
Study Area	454	395	545	-13%	+38%	+20%

**Source: Census of Population 1996, 2002 & 2006* (Central Statistics Office).

6.3.6 Principal Occupations

Table 6.6 outlines the principal occupations in the State, County Mayo and the Study Area. The percentage of people involved in primary activities in the Study Area (farming, fishery, and forestry) decreased from 25% in 2002 to 18% in 2006. The Census data confirm that, whilst these remain important economic activities within the Study Area, the number of people involved in such activities has been steadily declining over the inter-Censal period 2002-2006. The Cill Chomáin Development Plan 2006-2010 concurs with this trend, and qualifies it in Chapter 5 – Area Profile – as follows:

> *"The majority of the population is dependent on primary sector activities such as small-scale low-viability farming and fishing. Farming here is severely disadvantaged due to the poor soil quality (reclaimed bog), the small and fragmented holdings (the average farm size is below thirty acres), the lack of diversity and an ageing farming population. The fishing industry is undergoing radical changes in the context of the European Union Common Fishery Policy's rules and regulations and this has major implications for local inshore fishermen. Other primary sector activities such as forestry, which provided much employment in the 1980s generate few benefits directly into the local economy today".*

Plate 6.1: Typical agricultural activity in the locality

In addition to this, the Analysis of Strengths, Weaknesses, Opportunities, and Threats (SWOT Analysis) of the Development Plan also identifies that livelihoods of farmers and fishermen are under threat in view of increasing EU rules and regulations. It also identifies difficulties in attracting younger people into farming and fishing due to these problems currently experienced by farmers and fishermen. There is also the identified threat that educated young people are migrating from the area to larger urban centres in search of suitable employment opportunities. These recorded qualitative factors seem to support the trends of the official Census statistics.

The Manufacturing Sector and Services Sector in the Study Area experienced 5% and 3% increases respectively in the period 2002 to 2006. It is noteworthy in this specific respect, however, that the Cill Chomáin Development Plan also expresses concern for the future sustainability of this sector, stating as follows: *"There are relatively few opportunities for new employment in the manufacturing/production industry. Geographic isolation, the small population base, inadequate support services (e.g. poor broadband coverage) and the high transport costs of transporting both raw materials into the area and the final product to market are cited as some of the reasons for the lack of development in this area".*

The building and construction sector now employs the greatest percentage of people in the Study Area. It is a fact that the construction of the Bellanaboy Bridge Gas Terminal remains the largest construction project in this area, and in County Mayo. Having regard to the population trends detailed above, it is reasonable to suggest that a proportion of the persons in the Study Area previously recorded as engaged in primary activities, are now employed in building and construction in the area.

The Cill Chomáin Development Plan makes virtually no mention of the Corrib Gas Field Development, either in terms of the Area Profile or in its Action Plan, notwithstanding the stated threats of population and employment decline in the area. The only reference in the Plan to the overall Corrib Development is a statement in the Area Profile that "*The Corrib Gas Project is currently being developed but it remains to be seen what benefits will accrue to the parish should it proceed. A staffing complement of 27 is proposed. However, its potential negative impact on tourism, fishing and water supply is the dominant economic effect of the project".* This assessment does not therefore fully reflect local employment opportunities also occurring during the construction phase, and the overall potential positive economic impact of the project.

Table 6.6: Principal Occupations (%) 2002-2006*

	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
State 2002	5	13	8	18	6	13	17	10	11
State 2006	4	12	9	18	6	14	16	11	11
Mayo County 2002	11	14	11	13	5	12	15	10	9
Mayo County 2006	9	14	12	13	5	12	15	12	9
Study Area 2002	25	13	20	7	3	8	7	9	8
Study Area 2006	16	17	19	8	3	8	9	14	6

**Source: Census of Population 2006* (Central Statistics Office).

A. Farming, fishing & forestry managers.
B. Manufacturing workers.
C. Building & Construction workers.
D. Clerical, office administrative &government workers.
E. Communication &Transport workers.
F. Sales workers.
G. Professional workers.
H. Services workers.
I. Other workers.

6.3.7 Unemployment

Table 6.7 sets out details of unemployment from the 1996, 2002 & 2006 Census of Population. The 2006 Census records a continuing decline in unemployment levels. The State's unemployment level dropped from 14.8% to 8.8% between 1996 and 2002, with a further marginal drop to 8.5% by 2006. A decrease in unemployment was also experienced in County Mayo, where the rate fell from 16.3% in 1996 to 10.7% in 2002, to 9.1% by 2006.

Again, in significant contrast to the experience of the County and the State, the rate of unemployment in the Study Area remained relatively unchanged for the inter-Censal period 1996-2002, with a rate of 37.3% in 1996 and 35% by 2002. The Study Area, however, did record a significant drop in unemployment in 2006, reducing to a rate of 23%. Nevertheless, the rate of unemployment in the Study Area (including first time job seekers) was consistently much higher than that of the County and State over the period 1996-2006.

Table 6.7: Unemployment Rates 1996, 2002 and 2006 (%)*

	Unemployment Rate			Total Unemployed		
	1996	**2002**	**2006**	**1996**	**2002**	**2006**
State	14.8%	8.8%	8.5%	226,728	159,346	179,456
County Mayo	16.3%	10.7%	9.1%	7,141	5,350	5,240
Study Area	37.3%	35%	23%	243	202	163

**Source: Census of Population 1996, 2002 & 2006*

Having regard to the Census data presented in Tables 6.6 and 6.7 above, it is reasonable to suggest that loss of employment in primary sector activities in the Study Area has not been significantly offset by diversification into other employment activities, notwithstanding the increase in employment in building and construction, and services.

6.3.8 Social Class

The Census of Population determines social class by the nature of employment, and is therefore useful as a guide to the principal types of occupation in which the population is employed or in which the population is capable of being employed. According to Appendix 2 of Volume 8 of the 2006 Census of Population, the entire population is classified into a hierarchy of social class groups from Class 1 (professional and farmers with large landholdings) to Class 6 (unskilled persons) - Class 7 represents unknown occupations - which are defined on the basis of occupation and level of skill required. The detailed classification used for determining the social class group of all persons at work, unemployed or retired is given in Appendix 7 of Volume 8 of the 2006 Census of Population.

1. **Professional workers**: Including farm owners and managers (200 or more acres).
2. **Managerial and technical**: Including farm owners and managers (100-199 acres).
3. **Non-manual**: Including farm owners and managers (50-99 acres).
4. **Skilled manual**: Including farm owners and managers (30-49 acres).
5. **Semi-skilled**: Including farm owners and managers (0-29 acres and area not stated).
6. **Unskilled.**
7. **All others gainfully occupied and unknown.**

In general, therefore, Social Classes 1 to 3 includes professional workers, farmers on larger landholdings, as well as other non-manual occupations. Social Classes 4 to 7 includes skilled, semi-skilled and unskilled manual labour, service employment sectors, and farmers on smaller landholdings. Social Class composition data from the 1996, 2002 and 2006 Census of Population has been summarised for the subject areas in Table 6.8 below.

Table 6.8 Social Class Composition 1996, 2002 & 2006 (%)

Social Class	1	2	3	4	5	6	7	1 to 3	4 to 7
State 1996	5	21	19	20	13	9	13	45	55
State 2002	6	26	16	17	11	6	18	48	52
State 2006	7	26	17	17	11	4	18	50	50
Mayo County 1996	3	17	16	22	17	10	15	36	64
Mayo County 2002	4	22	16	20	13	7	18	42	58
Mayo County 2006	5	25	16	20	13	5	16	46	54
Study Area 1996	1	7	5	15	39	15	18	12	88
Study Area 2002	1	12	8	14	23	17	25	21	79
Study Area 2006	1	15	13	20	22	10	19	29	71

**Source: Census of Population 1996, 2002 & 2006 (Central Statistics Office).*

The proportion of the population of the State in Social Classes 1 to 3 increased from 45% in 1996 to 50% in 2006. An increasing trend is also evident for County Mayo where the proportion of the population in these Classes has increased from 36% in 1996 to 46% in 2006. The proportion of the population in Social Classes 1 to 3 in the Study Area more than doubled between 1996-2006, increasing from 12% in 1996 to 29% in 2006. However, the proportion of the population of the Study Area in these classes was significantly lower than that comparative figure for the County and State.

An analysis of the CSO figures for Social Classes 4 to 6, approximating to skilled, semi-skilled and unskilled manual labour, shows that between 1996 and 2006, the proportion of the State's population in these classes decreased from 55% to 50%. The proportion of the population in County Mayo within Social Classes 4 to 6 fell from 64% in 1996 to 54% in 2006. However, 71% of the population of the Study Area were in these Classes 4 to 6 in 2006, a decrease from the corresponding figure in 2002 of 79%, which itself was a decrease from the 1996 figure of 88%.

The Cill Chomáin Development Plan 2006-2010 presents a similar statistical demographic profile to that set out above, in reference to 2002 Census data. It acknowledges that the area experiences severe disadvantage, and summarises the issues in Section 4.5 as follows:

"The parish is entirely rural with an economy dependent for the most part on primary sector activities such as small-scale farming and seasonal fishing. The settlement pattern is largely dispersed and confined mainly to coastal areas. Kilcommon is one of the areas of County Mayo worst affected by the persistent trend in emigration with a declining population and high unemployment. Neglect by successive governments over the years has meant the area is way behind other parts of the county and country in terms of socio-economic development. The parish's disadvantaged status is further recognised by its designation as a CLÁR[2] area".

Consistent with this, the Regional Planning Guidelines for the Western Region 2004 outlines that, in general, the economy of the west is rural in nature and has suffered from a high dependency level due to the large number of small farm holdings. The Guidelines identify an urgent need to promote and encourage farm diversification and also to examine alternative means of earning incomes. There is

[2] CLÁR is an investment programme for disadvantage rural areas, introduced in October 2001

therefore a need to revitalise the area by creating new and alternative employment opportunities. This position is also reflected in the current Draft Regional Planning Guidelines, 2010-2022.

The Regional Planning Guidelines also outline that there is a significant shift in employment activity towards large urban areas, with a resulting decrease in rural populations in the peripheral locations of the Region. This has obvious adverse knock-on effects for the development of a prosperous working community of more isolated rural areas, such as the Study Area.

6.3.9 The National Deprivation Index

The National Deprivation Index 2007[3] provides an index for national health and health services research based on 2006 Census data. The original Index, prepared in 1997, was based on the 1991 Census. In 2004, the Index was updated to reflect the then newly-released 2002 Census results. Of note, the Cill Chomáin Development Plan 2006 – 2010 also refers to the methodology and findings of a previous Index based on 1996 Census figures (Section 4.5).

The Index is capable of use as a measure of relative material deprivation. Deprivation is defined in the Index as a state of *"observable and demonstrable disadvantage relative to the local community to which an individual belongs"*. This Index makes the distinction between conditions (physical and social circumstances) rather than resources and income, which allows deprivation to be distinguished from poverty. Thus, people can experience deprivation without living in poverty, and vice versa.

The Index uses a 10-point decile, with 10 as 'most deprived' and 1 as 'most affluent' or 'least deprived'. The 2007 index is based on four variables derived from the Census, namely:

- Unemployment (primarily reflecting lack of access to earned income and the facilities of employment),

- Low Social Class (based on the concept of groups whose members possess capacities for the generation of income through their occupations, as opposed to status/prestige associated with particular occupations),

- No Car (suggested as a surrogate for current disposable income and potential access to resources); and

- Local Authority Rented Accommodation (non-owner occupation is suggested as a surrogate for income in the long term).

Of note, previous Indexes included a fifth variable - Overcrowding (reflecting living circumstances and housing conditions); this indicator has been dropped in the 2007 Index, in view of the comparative lack of variation in overcrowding across EDs nationally, as reported in recent censuses.

County Mayo is recorded in the 2007 Index as having eleven of the most deprived Electoral Divisions (ED's) in the country. Map 1 of the Index confirms that these EDs are located within the western and north-western portion of the county, including the Iorras (Erris) area - the local and wider vicinities of the Corrib Gas Field Development. In total, 10,733 persons in the County – or 9% of its population - are recorded as in EDs within decile 10, out of a County population (2006) of 123,738 persons.

The 2007 Index displays comparative results based on both the 2006 Census and previous 2002 Census, and finds that the pattern of deprivation is unchanged over this inter-Censal period across the Iorras (Erris) area – this is confirmed in Map 8 of the 2007 Index. Moreover, Map 3 of the previous 2004 National Deprivation Index confirms that there has been *"Little or no Change"* in deprivation level in this area between 1991 and 2002. These conclusions are consistent with the findings of the Cill

[3] 'The National Deprivation Index for Health and Health Services Research' Small Area Health Research unit (SAHRU), Department of Public Health & Primary Care, Trinity College Dublin, December 2007.

Chomáin Development Plan 2006-2010, which records the fact that, based on the 1996 Census of Population, the parish of Cill Chomáin (Kilcommon) has suffered severe disadvantage. This confirms a long-term and unchanging pattern of relative material deprivation within the local and wider vicinity of the Study Area.

It is important to note the caveat of the Index that the designation of material deprivation is based on Census figures at ED level, and cannot therefore indicate the relative deprivation of individuals or settlements. In addition, it is reiterated that the Index is not a proxy measure for poverty. However, it does present a broad picture of social and economic circumstances in an area, and suggests an ongoing, long-term, and unchanging pattern of extreme relative material deprivation in the Study Area.

6.3.10 Settlement Survey of the Subject Site and Vicinity

Section 6.1 has defined what is understood by *"Community"* in respect of the proposed pipeline development. The term is not entirely interchangeable with *"Locality"* or *"Settlement"*. It is thus also essential to understand the locational context of the proposed development. As detailed in Chapter 4, the proposed pipeline makes landfall at Gleann an Ghad (Glengad), in the vicinity of the settlements of Gleann an Ghad (Glengad) and Poll an tSómais (Pollatomish); it then traverses Sruwaddacon Bay in a south-easterly direction, before emerging to the surface on the southern side of the Bay, east of the settlement of Na hEachú (Aghoos), and runs from there to the existing gas terminal at Bellanaboy Bridge. This area is defined as the local vicinity of the proposed pipeline.

However, the remainder of the rural community environment of Cill Chomáin (Kilcommon) Parish – the wider vicinity of the proposed pipeline - must also be addressed in this assessment, as it equally forms part of, and experiences the same long-term demographic and structural deficiencies that occurs to the local vicinity of the Corrib Gas Field Development. The potential impact of the project will not be restricted to its local environs, but will have implications for the overall Iorras (Erris) area, and beyond.

In addition, as detailed below, it is reasonable to consider that the pipeline will ultimately have significant and positive implications for other settlements and communities at some remove from the wider environs of the development, for example the larger towns of County Mayo, which are intended to benefit from the provision of natural gas. However, for the purposes of this assessment, no further reference is made to these more distant settlements, and the communities thereof.

The findings of the driving survey are set out below. For consistency, the findings of the survey have been referenced to the Area Profile contained in the Cill Chomáin Development Plan 2006-2010.

THE LOCAL VICINITY OF THE PROPOSED ONSHORE GAS PIPELINE

Gleann an Ghad/Poll an tSómais (Glengad/Pollatomish)

The environs of these settlements benefits visually from their setting within a scenic landscape, formed by uplands on the southern side of the local road, and the expanse of Broadhaven Bay, including the mouth of Sruwaddacon Bay, on its northern side, and beyond to uplands on the northern side of these water bodies. The coast road (L1202) functions as a local tourism driving route; a Bed & Breakfast establishment fronts onto this road, in the vicinity of the mouth of Sruwaddacon Bay. The linear settlements contains public houses - one of which offers accommodation and includes a tea room -, two graveyards – one of recent construction - a holiday hostel, church, post office and primary school. Both scattered and more clustered dwellings occur, primarily along the local road, within an otherwise generally agricultural landscape.

Na hEachú (Aghoos)

A linear settlement of dwellings along a local road which runs generally parallel to the coast road between Poll an tSómais (Pollatomish) and Gleann Na Muaidhe (Glenamoy). Scattered dwellings occur within what is primarily a rural agricultural landscape. The settlement includes a church, a post box and scattered dwellings lining the coast road. East of this settlement, and along the shore road from Poll an tSómais (Pollatomish), is a forest and bogland landscape. Two industrial premises occur along the eastern end of the coast road.

Ros Dumhach (Rossport)

Located on the northern side of Sruwaddacon Bay, a cluster of dwellings occurs at the crossroads of the local roads to Ros Dumhach (Rossport) and to Port an Chlóidh (Portacloy); a similar cluster occurs where the local road to Ros Dumhach (Rossport) Village junctions with the local road that links to the Ros Dumhach (Rossport) coast road. The settlement has a clustered core, including a post office (with a small shop), a transport firm, a shop, a pub, a primary and secondary school, a GAA sports pitch and a pier at its western end. Dwellings primarily line the northern side of the coast road extending out of the village; a very limited number of dwellings occur on the southern side of the coast road, which primarily comprises improved agricultural land.

Local information notes that previously a ferry operated across Sruwaddacon Bay, linking Ros Dumhach (Rossport) to Poll an tSómais (Pollatomish). As a consequence, although the distance by road between these two settlements is relatively large, there are many close community, kinship and family ties that link these settlements.

Béal an Átha Buí (Bellanaboy)

A small cluster of dwellings located in the vicinity of the Gas Terminal site, in the general location of the junction of the R314 Gleann Na Muaidhe (Glenamoy) - Barr na Trá (Barnatra) road, with the local road to Na hEachú (Aghoos).

THE WIDER VICINITY OF THE PROPOSED ONSHORE GAS PIPELINE

Barr na Trá (Barnatra)

A linear settlement at the southwestern end of the Study Area, spread along the local road network at the intersection of the R314 (Gleann Na Muaidhe (Glenamoy)) and local (An tInbhear (Inver)), An Cheathrú Mhór (Carrowmore)) roads, containing a primary school, public house, funeral home, bring centre and petrol station with shop and post office. Scattered dwellings occur in this rural coastal landscape.

An tInbhear (Inver)

A linear settlement on both sides of the local road which extends northwestwards from Barr na Trá (Barnatra) to Poll an tSómais (Pollatomish). The settlement contains a church, community centre, primary school, public house, and scattered dwellings within the village environs, along the local access road network. The result is a relatively populated settlement landscape. Other parts of the settlement environs contain agricultural activity. A roadside sign north of the settlement refers to a knitwear premises, café and holiday cottages.

Gleann na Muaidhe (Glenamoy)

A ribbon of dwellings extends along the R314 to the southwest of the settlement, and across the rural bogland and agricultural landscape. More clustered dwellings occur in closer proximity to the settlement. The linear settlement contains a public house, post office with shop and petrol station, a building and garden supplies premises, primary school, church, community hall, GAA club, Garda station, health centre, and a coach depot. New dwellings are being, or have recently been constructed in the village, while clusters of residences occur along the R314 between Gleann Na Muaidhe (Glenamoy) and Barr na Trá (Barnatra).

An Corrán Buí (Curraunboy)

A small cluster settlement, containing dwellings, a church and community hall, public house, a café, petrol pumps and the operating terminus of a community bus, within an otherwise sparse agricultural landscape.

Port an Chlóidh (Portacloy)

Port an Chlóidh (Portacloy) comprises a cluster of dwellings, set around the sheltered inlet. A B&B is located in this settlement. A graveyard is located on the eastern side of the R314, south of Port an Chlóidh (Portacloy).

Ceathrú Thaidhg (Carrowteigh)

The largest settlement of the north Iorras (Erris) area, of a generally clustered format, containing dwellings, local shop, post office, schools, church, a pub (Stonefield) and a community hall. There are scattered clusters of dwellings on the local road to Port an Chlóidh (Portacloy) and Ceathrú Thaidhg (Carrowteigh) from the R314. The local road extends westwards from the settlement to the townland of Cill Ghallagáin (Kilgalligan), beyond which to the south is Bioshell Teo, pharmaceutical manufacturers and Rinroe Pier, used as a port for inshore fishing.

Port Durlainne (Porturlin)

A small coastal settlement with a cluster of houses set around a pier, and dwellings extending westwards towards the R314. There is significant evidence (e.g. lobster cages and nets) of the active use of the port and pier for inshore fishing. A fish processing facility is located adjacent to the pier.

Beannchar (Bangor Erris)

Though actually located outside the defined Study Area, this settlement occupies an important crossroads setting between the R314 and the Study Area to the north, the R313 regional road to Béal an Mhuirthead (Belmullet) to the west, and the N59 which links to Ballina and Castlebar to the east, and Mulranny, Oileán Acla (Achill Island), and Westport to the south. The relatively compact settlement includes grocery shops, pubs, cafés, post office, a petrol station and garage and other commercial outlets, including barbers, butchers, hardware, B&B, bookmakers, tool hire and clustered residential development. The town contains a sub office of the Western Health Board. To the west of the settlement is the large Bord na Móna peat deposition site at An Srath Mór (Srahmore).

Béal an Mhuirthead (Belmullet)

The primary settlement of the Iorras (Erris) area, with a current population of some 2,000 persons. The town contains higher order retail, community, educational, medical and other facilities. This includes a community hospital (though with no casualty service), four supermarkets, banks and Credit Union, other retail outlets (clothes, shoes, hardware etc.), medical related facilities (dentist, doctor, pharmacies), educational facilities (primary and secondary schools), professional services (estate agent, accountancy office, opticians), church, garage, dry cleaners, Garda station, public houses, restaurants, a number of B&Bs and two hotels (one including a leisure centre with swimming pool). The area includes a popular golf course, which brings golf tourism to this area. It also contains a library, Court House and sub-offices of government and semi-state agencies. The settlement functions as the main service centre for the area – the nearest major centres being Ballina and Castlebar. There is a public bus service to Ballina and Castlebar from Béal an Mhuirthead (Belmullet).

6.3.11 Language

The rich linguistic heritage of the area is an important community identity, with the receiving environment of the pipeline designated as part of a Gaeltacht Area. The 2006 Census indicates that within the Study Area, a much higher percentage of people have responded that they speak Irish on a daily (18%) and weekly (16%) basis outside the education system than in the State as a whole (3% and 6%), and in County Mayo (4% and 7%).

The '*Comprehensive Linguistic Study of the use of Irish in the Gaeltacht'* (2007)[4] identifies three broad categories of Gaeltacht districts; Category A districts refer to electoral divisions where more than 67% of the total population (3 years+) are daily speakers of Irish; Category B districts refer to electoral divisions where between 44%–66% of the total population (3 years+) are daily speakers of Irish; Category C districts refer to electoral divisions where less than 44% of the total population (3 years+) are daily speakers of Irish. The majority of the Study Area is categorised as a Category C Gaeltacht district, with only Cnoc an Daimh classified as a Category A Gaeltacht district. The Study further records that the '*school-going age cohorts report the highest level of usage of Irish in these districts, indicating weak communal use of the language'*. Importantly, the Study states that within Category C Gaeltacht districts '*there are small Irish-speaking enclaves which do not readily conform with the sociolinguistic traits common to the rest of Category C*'. Therefore the suggested sociolinguistic profile of the Study Area as indicated in the Study is that Irish is used in varying degrees in social networks and in community and educational institutions.

In this context, it is a notable element of the Mission Statement of the Cill Chomáin Development Plan 2006-2010 *"to (a) preserve and promote the Irish language and culture"*. However, the Plan also acknowledges that *"Irish as a spoken language is coming under increasing pressure however and a concerted effort must be made by the community and the relevant state agencies to ensure its continued survival"*.

Plates 6.2 and 6.3: Road signage indicating the Gaeltacht region.

6.3.12 The Visiting Community

County Mayo as a whole is rich in cultural resources, both natural and man-made, including language, history, literature, archaeology and vernacular building traditions. Visitors are attracted to the region for its considered tranquillity, relatively unspoilt landscape, walking trails, scenic coastline and angling resources, and traditional community structure including language schools, festivals and music resources. Tourism has increasingly become an engine for growth in the County. In parallel, the expansion and marketing of tourism resources in the County has been facilitated by improvements in access infrastructure to, from and within the area and wider region, particularly by road and air.

[4] Comprehensive Linguistic Study of the use of Irish in the Gaeltacht', NUI Galway (2007). This report was prepared for the Department of Community, Rural and Gaeltacht Affairs

There is still considerable potential to develop the tourism resource of County Mayo further, particularly in the more remote and sparsely populated areas. The County Development Plan[5] states that the "*promotion and development of tourism in the County must be underpinned by protection of the natural environment, including appropriate and sensitive development, the provision of infrastructure developments in general and tourist related infrastructure and facilities in particular"* (pg. 21). In this context the Cill Chomáin Development Plan 2006-2010 states that *"There is wide scope for the development of cultural tourism given the area's rich heritage – walking, angling, bird watching, whale and dolphin watching, diving – the Céide Fields Interpretative centre has the potential to serve as a gateway to the parish, road signage within the parish has been greatly improved, tourist information panels have been designed, community-based festivals, sculpture trail project"*.

Within the Study Area, tourist attractions are primarily focused on daytime attractions generally derived from the local landscape, topography and natural resources. Such attractions include golfing, fishing and angling, horse riding, hill walking, and other specific and scenic tourism resources including the North West Sculpture Trail (Tír Sáile) and the scenic coastline and local beaches. Key elements of the Action Plan of the Cill Chomáin Development Plan concern developing and marketing of these primarily outdoor seasonal daytime activities. It may be the case that any enhancement of this local daytime activity tourism product will continue to be served by existing accommodation in the larger settlements of the wider vicinity of the Study Area, notwithstanding the recorded Action of the Development Plan to aim to increase the provision of registered accommodation in the area.

A number of festivals are held annually in the local and wider Study Area. Iorras (Erris) hosts the biggest Arts festival in Mayo - Féile Iorrais - which is a festival that celebrates the folk traditions of Ireland and the world. A special emphasis is placed on the performing arts, i.e. music, song and dance, through the medium of Irish. Again, it is a fact that most night-time tourism activities tend to occur within the larger settlements of the wider vicinity of the Study Area, and in particular Béal an Mhuirthead (Belmullet) (refer in this regard to www.feileiorras.org). In this regard, Béal an Mhuirthead (Belmullet), outside the Study Area, is the nearest location of any significant quantum of visitor accommodation and night-time based tourism facilities.

6.3.13 Community Infrastructure

It is a fact that the Study Area is very peripheral, even within County Mayo, and this presents significant development problems. For example, there is no frequent public transport provision serving the Study Area, or linking the Study Area to the rest of the county or country. This peripherality and remoteness is compounded by the relatively poor regional and local road infrastructure serving the area. The Cill Chomáin Development Plan notes that the poor condition of these roads is due to the fact that they were never intended for the volume and type of traffic now using them. It concludes that "*the physical infrastructure remains sub-standard and the road network is still very much in need of substantial investment".* Traffic issues are addressed in Chapter 7 and Appendices E and F in the EIS; however, it is essential to appreciate that the existing deficiency in road and public transportation infrastructure in the local and wider vicinity of the site, continues to have significant and negative consequences for the wider community of the Iorras (Erris) area.

The Development Plan also notes other significant deficiencies in community, social and economic infrastructure in the Study Area: the main fishing piers at Rinroe, and Port Durlainne (Porturlin) are in need of major improvement; there is no indoor sports facility in the area; there is significant deficiency in the provision of broadband, which acts as a major constraint to new employment in the area. In response, stated Actions of the Development Plan include lobbying relevant bodies to improve roads within the parish; improvement of bog roads, including in the vicinity of Rossport; lobbying relevant bodies to improve the pier at Rinroe, to upgrade the pier at Port Durlainne (Porturlin), including provision of a marina, and upgrading of the slipway at Ros Dumhach (Rossport); lobbying the relevant

[5] Mayo County Development Plan 2008-2014, Mayo County Council, 2008

agencies to provide broadband to the area; examining the feasibility of developing a multi-purpose cultural centre; aiming to develop community playgrounds for children at Ceathrú Thaidhg (Carrowteigh), Gleann Na Muaidhe (Glenamoy) and An tInbhear (Inver)/Poll an tSómais (Pollatomish); and investigating the feasibility of developing a multi-purpose indoor sports hall in the area.

6.4 POTENTIAL IMPACTS

For clarity, the potential Community and Socio-Economic Impacts of the proposed development are described separately in terms of demography, employment and community.

6.4.1 Construction Phase

6.4.1.1 Demography

In terms of demography, the construction phase of the proposed development is not expected to have any impact in terms of population change of the Study Area. It is expected that the portion of the workforce not from the immediate area will travel from existing places of residence to the construction site rather than move to the immediate environs of the site during the construction period.

6.4.1.2 Employment

In terms of employment, the construction phase of the proposed onshore pipeline development will take approximately two years on site. Approximately 120 - 140 no. persons will be employed on site at peak construction of the onshore pipeline element of the Corrib development. This primarily construction-related employment will be available to suitably qualified members of the local workforce. Overall, at the peak of construction activity on the overall Corrib Field development project, in summer 2009, when the offshore pipeline was being laid and activity on the construction of the terminal was at its height, some 1,500 people were employed on the project. Because of phasing of work, the peak work force in the Gas Terminal has now declined and will be reduced further before the pipeline workforce mobilises.

The project will also indirectly benefit or consolidate employment in local support industries including building suppliers, caterers, general retail, and accommodation. The potential impact during construction is therefore considered to be significant and positive in terms of employment, particularly having regard to the current recorded structural weakness of employment opportunities in this area.

6.4.1.2.1 Accommodation for Construction Workforce

SEPIL maintains a confidential database of accommodation details of its workforce. In 2009, of the workforce associated with Terminal and landfall construction aspects of the Corrib Gas project, approximately 30% were permanent residents within the local vicinity; another 30% were permanent residents within the wider County Mayo area, who still typically commute daily between their place of residence and place of employment; and 40% of the workforce permanently resided outside the County Mayo area, and resided in temporary rental or serviced accommodation during the course of the working week, generally returning to their permanent residences at weekends.

As recorded in the workforce database, these latter workers resided temporarily in either rented dwellings, or in serviced accommodation such as B&B’s, guesthouses, or hotels. The rented dwellings are virtually entirely located within and in the immediate vicinity of the larger settlements of the wider area, in particular Beál an Mhuirthead (Belmullet) and Bangor, where workers are close to community and amenity facilities such as shops, public houses and restaurants. The extent of serviced accommodation is limited within the immediate vicinity of the pipeline route. Having regard to this experience, the primary locations anticipated to be used by workers for B&Bs, hotels and other such accommodation will also comprise the larger settlements of the area, in particular Beál an Mhuirthead (Belmullet), Bangor and their environs.

6.4.1.3 Community

In terms of other community impacts, a development of the overall nature and scale proposed in this location would have the following temporary local impacts on the local resident, visiting and working community, during construction:

- Increased vehicular traffic (this is addressed in detail in Chapter 7);
- Increased noise (see also Chapter 9), dirt and dust generation (see also Chapter 8);
- Increased severance across existing landholdings (see Chapter 11);
- Visual impact of the works (this is addressed in detail in Chapter 10); and
- Increased disturbance, including temporary restricted local access.

The residential population with greatest potential for such impact is situated in the local vicinity of the Study Area including in particular Na hEachú (Aghoos), Gleann an Ghad (Glengad), Poll an tSómais (Pollatomish), Na hEachú (Aghoos) and Bellanaboy Bridge. While inconveniences and nuisance may be caused to these and other existing communities in the area due to construction, particularly in terms of noise and dust, traffic movements with necessary road diversions etc., as well as by the inevitable visibility of construction works, these impacts are such as could be expected with any significant construction project, and will be short-term and temporary. In this regard such nuisance impacts may be locally significant for the temporary period of construction if not adequately mitigated. The construction methodology, including a construction management strategy, is set out at Chapter 5.

There may be some minor severance of lands, as for health and safety reasons the area of the proposed development, including ancillary development and associated working areas and site compounds, are fenced off. However, such severance, if it occurs, will be restricted to the tunnelling compounds at Gleann an Ghad (Glengad) and Na hEachú (Aghoos), and within the forested lands between Na hEachú (Aghoos) and the terminal site at Bellanaboy Bridge.

In terms of potential impact on the visiting community during the construction stage of the proposed development, it is considered that the major existing and planned visitor attractions are sufficiently removed from the route of the pipeline such as to remain largely unaffected by its construction. It will undoubtedly be possible for visitors to the area who drive or walk within the vicinity of the above ground development at Gleann an Ghad (Glengad) and Na hEachú (Aghoos) to observe local construction activity within this coastal landscape during the construction period, and this may have a local adverse visual impact – such impact is addressed in Chapter 10. That is not to say that such observation of construction activity in itself necessarily causes an adverse impact on the visiting community, but rather may be a focus of local and visitor curiosity.

Overall in this regard, it is considered that the development will have a slight to moderate and short-term localised negative impact upon the residential and visiting communities of the local and wider vicinity of the proposed route during the construction phase, but a significant though short-term potential positive impact upon the working community. Any potential impact of the development, whether positive or negative, during construction will by its very nature be short-term and temporary.

6.4.1.3.1 Local Amenity

There are no active recreational (for example bathing) beaches within Sruwaddacon Bay in the area of the proposed onshore pipeline works. Walking at low tide may require being temporarily restricted during the tunnelling operation in the Bay but only in a scenario where surface intervention is required, which is unlikely and will only occur as an emergency measure. Similarly, leisure, fishing and shellfish foraging are unlikely to be restricted by the proposed works.

There are no exclusion zones defined for the proposed development. There will be, however, areas of privately owned lands at Gleann an Ghad (Glengad) and Na hEachú (Aghoos) where public access will be restricted during the construction period in the interests of public health and safety. These will be minor and temporary in nature.

As it is proposed to tunnel underneath Sruwaddacon Bay, it is anticipated that there will be no impact to shellfish foraging. In the unlikely event of an intervention pit being required, areas of shellfish foraging will be avoided if possible. If it is necessary to use an area of shellfish foraging, the potential impact in terms of community and socio-economics will be short-term, temporary and localised.

It is not envisaged that the construction of the proposed onshore gas pipeline, or indeed the overall Corrib Gas Field Development, will have any negative impact upon the extent of use of the Irish language within this Gaeltacht area. Due to the development of an Irish Language Policy for the operational phase of the project, however, there is potential for a positive impact on the language – its spoken and written usage – to take place in the next 15 to 20 years.

6.4.2 Operational Phase

6.4.2.1 Demography

No residential accommodation is proposed as part of the onshore pipeline development, or indeed the wider Corrib Gas Field Development. An existing uninhabited house, in the ownership of the Applicant, on the L1202 coast road in the townland of Na hEachú (Aghoos) will require to remain unoccupied for the duration of the operation of the Corrib Gas Field development. No alteration in population numbers in the local area is therefore envisaged to occur. However, it is anticipated that a significant proportion of the permanent workforce of the Terminal will continue to reside in the local and wider vicinities of the Study Area, and will thus serve to consolidate population levels in this area. This would result in a slight positive impact on demography in this area.

6.4.2.2 Employment

In terms of employment, the operation and management of the ongoing Corrib Gas Field Development, over its envisaged lifetime, will establish a new permanent employment base in the Study Area (Bellanaboy Bridge Gas Terminal). As set out in more detail in Section 6.6.2, it has been estimated by Goodbody Economic Consultants[6] that, during the operational phase, some 55 people will be employed directly and 76 people indirectly on the overall project, in a variety of skilled, semi-skilled and unskilled activities. Thus, the project has the potential to remain as a significant and long-term employer in this area. This is a significant and positive impact of the proposed development, particularly having regard to the socio-economic profile of the Study Area recorded above, based on Census statistics.

The positive impact of the overall Corrib Gas Field development in terms of employment is also confirmed by reference to the Area Profile of the Cill Chomáin Development Plan 2006-2010, which identifies a structural weakness of the area as the *“Limited number of quality employment opportunities to match educational attainment”*, and the current *“Overdependence on primary sector activity and fear to develop new ideas”*. The development will continue to offer an employment alternative to the declining importance of primary sector activities in this area, recorded both in official Census employment data, and in more qualitative terms in the 2006 Cill Chomáin Development Plan. Thus, the proposed development is consistent with the stated Opportunity in the 2006 Plan to *“Examine the feasibility of developing new initiatives as an alternative to traditional farming, fishing and industry*”. Equally, it will assist in combating the stated threat of *“Educated young people migrating to large urban centres in search of appropriate employment opportunities”*.

[6] *Economic Assessment of the Gas Project*, Goodbody Economic Consultants, November 2007.

6.4.2.3 Community

The proposed onshore pipeline development, as part of the overall Corrib Gas Field Development, is likely to have the following impacts during its operation:

- Create new jobs and demand for local services, benefiting the working community of the area;

- Positive impact, in terms of the provision of a new energy source to the wider residential and working communities of County Mayo, the West Region and the State as a whole;

- Associated short-, medium- and longer-term community gain, by means of a structured community investment programme; and

- Limited but unavoidable sterilisation of lands along the permanent wayleave of the pipeline. This is addressed in Chapter 11 in respect of land use and development potential.

As detailed above, the overall Corrib Gas Field Development will remain as a significant employer and income generator for the local area, and the wider region. This has the potential to benefit the local and wider communities of the Study Area, which is a significant and positive impact.

The gas pipeline will be buried, including in a tunnel under Sruwaddacon Bay, and will, therefore, have no visual impact during the operational phase of the development on the landscape or surrounding environs. The proposed landfall valve installation at Gleann an Ghad (Glengad) will be designed and located so as effectively not to be visible within the wider coastal landscape (see Chapter 10). As such, it will not intrude upon the surrounding landscape, and thus the level of impact for the local residential and visiting community following construction of the pipeline project is anticipated to be negligible.

There has been an associated positive impact for local traffic movements, resulting from the upgrading works undertaken on the L1202 and other local and regional roads, associated with the construction of other elements of the overall Corrib Gas Field development (see Chapters 4 and 7).

The operation of the proposed development, and the overall Corrib Gas Field Development, will have a potentially positive impact upon the use of the Irish language in this Gaeltacht area. As an Irish Language Policy is being developed by SEPIL for use on the terminal at Béal an Átha Buí (Bellanaboy) during the operation of the Corrib development, there will be potential for increased use of the language, verbally and through the use of written materials and signage on the terminal, both in the workplace and by staff. SEPIL will actively seek to promote active or passive use of the Irish language both within the workplace and elsewhere throughout the area.

It is acknowledged that the overall Corrib Gas Field Development has impacted upon the local and wider residential and working communities of the local and wider vicinities in terms of creating a conflict between individuals in favour of the development and those not in favour of the development. During both the construction and operational phase of the development, these communities may have ongoing queries and/or concerns relating to the project or aspects thereof. The failure to address such queries and concerns on an ongoing basis could lead to an unnecessary and avoidable adverse impact. It is notable in this regard that a number of recommendations of the Cassells Report relate to community issues, specifically recommending greater local and public consultation on the project and greater local involvement in ongoing monitoring of the project, with a pro-active and transparent system for dealing with local concerns.

The Cassells Report also recommended the associated provision of appropriate local economic benefits, including local development investment and compensation. The assurance of a significant long-term investment programme for the area, prepared and delivered in partnership with the local residential and working communities, can potentially ensure the realisation of the elements of the Action Plan of the Cill Chomáin Development Plan 2006-2010.

6.4.3 "Do-Nothing" Scenario

Under this scenario, there would be no alteration to the resident and visiting communities in the vicinity of the Study Area.

Specifically in reference to the proposed onshore pipeline development, no significant or likely adverse impact with regard to employment will arise. However, in the absence of this specific development, it is unlikely that continuing significant employment in construction of the Gas Terminal, and subsequently in its ongoing operation, would occur. As a consequence, there would be no increase in employment in the Study Area, nor indeed the economic reward arising from such employment. There will also be no benefit for support employment, such as building supplies and other retail activities. Finally, the social benefits arising from such employment, in terms of work experience, both in the construction and operational phases, will not occur.

Overall, and notwithstanding the provisions of the Action Plan in the Cill Chomáin Development Plan 2006-2010, it is likely that established long-term and widespread structural patterns of employment and unemployment will remain in this area. In this context, and in the absence of any other significant employer and income generator in the area, it is considered likely that the community of the Iorras (Erris) area will continue to experience the highest levels of material deprivation, as recorded in the National Deprivation Index 2007.

6.5 MITIGATION MEASURES

6.5.1 Construction Phase

The proposed development will not result in any significant adverse potential impact on population and demography during the course of construction. Neither is such construction envisaged to have any adverse impact upon matters of local cultural identity and continuing usage of the Irish language in this Gaeltacht area. As such, no remedial or reductive measures are required.

Directly, the proposed development, and the overall Corrib Gas Field Development, will result in the creation of a number of jobs in the construction engineering and support sectors; these jobs will be available for appropriate persons within the local area. It is considered that the skills and experience obtained during construction of the project will benefit workers as they subsequently seek or undertake other work, following completion of construction on the project. Indirectly, it will also benefit associated sectors and local businesses such as building supply and materials. This is considered a positive impact of the proposed development. No remedial or reductive measures are therefore required.

The principal remedial measures required to minimise the potential impacts of disturbance on the local resident, working and visiting communities during the construction phase relate to the application of appropriate methods of construction and appropriate hours of operation. With respect to the possible adverse impacts associated with dirt and dust generation arising from the construction works generally, a number of measures are proposed as outlined in Chapter 8. These will be contained in an overall and detailed Environmental Management Plan (EMP) for the construction phase (See Chapter 5 and Chapter 11). This EMP will also include appropriate and adequate road signage, and a structured system for public information, communication, consultation and feedback (as outlined in Chapter 2).

In this latter regard, the continuing availability of SEPIL's CLO team in the community, listening and responding to queries that individuals or groups may have, will facilitate the ongoing communication of issues with the technical team, which will allow for work practices to be altered if necessary.

6.5.2 Operational Phase

No adverse impacts relating directly to community and socio-economic issues are predicted during the operation of the overall Corrib Gas Field Development, of which the proposed pipeline forms an intrinsic element. Therefore no remedial or reductive measures are considered necessary.

There will be a structured compensation strategy, to compensate for loss of land and property, either temporarily or permanently, and for other impact as agreed to be appropriate (see Chapter 11). The details of the compensation strategy do not form a part of this assessment.

The dissemination of adequate accurate information, combined with ongoing community consultation, is crucial during both the construction and operational phases of the development, and will assist in minimising current potential conflict and/or misunderstanding of the overall scope and extent of the Corrib Gas Field Development over the long-term. The importance and significance of addressing public concerns or queries that may arise in respect of the proposed development and indeed, the overall Corrib Gas Field Development cannot be overestimated. Such potential adverse impact in this regard will be mitigated via ongoing pro-active and transparent community consultation.

6.5.3 The Community Social Investment Programme

The Corrib Gas Partners have established a short-, medium- and longer-term Community Social Investment Programme for the entire Cill Chomáin (Kilcommon) Parish, and the wider Iorras (Erris) area – the local and wider vicinity of the project. Until 2009, the Programme was made up of a Local Grants Programme and a Third-Level Scholarship Programme, open to students attending the four local secondary schools – Coláiste Chomáin, Ros Dumhach (Rossport); Our Lady's Secondary School, Béal an Mhuirthead (Belmullet); St Brendan's College, Béal an Mhuirthead (Belmullet), and St Patrick's College, Lacken Cross. In January 2009 SEPIL launched the long-term Corrib Natural Gas Erris Development Fund, with a front-loaded fund of €5m for the first three years. These three strands – the Local Grants Programme Third-Level Scholarship Programme and Erris Development Fund - now comprise SEPIL's Community Investment Programme. While the Programme is open to all community, voluntary and sporting organisations within the Erris area, projects brought forward by groups within the parish of Cill Chomáin are prioritised in the case of the Local Grants Programme and Erris Development Fund These strands are addressed in more detail below.

Corrib Natural Gas Erris Development Fund

A key recommendation of the Cassells' Report (2006) was that the Corrib Gas Partners set up a long-term development fund for Iorras (Erris). Specifically, it stated that the fund '*should be significant, should be front-loaded and should continue for the duration of this project'* and that it *'should seek to contribute to the long-term economic, social and environmental development of Rossport, Kilcommon Parish and the Erris area generally'.* In December 2007 an Advisory Board comprising representatives of local development agencies (Mayo County Council, Údarás na Gaeltachta, Leader, Mayo County Enterprise Board and the Council for the West) was appointed to help establish this Fund. The Corrib Gas Erris Development Fund was launched in January 2009, with two initial investments of €200,000 each to the Belmullet GAA Club and the RNLI.

The objectives of the fund, which will operate throughout the life of the overall Corrib project, are to contribute to the long-term economic, social and environmental development of the Iorras (Erris)area and to contribute to capacity building in the area by providing both financial and non-financial assistance which will benefit the local community. Phase 1 of the fund (2009 – 2012) has a budget of approximately €5 million. The fund provides funding to projects in the following categories:

i. Enterprise & Knowledge (including education)

ii. Marine & Environment (including tourism)

iii. Sports & Culture

In advance of the commencement of this long-term fund, a number of one-off financial grants were made in the Study Area and its environs. These included a grant of €150,000 to Béal an Mhuirthead (Belmullet) GAA Club towards the redevelopment of its clubhouse and playing field facilities, and a grant of €130,000 to the Glenamoy Community Angling Association to redevelop the fisheries at Gleann Na Muaidhe (Glenamoy). Since the establishment of the fund, over 50 applications have been received and over €2.2m has been allocated to 14 different projects within the Iorras (Erris) community.

The Local Grants Programme

An additional Local Grants Programme has been operating since 2006 - on an ad hoc basis up to 2008. In that year, the Programme was reviewed, clear criteria were applied, and a number of community information events were held to increase awareness of the revised programme. Increased engagement took place within the community and as a result the number of applications significantly increased, including participation from Cill Chomáin (Kilcommon). This Programme, supported by the contractors developing the Bellanaboy Bridge Gas Terminal, invites applications from local groups and organisations seeking funding – up to a maximum of €10,000 – for specific projects. All applications for funding under this Programme are assessed against three criteria:

- **Sustainability** – a sustainable project is one that continues to benefit a community. In practice, this means that the project must be financially viable and solvent. Short-term projects must have sufficient funds or firm commitments for funding in order to complete the project/event within a realistic timeframe.

- **Local** – all applications should be local to, and be of benefit to, the Iorras (Erris) area. However priority is given to applications from communities that are in close proximity to the project site, ie Cill Chomáin (Kilcommon).

- **Inclusive** – projects should demonstrate benefits to a general community, and not just to a few individuals. Priority will be given to initiatives which brings groups and individuals together in delivering their project or event, and which can demonstrate effective strategies to attract participation from all sections of the community.

In 2008, a total of 127 no. community groups applied for funding under this Programme and 83 no. groups were subsequently awarded grants of between €1,000 and €10,000. In 2009, 124 applications were received, 94 organisations were recommended for funding, with a total allocation of €350,000. Of these funded organisations, 14 were from Cill Chomáin (Kilcommon).

The Scholarship Programme

In 2007, the Corrib Gas Partners launched a scholarship programme for students from the four participating secondary schools in the Iorras (Erris) area (detailed above) to facilitate their going on to third level studies. The programme offers ten scholarships, each worth €4,000 per annum, to students studying engineering, natural or physical sciences, mathematics, business, finance, IT or operational health and safety. An Independent Selection Board was appointed to assess all applications and to award the scholarships; the Board is made up of local people including the former editor of a local newspaper, a parish priest, and a former school principal. All board members have local experience of involvement in education, either through teaching or involvement on school boards of management.

This programme ran successfully from 2007 to 2009, with a review thereafter. Some €450,000 was invested by SEPIL and its partners in the project. In 2009, a review of the programme was undertaken by the selection board and a recommendation was made that the programme be continued for a further three years, due to its widely accepted success as a sustainable investment programme. It was further proposed that the programme be open to students pursuing courses in any discipline, as distinct from the previously more limited range of applicable disciplines. SEPIL accepted these recommendations and, in January 2010, a public commitment was made to continue the programme for a further three years, with the new qualifying criteria in place.

6.6 RESIDUAL IMPACT

6.6.1 Construction Phase

The proposed development is not predicted to have any likely and significant impact on the population and demographic profile of the area during the construction phase. There may be some increased demand for local residential accommodation services arising from the workforce involved in the construction of the development; however this will be short-term and will not alter the established population profile of the area.

Approximately 120 - 140 no. persons will be employed on site at peak times during the construction of the onshore pipeline element of the Corrib development. The construction phase is likely to benefit suitably qualified members of the local community. The construction of the overall Corrib development will also support employment in associated sectors such as building supply and materials, as well as local businesses. It will also provide valuable experience for construction workers to utilise on other construction projects. This is considered to comprise a significant and positive impact.

It is predicted that there will be a slight and temporary adverse impact on the residential communities in the local vicinity of the subject site arising from general disturbance and inconvenience during construction works. However, the implementation of appropriate mitigation measures and adherence to a construction programme and associated management of works procedures, including the provision of adequate public information, and ongoing community liaison, will ensure that this inconvenience is minimised.

The Social Investment Programme will function as a planned and targeted programme of community gain, directed specifically at the needs of the local residential community; this is a significant and positive community impact of the proposed development. Overall, however, this source of short, medium, and long-term community gain will provide a significant and positive impact for the local and wider vicinity of the proposed Corrib Gas Field Development.

6.6.2 Operational Phase

The proposed development is not predicted to have any likely and significant impacts on population and demography of the area during the operational phase. It is more likely the case that the ongoing operation of the overall Corrib Gas Field Development, of which the proposed onshore pipeline comprises one crucial element, will assist in consolidating population levels within the Study Area, particularly in the context of recorded declining population levels in this area.

The overall Corrib Gas Field Development will directly employ approximately 55 no. people during its operation at the Bellanaboy Bridge Gas Terminal, in a variety of occupations, both skilled and unskilled. Based on the classification of people by principal occupation and social class profile above, much of the population in the local vicinity of the subject site are likely to be qualified to benefit from the type of new employment which will be created. This is a significant positive impact for the local and wider community. In addition, it is estimated that additional employment for approximately 76 no. people will be created, or existing employment consolidated, in support services including construction providers, catering, transport and logistics, and retailing.

Of note in this latter regard, whilst the Corrib Gas Field Development will remain an important employer in its receiving environment, with resulting economic benefit for the area, this in no way conflicts with other provisions for Enterprise and Employment contained in the Action Plan of the Cill Chomáin Development Plan 2006-2010. In particular, Action No. 1 seeks to examine the feasibility of developing new employment initiatives as an alternative to traditional farming, fishing, and industry. Whilst the Corrib Gas Field Development is not explicitly stated in this regard, it is clear that it will comprise an important local employment source which will assume much of the local impact arising from the envisaged continuing local decline in primary sector employment activities.

The conclusions of this assessment are supported by the findings of the Economic Assessment of the Corrib Gas Project (2007) carried out by Goodbody Economic Consultants[7] on behalf of the Corrib Gas Partners. Notwithstanding the fact that the local and wider vicinity of the proposed route comprises an area identified for decades as having the highest levels of material deprivation in the country, the Economic Assessment concludes that the construction and operation of the overall Corrib Gas Field Development will have significant benefits for both the local and national economy. The principal findings of the Economic Assessment are as follows:

- During the construction phase of the project, the local economy of County Mayo will directly benefit by approximately €181m by means of purchases from local suppliers and contractors, while the National economy will benefit by a contribution of €521m to Irish GDP.

- During construction an average of 815 no. jobs will be created in the Irish economy both by direct and indirect employment associated with construction of the overall project.

- The operation of the Corrib Natural Gas Field Development will support some 130 no. jobs. Approximately 55 no. people will be employed directly. A further 75 no. jobs will be created to supply the needs of the field and its workforce.

- The operation of the gas field will have a huge impact on GDP, by replacing imports of gas with Irish production. Without the Corrib field, Ireland will be importing 94% of its total energy needs by 2015. When Corrib is at peak production it could account for up to 17% of total energy needs, and imports of energy could drop to 76% of total needs.

- Over its lifetime, the Corrib Gas Field Development will contribute over €3bn to Ireland's GDP, supplying up to 60% of the country's natural gas needs at peak production. The gas field will have an operating life of 15-20 years.

- The Corrib Gas Field Development, as well as being a benefit for the residents of the region will make the West of Ireland a more attractive investment location. Successful completion of the project could lead to further investments in gas distribution and electricity generation in the region.

Overall, it is predicted that the proposed development will have a significant and positive impact on the local, regional and national economy. As well as being of benefit to the local communities of the Iorras (Erris) area, there arises the wider regional community impact of implementation of national policy promoting balanced regional development, facilitated by the provision of natural gas in County Mayo and the Western Region. This will act as a catalyst for economic development and investment.

The implementation of the Community Social Investment Programme developed in respect of the overall Corrib Gas Field Development represents a significant and positive community impact, and a significant community gain for an area identified as suffering the highest levels of material deprivation in County Mayo, and in the State as a whole. The Community Investment Programme will continue to operate for the operational phase of the development.

6.4.4 "Worst Case" Scenario

The failure of the proposed development to proceed to operation will not in itself lead directly to any profound or irreversible consequences in terms of population and employment change. However, and notwithstanding the provisions of the Action Plan in the Cill Chomáin Development Plan 2006-2010, it is reasonable to suggest that population and employment levels in the area will continue to decline, as

[7] Economic Assessment of the Corrib Gas Project, Goodbody Economic Consultants, November 2007.

declining traditional employment activities are not replaced with any significant and alternative employment source which can also offer indirect economic and employment benefits.

Furthermore, if the project is not completed, it is considered that it would be extremely difficult to attract other energy investors into natural gas exploration in Ireland. As such, such failure to proceed is considered in itself to comprise a worst-case scenario.

7 TRAFFIC

7.1 INTRODUCTION

This chapter considers the traffic impacts of the proposed Corrib Onshore Pipeline development on the local road network. It includes an assessment of the existing traffic conditions and the suitability of the road network for accommodating the relevant construction and operational vehicles. In addition, mitigation measures have been identified to alleviate any significant negative traffic impacts that may arise from the proposed development.

The characteristics of the Corrib Onshore Pipeline development are such that the dominant traffic impact will be during its construction stage. The operational stage will have minimal traffic movements associated with periodic maintenance checks. Therefore, the assessment focuses on the traffic impacts associated with the construction phase of the proposed development.

This chapter should be read in conjunction with the Traffic Management Plan (TMP) (see Appendix E) and layout plans for the proposed pipeline route (see Appendix A), project description (see Chapter 4) and the construction methodology section (see Chapter 5).

This assessment was prepared by RPS. Further details on the Traffic Impact Assessment TIA report are contained in Appendix F.

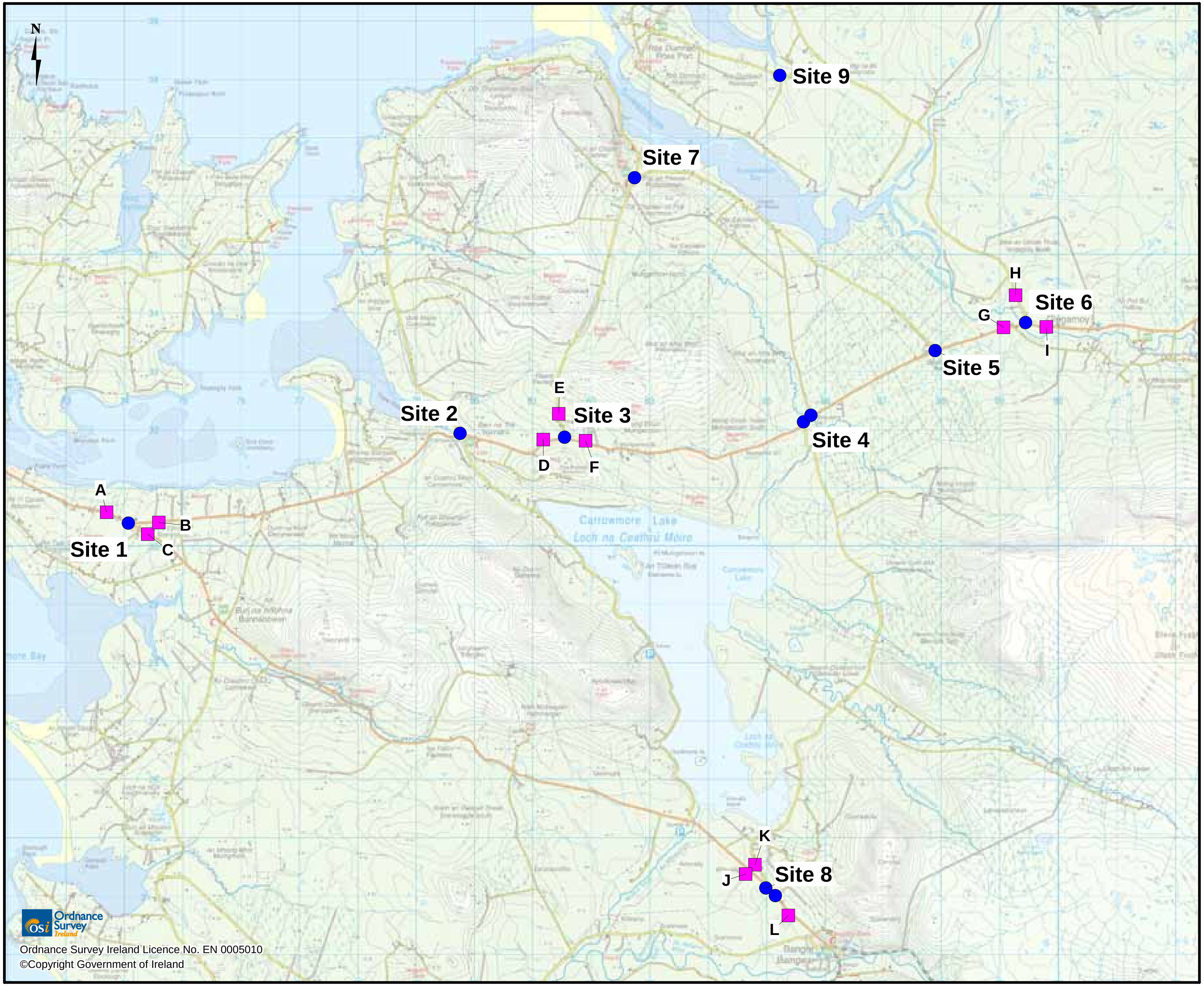
7.2 METHODOLOGY

7.2.1 Study Area

The proposed study area is shown in Figure 7.1. The proposed study area includes two regional roads, the R313 and the R314, and a number of local roads. Eight priority junctions, that surround the proposed pipeline route corridor, were included in the assessment of the study area.

A review and assessment of the existing road network and traffic conditions was undertaken to gain an appreciation of the current traffic patterns and trends within the study area. This included the following:

- Existing traffic conditions with the aid of traffic surveys, accident data etc;
- Road geometry assessing the adequacy of the road network;
- Junction capacity assessments determining possible queues and delays at individual junctions; and
- Link flow capacity assessment on roads within the study area, which would establish if the current road conditions can cater for the existing traffic volumes.



LEGEND:

- Link Surveys
- Junction Surveys

Traffic Survey Locations

Figure 7.1

File Ref: COR25MDR0470Mi2119A03
Date: May 2010

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7.2.2 Assessment Criteria

7.2.2.1 Construction Phase

Future traffic flows for all roads in the study network were forecasted using the NRA growth factors (NRA Future Traffic Forecasts 2002 – 2040, August 2003) in conjunction with recorded 2007 traffic flows. Each junction potentially impacted by the proposed development was assessed for junction capacity using the PICADY (Priority Intersection Capacity and Delay) computer modelling programme for predicting capacities, queues and delay at junctions. In addition, an assessment of the link flow capacity and the geometrics on each road impacted by the proposed development was undertaken to determine whether the road network has adequate capacity to cater for the traffic associated with the development.

7.2.3 Assessment Guidelines

This traffic impact assessment has been undertaken in accordance with the EPA document *Guidelines for Information to be contained in Environmental Impact Statements (2002),* the NRA document *Traffic and Transport Assessment Guidelines (2007)* and the Institute of Highways and Transportation document *Guidelines for Traffic Impact Assessment (1994).* Reference has also been made to a number of previous studies including the Bellanaboy Bridge Gas Terminal EIS, 2003 and the Corrib Offshore EIS 2001. Other guidelines and studies referred to in preparation of this traffic assessment are listed in the stand alone Traffic Impact Assessment Report contained in Appendix F.

7.2.4 Traffic Survey Details

In order to gain an appreciation of the existing traffic patterns in the area, the following traffic surveys, summarised in Table 7.1 were undertaken within the study area. The location of the surveys is shown in Figure 7.1.

Table 7.1 Location and Type of Junction Surveyed

Location	Survey Type	Site Reference Number from Figure TR0001 in Appendix F
R313/R314	12 Hour Manual Classified Turning Count and Three 7 Day Link Flow Surveys	1
Cross roads with the R314, the County Road to An tInbhear (Inver) and the L5284	12 Hour Manual Classified Turning Count	2
R314 with County Road to Poll an tSómais (Pollatomish)	12 Hour Manual Classified Turning Count and Three 7 Day Link Flow Surveys	3
Cross roads with the R314 and the L1204	12 Hour Manual Classified Turning Count	4
R314 with County Road L1202	12 Hour Manual Classified Turning Count	5
R314 with County Road towards Ros Dumhach (Rossport)	12 Hour Manual Classified Turning Count and Three 7 Day Link Flow Surveys	6
Poll an tSómais (Pollatomish)	12 Hour Manual Classified Turning Count	7
R313 with County Road L1204	12 Hour Manual Classified Turning Count and Three 7 Day Link Flow Surveys	8

Traffic surveys were carried out in August 2007 (Wednesday 8th to Tuesday 14th August 2007) and again in September 2007 (Monday 17th to Sunday 23rd September 2007). It is standard practice to undertake traffic surveys during the school term as this normally coincides with the highest traffic level. However given that the region of Bangor Iorras (Erris) is a tourist area, it was deemed appropriate to carry out surveys during the peak tourist season (August). The survey periods were selected to give traffic data during the busy tourist period during the summer months and the standard traffic levels during the school term. This will ensure that peak existing traffic volumes will be considered in this assessment.

The survey data was used to examine existing traffic patterns and characteristics and to provide a basis on which to predict future traffic volumes.

It should be noted that these traffic surveys were undertaken in the same locations as the traffic data collected in the Bellanaboy Bridge Gas Terminal EIS and the Corrib Offshore Pipeline EIS. The survey results showed a small increase in traffic on the local road network, which would be expected as the previous EIS data was collected in 2001 and 2002.

However, it should be noted that due to current and short term predicted economic conditions and other national and regional policy measures for reducing car usage levels, in general growth rates in background traffic flows have reduced from the peak levels of 2006/2007.

The Béal an Mhuirthead (Belmullet) Arts Festival took place from the 15th - 19th of August 2007. The traffic surveys were undertaken before this festival in August and, therefore, this traffic is not included in the traffic data.

7.2.4.1 Manual Classified Junction Turning Counts

The surveys (locations summarised in Table 7.1) were undertaken for a 12-hour period on Wednesday 8th August 2007 and on Wednesday 19th September 2007 at the eight survey sites shown in Figure 7.1. The data was then assessed in terms of total through movements, primary through movement, % Heavy Commercial Vehicle (HCV) etc for the full 12 hour period, AM peak, PM peak and off peak time periods. The turning movements for the eight sites are contained in Appendix F of the EIS.

In January 2009, a one day turning movement count was undertaken in Ros Dumhach (Rossport) at the junction of the L1203 and the Leana Mhianaigh Road. However as proposed haulage route would be confined to the roads south of Sruwaddacon Bay and the extent of the study area is to the Junction of the R314/L1203 it is considered that this junction survey data will not be required for the Traffic Impact Assessment.

7.2.4.2 Peak Hour Traffic Flows

The traffic survey data was examined in order to identify traffic flow patterns and trends. The existing daily traffic flow profiles for the road network surrounding the proposed site were analysed to identify the periods of peak traffic flow at all junctions as summarised below.

- The weekday AM peak hour period was identified as 09:00 – 10:00 hours for both survey periods.
- The weekday PM peak hour period was identified as 17:00 – 18:00 hours and 18:00 – 19:00 hours for the August and September Survey periods respectively. To ensure a robust assessment was undertaken the traffic flow for the PM Peak Hour at each junction was used as a worst-case scenario.

The analysis of these traffic flows has enabled the periods of maximum total traffic at each junction to be determined.

7.3 EXISTING ENVIRONMENT

The proposed development is located within the administrative area of Mayo County Council. It is situated in a predominantly rural area in northwest County Mayo. It is approximately 10km to the east of Béal an Mhuirthead (Belmellet) and 12km to the north of Bangor Iorras (Bangor Erris). The R314 regional road, which links Béal an Mhuirthead (Belmullet) to Ballycastle, is to the south of the proposed development. All other roads in the immediate vicinity of the proposed route are of local road status and provide linkages to villages such as Ros Dumhach (Rossport), Ceathrú Thaidhg (Carrowteige), Porturlin, An tInbhear (Inver), Na hEachú (Aghoos), Gleann na Muaidhe (Glenamoy), Béal an Mhuirthead (Belmullet) and Poll an tSómais (Pollatomish). Poll an tSómais (Pollatomish) National School is located on the L1202 in Poll an tSómais (Pollatomish) village.

7.3.1 Existing AADTs

Annual Average Daily Traffic (AADT) refers to 24-hour two-way flows on an average day. AADTs are determined by applying an expansion factor to short survey counts in accordance with a standardised method.

The AADTs on the road network were calculated using the 12 hour link flows over the two 7 day periods. The link flow data was converted to Annual Average Daily Traffic (AADT) using the appropriate expansion factors from *Expansion Factors for Short Period Traffic Counts 1978 by J Delvin.* Table 7.2 overleaf gives a summary of the results. The AADTs for the study area are also shown in Figure 7.2.

LEGEND:

R313	Road Numbers
4244	2007 AADTs
9.6%	HCVs

AADT = ANNUAL AVERAGE DAILY TRAFFIC

Road Network & 2007 AADTs

Figure 7.2

File Ref: MDR0470TR0002 - 2010
Date: May 2010

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Table 7.2 Existing 2007 AADT within the Study Area (TIA)

Reference Number from Figure TR0001 in Appendix F	Location Description	August Surveys		September Surveys		AADT Estimate
		Average Weekday Flows	HCV %	Average Weekday Flows	HCV %	
Site 1, Link A	Northwest side of the R313 at the junction with the R313 and R314	3,840	6.47	3,377	7.5	**3,624**
Site 1, Link B	R314 east of the junction with the R313	1,379	3.52	1,265	3.05	**1,324**
Site 1, Link C	Southeast side of the R313 at the junction with the R313 and R314	2,557	8.01	2,177	10.16	**2,382**
Site 3, Link D	West side of the R314 at the junction with the L5243 and R314	1,058	3.86	940	6.9	**993**
Site 3, Link E	L5243 north of the junction with the R314	268	4.21	370	5.82	**310**
Site 3, Link F	East side of the R314 at the junction with the L5243 and R314	845	3.69	813	7.75	**820**
Site 6, Link G	West side of the R314 at the junction with the L1203 and R314	995	5.6	897	5.96	**944**
Site 6, Link H	L1203 north of the junction with the R314	708	6.87	622	5.22	**665**
Site 6, Link I	East side of the R314 at the junction with the L1203 and R314	745	4.44	674	6.01	**709**
Site 8, Link J	West side of the R313 at the junction with the L1204 and R313	1,881	9.47	1,602	9.47	**1,750**
Site 8, Link K	L1204 north of the junction with the R313	697	7.65	808	17.79	**745**
Site 8, Link L	East side of the R313 at the junction with the L1203 and R313	2,560	9.6	2,348	10.97	**2,457**
Site 2, L1202*	L1202 north of the junction with the R314 and the L5284	788	5.2	635	4.7	**703**
Site 4, L5244*	L5244 north of the junction with R314	295	2.4	NA	NA	**319**
Site 5, L1202*	L1202 north of the junction with the R314	235	6.0	243	5.4	**233**
Site 5, R314*	R314 west of the junction with the L1202	869	4.8	800	5.0	**818**
Site 7, L1202 Westbound**	West side of the L1202 at the junction with the L1202 and the L5243	261	8.8	166**	8.6	**282**

*Based on one day 12 hour counts undertaken in August and September

** Based on one day 11.5 hour count undertaken in September. For a worst case analysis August 2007 flow was used to calculate AADT

NA= Not Available due to technical complications

The traffic flows, from Table 7.2 above, show that the highest movements are on the R313 near Béal an Mhuirthead (Belmullet). The traffic flows generally do not exceed an average weekday flow of 1,000 vehicles throughout the majority of the road network. The average weekday flows only exceed 1,000 vehicles on some of the regional roads. The regional roads are a higher standard of road compared to local roads and are capable of catering for this traffic volume. A full breakdown of the traffic flows in the study area is available in the TIA contained in Appendix F.

In addition to 12 hour surveys, seven day traffic surveys were undertaken to establish weekly traffic patterns on each road (link) surveyed. The surveys were undertaken from 7:00 to 19:00 each day and, therefore, no data was collected between the hours of 19:00 and 7:00. No firm conclusion can be made about the traffic levels during the hours of 19:00 and 7:00 but it is reasonable to assume that the traffic levels would be relatively low compared to daytime traffic levels. This data provides a traffic flow profile over a seven day period and represents the survey data as vehicle volumes versus time. The graphs and traffic flow summary data for all the links are contained in the TIA in Appendix F.

7.3.2 Existing Road Network

The road network (which is shown in Figure 7.2), was assessed for its ability to cater for vehicles associated with the proposed development. This assessment included a review of the road widths, lengths, road and junction geometry, junction visibility and the impact of HCV turning movements. The following summarises the assessment for those roads within the affected road network.

7.3.2.1 N59 Ballysadare to Galway

The N59 is a National Secondary Road which runs between Ballysadare and Galway via Ballina, Bangor, Westport and Clifden. It is a single carriageway for the full length with road widths from 5.5m to 6.5m. The horizontal and vertical alignments on this route vary substantially, which results in some restrictions relating to sight distances and safe passing at some locations. HCV movements can be readily accommodated on this road.

7.3.2.2 R313 Bangor to Béal an Mhuirthead (Belmullet)

The R313 is a regional road and runs from Bangor to Béal an Mhuirthead (Belmullet). It has an approximate length of 25km with road width varying from 4.5m to 6.5m. The pavement condition is generally good over the whole length of the road. .

7.3.2.3 R314 Derrycorrib to Gleann na Muaidhe (Glenamoy)

The R314 is a regional road and runs from Derrycorrib to Ballina via the towns of Killala and Ballycastle. This route is known as the North Coast Road and it is widely used by tourists as there are a number of scenic views along the route (See Chapter 10). The road width is generally greater than 5.5m. The horizontal and vertical alignments of the road vary considerably along the full length of the route. The R314 does cater for HCV movements in relation to peat extraction, timber transport and the transportation of stone and plant/materials.

7.3.2.4 L1204

The L1204 is classed as a local road and is located to the east of Carrowmore Lake. It is a link between the R314 and the R313 and has an approximate length of 9.5km. The road width is an average of 5.5m and has a good road surface condition. The full length of this road was upgraded in 2005 to cater for haulage associated with the construction of Béal an Átha Buí (Bellanaboy) Bridge Gas Terminal. The L1204 is also used for the transport of trees from tree felling operations in Béal an Átha Buí (Bellanaboy) Bridge at the north end of the road. There are a small number of residential dwellings along this route.

7.3.2.5 L1202

The L1202 is classed as a local road and runs from the R314 through the townland of An tInbhear (Inver) and the village of Poll an tSómais (Pollatomish) and reconnects with the R314 just to the east of the Bellanaboy Bridge Gas Terminal site. It has an approximate length of 16km. The road has a width greater than 5.5m for significant stretches of the eastern end between the R314 and Gleann an Ghad (Glengad) but can narrow to 4.0m to 4.5m in places, between Gleann an Ghad (Glengad) and Na hEachú (Aghoos). The majority of the reduced carriageway sections are currently located adjacent to the Public House and on the steep gradient stretch of the L1202 just west of Poll an tSómais (Pollatomish). Between Gleann an Ghad (Glengad) and Barr na Trá (Barnatra) via An tInbhear (Inver) the road width is approximately 5.5m for significant stretches of the route. There are approximately 100 houses along this route the greatest number of which are in An tInbhear (Inver) and Poll an tSómais (Pollatomish).

7.3.2.6 Other Roads

L5284

The L5284 is classed as a local road and is located to the west of Carrowmore Lake. It is a link between the R314 and the R313 and has an approximate length of 8km. On average the road width is less than 5m and has a general poor road surface condition. This road is known locally as Carrowmore Drive and is protected in the County Development Plan because of the scenic views of high importance along the route.

L5243

The L5243 is classed as a local road and runs from Poll an tSómais (Pollatomish) south to the R314, through Knocknalower. It is approximately 5km and has an average width of approximately 3.5m.

L5244

The L5244 is classed as a local road and connects the L1202 to the R314. It has an approximate length of 3km and has an average width of 5m but becomes narrower in some sections. This section of road has recently been upgraded by Mayo County Council from the R314 to the Gate 2 of the Bellanaboy Bridge GasTerminal.

L1203

The L1203 is classed as a local road and runs from the R314 at Gleann na Muaidhe (Glenamoy) to Portacloy. It has an approximate length of 13.5km with an average width of 6m. The road has a small number of houses on it with the majority of the road fronted with agricultural lands, which are primarily used for peat extraction

7.3.3 Existing Road Network Capacity

A link capacity assessment was undertaken of the road network in the study area. This would determine whether the existing road conditions could cater for the current traffic volumes. The NRA's document "Road Link Design" TD 9/07 was used to establish the theoretical capacity of the road sections within the study area. This document gives a number of different road types and the corresponding theoretical capacity of each in Table 4 'Recommended Rural Road Layouts'. The smallest road type provided is the reduced single (7.0m) carriageway S2. The roads within the study area have cross sections less than 7.0m and, therefore, the theoretical capacity for the reduced single (7.0m) carriageway S2 required a reduction to reflect this.

The saturation flows for a 7.0m carriageway and the road widths within the study area were calculated using the Greater Manchester Transportation Unit- Note 155, May 1991, The Estimation and Appraisal of Saturation Flows in Conjunction with SATURN Networks. The ratio between the 7m carriageway and the other road widths were calculated. These ratios were then applied to the 7m carriageway's theoretical capacity to establish the theoretical capacity for the roads within the study area.

Using these theoretical capacities and the existing AADTs on the road network it was possible to calculate the percentage link capacity, which is currently being used on the roads in the study area. Table 7.3 below summarises the results.

Table 7.3: Link Capacity Assessment for the study area road network.

Road Section	Survey Site	Theoretical Capacity* (AADT)	Demand (AADT)	% Used Capacity
R313 Bangor to Béal an Mhuirthead (Belmullet)	Site 1, Link A	8381	3,624	43.2%
	Site 8, Link L	8381	2,457	29.3%
	Site 8, Link J	8381	1,750	20.9%
R314	Site 1, Link B	8381	1,324	15.8%
	Site 6,Link G	8381	944	11.3%
L1202	North of Site 5	8250	233	2.8%
L1203	Site 6 Link H	8381	665	7.9%
L1204	Site 8, Link K	8250	745	9.0%

***The Theoretical Capacity corresponds to a carriageway width of 6m for the R313, R314 and L1203. The Theoretical Capacity corresponds to a carriageway width of 5.5m for the L1202 and the L1204.**

The results show that there is spare capacity on the current road network in the study area.

7.3.4 Existing Traffic Impact at Poll an tSómais (Pollatomish) National School

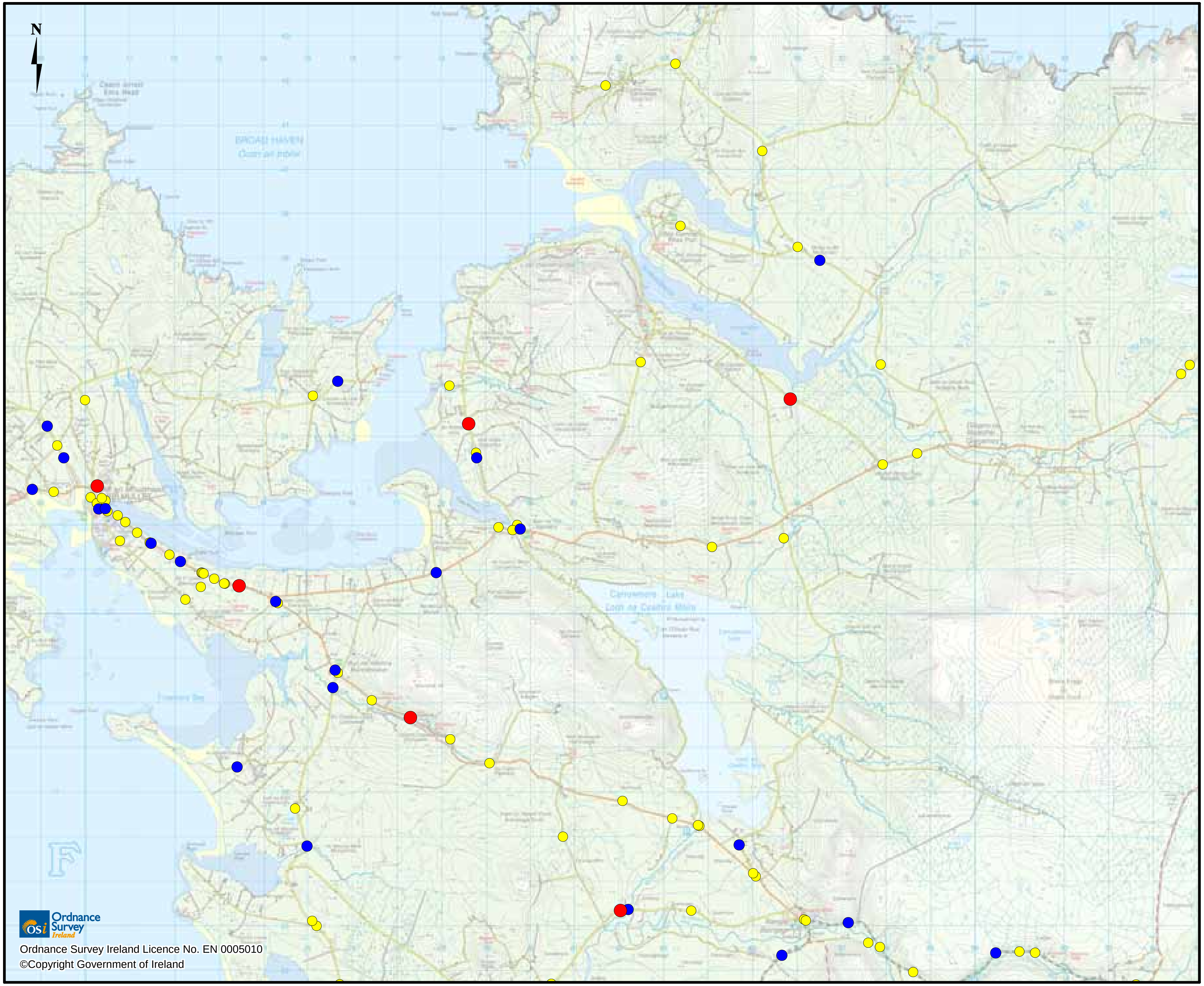
In order to gain an appreciation of the existing scale of traffic and the parking arrangements during the peak 'drop off' and 'collection' periods at Poll an tSómais (Pollatomish) National School, a traffic observation survey was undertaken on Friday March 19th 2010. During the morning 'drop off' period (8:45am to 9:40am), five vehicles arrived and stayed at the school. In total, 19 vehicles stopped outside the school (17 cars directly outside the school with two cars stopping on the opposite side) and dropped off one or more students in the 55-minute period. A bus arrived at the school with 13 pupils with another four arriving by foot with three of these pupils crossing the road unaccompanied. It was noted that four vehicles who set-down to drop off children performed 'U-Turns' at the school and caused a brief obstruction to vehicles arriving.

During the afternoon 'collection' period (2:45pm to 3:15pm), 17 cars, one van and one bus parked on both sides of road at 3pm. Three cars and the bus were double-parked. Several children crossed the road unattended.

It was also noted that no vehicles passed the school at excessive speeds during the peak 'drop off' and 'collection' periods.

7.3.5 Accident Data

An assessment of the accident data within the Study Area for the TIA was undertaken to determine if there were any existing problems on the road network. The NRA accident data for a 16 year period (1990– 2006) was extracted for the road network in the vicinity of the proposed development. The examination of this information has been summarised in Table 7.4 below. The results of the accident data were divided into different categories of 'Fatal', 'Serious' or 'Minor'. The accident locations are shown in Figure 7.3. The recorded accident data does not include "material damage only" accidents, or accidents which were not reported to or recorded by An Garda Síochána.



LEGEND:

Accidents from 1990 to 2006

Source NRA and RSA

- Minor (73)
- Serious (22)
- Fatal (6)

Accident Data

Figure 7.3

File Ref: COR25MDR0470Mi2121A03
Date: May 2010

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Table 7.4 Accident Statistics for study area road network

Road Section	Fatal Injury (Number of Incidents)	Serious Injury (Number of Incidents)	Minor Injury (Number of Incidents)
R313 Bangor to Béal an Mhuirthead (Belmullet)	2	4	23
R314 Ballina to Gleann na Muaidhe (Glenamoy)	0	3	9
L1204	0	1	0
L5284	0	0	0
L1202	2	1	2
L5243	0	0	1
L1203	0	1	4
L5245	0	0	2

The results show that the majority of accidents were recorded on the R313 with two of these being fatal accidents. The R314 had a number of accidents but none of these were fatal. A number of accidents did occur near Site 2, the cross roads with the R314, the L1202 to An tInbhear (Inver) and the L5284. On the local roads in the study area the majority of accidents were minor ones with a small number of serious accidents and two fatal accidents. Since this data was published a fatal accident occurred in the R313 near Béal an Mhuirthead (Belmullet) in 2009 in which two people were killed.

A serious accident occurred on the south end of the L1204 near the R313. This was a single vehicle accident and occurred on the 4th June 2001. However, it should be noted that this accident took place prior to the widening and upgrade works carried out in 2005. One serious and two fatal accidents occurred on the L1202 road. One of the fatal accidents occurred on the L1202 north of the Bellanaboy Bridge Gas Terminal site, which is part of the proposed haulage route. This was a single vehicle accident and it occurred on the 16th February 1998. The second fatal accident on the L1202 was in An tInbhear (Inver).

It is noted that the section of the L1202 where the accident occurred and which will be used by construction vehicles was upgraded by Mayo County Council in 2008.

7.3.6 Public Transport

The study area is served by a number of bus routes. Bus Éireann provides regular service (No. 446) from Béal an Mhuirthead (Belmullet) to Ballina and vice versa stopping at various locations including Bangor and Bellacorick.

There are also a number of additional local bus services supplied by private bus companies. These bus routes serve a number of locations within the Study Area. A bus service runs every weekday departing Ros Dumhach (Rossport) at approximately 10.00am to Béal an Mhuirthead (Belmullet) and it returns to Ros Dumhach (Rossport) approximately 6.00 PM (on Fridays there is an extra bus back which arrives at Ros Dumhach (Rossport) at approximately 2.00pm). There is also a service from Na hEachú (Aghoos)/ Gleann an Ghad (Glengad) to Béal an Mhuirthead (Belmullet) (Monday to Friday), departing Na hEachú (Aghoos)/ Gleann an Ghad (Glengad) at approximately 10.30am and returning to Na hEachú (Aghoos)/ Gleann an Ghad (Glengad) at approximately 2.00pm. There is a service from Poll an tSómais (Pollatomish) to Ballina (Monday to Friday) which departs Poll an tSómais (Pollatomish) at approximately 10.15am and returns to Poll an tSómais (Pollatomish) at approximately 6.15pm.

There are private bus services from Béal an Mhuirthead (Belmullet) (predominantly for college students) to Galway and Limerick.

In addition to these services, there are daily school services throughout the Bangor Iorras (Erris) area, which serve the schools within the vicinity of the study area. There are also taxi services available in the study area. There are limited cycling and pedestrian facilities available within the study area.

7.3.7 Committed Development and Traffic Generators

A review of planning applications submitted to Mayo County Council over the past five years was undertaken to establish the extent of development which received planning permission within the vicinity of the proposed onshore pipeline. This information would determine if the planned development would result in increased traffic levels within the vicinity of the proposed onshore pipeline. It was also assessed whether any additional traffic flows would have been accounted for in the traffic surveys undertaken in 2007.

7.3.7.1 Bellanaboy Bridge Gas Terminal

Given that the Terminal construction is essentially complete, it will not coincide with the construction programme of the pipeline. The peak traffic movements for pipeline commissioning on the Bellanaboy Bridge Gas Terminal are predicted to be 349 personnel daily trips and 43 HCVs daily trips to the site in Month 21. However this volume of HCV trips is scheduled to occur in Month 21 (due to testing of the pipeline), with a volume of 11 HCV a day occurring in Month 20 and a volume of eight HCV a day predicted for the remaining months. The trips related to the terminal have been included in the overall trip generation volumes estimated as part of this traffic assessment

Transport Haulage associated with the Bellanaboy Bridge Gas Terminal for August and September 2007, the months when the traffic surveys were undertaken, was examined. This showed that there was an average daily volume of 135 cars and 66 HCVs in August and 180 cars and 57 HCVs in September predicted to access the site. These flows would have been reflected in the junction counts when the surveys were undertaken. In order to provide a robust assessment these flows have been left in the background traffic flows for this traffic impact assessment.

7.3.7.2 Kilcommin GAA Club

Kilcommin GAA Club have submitted a planning application to develop the GAA pitch and facilities at their grounds at Lenarevagh, Gleann na Muaidhe (approximately 20km away from the proposed development site). The development of the GAA Pitch and facilities will generate additional traffic volumes on the network but due to the distance away from the proposed development it is considered that the traffic impact of these trips would have dissipated into the background traffic flows within our study area. It also noted that due to current economic conditions and other national and regional policy measures for reducing car usage levels, in general growth rates in traffic flows have reduced since 2007. However, to ensure a robust assessment the recorded 2007 traffic flows were factored upwards using the NRA growth rates. Therefore it is considered that using the conservative approach when predicting the growth in background traffic flows between 2007 and 2011 will account for the typical weekday traffic volumes generated by the proposed development of Kilcommin GAA club.

7.3.7.3 Other Committed Development

The remaining committed developments relate to one-off houses or amendments to existing dwellings, which would not add a significant traffic contribution to the road network in this locality. They have therefore been discounted in terms of the traffic assessment for this development.

7.4 FUTURE TRAFFIC FORECASTS

7.4.1 Future Background Traffic Flows

The estimated future year traffic volumes within the study area were calculated using the National Roads Authority's (NRA) traffic growth figures (*NRA Future Traffic Forecasts 2002 – 2040, August 2003*). These growth factors were applied to the existing traffic flows on the road network surrounding the development. A summary of the existing traffic flows and future background traffic flows are shown below in Table 7.5 and are also shown in Figures 7.4-7.6.

LEGEND:

R313	Road Numbers
3805	2011 AADTs
7.0%	HCVs

AADT = ANNUAL AVERAGE DAILY TRAFFIC

2011 Background Traffic Flows (Construction Year)

Figure 7.4

File Ref: MDR0470TR0005 - 2010
Date: May 2010

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LEGEND:

R313	Road Numbers
3855	2013 AADTs
7.0%	HCVs

AADT = ANNUAL AVERAGE DAILY TRAFFIC

2013 Background Traffic Flows (Opening Year)

Figure 7.5

File Ref: MDR0470TR0006 - 2010
Date: May 2010

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LEGEND:

R313	Road Numbers
4464	2028 AADTs
7.0%	HCVs

AADT = ANNUAL AVERAGE DAILY TRAFFIC

2028 Background Traffic Flows (Design Year)

Figure 7.6

File Ref: MDR0470TR0007 - 2010
Date: May 2010

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Table 7.5: Future Background Traffic Flows

Road Section	2007 AADT	2011 AADT Construction[1] Year	2013 AADT Opening Yea[2]r	2028 AADT Design Year[3]
R313 west of junction with R314	3624	3841	3948	4465
R313 east of junction with R314	2382	2525	2594	2936
R313 west of Junction with L1204	1750	1855	1906	2157
R313 east of junction with L1204	2457	2604	2676	3030
R314 north of junction with R313	1324	1403	1443	1630
R314 west of junction with L5243	993	1053	1082	1223
R314 west of junction with L1204	820	869	893	1010
R314 west of junction with L1202	818	867	891	1007
R314 east of junction with L1202	944	1001	1028	1163
R314 east of junction with L1203	709	752	772	873
L1204 north of junction with R313	745	790	811	919
L1202 west of junction with R314	233	247	254	287
L1202 west of Poll an tSómais	282	299	307	348
L1202 south of An tInbhear (Inver)	703	745	766	866
L1203 west of junction with R314	665	705	724	819
L5243	310	329	338	382
L5244	319	338	348	393

The future predicted traffic volumes combined with the traffic demand associated with the construction of the proposed development were entered into an excel spreadsheet model. These scenarios included the comparison of *Do Nothing* (without the development in place) and *Do Something* (with the development in place).

7.5 POTENTIAL IMPACTS

This section examines the potential impact of the proposed development on the surrounding road network. Given the nature of the development the potential impacts will all be during the construction phase and be of a temporary nature. The road network is tested with and without the proposed development in place i.e. 'Do Nothing' and 'Do Something'. The proposed development traffic in the 'Do Something' scenario includes the traffic from construction delivery and construction activities (both HCV and Personnel trips).

7.5.1 Haulage Route

The haulage route for the construction traffic travelling to and from the proposed construction site will use the national primary and secondary road network as much as possible. When the construction vehicles leave the N59 to route to the site compounds, the roads used will be the R313, the upgraded L1204, the R314 and the L1202 as far as Gleann an Ghad (Glengad). The proposed haulage route is shown in Figure 7.7.

In 2005 and 2007 sections of the haul route (R314 and L1204) were used to transport significant volumes of peat (transportation by road of over 450,000m^3 of peat) from the Bellanaboy Bridge Gas Terminal site in Béal an Átha Buí (Bellanaboy) to the Bord Na Móna Peat Deposition site at An Srath

[1] Construction year 2011: this refers to the year where construction commences
[2] Opening year 2013: this refers to the year when the pipeline commences operation
[3] Design year 2028: this refer to a period 15 years after the opening year which is a standard criteria for assessing the traffic impact of a development.

Mór (Srahmore). The relevant sections of the proposed haulage were upgraded to accommodate HCVs.

7.5.2 Operational Phase Impacts

There will be very little traffic associated with the operation of the Corrib Onshore Pipeline. The traffic movements associated with the occasional safety checks and maintenance will be negligible and will not generate a potential traffic impact on the surrounding road network. Once every 4-5 years the LVI will require a maintenance inspection, which will require the use of heavy machinery, but this will not involve a high number of traffic movements.

7.5.3 Construction Phase Impacts

7.5.3.1 Trip Generation

It is estimated that construction will take approximately 26 months to complete. The proposed construction schedule was used to generate traffic volumes for the works.

In Na hEachú (Aghoos), the highest number of traffic movements in the first three months of construction is associated with the import of stone and the removal of excess peat. Stone will come from the local quarries and peat will be transported to the Bord na Móna Peat Deposition site at An Srath Mór (Srahmore).

There will also be stone road construction and peat removal in Na hEachú (Aghoos) during Months 13 to 15. The tunnelling operations at Na hEachú are expected to be running for a 15 month period between Months 5 and 19. The highest vehicle movements associated with the tunnelling operations are related to tunnel arisings being taken from the sites and tunnelling materials being delivered to Na hEachú (Aghoos).

In Gleann an Ghad (Glengad), the scale of HCV movement is significantly less than Na hEachú (Aghoos), with the highest HCV movements associated with the excavation work for the LVI, the umbilical pull ashore and the erection of fencing and access road construction. These activities are expected to occur for a three-month period between Months 2 and 4. Other construction activities that will generate traffic movements at Gleann an Ghad (Glengad) will include the movement of mechanical equipment and miscellaneous material associated with the LVI and general equipment associated with the civil and structural works.

It is estimated that the highest daily number of HCV movements at Na hEachú (Aghoos) will occur in months 13-15 as the tunnelling works coincide with stone road construction and peat removal in the Na hEachú (Aghoos) area. It is estimated that a total of 368 (two-way) HCV trips will be generated daily at Na hEachú (Aghoos) in Months 13-15.

It is estimated that the highest daily number of HCV movements at Gleann an Ghad (Glengad) will occur in Month 2 as the LVI excavation works coincide with the importation of stone for the access road. It is estimated that 48 two-way HCV daily trips will be generated at Gleann an Ghad (Glengad) during Month 2. However this peak will only occur in month two and by month five the number of HCV movements at Gleann an Ghad (Glengad) is expected not to exceed 20 two-way trips per day for the remaining 20 months of the construction programme (except Months 19 and 20 where Gleann an Ghad (Glengad) will generate a maximum 30 two-way HCV trips a day).

In addition to the traffic movements associated with the site compounds at Na hEachú (Aghoos) and Gleann an Ghad (Glengad), there will also be traffic generation from An Srath Mór (Srahmore) Peat Deposition site and Bellanaboy Bridge Gas Terminal site. These traffic movements have been included in this trip generation assessment.

In terms of personnel trips, it is proposed that a significant number of staff will be transferred to the site compounds at Na hEachú (Aghoos) and Gleann an Ghad (Glengad) from the Bellanaboy Bridge Gas Terminal using shuttle buses. To ensure a robust assessment of both scenarios, additional car trips were assigned to the sites at Gleann an Ghad (Glengad) and Na hEachú (Aghoos) to account for multiple daily trips by management and supervisors. Also, an additional ten two-way car trips per day were assigned to Gleann an Ghad (Glengad) to account for the escort vehicles associated with the HCV convoys.

For the purpose of the assessments, it is assumed that all stone material HCV trips will come from local quarries.

To avoid the possible conflict between HCV movement and pedestrian movement at Poll an tSómais (Pollatomish) National School, it is proposed that HCV trips past the school will not take place during school opening and closing time periods.

In order to provide a robust assessment of the traffic impact generated by the proposed works it is proposed to assess two different scenarios. As the movement of HCV is the critical issue during construction, the core scenario will be an assessment of the actual peak construction period for HCV movements in the study area (The study area comprises all compounds at Gleann an Ghad (Glengad), Na hEachú)Aghoos), Bellanaboy Bridge Gas Terminal and An Srath Mór). The actual peak construction period for HCV movements in the study area occurs in Month 2 in the construction programme.

The construction programme shows that the peak HCV movements and peak personnel movements will not occur simultaneously. The programme also shows that the peak construction periods for each site will not occur simultaneously. However, to provide a robust assessment of the traffic levels on the road network it is proposed to assess a hypothetical 'worst-case' scenario where all peak HCV/Personnel trips for each site are combined and assigned to the network. This scenario cannot occur in the construction programme but for the purpose of undertaking a robust traffic impact assessment, the scenario was assessed to show that the junctions have sufficient capacity to cater for the demand.

Therefore the following two scenarios will be assessed:

- Peak Construction Period for HCV Movements

- A hypothetical 'Worst Case' scenario where the peak HCV and Personnel trips for the works at Na hEachú (Aghoos), Gleann an Ghad (Glengad), Bellanaboy Bridge Gas Terminal and An Srath Mór (Srahmore) Peat Deposition Site are assumed to occur simultaneously

7.5.3.2 Peak Construction Period for HCV Movements – Trip Generation

The estimated traffic volumes generated by the proposed works during the peak period for HCV movement was extracted from the construction schedule. A breakdown of the construction movements at each site has been summarised in Table 7.6.

Table 7.6 Traffic Movements during the Peak Period for (Month 2-April 2011)

	AM Peak		PM Peak		Daily	
Construction	**Arrivals**	**Departures**	**Arrivals**	**Departures**	**Arrivals**	**Departures**
Gleann an Ghad (Glengad)						
HCV	3	3	3	3	24	24
Cars/Buses	6	0	0	6	21	21
Na hEachú (Aghoos)						
HCV	16	16	16	16	157	157
Cars/Buses	8	0	0	8	18	18
Bellanaboy Terminal						
HCV	1	1	1	1	8	8
Cars/Buses	272	7	7	272	279	279
An Srath Mór (Srahmore)						
HCV	5	5	5	5	47	47
Cars/Buses	13	0	0	13	13	13
Total	**324**	**32**	**32**	**324**	**567**	**567**

It is estimated that the four sites would generate a total of 472 daily two-way HCV trips and 662 daily car/bus two-way trips during the peak period for construction movement.

Table 7.6 also shows the estimated trips generated during the AM and PM Peak Hour. It is assumed that HCVs will arrive and depart the site compounds at a uniform rate over a typical ten-hour working day. Therefore, the scale of the AM and PM peak hour HCV trips is 10% of the daily flows. The HCV arriving in the AM peak hour will avoid school opening periods.

It is also assumed that all employee car trips to each of the sites will arrive in the AM Peak Hour and depart in the PM Peak Hour. In relation to the buses transporting employees from Bellanaboy Bridge Gas Terminal to the site compounds, it is assumed that the majority of bus trips will arrive at the site compounds in the AM Peak Hour and depart in the PM Peak Hour. Since the buses are leaving the Terminal to go to the site compounds the majority of buses will depart Bellanaboy Bridge Gas Terminal in the AM Peak Hour and arrive back in the PM Peak Hour. During the day bus transfers may be required for small personnel movements between the site compounds and the Terminal.

7.5.3.3 Peak HCV and Personnel trips for all sites occurring simultaneously

The estimated traffic volumes generated by a hypothetical ‘worst-case’ scenario of all peak HCV and personnel movements at each site occurring simultaneously was extracted from the construction schedules. A breakdown of the construction traffic movements at each site has been summarised in Table 7.7.

Table 7.7 Traffic Movements if all the peak movements at all sites occurred simultaneously

	AM Peak		PM Peak		Daily	
Construction	**Arrivals**	**Departures**	**Arrivals**	**Departures**	**Arrivals**	**Departures**
An Srath Mór (Srahmoe)						
HCV	3	3	3	3	24	24
Cars/Buses	9	0	0	9	24	24
Na hEachú (Aghoos)						
HCV	19	19	19	19	184	184
Cars/Buses	12	0	0	12	22	22
Bellanaboy Terminal						
HCV	5	5	5	5	43	43
Cars/Buses	349	8	8	349	357	357
An Srath Mór (Srahmore)						
HCV	6	6	6	6	52	52
Cars/Buses	31	0	0	31	31	31
Total	**434**	**41**	**41**	**434**	**737**	**737**

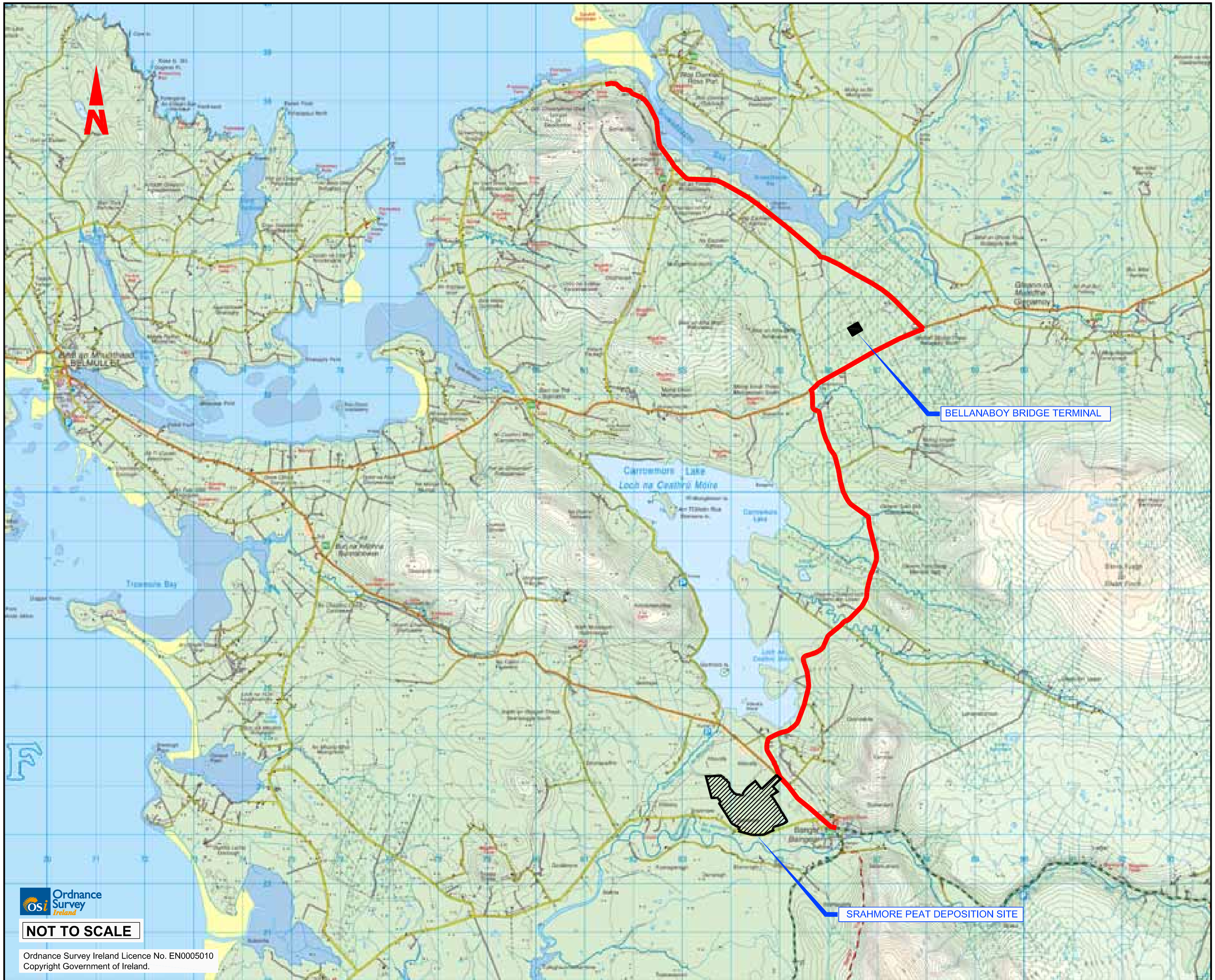
It is estimated that the four sites combined could generate a total of 606 daily two-way HCVs trips and 868 daily car/bus two-way trips if the peak construction activities at each of the sites were to occur simultaneously. However the total figures shown in Table 7.7 are only used for capacity assessment purposes and they will not occur on the network within the construction programme.

The AM and PM Peak Hour traffic volumes were estimated using the same methodology as used in the first scenario.

7.5.3.6 Trip Distribution

The number of HCV trips were distributed between sections of the road network in accordance with the proposed haulage route.

The personnel trips (including the employee bus trips) were distributed onto the road network based on the recorded 2007 percentage distribution of traffic volumes on the local road network. The distribution of the construction related traffic flows for the peak month for HCV movements are shown in Figure 7.8.



LEGEND:

Proposed Access/Haulage Route

Proposed Access/Haulage Routes

Figure 7.7

File Ref: MDR0470TR0004 - 2010
Date: May 2010

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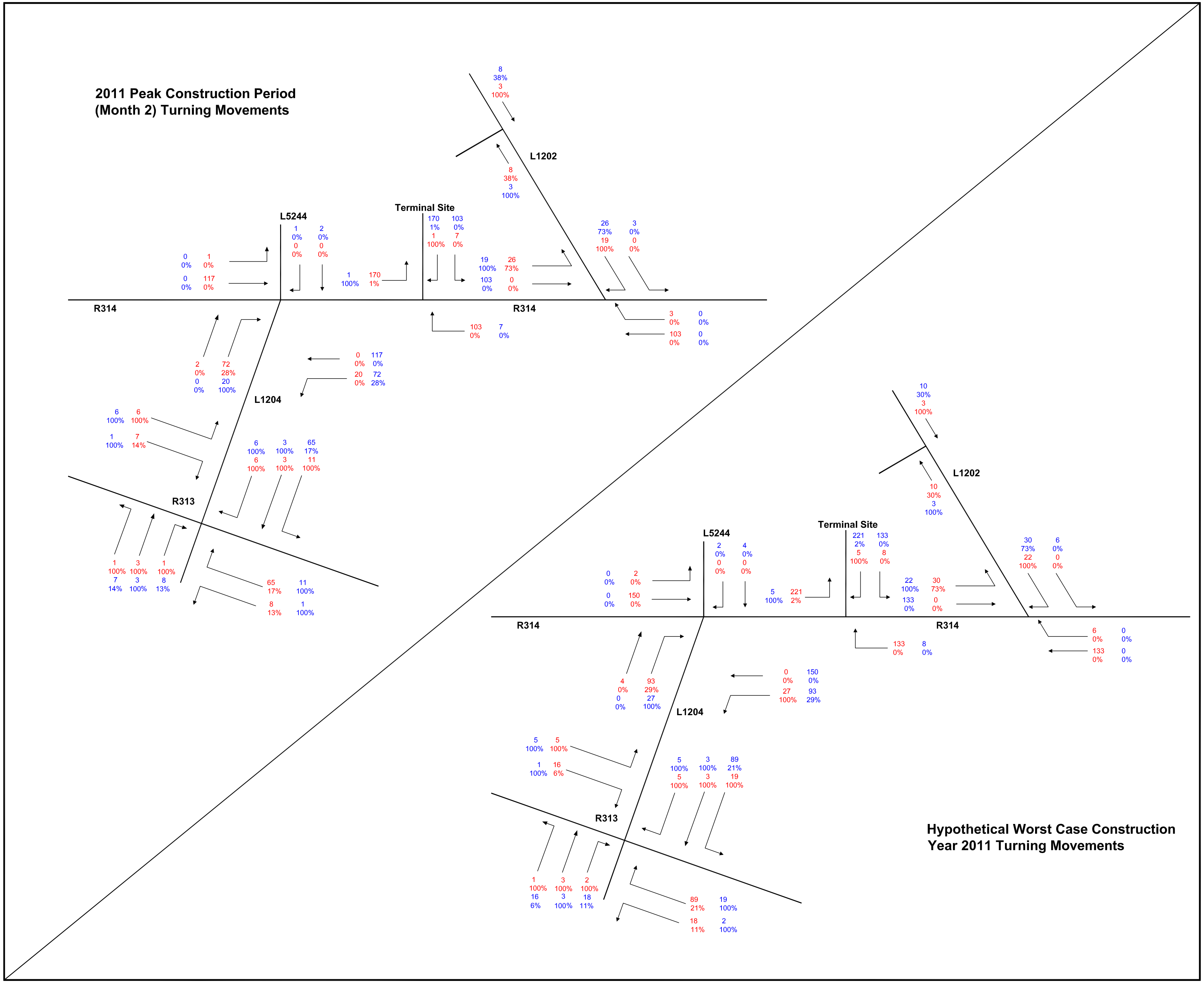

LEGEND:

2011

AM
PM

8 = Total Vehicles

100% = % HCVs

2011 Construction
Traffic Distribution

Figure 7.8

File Ref: MDR0470TR0009-0021 - 2010
Date: May 2010

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7.5.4 Traffic Assessments

Based on the existing traffic flows, the proposed haul route and the location of the site compounds, it was determined that the proposed study area comprises all of the key links and junctions within the confines of the following locations:

- Junction of the R313/R314 - located approximately 5 km southeast of Béal an Mhuirthead (Belmullet) (Site 1)

- Junction of the R314/L1203 - located in the townland of Gleann na Muaidhe (Glenamoy) (Site 5).

  To maintain consistency with previous studies, the junction of the R314/L1203 will be included in the study area for this assessment. However the curtailments of the proposed haul route to the south of Sruwaddacon Bay will result in no construction related HCV impact at the junction of the R314/L1203.

- Junction of the R313/L1204/Entrance to An Srath Mór (Srahmore) Peat Deposition Site - located approximately 2km west of Bangor Iorras (Bangor Erris) (Site 8)

It is expected that construction related HCV trips will use the N59 and the National Primary Roads to access key locations (including ports) around the country. However it is considered the volume of construction related HCV trips generated by the onshore pipeline works would be significantly less than the background traffic flow on the relevant National Road network and the direct traffic impact would dissipate into the background traffic flow. Therefore detailed capacity analysis was not required on the National Road network

To ensure a robust traffic study, two traffic scenarios were assessed. The first scenario is the daily construction traffic during the predicted peak month for HCV movement, which is the second month of construction programme, and the second scenario is hypothetical scenario which relates to the daily construction traffic flows if all construction activities were to peak simultaneously.

7.5.4.1 Peak Period for HCV Movements

Link Capacity

A link capacity assessment of the road network in the study area was undertaken for the month of peak HCV traffic movements. The results indicate that the road network has sufficient capacity to accommodate the estimated peak HCV volumes. It is considered that queuing and delays will not occur on the road network during this period. The carriageway widths for R313, R314, L1204 and the L1202 as far as Na hEachú (Aghoos) have sufficient width to allow two HCVs to pass each other without obstruction. However, the carriageway width on sections of the L1202, west of Poll an tSómais (Pollatomish), can drop to approx 4.0m which is not sufficient to allow two HCVs to pass simultaneously. Therefore, even though the road has sufficient capacity to cater for the volume of vehicles, the reduced carriageway width would result in the need for all HCV movements to Gleann an Ghad (Glengad) on the L1202, west of Poll an tSómais (Pollatomish), to be managed carefully.

Only HCVs travelling to Gleann an Ghad would use the L1202 west of Poll an tSómais (Pollatomish) and the scale of HCV movement at Gleann an Ghad (Glengad) is significantly less than the scale of HCV movement at Na hEachú (Aghoos), where the tunnelling activity will take place.

It is estimated that the works at Gleann an Ghad would generate 48 two-way daily HCV trips during the peak month. The peak volume of HCV movement in Gleann an Ghad (Glengad) is expected to last for only three months and HCV movements will significantly drop after the fourth month of the construction programme.

HCV traffic to Gleann an Ghad (Glengad) will be managed using a controlled convoy system, which will be further developed from the management of HCV movements used previously during the Landfall construction. The peak daily HCV movement to the Landfall site was more than the peak daily volume of HCV movement estimated at Gleann an Ghad (Glengad) for these onshore pipeline works.

The Traffic Management Plan, developed by Tobin Consulting Engineers, which complements this TIA, provides details of the proposed convoy system and illustrates the measures that will be put in place in order to ensure the safe movement of HCVs to Gleann an Ghad (Glengad).

Junction Capacity

Ensuring the safe movement of HCVs will be the critical traffic concern during the construction stage. In order to provide a robust assessment, peak hour capacity analysis was undertaken at key junctions along the haul route.

From on-site observations during site visits in February 2010 and a review of the recorded traffic data in the study area, it was determined that the following are the key junctions along the haul route:

- Cross roads with the R314, the L1204 and the L5244 (Site 4)
- Junction R314/L1202 (Site 5)
- Junction L1202/L5243 in Poll an tSómais (Pollatomish) (Site 7)
- Junction R313/L1204, adjacent to the entrance to An Srath Mór (Srahmore) Peat Deposition Site (Site 8)

The four main priority junctions that will be most affected during the construction period were tested for operational capacity in order to determine whether they will operate effectively or have capacity issues by the way of queuing and delays.

The junctions were analysed using the junction capacity model, PICADY (Priority Intersection Capacity and Delay) version 5.0. The junction models are based on the Ratio of Flow to Capacity (RFC), which is the output figure of each junction arm. If the RFC value exceeds 0.85, then the junction is considered to be operating unsatisfactorily and would experience junction delays and queuing.

The following summarises the results of the junction capacity analysis for each junction. The relevant turning count traffic flows for each junction are shown in the Traffic Impact Assessment Report in Appendix F. Note that the junction locations are referred to by names and reference numbers used in Figure 7.1.

Cross roads with the R314, the L1204 and the L5244 (Site 4)

The results indicate that the crossroads junction of the R314, the L1204 and the L5244 will operate below capacity during the AM and PM peak hours in the peak construction period for HCV Movements. It is considered that queuing and delay will not occur at this junction. Therefore the junction is expected to perform satisfactorily.

L1202 Local Road and R314 Junction (Site 5)

The results indicate that the junction of the R314/L1202 will operate significantly below capacity during the AM and PM peak hours in the peak construction period for HCV Movements. Arm A (R314 West) does not have any values as its associated movements are not required to give way to any other arms (i.e. straight through movement and a left turn movement). It is considered that queuing and delay will not occur at this junction. Therefore the junction is expected to perform satisfactorily.

L1202/L5243 in Poll an tSómais (Pollatomish) Junction (Site 7)

The results indicate that the junction of the L1202/L5243 will operate below capacity during the AM and PM peak hours in the peak construction period for HCV Movements. Arm A (L1202 East) does not have any values as its associated movements are not required to give way to any other arms (i.e. straight through movement and a left turn movement). It is considered that queuing and delay will not occur at this junction. Therefore the junction is expected to perform satisfactorily..

R313/L1204/ An Srath Mór (Srahmore) Junction (Site 8)

The results indicates that the junction of the R313/L1204/ An Srath Mór (Srahmore) Entrance will operate below capacity during the AM and PM peak hours in the peak construction period for HCV Movements. It is considered that queuing and delay will not occur at this junction. Therefore the junction is expected to perform satisfactorily.

Conclusion from the Junction Assessments for the Peak Period for HCV Movement

The capacity assessment results indicate that all of the key junctions on the haul route will operate within capacity for the AM and PM Peak Hours based on the estimated traffic volumes generated by construction activities during the peak month for HCV movement. It is predicted that the additional volumes generated during the peak month of construction will not cause queuing and delays at the junctions.

7.5.4.2 Hypothetical Scenario - Peak HCV and Personnel trips for all sites occurring simultaneously

Link Capacity

A link capacity assessment was undertaken of the road network in the study area for the hypothetical scenario of all construction related traffic (both HCV and Personnel) peaking simultaneously. The results indicate that the road network surrounding the development can accommodate this scenario. It is considered that queuing and delays will not occur on the road network for this scenario

The volume of HCV movements assumed for Gleann an Ghad (Glengad) in this scenario is 48 two-way HCV daily trips which is the same as the volume assessed in the previous scenario (peak month for HCV movement). Therefore the methodology for operated and managed the HCV movement to Gleann an Ghad, outlined in Section 7.5.4.1, will be sufficient to cater for peak HCV demand at Gleann an Ghad (Glengad).

The Traffic Management Plan, contained in Appendix E, provides details of the proposed convoy system and illustrates the measures proposed to be put in place in order to ensure the safe movement of HCV traffic to Gleann an Ghad (Glengad).

Junction Capacity

The four main priority junctions that will be affected the most during the construction period were analysed for operational capacity in order to determine whether they will operate effectively or have capacity issues such as of queuing and delays.

The following summarises the results of the junction capacity analysis for each junction. The relevant turning count traffic flows for each junction are shown in the Traffic Impact Assessment in Appendix F. Note that the junction locations are referred to by names and reference numbers used in Figure 7.1.

Cross roads with the R314, the L1204 and the L5244 (Site 4)

The results indicate that the crossroads junction of the R314, the L1204 and the L5244 will operate below capacity during the AM and PM peak hours for the scenario of all construction activities (both HCV and Personnel) peaking simultaneously. It is considered that queuing and delay will not occur at this junction. Therefore the junction is expected to perform satisfactorily.

L1202 Local Road and R314 Junction (Site 5)

The results indicate that the junction of the R314/L1202 will operate significantly below capacity during the AM and PM peak hours for the scenario of all construction activities peaking at the same time. Arm A (R314 West) does not have any values as its associated movements are not required to give way to any other arms (i.e. straight through movement and a left turn movement). It is considered that queuing and delay will not occur at this junction. Therefore the junction is expected to perform satisfactorily.

L1202/L5243 in Poll an tSómais (Pollatomish) Junction (Site 7)

The results indicate that the junction of the L1202/L5243 will operate below capacity during the AM and PM peak hours for the scenario of all construction activities peaking at the same time. Arm A (L1202 East) does not have any values as its associated movements are not required to give way to any other arms (i.e. straight through movement and a left turn movement). It is considered that queuing and delay will not occur at this junction. Therefore the junction is expected to perform satisfactorily.

R313/L1204/ An Srath Mór (Srahmore) Junction (Site 8)

The results indicate that the junction of the R313/L1204/ An Srath Mór (Srahmore) Entrance will operate below capacity during the AM and PM peak hours for the scenario of all construction activities peaking at the same time. It is considered that queuing and delay will not occur at this junction. Therefore the junction is expected to perform satisfactorily.

Conclusion

The capacity assessment results indicate that all of the key junctions on the haul route will operate within capacity for the AM and PM Peak Hours, based of a hypothetical scenario of peak traffic demand generated by all construction activities at each site occurring simultaneously. It is predicted that this scenario would not cause queuing and delays at the junctions.

7.5.4.3 Public Transport Impacts

There will be no significant impact on public transport within the study area during the construction stage.

7.5.5 HCV Traffic Impact in Béal an Mhuirthead (Belmullet)

In order to undertake an assessment of the potential traffic impact of the proposed construction works in 'non-rural' areas, it was determined that a scenario where a percentage of HCV trips carrying tunnelling material through Béal an Mhuirthead (Belmullet) should be assessed.

An assessment of the potential available capacity at the proposed Tallagh landfill site in the Béal an Mhuirthead (Belmullet) area showed that an estimated maximum of five daily HCV loads could be accommodated based on the annual capacity of the proposed landfill. Therefore, this would equate to a maximum of ten two-way trips per day through Béal an Mhuirthead (Belmullet).

In September 2008, Abacus Transportation Surveyors undertook a traffic survey in the centre of Béal an Mhuirthead (Belmullet) at the roundabout junction of American Street/ Main Street/ High Street/ Barrack Street. The survey was undertaken for a 12-hour period between 07:00-19:00. The total two-way flow for the 12-hour period on Barrack Street and American Street was 4,424 vehicles and 5,412 respectively. Therefore the traffic impact generated by an additional 10 HCV trips would be negligible in relation to the existing scale of traffic flow in the town.

7.5.6 Junction Visibility for HCV Movement

7.5.6.1 Access Junctions

Na hEachú (Aghoos)

There will be two access roads to Site Compound (SC3) and the Stringing Area at Na hEachú (Aghoos). The access to SC3 will be constructed first and the access road to the stringing area will be constructed approximately ten months later. Once both access roads are complete a one-way system will be put in operation whereby one road will be used as an entrance only and the other as an exit only. The proposed junctions will be approximately 100m apart. The proposed access to Site Compound (SC4) will be located to the east of the stringing area on the L1202.

The proposed access roads will be located adjacent to an upgraded section of the L1202. The area surrounding the Na hEachú (Aghoos) compounds is flat terrain which will provide good visibility for HCV access/egress the sites. The access points will be located in strategic positions to ensure that sufficient sight visibility and stopping sight distance is provided along the L1202. The L1202 has a carriageway width greater than 5.5m, adjacent to the proposed site compounds. This will allow two HCV to pass each other simultaneously. An overview of the proposed sight visibility distance at the Na hEachú (Aghoos) (complemented with photographs of the adjacent road network) is shown in the Traffic Impact Assessment in Appendix F.

Gleann an Ghad (Glengad)

The proposed access road to the Gleann an Ghad (Glengad) Compounds will be a temporary road approximately 6.0m wide. On completion of the construction, this temporary road will be reinstated to provide a 3.5m permanent access road to serve the LVI. The access point is located to ensure that adequate sight visibility and stopping sight distance is provided along the L1202.

An overview of the proposed sight visibility distance at the access roads to the Gleann an Ghad (Glengad) sites complemented with photographs of the adjacent road network) is shown in the Traffic Impact Assessment in Appendix F.

An Srath Mór (Srahmore) Deposition site

The access to the An Srath Mór (Srahmore) Peat Deposition Site is located off the R313 with the access junction forming a crossroads junction with the R313 and L1204. The crossroads junction was upgraded before the site opened for peat deposition in 2005. The proposed access road has a carriageway width of 7.6m on approach to the R313. The entry width of the access road is approximately 11m at the intersection with the R313. The junction radii are adequate to allow HCV to access/egress the An Srath Mór (Srahmore) Site without obstructing the opposing lane on the access road.

Due to flat terrain surrounding the junction and the horizontal alignment of the R313, the sight visibility distance along the R313 from 3m back along the access road is adequate to the west of the access road.

However the sight visibility distance to the east of the access road is restricted for cars to approx 40m due to the position of a street furniture sign adjacent to the R313. It is considered that this sign would not restrict visibility for HCV drivers but it should be set-back outside the sight visibility splay from a 3m set back to ensure that maximum sightlines are provided for all vehicles.

An overview of the existing sight visibility distance at the entrance to An Srath Mór (Srahmore) Peat Deposition Site (complemented with photographs of the adjacent road network) is shown in the Traffic Impact Assessment in Appendix F.

Bellanaboy Bridge Gas Terminal

The main traffic to the Bellanaboy Bridge Gas Terminal site will be predominately light vehicles, however, there will be HCV movements to the terminal for general deliveries/services and during the pipeline construction and commissioning phases. The construction compound at the terminal will be used as a base for project construction management employees and also be used as outlined below,

- HCVs will use the terminal as a temporary holding point during the operation of convoys to Gleann an Ghad (Glengad).
- HCVs will park over night at the terminal
- HCVs will use the terminal as a secure serviced holding facility for HCV construction traffic.
- Designated destination point for group transport by bus of specific construction personnel to construction compounds in Na hEachú (Aghoos) and Gleann an Ghad (Glengad).

An overview of the sight visibility distance at the entrance to the Bellanaboy Bridge Gas Terminal (complemented with photographs of the adjacent road network) is shown in the Traffic Impact Assessment in Appendix F.

7.5.6.2 Existing Junctions on the Haul Route

The provision of adequate sight visibility distances at key junctions on the haul route is critical to ensuring that HCVs can manoeuvre safely at the junctions. At three junctions on the haul route, HCVs will be crossing traffic streams when manoeuvring from the minor arm to the major arm of the junction. The following is a brief description of the existing sight visibility at these three junctions.

Cross roads with the R314, the L1204 and the L5244 (Site 4)

The L1204 and R313 were upgraded to accommodate HCV traffic associated with the construction of Bellanaboy Bridge Gas Terminal. As part of these works, the junction of the R314/L1204 was upgraded with adequate visibility provided along the R314 for HCVs turning onto the Regional Road. The sight visibility at this junction did not have any negative implications on road safety during the construction stage for the Bellanaboy Bridge Gas Terminal. A profile of the sight visibility at the junction is shown in the plate 7.6.1.

Plate 7.6.1: Sight visibility looking east at Site 4

L1202 Local Road and R314 Junction (Site 5)

Sections of the L1202, including the junction with the R314, were upgraded as part of the Corrib Offshore Pipeline Landfall Works. The upgrade works improved the visibility along the R314 for HCVs accessing from the L1202. However, in order to maintain the sight visibility, maintenance of the verges and hedgerows is necessary to ensure that all vegetation remains cut-back on the R314. A profile of the sight visibility at the junction is shown in the plates 7.6.2 and 7.6.3 below.

Plate 7.6.2: Sight visibility at Site 5

(looking west)

Plate 7.6.3: Sight visibility at Site 5

(looking east)

R313/L1204/ An Srath Mór Junction (Site 8)

The junction of the R313 and the L1204 was upgraded as part of the improvement works for the Bellanaboy Bridge Gas Terminal construction haul route. The flat profile of the surrounding terrain and the broad splays at the intersection of the L1204 and the R313 provide adequate visibility along the R313. As the entrance to An Srath Mór (Srahmore) Peat Deposition Site is located directly opposite the L1204 and a significant number of HCV trips will be between Na hEachú and An Srath Mór (Srahmore), this would result in a number of HCV trips crossing the R313. From on-site observations it is considered that drivers would have adequate sight visibility distances to see HCVs crossing at this junction and that HCVs will have ample distance to see oncoming vehicles. A profile of the sight visibility at the junction is shown in the plate 7.6.4 and 7.6.5 below.

Plate 7.6.4: Sight visibility at Site 8

(looking east along the R313)

Plate 7.6.5: Sight visibility at Site 8

(looking west along the R313)

7.6 MITIGATION MEASURES

7.6.1 Operational Mitigation Measures

The development of the pipeline will have minimal traffic associated with it during its operation apart for safety checks and maintenance purposes. This means no mitigation measures will be required for the operational stage of the pipeline.

7.6.2 Construction Mitigation Measures

7.6.2.1 Road Upgrades

The traffic assessment confirms that the existing road network and proposed materials haul route for the onshore pipeline can cater for the overall construction traffic volumes generated by the scheme. However, the project aims to minimise the overall traffic impact of the construction phase on residents and on the general environment within the study area. With this in mind, a Traffic Management Plan has been developed by Tobin Consulting Engineers to actively manage the control of HCVs arriving/departing the site compounds at Na hEachú (Aghoos), Gleann an Ghad (Glengad) and An Srath Mór (Srahmore) and the times at which such traffic movements can occur.

The management of the movement of construction vehicles between the site compounds, the Bellanaboy Bridge Gas Terminal and the peat deposition site will draw on the experience of previous traffic management plans developed for the construction of the Terminal where significant amounts of peat were transferred from the Terminal site to An Srath Mór (Srahmore) in 2005 and 2007. During the construction period for the Terminal, the L1204 was upgraded to provide sufficient infrastructure for the transport of the peat. Also, the L1202 was upgraded from the junction with the R314 to Na hEachú (Aghoos) during the Landfall construction stage albeit some sections could not be upgraded at the time. Therefore, the roads on the haul route (R313, L1204, R314 and L1202) are of adequate quality to cater for HCV movements as far as the Na hEachú (Aghoos) where the majority of HCV movement will be generated.

In relation to the L1202 between Na hEachú (Aghoos) and Gleann an Ghad (Glengad), road widening and strengthening has been implemented on sections of the route. SEPIL in conjunction with Mayo County Council intend to undertake further works on the sections of the L1202, as outlined in Appendix E TMP, which is expected to be completed prior to the commencement of the Onshore Pipeline works. It is acknowledged that, not all the roads may be widened so ‘pinch points’ may remain for HCVs. However, as the number of HCV trips generated by the works at Gleann an Ghad (Glengad) will be significantly less than at Na hEachú and are significantly less than the landfall peak daily movements in 2009, it is considered that the ‘convoy’ system and traffic controls proposed in the Traffic Management Plan will ensure the safe movement of HCVs from Gleann an Ghad (Glengad).

In addition to the suitability of the road infrastructure for catering for HCV trips, the following restrictions are recommended to provide for an ordered and regulated system of traffic management for this operation. A number of mitigation measures are proposed as follows:

- To minimise any impacts on other road users and to maximise road safety on the haulage route, a comprehensive Traffic Management Plan has been developed (see Appendix E to outline how the construction traffic associated with the onshore pipeline will be marshalled and managed).

- Haulage traffic must share the route with forestry traffic, local residents, school buses, and other road users. The common usage of the local road network by haulage and local traffic presents risks. These risks will be reduced by proper road signs, regular communication, awareness of school bus runs, driver training and communication, speed controls and the maintenance of clean loading and unloading areas on the site;

- It is proposed that a minibus service will be implemented to bring site operatives to and from the construction site and the terminal site; Site operatives will park at the terminal and be bussed to the sites at Gleann an Ghad (Glengad) and Na hEachú (Aghoos);

- Although the construction works at Na hEachú (Aghoos) Site Compound (SC3) will be undertaken 24-hours a day/seven days a week, HCV movement associated with the construction stage will be restricted to the hours of 07:00 – 19:00, Monday to Friday, 08:00 – 16:00 on Saturday with no HCV movements on Sundays or Bank Holidays (However occasional abnormal loads may have to arrive at the Bellanaboy Bridge Gas Terminal outside these working hours due to permit requirements). To avoid the possible conflict between HCV movement and pedestrian movement at Poll an tSómais (Pollatomish) National School, HCV trips will be restricted to/from the Na hEachú during school opening and closing time periods. Special provision will also be made to restrict HCV movement during periods of irregular short term local traffic associated with large funerals at the local church in Na hEachú (Aghoos);

- All signage relating to the proposed construction routes for construction traffic must be positioned clearly and designed to the satisfaction of Mayo County Council. Advanced warning signs were positioned on the R313 to warn drivers of HCV movement as part of the construction works for the Bellanaboy Bridge Gas Terminal. It is recommended that these signs be provided on the R314 and L1202 on approaches to key junctions and the accesses to the site compounds. Drivers of vehicles failing to observe the signed routes will initially be given a warning and thereafter be subject to consequential actions;

- The maintenance of adequate sight visibility distances at key existing junctions and the proposed access to the compounds is essential. Therefore, all vegetation should be cut-back (in consultation with the project ecologist) and maintained to ensure that visibility isn’t restricted. In addition the street sign to the east of the An Srath Mór (Srahmore) Peat Deposition site will need to be set back accordingly to provide adequate sight visibility for cars;

- At areas of reduced carriageway width, where two trucks cannot safely pass, priority will be given to the laden vehicle and signage will be provided at such locations to warn drivers to this effect. A pause point for the yielding vehicles will also be provided at these locations. The implementation of an effective communications system will facilitate this proposal;

- A maximum speed limit of 60 km/hr will be imposed for HCVs on the Haul Route on the R313, L1204, R314, L1202 (between Na hEachú (Aghoos) and Gleann an Ghad (Glengad) on reduced widths sections of the L1202 the maximum speed limit varies between 30 km/hr and 50 km/hr) and all other local roads during the construction phase. A pacing vehicle will from time to time be deployed as part of the enforcement of this requirement;

- As part of the Traffic Management Plan drivers will be instructed to maintain, as far as possible, the separation between vehicles travelling in the same direction so that the space available for locally widened sections at areas of poor sight distance, and where oncoming traffic must yield, need not be designed to accommodate more than two vehicles waiting. The separation distances may vary on direction from An Garda Síochána. In any queuing situation on the local road network drivers will be instructed to maintain a minimum separation of 20m from each other and from entrances to dwellings so that safe visibility around each vehicle can be maintained;

- SEPIL is proposing to reinstate the proposed haul route following the completion phase, to be agreed with Mayo County Council. It is proposed that a pre and post construction survey of the route be undertaken and that the route be reinstated to its original condition;

- At points where construction related vehicles travel from the works area onto the public road network they will be inspected and cleaned where necessary. The public road network in the vicinity of the works will be inspected daily and will be maintained as required. Road cleanliness will be maintained using road sweepers. In dry, windy periods site roads used for the construction works will be sprayed where required with water to prevent raising dust;

- Whilst parking will be provided on site for both employees and visitors, restrictions will be put in place to ensure only designated parking areas are used. Parking will not be allowed on the local roads surrounding the construction sites associated with the development.

7.7 RESIDUAL IMPACTS

The proposed development has been assessed with the recommended mitigation measures detailed in this traffic impact assessment. The results show that no operational difficulties are expected and that the adverse traffic impacts during construction can be satisfactorily mitigated. It can be stated, therefore, that the overall impact of the onshore pipeline construction in terms of traffic will be imperceptible.

8 AIR QUALITY AND CLIMATE

8.1 INTRODUCTION

This section describes the potential impacts to ambient air quality and climate from the proposed development. Particular attention is given to sensitive receptors, including local houses and ecosystems adjacent to the project, and to the potential exposure of these receptors to airborne pollutants resulting from the proposed development.

There will be no direct impacts on local air quality as a result of the operation of the proposed Corrib Onshore Pipeline development. Impacts to air quality will arise during the construction phase, such as from the generation of construction dust, construction plant emissions and from emissions of construction traffic. The construction activities have been examined to identify those that have the potential for air emissions. Where applicable, a series of suitable mitigation measures have been listed.

There will be no direct impacts on climate as a result of the operation of the proposed Corrib Onshore Pipeline development, although activities during the construction phase of the development have the potential to generate greenhouse gases. These emissions are produced by the generation of construction materials, construction machinery, etc. as well as through the disturbance of peat for pipe laying. Greenhouse gas emissions from these sources have been quantified using standard procedures.

8.2 METHODOLOGY

The methodology to assess the impacts on air quality and climate involved a series of site visits and desktop assessments as described in Sections 8.2.1 and 8.2.2.

8.2.1 Site Visits

A series of site visits were conducted in the period 2007 to 2010 to determine the nearest sensitive receptors, the land use along the proposed route and the local topography. In addition, existing sources of air pollution were noted.

8.2.2 Desk-top Assessment

A desktop assessment was carried out to determine the potential impacts of the proposed development on the local and regional air quality and on greenhouse gas emissions. This involved a review of:

- Existing air monitoring data to determine baseline air quality;
- Relevant assessment criteria (see Section 8.2.2.1) to estimate and evaluate the impact of the proposed scheme on air quality (at sensitive receptors) and climate;
- Construction details (see Chapter 5) and it's potential for generation of dust (see Section 8.2.2.2);
- Construction details and the potential for construction plant emissions to impact on local residential and ecological receptors (see Section 8.2.2.3);
- Construction related traffic (see Section 8.2.2.4 and Chapter 7). Predictive air quality modelling of predicted impacts of construction traffic (regional and local) has been carried out;
- Construction details (see Chapter 5) and levels of peat disturbance were assessed to determine potential greenhouse gas emissions (see Section 8.2.2.5).

8.2.2.1 Assessment Criteria – Air Quality

Certain combustion products have the potential to affect health and European Union air quality standards are specified to ensure air emissions do not exceed levels that are designed to protect human health and ecosystems.

The European Commission (EC) has formally adopted the Air Quality Framework Directive (96/62/EC). The first daughter Directive, 99/30/EC (adopted April 1999), set specific limits for four air pollutants: nitrogen dioxide, sulphur dioxide, Particulate Matter (PM_{10}) and lead. In December 2001, the EC adopted the second daughter Directive, 2000/69/EC, relating to limit values for benzene and carbon monoxide (CO) in ambient air. These Directives have been transposed into Irish legislation by the Air Quality Standards Regulations, 2002 (SI No. 271 of 2002). Two further daughter Directives have come into force relating to ozone (third daughter Directive) and polyaromatic hydrocarbons, arsenic, nickel, cadmium and mercury (fourth daughter Directive) in ambient air under separate national legislation.

The original Air Quality Framework Directive and first three daughter Directives are due to be replaced by one over-riding European Directive (2008/50/EC published in May 2008 and known as the “CAFE Directive”) which is due to be transposed into Irish law by June 2010. However, the specified limits for the protection of human health will remain unchanged from those specified in SI No. 271 of 2002. In addition to the limits for the existing parameters, this new Directive sets an annual “target value” for the smaller particulate fraction ($PM_{2.5}$) for the protection of human health.

The above standards have been set by environmental and health professionals across Europe following extensive worldwide research and are designed to protect the most sensitive of receptors, including for example elderly humans with existing respiratory ailments and areas valued for their flora and fauna.

The effects on human health and ecosystems of the various compounds discussed in this Chapter are summarised in Section 8.4.

Various international initiatives, protocols and Directives also exist to limit and reduce emissions at a national level.

The following criteria were considered in the assessment of impact on air quality:

- Air Quality Standards Regulations (S.I. No. 271 of 2002).
- Directive 2001/81/EC on National Emission Ceilings for certain pollutants (NECs) (S.I. No. 10 of 2004).
- There are no statutory limits for deposition of dusts and industry guidelines are typically employed to determine any impact. The TA Luft (German Government ‘Technical Instructions on Air Quality’) states a guideline of 350 mg/m^2/day for the deposition of non-hazardous dusts. This value was used to determine the impact of residual dust as an environmental nuisance.
- The National Roads Authority (NRA) has published guidance for assessing dust impacts from road construction (‘Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes’). This has been used to determine the potential impacts from the proposed construction site operations.

In terms of impacts on climate, the EIS aims to identify and assess the sources and describe the measures in place to minimise releases of compounds with global warming potential. The residual generation of these compounds during the construction phase has been quantified. Many natural and human activities generate releases that can contribute to global warming. Due to the diverse and diffusive nature of sources, the effect that releases from the proposed development have on global warming cannot be specifically quantified within this EIS, however, a conservative quantification of total greenhouse gas emissions is presented.

Reference is made to Ireland's commitment to reduce greenhouse gases nationally. The National Kyoto Target for the first commitment period 2008 – 2012 sets the cap on GHG Emissions at 13% above 1990 levels, equivalent to 62.837 million tonnes of CO_{2eq}. The most recent data submitted by Ireland to the UNFCC in April 2010 indicated that National GHG Emissions in 2008 were 67.44 million tonnes (7.3% above the Kyoto target).

Appendix G provides further details on the aforementioned standards.

8.2.2.2 Construction Dust

Construction dust has the potential to cause local impacts through dust nuisance at the nearest houses and also to sensitive ecosystems.

The potential for dust generation from the construction activities associated with the proposed development has been assessed on the basis of a review of the construction methodologies for the project (see Chapter 5) and the proximity of these methodologies to sensitive receptors. Construction activities such as material importation, excavation, earth moving, material export and backfilling may generate quantities of dust, particularly in dry weather conditions. The extent of any dust generation depends on the nature of the dust (soils, peat, sands, gravels, silts etc.) and the nature of the construction activity. In addition, the potential for dust dispersion and deposition depends on local meteorological factors such as rainfall, wind speed and wind direction (see Section 8.3.2).

A dust risk assessment has been undertaken using the procedures presented in the National Roads Authority (NRA) "Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes".

8.2.2.3 Construction Plant Emissions

In order to power the tunnel boring machine and associated separation plant, it is proposed to include three large diesel generators at the tunnelling compound in Na hEachú (Aghoos). These generators will operate continuously throughout the tunnel boring and will emit combustion gases such as oxides of nitrogen, particulate matter and carbon monoxide. The potential impact of the emissions from the generator system employed to power the tunnel boring machine and separation plant have been quantified using a refined air dispersion model

The air dispersion model employed is the US EPA AERMOD model, which is the approved regulatory model in the US and widely used in Europe. The model has incorporated standard emission factors, local meteorological conditions and local topography to simulate the dispersion characteristics to determine the impact on sensitive receptors. All results presented are compared to the statutory limits for the protection of human health and ecosystems (S.I. 271 of 2002).

8.2.2.4 Construction Traffic

Emissions from construction related traffic have been assessed in terms of their potential for local impact on human health and sensitive ecosystems and the regional impact.

The main pollutants of concern from traffic emissions in terms of local impact are carbon monoxide, benzene, hydrocarbons, nitrogen oxides and particulate matter PM_{10}, and these are compared to the relevant statutory limits on air quality. On a regional scale the main pollutants of concern from traffic are oxides of nitrogen and hydrocarbons and these are presented in terms of Ireland's commitments under the trans-boundary air pollution regulations.

A prediction of the local impact of traffic-derived pollution was carried out using the Local Assessment model in the Design Manual for Road and Bridges (DMRB), Volume 11, Section 3, Part 1 as per the NRA guidelines for assessment of impacts to air from road transport. Construction traffic data was provided in the form of Annual Average Daily Traffic (AADT) for the existing scenario and maximum construction operations (see Chapter 7).

The regional impact of the construction phase of the project has been assessed in terms of the total mass of pollutants emitted using the Regional Assessment model in the Design Manual for Road and

Bridges (DMRB). This calculation is based on the AADT figures provided in the Traffic Impact Assessment (see Chapter 7) for the road network under both the existing scenario and the peak construction scenarios.

8.2.2.5 Greenhouse Gas Emissions

This assessment has been carried out to identify sources and quantify total greenhouse gas (GHG) emissions generated from the construction activities. The assessment has been carried out using the carbon calculator tool developed by the Environment Agency in the UK specifically for construction projects. The carbon calculator calculates the embodied carbon dioxide (CO_2) of materials plus CO_2 associated with their transportation. It also considers personal travel, site energy use and waste management.

In addition to the above construction activities, the disturbance of peat may also have a climate impact through net carbon losses to atmosphere. In June 2008, the Scottish Government published a methodology for "Calculating Carbon Savings from Wind Farms on Scottish Peatlands – a new approach", prepared by the University of Aberdeen. While this methodology is principally aimed at wind farms, it does contain detailed calculations for the quantification of carbon losses from peat disturbance that may be applied to any construction project in peat areas such as the Corrib Onshore Pipeline.

8.3 EXISTING ENVIRONMENT

The following section describes the existing environment in terms of air quality and climate, including meteorological conditions and existing sources of air pollution in the vicinity of the proposed pipeline route. Information on the nearest sensitive receptors is also outlined.

8.3.1 Existing Air Quality

The EU Air Framework Directive deals with each EU Member State in terms of Zones and Agglomerations for Air Quality. For Ireland, four zones, A, B, C and D have been defined and are included in the Air Quality Standards (AQS) Regulations (SI No 271 of 2002). County Mayo has been classified as falling within Zone D - Rural Ireland.

While there is some availability of recent and historic data for air quality in Castlebar, there is limited data available from the national air quality monitoring database for air quality specifically in this rural part of County Mayo. As such, available data from the EPA Monitoring Site at Kilkitt in Monaghan, which is a similar Zone D (rural) location, has been referenced for Nitrogen Oxides, Sulphur Dioxide and PM_{10} levels (see Appendix G for background data) and is considered representative of background air quality in the study area. The following sub-sections provide details on the sources of these emissions and the background levels at Kilkitt. In addition, baseline air quality data reported in the Bellanaboy Bridge Gas Terminal EIS has been examined to verify the data.

8.3.1.1 Nitrogen Oxides

Nitrogen dioxide is classed as both a primary pollutant and a secondary pollutant. As a primary pollutant NO_2 is emitted in small concentrations from all combustion processes (such as a gas/oil fired boiler or a car engine). As a secondary pollutant NO_2 is derived from the atmospheric oxidation of NO_x.

Air quality data from Kilkitt show levels are below the relevant air quality limits for each year in the period 2003 to 2008. The annual average concentration of 2-3$\mu g/m^3$ is typical of rural background locations and this is considered indicative of the area of the proposed development. This is supported by the baseline air quality assessment undertaken for the Gas Terminal EIS in which monitoring in 2001, 2002 and 2003 indicated an annual average NO_2 concentration in the region of 2$\mu g/m^3$. Therefore, it has been assumed with some confidence that background NO_2 levels in the area are less than 5$\mu g/m^3$ compared to the annual limit for the protection of human health of 40$\mu g/m^3$.

8.3.1.2 Sulphur Dioxide

Sulphur dioxide is classed as a primary pollutant. It is principally emitted from the combustion of fossil fuels (diesel, coal, oil, etc.). As a traffic based pollutant, SO_2 is mainly emitted from vehicles running on diesel fuel, which will include most light goods vehicles (LGVs) and heavy goods vehicles (HGVs). The "Air Pollution Act 1987 (Environmental Specifications for Petrol and Diesel Fuels) Regulations 2003" (SI No. 541 of 2003) provided for the marketing of petrol and diesel fuels with a maximum sulphur content of 10mg/kg ("sulphur free") from 1 January 2005 and since January 2009 all petrol and diesel sold in the state is required to be "sulphur-free". As such, sulphur dioxide emissions from diesel powered engines (road vehicles, mobile plant, generators, etc.) are not considered significant. SO_2 emissions from burning of solid fossil fuels are the main cause of "sulphurous smog" in urban areas.

The air quality data from Kilkitt show background SO_2 concentrations (annual averages 2-3 $\mu g/m^3$) below the relevant air quality limits for all averaging periods in the years 2003 to 2008. Levels are typical of rural background SO_2 concentrations and represent the annual average concentrations in rural areas in Ireland where there is an absence of major sources of SO_2. These levels are verified by the baseline SO_2 monitoring undertaken for the Gas Terminal EIS where an average background SO_2 concentration of 2 $\mu g/m^3$ was detected in three monitoring periods between 2001 and 2003. Therefore it has been assumed with some confidence that background SO_2 levels in the area are less than 5$\mu g/m^3$ compared to the annual limit for the protection of human health of 20$\mu g/m^3$.

8.3.1.3 Particulate Matter (PM_{10})

Particulate matter (PM_{10}) is considered a primary pollutant. It arises from road vehicle exhausts and other machinery. Point sources such as combustion, i.e. domestic fires, industrial boilers etc. are also sources of PM_{10}. In addition, natural sources of PM_{10} include re-suspended dusts and sea salts in coastal areas such as the location of the proposed pipeline route. PM_{10} may also be formed as secondary pollutants from the condensation or reaction of chemical vapours in the atmosphere.

The concentrations of PM_{10} measured at Kilkitt indicate an annual average of 10-15 $\mu g/m^3$ in the period from 2006 to 2008. This is verified by the levels detected during the baseline monitoring carried out for the Terminal EIS where the average PM_{10} levels detected were 12.4$\mu g/m^3$. EPA monitoring undertaken at Castlebar between 2005 to 2008 indicate annual averages of the range of 14-16 $\mu g/m^3$. However, these levels are considered more representative of an urban environment and not indicative of the site of the proposed development. It has been assumed with some confidence that background PM_{10} levels in the area are of the order of 10-15$\mu g/m^3$ compared to the annual limit for the protection of human health of 40$\mu g/m^3$.

8.3.1.4 Particulate Matter ($PM_{2.5}$)

Particulate Matter ($PM_{2.5}$) has similar effects on health as PM_{10}, however, $PM_{2.5}$ is a better indicator of anthropogenic (man-made) emissions. Fine particulate matter $PM_{2.5}$ can be responsible for significant negative impacts on human health.

Currently the EPA only carries out $PM_{2.5}$ monitoring at one location nationally. This is the Old Station Road monitoring location in Cork (Zone B) and not representative of the area of the proposed works. The EPA have published a research report entitled "Nature and Origin of PM_{10} and Smaller Particulate Matter in Urban Air" in 2006 which examined the relationship between PM_{10} and $PM_{2.5}$ in Ireland. The study found that consistently between urban, rural and coastal locations in Ireland, the $PM_{2.5}$ fraction of PM_{10} is approximately 60%. Applying this fraction to the PM_{10} concentrations determined in Kilkitt would lead to an approximate $PM_{2.5}$ annual average of 6-9$\mu g/m^3$ compared to the annual target value for the protection of human health of 25$\mu g/m^3$ (2008/50/EC). This range of 6-9$\mu g/m^3$ (as an annual average $PM_{2.5}$) is considered indicative of the air quality in the area of the proposed development.

8.3.1.5 Total Suspended Particulates (Dust)

Health affects associated with dusts are typically associated with finer particulates such as PM_{10} discussed above. More commonly, dusts are associated with causing an environmental nuisance to residential, ecological and agricultural receptors. A guideline level for the prevention of dust nuisance is the TA Luft guideline of 350 mg/m^2/day as an annual average of monthly results. Background levels of dust in rural areas would typically demonstrate levels of 50-150 mg/m^2/day, dependent on the weather and seasonal agricultural practices in the area (e.g. ploughing, harvest time, etc.).

Dust is not a pollutant regulated by national or European legislation and is therefore not included in the national monitoring network. However, ongoing dust monitoring is carried out at the site of the Bellanaboy Gas Terminal site since February 2005 and the results are published on the Mayo County Council website. Monitoring is undertaken on a monthly basis at the four boundary locations of the site and average results over the period range from 138 mg/m^2/day at the north of the site to 151 mg/m^2/day to the south and east of the site. Dust levels at the site are maintained below the guideline for dust nuisance through a dedicated dust management plan and dust mitigation measures. In the five years of monthly monitoring undertaken at these four locations, only five validated measurements have been reported over the TA Luft guideline of 350 mg/m^2/day, representing a 97% compliance rate.

8.3.2 Meteorological Conditions

8.3.2.1 Microclimate

The landscape along the route and the surrounding area is gently undulating with rounded grassland that is extremely open due to the lack of topographical features and tall vegetation. The prevailing wind direction is from the west-southwest. However, localised land-sea effects, land to lake effects and the influence of hills on wind direction can be expected. Such effects are likely to lead to higher localised winds than would otherwise be the case, again aiding dispersion.

Poor dispersion can occur under certain weather characteristics known as inversions that form in very light or calm wind and stable atmospheric conditions. The wind rose illustrated in Figure 8.1 identifies that such wind conditions are very infrequent (2.8% of hours in the year 2009).

8.3.2.2 Meteorological Data

The nearest meteorological station to the area is the Met Éireann Station in Béal an Mhuirthead (Belmullet) which lies approximately 14km south west of the area of Gleann an Ghad (Glengad).

The weather in the area is influenced by the Atlantic Ocean, resulting in mild, moist weather dominated by maritime air masses. The prevailing wind direction in Ireland is from a quadrant centred on west-southwest. These are relatively warm winds from the Atlantic and frequently bring rain. Easterly winds are weaker and less frequent and tend to bring cooler weather from the northeast in spring and warmer weather from the southeast in summer.

The 30-year averages from the station at Béal an Mhuirthead (Belmullet) are presented in Table 8.1 below.

Table 8.1: 30-year Average Meteorological Data from Béal an Mhuirthead (Belmullet) (Annual Values from 1961-1990, source: www.met.ie.

Parameter	30-year Average
Mean Temperature (^{0}C)	9.6
Mean Relative Humidity at 0900UTC (%)	83
Mean Daily Sunshine Duration (hours)	3.5
Mean Annual Total Rainfall (mm)	1142.7
Mean Wind Speed (knots)	13.1

The prevailing wind direction for the area is between west to southwest as presented in the windrose for Belmullet Met Station in 2009 in Figure 8.1. Southerly and easterly winds tend to be very infrequent. Wind characteristics vary between a moderate breeze to gales (average 30.5 days with gales per annum). Monthly average wind speeds range between 11.3 and 14.7 knots with highest wind speeds occurring during winter months (December and January). Lowest wind speeds were recorded in the June, July and August period.

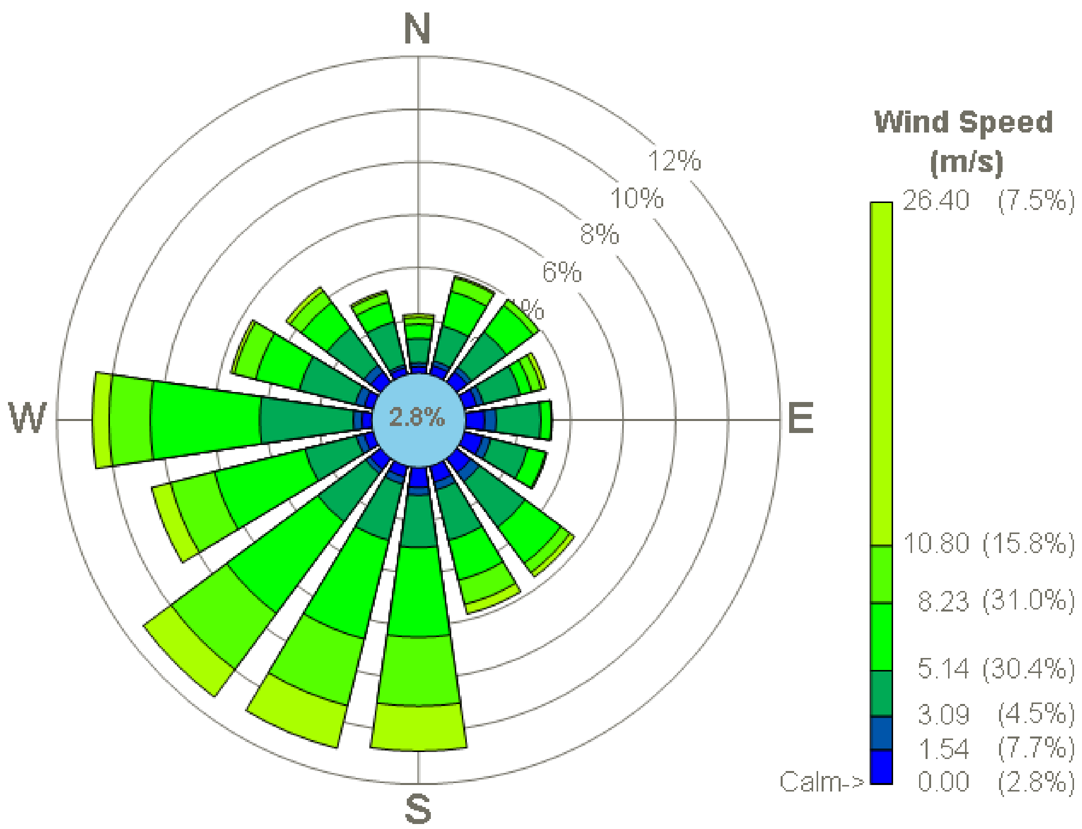


Figure 8.1: Windrose for Belmullet Met Station 2009

8.3.3 Existing Sources of Air Pollution

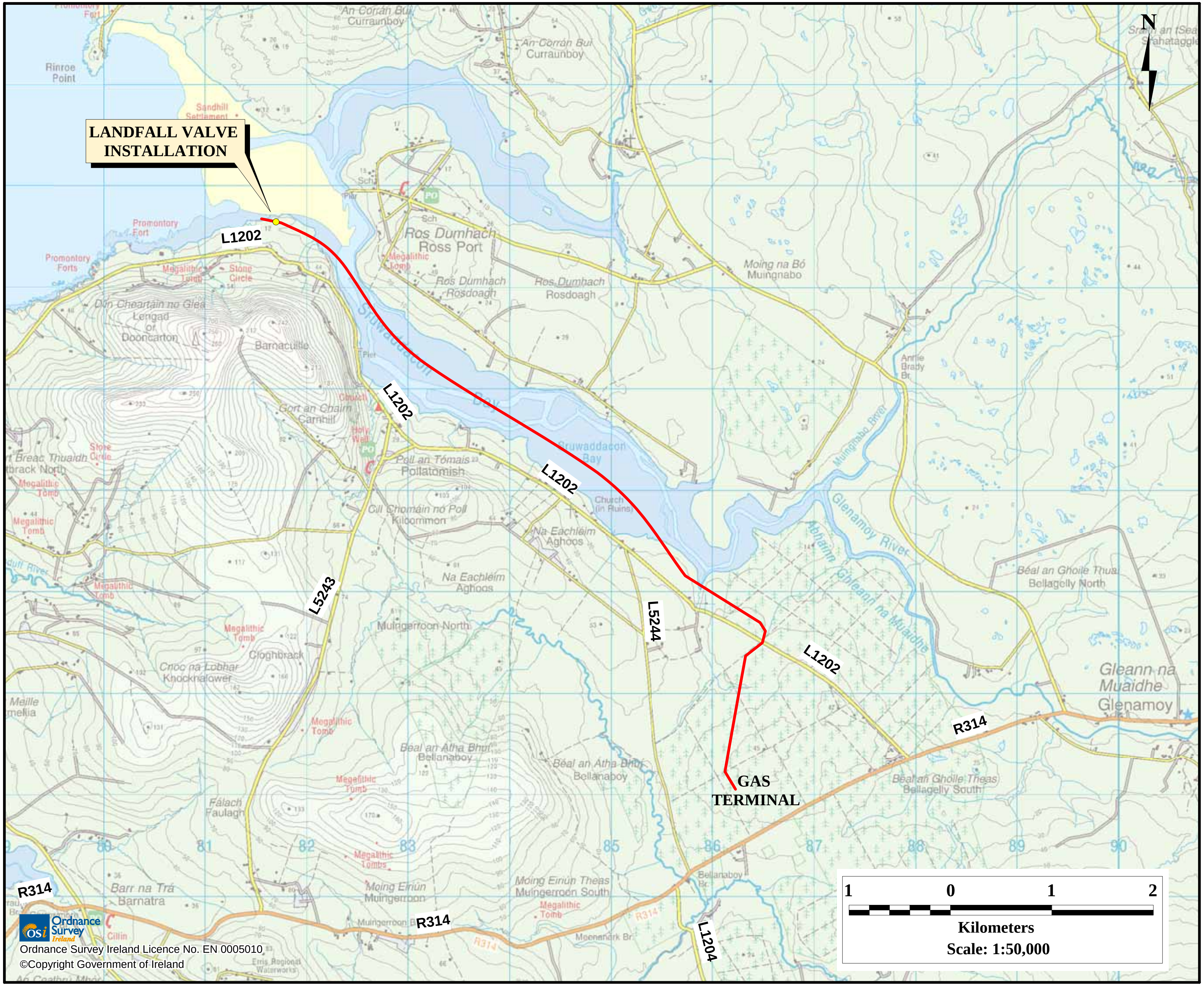
Given the location of the site on the west coast and the nature of the prevailing westerly winds, the area is expected to experience clean Atlantic air with only background levels of pollutants. There are no major sources of air pollution in the area, apart from agricultural activities and road traffic. The only major non-agricultural source of greenhouse gas emissions in the area, the 40MW peat fired power station in Bellacorick, ceased operation in 2004. As such, air quality in the area is considered very good.

The main source of air pollution in the area is emissions from vehicles using the local road network. There is a network of third class roads around the area of Sruwaddacon Bay and the R314 running east/west south of the bay (see Chapter 7 and Figure 8.2). The low volumes of traffic on these roads may have a minor impact on air quality, however, as the traffic is free flowing the potential for traffic congestion and elevated levels of pollution is not considered high.

8.3.4 Sensitive Receptors

There are a number of houses along the L1202 road around Gleann an Ghad (Glengad) at a distance 250m south of the proposed construction compounds at Gleann an Ghad, i.e. Site Compounds SC1 (LVI installation) and SC2 (the tunnel reception compound). Similarly, at the proposed tunnelling compound in Na hEachú (Aghoos) (tunnelling compound SC3), the nearest sensitive residential receptors are approximately 350 metres to the west of the compound.

In addition, to the site compounds, houses along the proposed haul routes (see Chapter 7 and Figure 7.7) will also be subject to any changes in local air quality during the construction stage. The proposed haul route is from the Gleann an Ghad Site Compounds (SC1 - LVI installation and SC2 - the tunnel reception compound) to Na hEachú (Aghoos) (Site Compound SC3) along the L1202 to the



LEGEND:

Proposed Route

Air Quality -
Local Road Network

Figure 8.2

File Ref: COR25MDR0470Mi2150A03
Date: May 2010

CORRIB ONSHORE PIPELINE

R314 to the southeast of the bay. From the R314 construction traffic will travel along the L1204 to the R313 west of Baingear (Bangor).

There are several designated conservation sites in the area (see Preface to Section C 'Natural Environment' in this EIS), which are also considered to be sensitive receptors.

8.4 POTENTIAL IMPACTS

8.4.1 Operation Phase – Air Quality and Climate

There are no planned emissions from the proposed development during operation and therefore there will be no impacts on air quality.

8.4.2 Construction Phase – Air Quality and Climate

The following sections describe the potential impacts on air quality resulting from the construction phase of the proposed development. The impacts have been assessed on a local scale to determine impact on human health. An assessment of the emissions in the context of national emission targets has also been carried out.

The aspects considered include:

- Construction dust and its potential to impact on sensitive receptors and to cause an environmental nuisance;
- Construction plant emissions and their potential to cause significant impact on human health and/or sensitive ecosystems; and
- Construction traffic related emissions and their potential for impacts on sensitive receptors along haul routes.
- Greenhouse gas emissions from construction operations and peat disturbance.

The impacts are assessed in the following sections with respect to the relevant assessment criteria where appropriate.

8.4.3 Local Impacts to Air Quality

8.4.3.1 Construction Dust

Construction activities such as excavation, earth moving and backfilling can generate dust, particularly in dry weather conditions. The extent of dust generation will depend on the nature of the dust (soils, peat, sands, gravels, silts etc.), location of the main site compounds and the construction activity. In addition, the potential for dust dispersion depends on the local meteorological factors such as rainfall, wind speed and wind direction (see Section 8.3.2). Vehicles transporting material to and from the site also have the potential to cause dust generation along the selected haul routes from the construction areas (see Chapter 7).

Table 8.2 presents a list of distances within which dust could be expected to result in a nuisance from construction sites for impacts such as soiling (dust nuisance), PM_{10} deposition and vegetation effects. This data has been taken from guidance published by the National Roads Authority for roads schemes but is considered applicable to this linear project. These distances present the potential for dust impact with standard mitigation in place.

Table 8.2: Assessment criteria for the impact of dust from construction, with standard mitigation in place (Source: National Roads Authority, 2006)

Source		Potential distance for significant effects (distance from source)		
Scale	**Description**	**Soiling**	**PM_{10}**	**Vegetation effects**
Major	Large constructions sites, with high use of haul roads.	100m	25m	25m
Moderate	Moderate sized construction sites, with moderate use of haul roads.	50m	15m	15m
Minor	Minor construction sites, with limited use of haul roads.	25m	10m	10m

Using this screening assessment tool, at a large construction site there is a risk that dust may cause an impact at sensitive receptors within 100m of the source of the dust generated. In Table 8.3, a list of the provisional site compounds for the proposed construction phase have been presented in conjunction with the scale of each site as outlined in Table 8.2. The provisional location of each compound is presented in Figure 5.2 in Chapter 5 but described briefly in the table. Also listed in the table are the approximate distances to the nearest sensitive residential and ecological receptor.

Table 8.3: Scale and location of proposed temporary site compounds and approximate distances to sensitive receptors

Temporary Source	Scale	Location	Approx distance to Residential Receptor	Approx. distance to Ecological Receptor
Site Compound 1	Moderate	LVI at Gleann an Ghad (Glengad).	250m	Within cSAC
Site Compound 2	Moderate	Tunnel Reception Compound – Gleann an Ghad (Glengad).	250m	Within cSAC
Site Compound 3	Major	Tunnel Launch Compound – Na hEachú (Aghoos).	350m	50m
Site Compound 4	Moderate	Support Compound – Na hEachú (Aghoos)	500m	600m
Site Compound 5	Moderate	Terminal	700m	2,000m

All site compounds and the temporary working area along the route can be considered of moderate to major scale and therefore potential distance of significant effects would be maximum 100m (see Table 8.2).

Site compounds 1 and 2 in Gleann an Ghad (Glengad) are partially located within the Glenamoy Bog Complex cSAC. Similarly Site compound 3 in Na hEachú (Aghoos) is located adjacent to the Glenamoy Bog Complex cSAC. Given the proximity of construction in these areas to the designated site, there is a risk of dust impacts on the cSAC. However, stockpiling of materials will be minimised in those compounds located within the cSAC thereby reducing the potential for dust generation at these locations. Additional mitigation measures have been specified for these higher risk construction areas in Section 8.5.1.1.

As all construction site compounds are located at sufficient distances (i.e. greater than 100 metres) away from residential receptors, dust related impacts to residential receptors will be minimal.

In terms of dust impacts on local agricultural properties, it is predicted that the levels of dust generated by the construction activity will be similar to the existing background levels generated by typical agricultural activities and the impact is considered negligible.

8.4.3.2 Construction Plant Emissions

The tunnelling process requires the use of a series of three diesel generators at the Na hEachú (Aghoos). For the purposes of this assessment it has been assumed that these generators (two 1MW generators and a 0.5MW generator) will operate full time for the duration of tunnelling works to power to tunnel boring machine, separation plant and site compound.

The results of the modelling, incorporating background concentrations, are presented in Table 8.4. All results presented are compared to the statutory limits for the protection of human health (S.I. 271 of 2002), with the exception of $PM_{2.5}$, which is compared to the annual target value presented in Directive 2008/50/EC.

Table 8.4: Predicted impact of generator emissions from the Aghoos Tunnel Compound (SC3)

Parameter	Averaging Period	Background	Predicted Impact from Generators	Total Predicted Impact	Limit for the Protection of Human Health
Nitrogen Dioxide (NO2)	Annual Average	3 μg/m3	0.74 μg/m3	3.74 μg/m3	40μg/m3
	Hourly Maximum	6 μg/m3	52μg/m3	58 μg/m3	200μg/m3
Nitrogen Oxides (NOx)	Annual Average	4 μg/m3	1.49 μg/m3	5.49 μg/m3	30μg/m3
Particulate Matter PM10	Annual Average	10 μg/m3	0.09 μg/m3	10.09 μg/m3	40μg/m3
	24-hour Average	10 μg/m3	1.49 μg/m3	11.49 μg/m3	50μg/m3
Carbon Monoxide	8-hour limit	0.4 mg/m3	0.02 mg/m3	0.42 mg/m3	10 mg/m3
Particulate Matter PM2.5	Annual Average	6 μg/m3	0.09 μg/m3	6.09 μg/m3	25 μg/m3

The results indicate that the predicted impact to air quality of the operation of the generators on the Aghoos tunnelling compound on the nearest residential dwellings will be a slight adverse impact in the short term. This is based on a "large" increase in annual average NO_2, albeit well below the limit for the protection of human health. The nearest residential receptors are those approximately 350 metres west of the compound.

It should be noted that the results indicate that the annual average levels of nitrogen dioxide at these houses will be less than 10% of the annual limit for the protection of human health. In addition, based on the EPA air quality index, the air quality in this area will remain in the range of "good" to "very good" with the generators in operation.

8.4.3.3 Construction Traffic Emissions

Construction traffic can impact on local air quality. In particular, the proposed haul routes used for deliveries and any sensitive receptors that line these routes may experience the impacts to local air quality. The potential impact of this construction traffic was quantified by employing the peak month traffic figures presented in Chapter 7 as a worst case scenario. The detailed results of the modelling exercise are presented in Appendix G and the summary impacts for each road in the network are presented in Table 8.5.

Table 8.5: Predicted impact of traffic pollutants on the road network during peak construction and post construction

Road Section	Impact During Peak Construction	Impact Post Construction
R313 west of junction with R314	Negligible	Negligible
R313 east of junction with R314	Negligible	Negligible
R313 west of Junction with L1204	Slight Adverse	Negligible
R313 east of junction with L1204	Slight Adverse	Negligible
R314 north of junction with R313	Negligible	Negligible
R314 west of junction with L5243	Negligible	Negligible
R314 west of junction with L1204	Negligible	Negligible
R314 west of junction with L1202	Moderate Adverse	Negligible
R314 east of junction with L1202	Negligible	Negligible
R314 east of junction with L1203	Negligible	Negligible
L1204 north of junction with R313	Moderate Adverse	Negligible
L1202 west of junction with R314 up to Na hEachú (Aghoos) Compound	Moderate Adverse	Negligible
L1202 west of Na hEachú (Aghoos) Compound	Slight Adverse	Negligible
L1202 south of An tInbhear (Inver)	Negligible	Negligible
L1203 west of junction with R314	Negligible	Negligible
L5243	Negligible	Negligible
L5244	Negligible	Negligible

The results of the air quality modelling predict varying impacts along the proposed haul routes with peak month construction traffic in operation. At all locations the predicted air quality levels associated with the construction traffic are significantly lower than the relevant air quality limits (see Appendix G, Table 1A.1) for the protection of human health.

The proposed haul routes for the gas pipeline are along the R313 east and west of the junction with the L1204, north along the L1204 to the R314, along the R314 to the L1202 for traffic up to the main tunnelling compound at Na hEachú (Aghoos) with some minor traffic continuing to the tunnel reception compound and LVI site at Gleann an Ghad (Glengad) (refer Chapter 7, Figure 7.7). The proposed haul route for the removal of peat to the An Srath Mór (Srahmore) site is also along the L1202 onto the R314 and south along the L1204 to the R313.

For the section of haul route along the R313 (both east and west of the junction with the L1204) the impact as a result of peak construction traffic is considered "large" (NRA terminology) and as such, the worst-case receptors along this road will experience a "slight adverse" impact to air quality during the peak month of construction traffic. Along the L1204, along the R314 between the junctions with the L1202 and L1204 and finally along the L1202 to the main tunnelling compound at Na hEachú (Aghoos), the impact as a result of the construction traffic is considered to be "very large" (NRA terminology) during peak construction. All sensitive receptors along this route will experience a "moderate adverse" impact to air quality in the short term (1-2 years). It should be noted that the levels of pollutants at all sensitive receptors along these routes will remain well below the limits for the protection of human health, even during peak construction traffic.

There is some construction traffic proposed for L1202 between the compounds at Na hEachú (Aghoos) and Gleann an Ghad (Glengad). As these traffic volumes are considerably lower than the main haul routes above, the resultant impact to air quality along this route is considered "small" (NRA terminology) and the magnitude of impact is considered "slight adverse" in the short term. Sensitive receptors (including the primary school in Poll an tSómais (Pollatomish)) along this section of the

L1202 will experience a “slight adverse” impact to air quality in the short term (1-2 years) but the levels of pollutants will remain well below the limits for the protection of human health, even under peak construction traffic.

For all other roads in the local network that are not proposed as haul roads the impact to air quality is considered negligible. Similarly, once construction is completed the impacts to air quality from traffic associated with the project on all roads are considered negligible.

In summary, the impacts of the construction traffic on the local road network and proposed haul routes (see Chapter 7) is predicted to range from negligible to moderate adverse over the short term of the construction period. It should be noted that these predictions are based on peak estimated construction traffic and represent the maximum impact. In addition, the predicted ground level concentrations of all pollutants are predicted to be within the relevant statutory limits for the protection of human health at all times.

8.4.3.4 Cumulative Combustion Emissions

There are a number of residential dwellings along the construction haul route at the southern section of the L1202 road that will be near enough to experience an impact from the construction plant emissions as well as traffic emissions from construction vehicles. The residential receptors concerned are those along the L1202 directly north of the Na hEachú (Aghoos) site entrance and directly west of the site compound.

The potential cumulative impact of both sources is assessed against the statutory limits for the protection of human health (S.I. 271 of 2002). The assessment concentrates on nitrogen dioxide and particulate matter (PM_{10}) as these are the pollutants of greatest concern to human health.

The residential receptors concerned are those along the L1202 directly north of the Na hEachú (Aghoos) site entrance and directly west of the site compound. The results for the worst case receptor (i.e. the receptor predicted to experience the greatest impact) are presented in Table 8.6. All other sensitive receptors in the area are predicted to experience levels lower than those presented in this table.

Table 8.6: Predicted cumulative impact (worst case) at receptors on the section of the L1202 north of the site entrance.

Parameter	Averaging Period	Background (µg/m3)	Impact from Plant Emissions (µg/m3)	Impact from Traffic Emissions (µg/m3)	Total Cumulative Impact (µg/m3)	Limit for the Protection of Human Health
Nitrogen Dioxide (NO2)	Annual Average	3	0.74	0.49	4.23	40µg/m3
Particulate Matter PM10	Annual Average	10	0.09	0.11	10.20	40µg/m3

The results indicate that the predicted annual average NO_2 concentration will increase by 41% as a worst case (peak construction and all generators operating). This percentage increase on the existing baseline levels is considered to be “very large” (NRA terminology) and will lead to a moderate adverse impact on these receptors over the short term of the construction operation. It should be noted that the results indicate that the annual average levels of nitrogen dioxide at these houses will be less than 11% of the annual limit for the protection of human health.

8.4.3.5 Potential Impact on Sensitive Ecosystems

The principal pollutants of concern for sensitive ecosystems are nitrogen oxides. Nitrogen oxides may have a positive or negative impact by acting as a fertiliser or a phytotoxicant. The potential impact of exposure of plants to nitrogen oxides are mainly on growth, photosynthesis and nitrogen assimilation/metabolism.

The National Roads Authority (NRA) has developed guidelines for the assessment of the significance of impact of construction projects on sensitive ecosystems. These guidelines state that should the predicted concentrations exceed the annual NO_x limit (30μg/m^3 – Appendix G Table 1A.1) then the sensitivity of the relevant species should be assessed by the project ecologist.

The construction traffic associated with the pipeline is not predicted to cause NO_x levels that would breach this limit along haul routes and the highest levels of NO_x along the proposed haul routes is predicted to remain below 41% of this limit during peak construction (calculated on the basis of the peak month of construction traffic).

The operation of the generators at the Aghoos tunnelling compound have the potential to breach the NO_x limit at the Glenamoy Box Complex cSAC. The cSAC hosts habitat adjacent to the compound and is approximately 50 metres from the proposed location of the generators in the compound. The dispersion modelling results for the generator plant emissions indicate that levels of NO_x has the potential to breach the annual average limit at a small section of the cSAC at the nearest point to the compound.

An assessment of the dry deposition of nitrogen on the cSAC has been undertaken using the procedures outlined in the NRA guidelines. The levels of nitrogen deposition from the generators on the cSAC using the NRA procedures are predicted to be up 7 kg N ha^{-1} yr^{-1} for the period of tunnelling at the immediate boundary of the cSAC to the compound.

The UNECE (United Nations Economic Commission for Europe) have devised a series of critical loads for nitrogen deposition on a range of ecosystems and these critical loads are applied in the NRA Guidelines for the air quality assessment. In the area of the cSAC adjacent to the compound and affected by the elevated NO_x emissions, the habitats are estuarine and salt marsh. The UNECE critical load for nitrogen deposition on “pioneer and low-mid salt marshes” is 30-40 kg N ha^{-1} yr^{-1}.

These results indicate that nitrogen deposition on the cSAC as a result of construction will be well below (i.e. less than 24%) the critical load for such salt marsh and as such the impact is considered imperceptible.

8.4.4 Regional Impacts to Air Quality

8.4.4.1 Construction Traffic

Construction traffic gives rise to emissions of compounds with potential significance in a regional or national context. The construction of the proposed pipeline development will involve mobilisation of heavy vehicles through road transport of materials and plant to the site for the duration of the works. Details of the construction traffic are presented in Chapter 7 and this data has been used to quantify the emissions.

Table 8.7: Total Annual Emissions of Certain Pollutants from Road Transport during the Construction Phase of the Project

Source	Total Carbon Monoxide CO (tonnes)	Total Nitrogen Oxides NO_x (tonnes)	Volatile Organic Compounds (tonnes)	Total Particulate Matter (tonnes)
2011 Do-Nothing Traffic	25.2	17.6	3.6	0.5
2011 Do Something Traffic (Peak Construction)	30.6	30.1	5.1	0.8

The results presented in Table 8.7 indicate an increase in the total pollutant emissions when the proposed construction traffic is included. This is due to the increased number of vehicles on the local road network as well as the predicted increase in the number of HGVs on the network.

The predicted levels of NO_x arising from the construction traffic (12.5 tonnes) are less than 0.02% of the National Emissions Ceiling Target for 2010. The predicted levels of VOCs are less than 0.01% of the National Emissions Ceiling Target for 2010.

8.4.4.2 Carbon Losses from Peat Disturbance

Project specific data for the Corrib Onshore pipeline such as volumes and areas of peat, timeframes for construction, etc are presented in Table 8.8. This data has been compiled from the various sections of the EIS. It should be noted that these calculations have assumed a worst case scenario whereby all peat up to 100 metres from the disturbed peat will be impacted by drainage.

Table 8.8 Input Data for Corrib Onshore Pipeline Carbon Losses Calculator

Parameter	Description	Approx. Value
A_{direct}	Area of Peat directly disturbed by construction	6.5 ha
$A_{indirect}$	Area of Peat where drainage may be affected by construction (construction site with 100m (max impact) drainage impact boundary).	70 ha
A_{forest}	Area of trees felled	3.5 ha
V_{direct}	Maximum volume of Peat removed during construction.	75,000 m^3
t	Time – is the time to restoration (years)	2 year

This input data has been applied to the Scottish Parliament methodology for calculating carbon losses from the various sources during construction. A more detailed description of these calculations is presented in Appendix G. The estimated total carbon losses from the Corrib Onshore Pipeline are presented in Table 8.9 below:

Table 8.9 Summary of Carbon Losses from the Corrib Onshore Pipeline

Item	Carbon Losses (tCO_2eq)
Loss of Carbon Fixing Potential of Peat Lands	142
Changes in Carbon Stored in Peat Lands – Removed Peat	0
Changes in Carbon Stored in Peat Lands – Drained Peat	3,061
Loss of Carbon Dioxide due to Leaching of Dissolved and Particulate Organic Carbon	764
Loss of Carbon due to Peatslide	0
Loss of Carbon due to Forestry Clearance	92
Carbon Dioxide Saving due to Improvement of Peat Land Habitat	0
Total Carbon Losses	**4,059**

This assessment indicates that carbon losses from the disturbance of peat during the construction of the onshore pipeline amount to 4,059 tonnes CO_{2eq}. Based on the fact that the highest predicted emissions are from drained peat and the worst case assumption for area affected by peat drainage, this figure can be considered a worst-case carbon loss from the project.

8.4.4.3 Construction Emissions of Greenhouse Gases

Emissions with the potential to cause climate change will arise from embodied carbon dioxide in site materials as well as vehicles delivering this material to the construction site. These emissions have been quantified using the Environment Agency carbon calculator for construction sites and the results are presented in Table 8.10. Carbon losses from peat removal are included from the results presented in Table 8.9.

Table 8.10: Summary of Greenhouse Emissions for Construction (Tonnes of Carbon Dioxide Equivalent).

Item	Estimated GHG Emissions (tCO_2eq)[1]
Quarried Material	2,043
Concrete, Mortars, Cement	12,405
Metals (pipeline Steel)[2]	5,956
Plant Emissions	1,464
Peat Removal	4,059
Material Transport	4,451
Personnel Transport	212
TOTAL	**30,590**

1. Tonnes Carbon Dioxide Equivalent

2. Already Fabricated

The results indicate that the main emissions of greenhouse gas are from the precast concrete segments and materials (bentonite, grout, etc.) used in the tunnelling, production of the pipeline steel (already fabricated) and the transport of materials to the site. The total estimated greenhouse gas emissions associated with the proposed construction is calculated at 30,590 tonnes of $CO_{2eq.}$

8.4.5 'Do Nothing' Scenario

If the proposed development did not proceed the air quality would remain unchanged.

8.5 MITIGATION MEASURES

The following sections describe the mitigation measures to be implemented during construction to minimise the potential impacts on air quality. As no negative impacts are predicted during the operational phase, mitigation measures have not been proposed.

8.5.1 Air Quality

8.5.1.1 Construction Dust

In order to minimise dust nuisance during construction a series of mitigation measures and good working practices will be implemented such as those successfully implemented at the construction of the Bellanaboy Bridge Gas Terminal. These measures will be included in the Environmental Management Plan for the Construction phase, and will include standard mitigation measures outlined below.

The UK British Research Establishment (BRE) document 'Control of Dust from Construction and Demolition Activities' (February 2003) and the Construction Industry Research and Information Association (CIRIA) 'Environmental Good Practice on Site' are best practice international guidance documents for dust minimisation plans. In addition, the NRA has published general guidance entitled 'Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan' that contains details on environmental control measures for air pollutants during construction projects.

Mitigation measures to minimise dust will include:

- Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions (also applies to vehicles delivering material with dust potential).

- The designated public roads outside each site compound will be regularly inspected for cleanliness, and cleaned as necessary.

- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind.

- Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.

Additional measures include:

- The transport of soils or other material, which has the potential to cause dust will be undertaken in tarpaulin-covered vehicles where necessary.

- All construction related traffic will have speed restrictions on un-surfaced roads.

- Water misting or bowsers will operate at the site on a daily basis to mitigate dust in dry weather conditions.

- Monthly dust monitoring will be undertaken in order to monitor the efficiency of dust management, an ambient dust deposition survey is recommended for the duration of the construction phase. The TA Luft (German Government 'Technical Instructions on Air Quality') states a guideline of 350 mg/m^2/day for the deposition of non-hazardous dusts. This value will be used to determine the impact of construction dust as an environmental nuisance. Any breaches of this guideline will require a review of operations and dust mitigation in the area to ensure any dust nuisance does not continue in future months.

- Daily inspection of construction sites to examine dust measures and their effectiveness.

8.5.1.2 Construction Traffic Emissions

- Regular maintenance of plant and equipment. Technical inspection of vehicles to ensure they will perform most efficiently.

- Implementation of the Traffic Management Plan to minimise congestion.

- Where possible haul roads within the temporary working area will be used to minimise traffic on the local road network.

8.5.2 Greenhouse Gas Emissions

Mitigation measures to minimise CO_2 emissions include the following:

- Implementation of the Traffic Management Plan. This will outline measures to minimise congestion and queuing, reduce distances of deliveries and eliminate unnecessary loads.

- Reducing the idle times by providing an efficient material handling plan that minimises the waiting time for loads and unloads. Reducing idle times could save up to 10% of total emissions during construction phase.

- Turning off engines when not in use for more than five minutes. This restriction will be enforced strictly unless the idle function is necessary for security or functionality reasons

- Regular maintenance of plant and equipment. Technical inspection of vehicles to ensure they will perform the most efficiently.

8.6 RESIDUAL IMPACT

There will be no residual impact on air quality as a result of the proposed Corrib Onshore Pipeline development.

It is not possible to quantify the actual impact of specific greenhouse gas sources or sinks on the climate or environment as a whole, but the contribution of greenhouse gas emissions arising from the construction of the onshore pipeline in the context of the national emission levels is negligible.

9 NOISE & VIBRATION

9.1 INTRODUCTION

This chapter describes the potential noise and vibration impacts resulting from the terrestrial construction works associated with the proposed development as well as its operation. This chapter also summarises the potential noise and vibration impacts associated with the proposed tunnelling works. A detailed noise and vibration impact assessment of the terrestrial construction works is provided in Appendix H1. An assessment of potential impacts of noise and vibration from the construction of a 4.9km tunnel, most of which will be beneath Sruwaddacon Bay, is provided in Appendix H2. The outputs from modelling of vibration and noise from the tunnelling operation are outlined in Appendix H3.

The construction phase of the proposed project has been examined to assess which activities have the potential to result in noise and vibration impacts. Noise and vibration impacts will arise during the construction phase, but these will be temporary/short-term in nature. Where the pipeline will be installed in a trench on land, any potential impact on individual receptors will be progressive in nature. The tunnelling compound at na hEachú (Aghoos) will be in place for the duration of the tunnelling works and will have a short-term impact on the surrounding area. Where applicable, a series of suitable mitigation measures has been listed. Strict adherence to these mitigation measures and the best practice construction methods presented herein will ensure that any potential negative impact from noise and vibration is kept to a minimum.

There will be no significant noise and vibration impacts as a result of the operation of the proposed development.

The potential impact of noise and vibration from the construction works (associated with both tunnelling and on land works) on terrestrial and marine ecology are assessed in Chapters 12, 13 and 14 of this EIS.

9.2 METHODOLOGY

The followings sections outline the methodology used and the criteria addressed in this impact assessment. The potential sources of noise and vibration resulting from the construction of the proposed development are also described.

The methodology for the assessment of potential noise impacts from works on land involved the following:

- A desktop review of the relevant codes, standards and guidelines (see Sections 9.2.1 and 9.2.2).
- Identification of sensitive receptors using aerial photography (2006, 2008 and 2009) and a site visit to the area. A noise sensitive location is defined by the Environmental Protection Agency (EPA), "*Environmental Noise Survey Guidance Document, 2003,*" as "*any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels*". Designated conservation sites are also considered to be sensitive noise receptors.
- Baseline noise monitoring (Section 9.3.1) was undertaken in accordance with the National Roads Authority (NRA), "*Guidelines for the Treatment of Noise and Vibration during the construction of National Road Schemes, 2004,*" and BS 7445-1:2003 (BS 7445-1:1991; ISO 1996), *"Description and Measurement of Environmental Noise"*. In total, twenty representative noise monitoring locations (N1-N20) were chosen in the area of the proposed pipeline route, although it was not possible to access one of the proposed monitoring points (at the noise sensitive location N4). In addition, the monitoring point N20 was located at a residential property in na hEachú (Aghoos), which is currently vacant and is owned by SEPIL (the

developer of the proposed onshore pipeline) and is therefore not considered to be a noise sensitive receptor as such. However, baseline surveys were undertaken at this property regardless, in order to determine existing ambient noise levels at this location as part of the process to describe the existing noise environment in the area.

- Three rotational 15-minute measurements were taken at the nineteen locations listed above and 24-hour noise monitoring was undertaken at five of the nineteen locations (24hr1 - N15, 24hr2 - N20, 24hr3 - N2, 24hr4 - N7 and 24hr5 - N13). Noise monitoring was undertaken in March 2010. Noise monitoring locations are illustrated on Figures 9.1a and 9.1b.

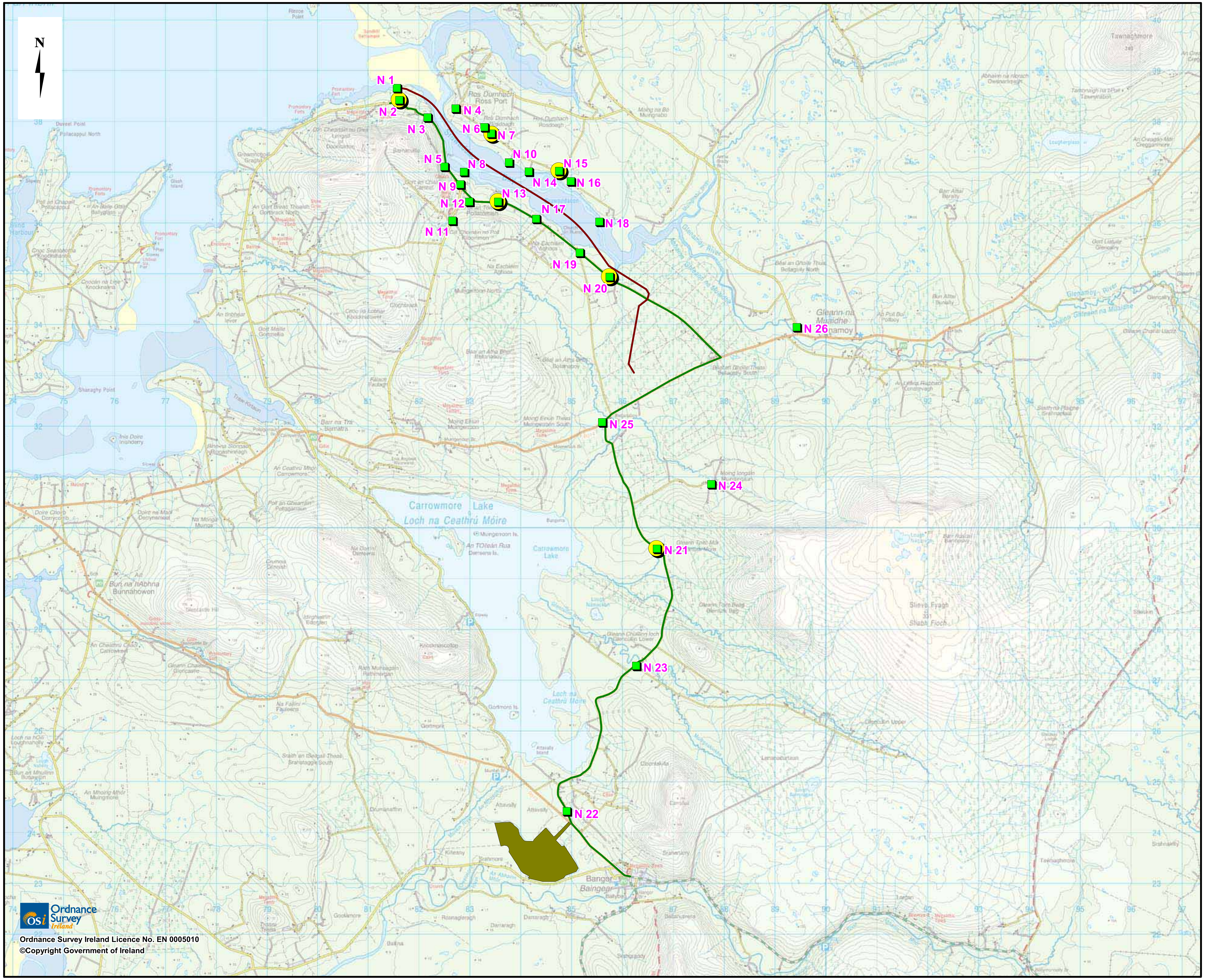
- A baseline noise monitoring programme was also undertaken in January 2009 at representative noise sensitive receptors located in the vicinity of the proposed haul route. Noise monitoring was undertaken at nine locations (N2, N7, N20, N21, N22, N23, N24, N25 and N26), and 24-hour noise monitoring was undertaken at four of the nine locations (24hr6 - N20, 24hr7 - N21, 24hr8 - N2 and 24hr9 - N7). These noise monitoring locations are also illustrated on Figures 9.1a and 9.1b.

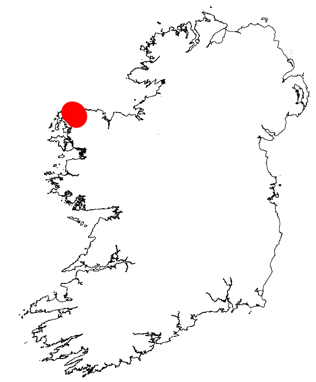
- Baseline vibration monitoring surveys were carried out at four of the properties where noise monitoring surveys were undertaken (N2, N7, N13 and N20). The vibration surveys were undertaken in March 2010. The location of the monitoring points is illustrated on Figures 9.1a and 9.1b.

- Review of the construction methodologies (see Chapter 5) and proposed temporary working areas with respect to the location of sensitive receptors.

- Assessment of noise emissions from the proposed works. Noise prediction modelling was undertaken using the Bruel & Kjaer Type 7810 Predictor Noise Modelling Package to predict noise levels at the nearby houses. The noise-modelling package uses a computer based noise propagation model, in accordance with the ISO 9613-2 standard, "*Acoustics - Attenuation of sound during propagation outdoors*", which is an international standard used to undertake noise prediction modelling. Noise modelling was also undertaken in accordance with the NRA, "*Guidelines for the Treatment of Noise and Vibration during the construction of National Road Schemes, 2004".* The plant and machinery sound power levels were sourced from manufacturer's data for the tunnelling equipment, provided by de la Motte & Partner. Noise data for plant and machinery associated with the construction works other than the tunnelling equipment were sourced from BS 5228, "*Noise and Vibration Control on Construction and Open Sites, 2009,*" and the UK Department for Environment Food and Rural Affairs (Defra), "*Updated Noise Database for Prediction of Noise on Construction and Open Sites, 2005".* The noise model was constructed based on the ISO 9613-2 standard method using the receptor locations outlined earlier. The proposed pipeline was imported into the noise prediction model along with the local topography. The list of plant and machinery input into the model and the corresponding noise data is included in Appendix H1.

- The proposed haul route was also imported into the noise prediction model, which uses the existing road network. Existing baseline traffic volumes were modelled and subsequently the volume of construction traffic was modelled in order to predict the changes in traffic noise levels along the haul route. The peak daily construction traffic volumes (see Chapter 7) were used in order to determine the worst-case scenario in terms of potential construction traffic increases.





Proposed Pipeline Route

Proposed Haul Route

Noise Monitoring Location

24 hr Noise Monitoring Location

Srahmore Peat Deposition Site

Noise Monitoring Locations

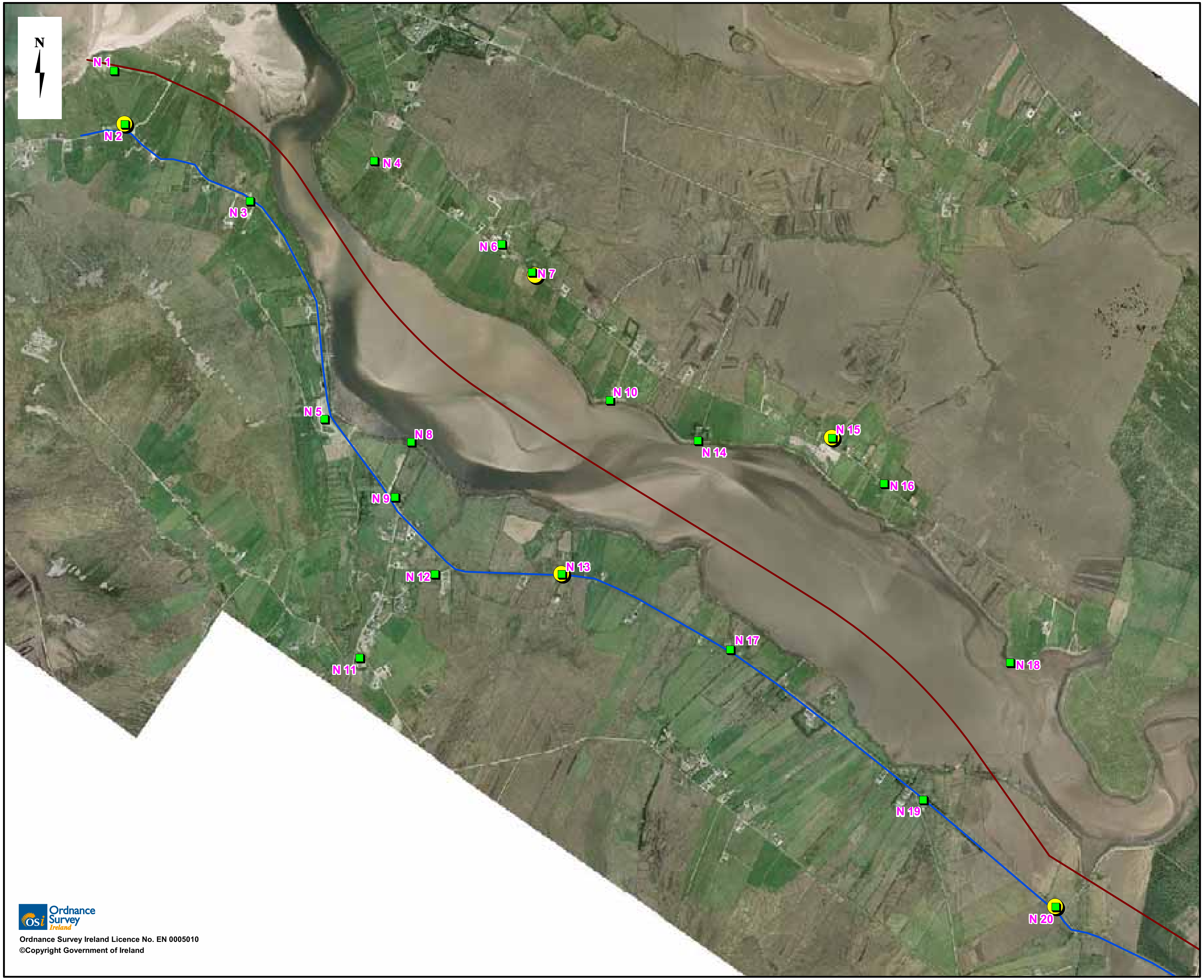
Figure 9.1a

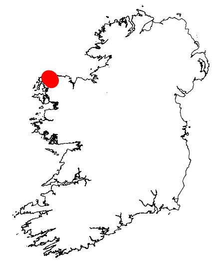
File Ref: COR25MDR0470Mi2113A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS





Proposed Pipeline Route

Proposed Haul Route

Noise Monitoring Location

24 hr Noise Monitoring Location

Srahmore Peat Deposition Site

Noise Monitoring Locations

Figure 9.1b

File Ref: COR25MDR0470Mi2457R04
Date: May 2010

Corrib natural gas

RPS

The methodology for the assessment of potential vibration impacts from works on land involved the following (see Appendix H1 for further details):

- Review of the relevant codes, standards and guidelines; and
- Review of the proposed construction methodologies (see Chapter 5) and location of temporary working areas with respect to sensitive receptors.

In order to consider the effects of groundborne noise and vibration from tunnelling, modelling has been carried out using a FINDWAVE model to predict vibration generated by the tunnel excavation. The FINDWAVE model uses input data representing the forces generated by the excavation at the tunnel face and calculates how these propagate through the various layers within the ground to the surface. In the case of the modelling carried out for this project, models have been run at four representative points along the length of the tunnel. At each of these cross-sections, the model has been run with and without a layer of water as the surface layer, thus representing conditions at high water and low water. This has allowed the sound pressure due to the tunnel excavation to be predicted within the Bay with the tide in and vibration to be predicted on the sands with the tide out. Vibration and groundborne noise levels at the nearest residential buildings to the tunnel have also been calculated. A report describing the nature of the model, input data and assumptions and the results obtained is presented in Appendix H3 along with graphical representations of the results of these predictions.

9.2.1 Noise Assessment Criteria

In the absence of any national legislation relating to environmental noise emission limits the assessment criteria used in this report are those used by regulatory bodies and local authorities. Noise limits outlined in the construction and operational phases of the Bellanaboy Bridge Gas Terminal EIS are also referenced. The predicted change in the existing noise environment is also considered.

9.2.1.1 Construction Noise Criteria

BS 5228 states that complaints about noise that have originated from new industrial sources indicate that the likelihood of a complaint increases as the difference between the industrial noise and existing background noise increases. It is possible that a similar effect occurs with the noise originating from construction and open sites since the noise will, in general, be more noticeable in quieter areas. However, the standard acknowledges that the relationship between response and noise level can be different, in particular a greater difference may be tolerated when it is known that the operations are of short duration.

The NRA outlined construction noise limits in its, "*Guidelines for the Treatment of Noise and Vibration in National Roads Schemes, 2004*". These limits, which are presented in Table 9.1, represent a reasonable compromise between the practical limitations in a construction project, and the need to ensure an acceptable ambient noise level for residents. As the pipeline is also a linear development it is considered appropriate to apply the NRA guideline values. Therefore, these guidelines were used, given that there are no statutory Noise Regulations with regard to control of noise during construction activities in Ireland. The general construction works associated with the onshore pipeline are similar to earthworks and drainage works associated with road construction activities.

Table 9.1 Maximum permissible noise levels at the façade of dwellings during construction* (NRA Guidelines, October 2004)

Days & Times	$L_{Aeq\,(1hr)}$ dB	L_{AMax} dB
Monday to Friday - 07.00 to 19.00	70	80**
Monday to Friday - 19.00 to 22.00	60**	65**
Saturday - 08.00 to 16.30	65	75
Sundays and Bank Holidays - 08.00 to 16.30	60**	65**

* Indicative only – it may be more appropriate to apply more stringent limits in areas where pre-existing noise is low.
**Construction activity at these times, other than that required in respect of emergency works, will normally require the explicit permission of the relevant authority.

The Bellanaboy Bridge Gas Terminal EIS, associated with the planning permission granted in 2004, suggested a construction noise limit of 65dB $L_{Aeq,\ 1\ hour}$. This limit is in line with the NRA guideline values presented in Table 9.1 and will also be adopted for this assessment. In addition, as this is a quiet rural area, actual baseline conditions have been considered in the assessment.

No night-time limit is specified in Table 9.1; however, the EPA guideline noise limit for industrial noise during the night-time (22:00 – 08:00) is 45 dB(A), at the nearest noise sensitive location(s)[1]. Any noise limit that may be applied during the night-time will be subject to agreement with the relevant authorities.

The World Health Organisation (WHO) *Guidelines for Community Noise* [Note2] states that, "*in dwellings, the critical effects of noise are on sleep, annoyance and speech interference*". In order to avoid sleep disturbance it is recommended that indoor guideline values for bedrooms are 30dB L_{Aeq} for continuous noise and 45dB L_{AMax} for single sound events. The EPA night-time level pf 45dB(A) is based on an inside noise level of 30db(A) and the WHO assumption that the noise reduction from outside to inside with a window partly open is 15dB. It is noted that lower levels may be annoying, depending on the nature of the noise source. Therefore, during the night-time, sound pressure levels at the outside façades of the living spaces should not exceed 45dB L_{Aeq} and 60dB L_{AMax}, so that people may sleep with bedroom windows open.

A subterranean tunnel-boring machine (TBM) will be used to construct the tunnelled section of the pipeline underneath Sruwaddacon Bay. The tunnelling works will be required to operate throughout the night for the duration of the construction programme, for approximately 14 months, with the compound in place for approximately 26 months. Some plant and machinery required in the tunnelling compound at na hEachú (Aghoos) will be required to operate on a 24-hour basis during the 14 month tunnelling programme. In this regard, the EPA night-time criterion of 45dB(A) at the closest sensitive receptors will apply in those circumstances in order to prevent sleep disturbance. Mitigation measures have been incorporated into the design of the tunnelling compounds and have been incorporated into the proposed constructions works arrangements in order to minimise potential noise and vibration impacts. Details of the mitigation measures are outlined in Section 9.5 of this chapter.

Subjectively, the significance that can be attached to changes in noise levels (perceptible to human beings) can be described as follows in Table 9.2. It should be noted that the subjective description outlined in Table 9.2 applies to relatively continuous traffic noise. However, it can be used as likely indicative responses to changes in ambient noise levels.

Table 9.2 Significance scale for changes in noise levels (perceptible to human beings)

Change in Noise Level	Impact Rating	EPA Glossary of Impacts	Subjective Reaction
0	No change	n/a	n/a
<3 dB(A)	Not significant	Neutral, Imperceptible or Slight Impact	Barely perceptible
3 – 5 dB(A)	Minor	Significant Impact: Positive or Negative	Perceptible
6 – 10 dB(A)	Moderate		Up to a doubling of loudness
11–15 dB(A)	Major		Over a doubling of loudness
>15 dB(A)	Severe	Profound Significant Impact: Negative only	---

[1] EPA, Guidance note for noise in relation to scheduled activities.

[Note2] World Health Organisation, *Guidelines for Community Noise*. This document is the outcome of the WHO-expert task force meeting held in London, United Kingdom, in April 1999. It is based on the document entitled "*Community Noise*" that was prepared for the World Health Organisation and published in 1995 by the Stockholm University and Karolinska Institute.

Subsequent to the WHO Guidelines for Community Noise published in 1999, the WHO published the *Night Noise Guidelines for Europe* in 2009. These guidelines are applicable to the Member States of the European Region and are considered as an extension to and update of the previous 1999 guidelines. The WHO *Night Noise Guidelines for Europe* (NNG) consider the affects of night-time noise using a different noise descriptor (i.e. noise parameter), the $L_{night,\ outside}$ as defined in the EU Environmental Noise Directive (2002/49/EC).

It should be noted that the noise indicators of the 1999 WHO Guidelines are L_{Aeq} and L_{AMax}, **measured inside** for continuous and non-continuous noise, respectively. The 2009 WHO Guidelines adopt a harmonised noise indicator as defined by the Environmental Noise Directive, $L_{night,\ outside}$ **measured outside, averaged over a year**.

In terms of the different sectors required to be taken into consideration in Strategic Noise Maps, to be prepared as per the requirements of the Environmental Noise Directive, construction noise specifically is not included in the Environmental Noise Directive (as transposed by the Environmental Noise Regulations (S.I. No. 140 of 2006)). Therefore, as outlined above, the EPA Guideline limit of 45dB(A) is the criterion which has been adopted for assessment of construction noise during the night-time, as is standard practice by regulatory bodies and local authorities in Ireland.

9.2.1.2 Operational Noise Criteria

Although operational noise limits are discussed, there will be negligible noise during the operational phase of the development. Occasional maintenance visits to the Landfall Valve Installation (LVI) will be the only noise generating activities during the operational phase. Noise associated with the flow/transmission of gas through the onshore pipeline will be negligible.

The noise impact of the development is assessed taking account of absolute noise criteria contained in the EPA, "*Guidance note for noise in relation to scheduled activities*", and WHO document, "*Guidelines for Community Noise 1999*". However, considering the quiet nature of the area it is considered that operational noise limits set out in the Bellanaboy Bridge Terminal EIS are also appropriate for this development. These limits are 35dB(A) by night and 45dB(A) by day.

9.2.2 Vibration Significance Criteria

Best practice guidance documents for vibration were used for the assessment with regard to vibration levels that would be likely to lead to complaints, and vibration levels that would be likely to lead to structural damage.

Common practice in Ireland has been to use guidance from the following internationally recognised standards, which address vibration standards in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings.

- BS6472: 1992 - *Guide to Evaluation of human exposure to vibration in buildings (1Hz to 80Hz)*; and

- BS7385: Part 2 1990 - *Evaluation and measurement for vibration in buildings - Guide to damage levels from ground-borne vibration*.

It is noted that there is other relevant, internationally recognised guidance on human response to vibration such as the German Standard 4150. However, the above British Standards are considered to be the most relevant as they also link into BS 5228: Part 2, which specifically deals with vibration from construction works, which is the principle potential vibration effect for this project.

Also, BS 5228:2009, "*Code of practice for noise and vibration control on construction and open sites, Part 2: Vibration,*" provides useful guidance, information and procedures on the control of vibration from construction sites.

Human beings are known to be very sensitive to vibration, the threshold of perception being typically in the PPV (Peak Particle Velocity) range of 0.14 mm/s to 0.3 mm/s. Guidance on the human response to vibration from demolition and construction activities that is contained within BS 5228-2 is provided in Table 9.3.

Table 9.3 Human Response to Vibration from Construction and Demolition Activities

Vibration Level PPV (mm/s)	Effect
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3	Vibration might be just perceptible in residential environments.
1.0	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Measurements of vibration from construction sites have shown that, even from rock breaking and piling works, levels typically become imperceptible at relatively short distances from the vibration source. However, higher levels of vibration are typically tolerated for single events or events of short duration. For example, piling, where rock is encountered, is typically tolerated at vibration levels up to 2.5 mm/s.

The NRA guidelines identify 2.5 mm/s as the vibration level that may be considered tolerable due to piling works. The potential vibration levels that could be generated by rock breaking works, if required would be expected to be comparable to the level of vibration that may be generated by piling works. The vibration level of 2.5 mm/s is substantially below the guideline values for protection of properties against cosmetic damage. The NRA limits for protection against cosmetic damage are given as a function of vibration frequency, as shown below:

- 8 mm/s (vibration frequency <10Hz);
- 12.5 mm/s (vibration frequency 10 to 50Hz); and
- 20 mm/s (vibration frequency >50 Hz).

The NRA 2.5 mm/s limit is for piling, which is a continuous activity. This limit provides for protection against the vibration nuisance, and is comfortably within the limits for cosmetic damage.

Blasting is not proposed during construction works associated with the proposed pipeline.

9.2.3 Noise and Vibration Sources

The potential sources of noise and vibration associated with the proposed development have been assessed for the construction phase (including onshore pipeline commissioning works) and the operational phase in Sections 9.2.3.1 – 9.2.3.5. These have been assessed both for ‘on land’ works and tunnelling works.

9.2.3.1 Construction Phase - Noise from Terrestrial Works

The general construction methodology employed along the ‘on land’ sections of the pipeline route (approximately 3.4km) will require a selection of heavy earth-moving machinery and specialist equipment to be used for importation of rock, topsoil stripping, excavation, trenching, pipe stringing, bending, bevelling and welding, etc. During trenching, where rock occurs and ground conditions are not suitable for normal excavation, it may be necessary to break the rock mechanically. At some locations piled supports may need to be added to the trench to stabilise it. A vibrating piling rig will be used to install the sheet piles.

As outlined above, a subterranean tunnel boring machine (TBM) will be used to construct the 4.9km tunnelled section of the pipeline route, most of which will be beneath Sruwaddacon Bay. The tunnelling operations will involve 24-hour, 7-day operation at the Aghoos tunnelling compound for approximately 12-14 months.

Conventional construction methods will be used to construct the LVI at Gleann an Ghad (Glengad). This will involve excavation and installation of mechanical elements (pipework and valves), which will be welded in-line with the offshore and onshore elements of the pipeline.

After backfilling the trenches associated with the on land section of the pipeline and the launch and reception pits associated with the tunnelling works, the top layers will be replaced and all hedges, sod banks and other boundaries will be rebuilt. Noise sources during the reinstatement phase will include tracked excavators, dozers, land drain ploughs and agricultural plant. The noise levels generated during the reinstatement phase will be considerably lower than general construction activities.

The construction phase is expected to last for approximately 26 months.

Apart from the 24-hour, 7-day tunnelling operation construction activities, normal working hours will be 0700-1900 hours Monday to Friday and 0700-1600 hours on Saturdays. However, some additional work may be required outside these hours, e.g. inspection and commissioning. Night-time security will patrol the temporary compounds and working areas. Apart from the tunnelling works, Sunday working will be avoided, where possible, but cannot be entirely excluded. Aside from the tunnelling works, construction activities outside of normal hours will only take place after prior consultation with Mayo County Council and notification of the local community.

9.2.3.2 Construction Phase– Vibration from Terrestrial Works

Potential sources of vibration during construction include rock-breaking equipment, sheet piling machinery, excavators, dump trucks and HCVs.

During trenching, where rock occurs and ground conditions are not suitable for normal excavation, it may be necessary to break the rock mechanically and at some locations piled supports may need to be added to the trench to stabilise it (see Chapter 5). It is anticipated that blasting will not be required during construction works on land.

As a vehicle travels along a road, vibration can be generated in the road and subsequently propagate towards nearby buildings. Such vibration is generated by the interaction of a vehicle’s wheels and the road surface and by direct transmission through the air of energy waves (sound waves). Some of these waves arise as a function of the size, shape and speed of the vehicle and others from pressure fluctuations due to engine and exhaust noise generated by the vehicle. It has been found that ground vibrations produced by road traffic are unlikely to cause perceptible structural vibration in properties located near well-maintained and smooth road surfaces. Road traffic vibration levels can therefore be largely minimised by maintenance of the road surface.

There will be no significant sources of vibration during reinstatement.

9.2.3.3 Construction Phase – Groundborne Noise and Vibration from Tunnelling

As the TBM excavates its way forward, the tunnel will be lined (from within) using concrete rings. During tunnelling hydraulic cylinders push against completed concrete rings located inside the TBM, which are used to progressively drive the TBM forward. As one section of tunnel is completed this is followed by the assembly and installation of another set of concrete rings. Jacking cylinders are then extended to advance the TBM for the next excavation cycle. Progress of the TBM is expected to be on average 11 m per day.

At the cutting face the soil/rock is loosened by the TBM cutting head, which rotates at approximately 6 revolutions per minute and is fitted with excavation tools. On average it is estimated that for every hour, the excavation process will take approximately 15 - 20 minutes and the assembly of concrete segments and other activities associated with extending the tunnel will take 40 - 45 minutes.

The excavation process will generate forces within the rock or other ground layer that may propagate as groundborne vibration. These vibrations will travel through the ground as various different waveforms dependent on the nature of the geology surrounding the TBM (the geological conditions within Sruwaddacon Bay are described in Chapter 15 and in Appendix M). The other activities within the main tunnelling cycle are unlikely to generate significant vibration within the ground. A temporary railway will be used within the tunnel during construction to deliver concrete segments. This may cause very transient vibrations to be generated, particularly when segment wagons pass over rail joints. However, levels of vibration would generally be no higher than those expected from the TBM and would only occur for a matter of seconds at any particular location.

There is potential for groundborne vibration from excavation of the tunnel by the TBM to be detected within the sands forming the seabed within Sruwaddacon Bay. This vibration will also be transmitted to water within the Bay and will generate sound within the water body. The nature and extent of the sound levels will vary with the amount of water in the Bay and the location of the TBM.

Groundborne vibration also has the potential to be transmitted to residential and other buildings near to the shore. This vibration may be detectable as “feelable” vibration and groundborne noise re-radiated from the ground via building structures to cause audible sound.

The potential for effects on ecology, such as vibration transmission to birds that may be present in the intertidal zone and for the effects of underwater noise on fish and marine mammals within Sruwaddacon Bay is discussed in Chapters 12, 13 and 14. The potential for effects on peat stability in relation to groundborne vibration from tunnelling are addressed in Chapter 15 and Appendix M2.

9.2.3.4 Construction Phase - Noise and Vibration from Traffic

Commercial vehicles will deliver materials and equipment including site accommodation, pipeline and umbilical sections, sheet piles, tunnelling equipment, bentonite, water, concrete segments, cement and bog mats as well as ducting and outfall pipework, and will be used for haulage of surplus peat and tunnelling material away from the area. It is calculated that HCV (Heavy Commercial Vehicle) traffic will range between 155 and 170 vehicle movements per day to na hEachú (Aghoos) in the period from Month 1 to Month 3 of the construction phase, with HCV movements diminishingly significantly to an estimated 31 movements per day during Month 4 (see Chapter 7). The peak volume of HCV traffic travelling to na hEachú (Aghoos) is estimated to be 184 HCV movements per day during Months 13 - 15 and will again diminish significantly to an estimated 112 HCV movements per day in Month 16 and 64 HCV movements per day during Months 17 – 19, with a temporary increase to 130 HCV movements per day during Months 23 – 24. Volumes will subsequently fall to a predicted 99 HCV movements per day towards the end of the construction phase during Month 26.

The peak volume of HCV traffic travelling to Gleann an Ghad (Glengad) has been estimated to be 24 movements per day during Month 2, diminishing thereafter until another peak of 15 movements per day during Month 20. Traffic associated with personnel employed on the construction work is expected to vary between 630 and 1,180 vehicle movements per month in connection with Gleann an Ghad (Glengad) and is predicted to vary between 1,080 and 1,980 vehicle movements per month in connection with na hEachú (Aghoos). Details of the traffic movements throughout the construction phase are outlined in Chapter 7 of the EIS. The greater number of private vehicle movements associated with the workforce will tend to be more concentrated at the start and end of the working day. Parking facilities off the public road will also be provided and group transport of personnel will be used to the greatest extent feasible. Construction traffic associated with the Terminal will have been reduced to a minimum before works on the pipeline are due to start.

This additional traffic will cause a localised increase in noise in the vicinity of the local road network during the construction works. However, considering the non-permanent nature of the works and the time frame for the peak traffic volumes, which typically will not extend for more than 3 months continuously during the overall anticipated 26-month construction phase, the impact is considered to be short-term to temporary in duration.

There will be no construction traffic travelling on the L1203 (and the L52453-0 and L52453-25) between Gleann na Muaidhe (Glenamoy), Muingnabo and Ros Dumhach (Rossport).

9.2.3.5 Commissioning – Noise and Vibration

Once all sections of the pipeline have been welded together, it will be filled with water for a pressure test. Testing involves pressuring the water within a section of the pipeline for standard periods of time. This will involve the use of a pump (see Chapter 5).

Temporary ‘pigging runs’, which evacuate water and ‘gauge’ the pipeline internal diameter after dewatering will also be carried out. There will be no significant sources of noise or vibration during hydrostatic testing. Considering the temporary nature and the short timeframe, noise impacts from testing of the pipeline will be significantly less than general construction activities.

Certain pipeline commissioning activities for the offshore pipeline will also need to be undertaken on a continuous basis; however, these works are expected to be completed in a limited amount of time (approximately two weeks). These works are essentially not part of the onshore pipeline development but are included within this section for information purposes only.

9.2.3.6 Operational Phase

There will be no noise or vibration generated by the proposed development during the operational phase except during the following activities associated with the LVI:

- Weekly visits for regular inspection and maintenance;
- One week of maintenance approximately every five years. This typically involves a 45 tonne crane, if deemed necessary, and up to six truck movements and personnel cars; and
- In the unlikely occurrence of an emergency shutdown of the LVI system, the re-starting would produce a high tone noise for a maximum 36 hours. This would produce a noise level of approximately 80dB within the LVI compound for a maximum 36 hours; however, as the noise source in this case is buried in the dished area, the emission of noise from this source would be lower than the 80dB.

The tunnel will be grouted at the end of the construction phase. Therefore, there will not be any perceptible noise or vibration impact from the movement of gas through the pipeline within the tunnel.

9.3 EXISTING ENVIRONMENT

A description of the receiving noise environment based on the results of the baseline noise monitoring survey is outlined below with further details provided in Appendix H1.

9.3.1 Baseline Monitoring

The primary measurement parameter was the equivalent continuous A-Weighted Sound Pressure level, $L_{Aeq,\ T}$ for the duration of the monitoring surveys. A statistical analysis of the measurement results was also completed so that the percentile levels, $L_{AN,\ T}$, for N = 90% and 10% over the measurement intervals were also recorded. The percentile levels represent the noise level in dB(A) exceeded for N% of the measurement time. L_{A10} values are used to describe intermittent, high-energy noise events whereas L_{A90} values are representative of background noise levels. A glossary of noise related terms, including L_{Aeq}, L_{A10}, L_{A90} and others referenced in this Chapter, is included as Appendix H1.

9.3.1.1 Rotational 15-Minute Measurements

The on site observations noted typical examples of biophonic (vegetation, animals), geophonic or non-biological sounds (streams, wind, rain, and the ocean) and anthropogenic or man made (mainly traffic) noise sources. In measuring background environmental noise in quiet areas, the L_{A90} indicator is regarded at the most appropriate measurement unit. The 15 minute measurement background noise level ranged from 24.9 dB(A) to 44.0 dB(A) which is typical of a rural environment.

In general the main contributing noise sources included wind borne noise, birdsong, ocean noise and intermittent traffic. As the measurement locations were situated at sensitive receptors, i.e. residences, and consequently near local access roads, traffic noise impacted on the noise level to varying extents. Table 9.4 outlines the locations where traffic is estimated to currently have the most impact. L_{A90}, (average) gives a good indication of the noise level without the contribution of traffic.

Table 9.4 Locations predominantly impacted by current traffic noise

Sensitive receptor locations	L_{Aeq} (average) in dB	L_{A90}, (average) in dB
N2	48.8	30.9
N5	43.0	27.8
N9	49.2	40.4
N11	51.9	40.0
N12	48.8	31.1
N13	44.6	28.5
N16	42.8	31.9
N17	58.7	32.6
N18	41.5	33.4
N19	48.6	35.9
N20	46.5	28.7

In the absence of the short high-energy noise events such as the occasional passing car, natural background environmental noise sources were the main contributing noise sources at the remaining locations (see Table 9.5). Contributing noise sources included noise from breezy conditions and associated rustling foliage in addition to turbulence associated with wind/breezes in the area; ocean noise (waves washing against shoreline), birdsong, noise from animals including dogs, sheep, cattle, donkeys and noise from water flowing in streams. Noise from occasional aircraft passing overhead was noted, in addition to noise associated with agricultural activities in the area, which included noise from small excavators working in the area (used for excavation of drains and for turf extraction). Noise from audible church bells in the study area was also noted, in addition to noise from children in a school playground. It was noted that in the absence of traffic noise, ambient noise levels in the study area were generally influenced by birdsong and rustling foliage in association with wind noise.

Table 9.5 Locations predominantly impacted by current non-traffic noises

Sensitive receptor locations	L_{Aeq} (average) in dB	L_{A90}, (average) in dB
N1	44.1	38.3
N3	46.5	38.6
N6	46.5	34.9
N7	38.0	30.6
N8	43.2	37.8
N10	41.9	31.3
N14	43.9	37.4
N15	40.3	33.1

9.3.1.2 24-Hour Measurements

The results of the 24-hour noise monitoring surveys are presented in Table 9.6. The Sound Level Meter (SLM) was programmed to monitor continuously over consecutive 15-minute intervals. The results are presented below as averaged values for the day, evening and night-time periods. The daytime period represents 7 am to 7 pm, the evening period represents 7 pm to 11 pm and the night-time period represents 11 pm to 7 am.

Table 9.6 24-hour Noise Measurement Results

Monitoring Location	Date	Daytime dB		Evening dB		Night-time dB	
		L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}
24hr1 - N15	11/03/2010	43.2	29.9	38.6	29.8	34.7	26.0
24hr2 - N20	12/03/2010	41.2	27.5	40.9	22.0	37.9	22.6
24hr3 - N2	15/03/2010	49.9	33.6	47.7	27.3	39.5	25.0
24hr4 - N7	16/03/2010	54.0	48.6	49.7	43.6	47.3	42.1
24hr5 - N13	24/03/2010	42.0	30.9	38.8	22.3	34.6	26.6
24hr6 - N20	06/01/2009	40.7	30.1	34.8	26.6	35.8	28.1
24hr7 - N21	06/01/2009	50.3	40.6	45.6	29.6	38.7	23.4
24hr8 - N2	07/01/2009	48.1	39.0	43.8	36.2	39.5	36.9
24hr9 - N7	07/01/2009	50.5	40.3	42.6	31.4	43.0	35.9

Existing traffic was the main contributor to the noise levels monitored at locations N20 (24hr2 and 24hr6), N2 (24hr3 and 24hr8) and N13 (24hr7). Other minor contributors included wind in nearby vegetation and birdsong. A combination of traffic noise, rustling foliage and birdsong contributed to the noise levels monitored at locations N15 (24hr1), N7 (24hr4 and 24hr9) and N13 (24hr5). Waves breaking on the shoreline also contributed to the noise levels monitored at location N2 (24hr3 and 24hr8) (refer to Appendix H1). The L_{90} levels are for the most part below 45dB(A), which is typical of a rural environment. It is considered that the measured noise levels are typical of rural background noise and reflect the noise levels measured during the shorter rotational measurements.

The average daytime L_{Aeq} levels ranged from 40.7 to 54.0dB(A). The lowest average daytime ambient noise level was measured at N20 (24hr6). The highest average daytime ambient noise level was measured at N7 (24hr4). The lowest average evening ambient noise level was measured at N20 (24hr6). The highest average evening ambient noise level was measured at N7 (24hr4). The lowest average night ambient noise level was measured at N13 (24hr5). The highest average night ambient noise level was measured at N7 (24hr4) (refer to Appendix H1).

9.3.1.3 Vibration Measurement Results

The results of the baseline vibration monitoring surveys are presented in Table 9.7 below.

Table 9.7 Vibration Monitoring Results

Location	V1 - N2		V2 - N13		V3 - N20		V4 - N7	
	Max. value (PPV)	Time hr:mm:ss	Max. value (PPV)	Time hr:mm:ss	Max. value (PPV)	Time hr:mm:ss	Max. value (PPV)	Time hr:mm:ss
Date	15/03/2010		24/03/2010		25/03/2010		31/03/2010	
Event Max (mm/s)	2.03	16:54:40	2.2	11:45:00	48.0	12:59:40	4.55	16:05:30
Hour Max1 mm/s	0.175	14:44:00	2.2	11:45:00	48.0	12:59:40	4.55	16:05:30
Hour Max2 mm/s	0.25	15:25:40	0.3	12:00:20	0.175	13:00:10	0.175	17:00:10
Hour Max3 mm/s	2.03	16:54:40	0.375	13:59:59	0.175	14:00:10	0.175	18:00:10
Hour Max4 mm/s	0.275	17:05:00	0.175	14:00:30	42.4	15:03:10	1.3	19:25:00
Hour Max5 mm/s	0.725	18:04:30	0.2	15:04:30	0.175	16:00:10	0.175	20:00:10
Hour Max6 mm/s	0.175	19:00:10	0.3	16:55:20	1.48	17:18:00	0.175	21:00:20
Hour Max7 mm/s	0.225	20:30:10	0.175	17:00:20	0.175	18:00:20	0.175	22:00:10
Hour Max8 mm/s	0.175	21:00:30	0.175	18:00:10	0.175	19:00:10	0.175	23:00:20
Hour Max9 mm/s	0.175	22:00:20	0.175	19:00:10	0.175	20:00:20	0.175	00:00:10
Hour Max10 mm/s	0.175	23:00:10	0.175	20:00:10	0.175	21:00:10	-	-
Hour Max11 mm/s	-	-	0.175	21:00:50	0.275	22:18:50	-	-
Hour Max12 mm/s	-	-	0.175	22:00:10	0.175	23:00:10	-	-

The summary results of the vibration monitoring presented in Table 9.7 indicate that there are negligible baseline levels of vibration at properties in the study area. The event maximum levels of vibration detected during each of the surveys were attributable to vibration created during the setting up and collection of the monitoring equipment. It can be seen from the results that the baseline levels of vibration generally during the monitoring periods were only detectable at trace levels, i.e. typically 0.175 – 0.275 mm/s. The lowest detectable vibration velocity recordable by the survey instrument was 0.175 mm/s. Therefore, the actual typical background vibration will be below this value. The intermittent higher levels were associated with persons adjacent to the monitoring equipment and handling the equipment.

9.4 POTENTIAL IMPACTS

9.4.1 'Do Nothing' Scenario

Should the proposed works not to be carried out, i.e. the 'do nothing' scenario prevailed, it is considered that there would be no significant change in the existing noise environment in the vicinity of the site. The site currently comprises agricultural lands and tracts of open countryside. Therefore, should the 'do nothing' scenario continue there would be no predicted change in noise levels at the site with the exception of variations in external noise sources (traffic noise) apparent in the area.

9.4.2 Construction Phase – Noise from Terrestrial Works

The most noticeable noise impact will occur during activities employed during the various stages of terrestrial pipeline construction. Accordingly, in order to assess the worst-case scenario the predicted impact for this phase of the proposed development is presented below.

Sensitive receptors representing both the closest properties to the proposed development as well as properties in the surrounding area were identified and included the monitoring locations N1 - N26. These receptors include properties that represent a worst-case scenario due to their proximity to the works. As such, noise levels at the remaining receptors located further from the proposed development are expected to be lower. The locations of the identified sensitive receptors are illustrated on Figures 9.1a and 9.1b.

A digital noise prediction model for the scheme was constructed using the Bruel and Kjaer 7810 Predictor Version 6 software package. The noise-modelling package uses a computer based noise propagation model, in accordance with the ISO 9613-2 standard, "*Acoustics - Attenuation of sound during propagation outdoors*", which is an international standard used to undertake noise prediction modelling. The plant and machinery sound power levels were sourced from manufacturer's data for the tunnelling equipment, provided by de la Motte & Partner. Noise data for plant and machinery associated with the construction works other than the tunnelling equipment were sourced from BS 5228, "*Noise and Vibration Control on Construction and Open Sites, 2009,*" and the Defra, "*Updated Noise Database for Prediction of Noise on Construction and Open Sites, 2005"*. The noise model was constructed based on the ISO 9613-2 standard method using the receptor locations outlined earlier.

To allow for prediction of the worst-case scenario the total number of plant involved in all stages of the construction works was input as individual sources within the boundaries of the construction working areas, which are in relatively close proximity to a number of the sensitive receptors.

Considering the progressive nature of the works, i.e. soil and peat will need to be excavated before the tunnelling launch and reception pits can be constructed and before the trenches can be excavated, each item of plant will not be operating simultaneously. However, in order to predict the absolute worst-case scenario, each item of plant that will be operational during the day has been input into the model as operational for 100% of the time. Similarly, each item of plant that will be operating on a 24-hour basis in association with the on land tunnelling works has also been input into the model as operational for 100% of the time.

Therefore, the results represent an overestimate of the potential construction noise that may be generated at the site, as much of the plant and machinery will not be operational simultaneously and will not be operational at the same location. However, it should be noted that noise emissions associated with plant servicing the tunnelling compound at na hEachú (Aghoos) will be operational on a continuous basis for the duration of 12 – 14 months, although not all noise sources at na hEachú (Aghoos) will typically operate simultaneously. These noise sources have been input into the model as being operational for 100% of the time on a 24-hour basis. These noise sources have been modelled in tandem with the site preparation noise sources at the reception pit at Gleann an Ghad (Glengad) in order to predict the potential worst-case noise emissions during the construction phase. However, it should be noted that the noise sources at the reception pit in glean an Ghad (Glengad) will be present for less than 12 months and will not generate noise on a continuous basis, when present. Night-time works are not anticipated at Gleann an Ghad (Glengad), with the possible exception of a dewatering pump being operational during the night, which has been taken into account in the predicted noise levels. Details of the plant and machinery input into the noise model are presented in Appendix H1.

The predicted daytime and night-time noise levels at the various receptors are presented in Table 9.8 and Table 9.9 and illustrated in Figures 9.2a and 9.2b, respectively. The results were compared to existing baseline noise levels in the vicinity of each receptor (both existing ambient noise levels (L_{Aeq}) and existing background noise levels (L_{A90})). The cumulative noise levels are shown for a combination of the predicted levels with both existing ambient noise levels and existing background noise levels. The predicted noise levels were also compared with assessment criteria adopted by the NRA and the Bellanaboy Bridge Terminal EIS.

The following is an explanation of the information provided in Table 9.8:

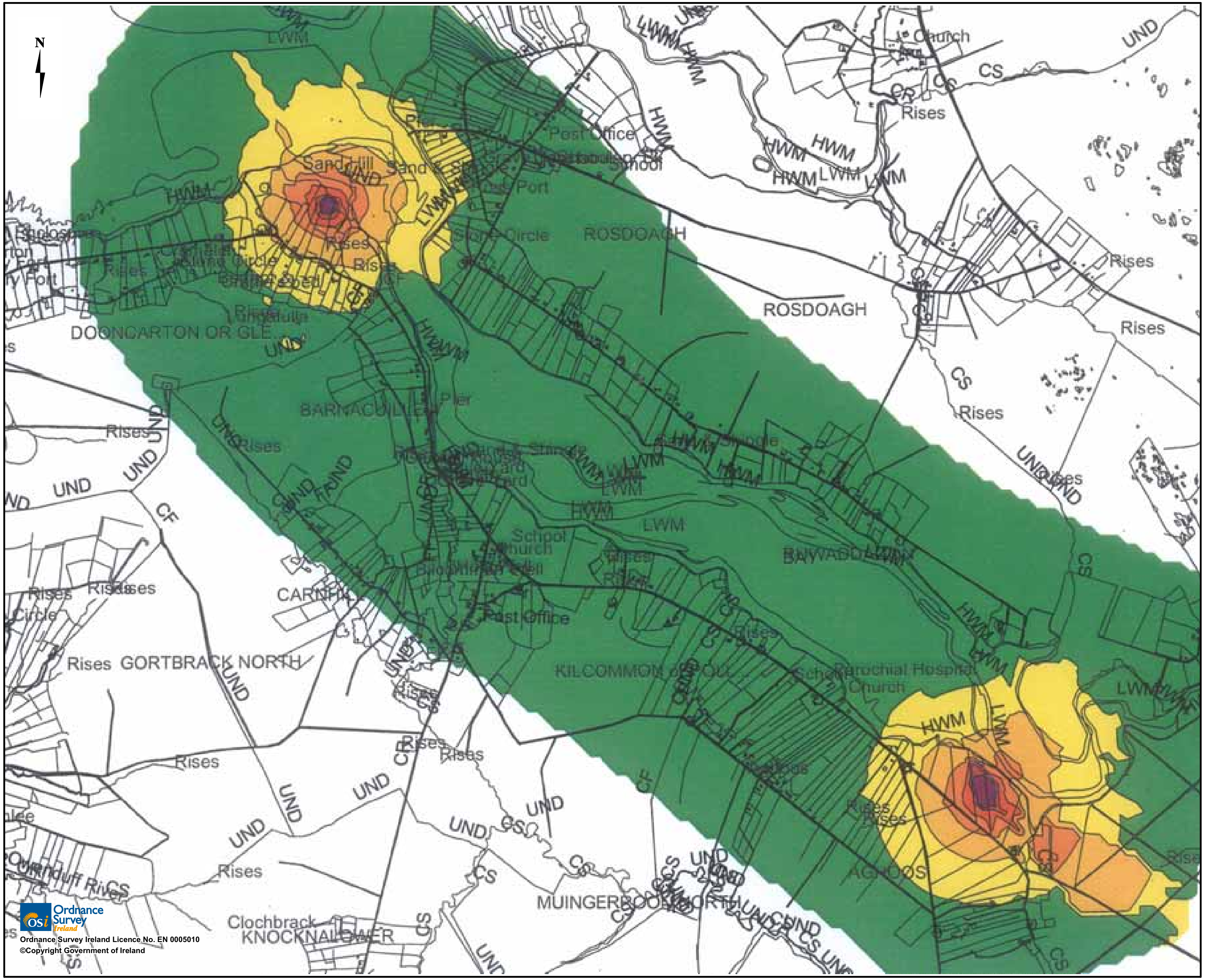
- Column 2: Is the measured baseline ambient level, i.e. the measured level during the monitoring period (L_{Aeq}) and represents the continuous steady noise level or the average noise level during the survey;
- Column 3: Is the measured baseline background level, i.e. the measured noise level that is equalled or exceeded for 90% of the monitoring period (L_{A90});
- Column 4: Is the predicted construction noise level (L_{Aeq});
- Column 5: Is the difference between the baseline ambient level (L_{Aeq}) in Column 2 and the predicted construction noise level (L_{Aeq}) in Column 4 and is used to determine the impact rating in Column 7;
- Column 6: Is the cumulative noise level arising from the combination of the baseline ambient level (L_{Aeq}) in Column 2 and the predicted construction level (L_{Aeq}) in Column 4;
- Column 7: Is the impact rating based on the information in Column 5 and compared with Table 9.2;
- Column 8: Is the difference between the baseline background level (L_{A90}) in Column 3 and the predicted construction noise level (L_{Aeq}) in Column 4 and is used to determine the impact rating in Column 10;
- Column 9: Is the cumulative noise level arising from the combination of the baseline background level (L_{A90}) in Column 3 and the predicted construction level (L_{Aeq}) in Column 4;
- Column 10: Is the impact rating based on the information in Column 8 and compared with Table 9.2; and
- Column 11: Is the comparison of the cumulative noise level in Column 9 with the NRA Guideline value of 65 dB(A).

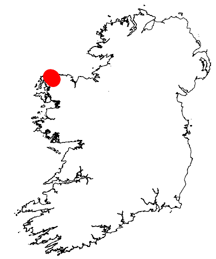
Interpretation of Table 9.9 is similar to the above.

The predicted traffic noise levels associated with the construction phase of the proposed pipeline are presented in Table 9.10. It is predicted that properties located along the haul routes will experience an increase in traffic noise levels ranging from a minimum of less than 1dB (0.2dB), which would be considered as no change or an imperceptible impact, based on existing ambient noise levels measured at the sensitive receptor N22 (located off the L1204); to a maximum of 15.1dB, based on the existing ambient noise levels measured at the sensitive receptor N19 (located off the L1202), which would be considered as a major significant, temporary to short-term impact associated with construction traffic and would occur during the busiest stage of the construction programme (Month 2).

For properties located along the L1202 between Béal an Ghoile Theas (Bellagelly South) and Gleann an Ghad (Glengad), the predicted increase in traffic noise levels due to construction traffic ranges from 0.0dB to 7.8dB, based on predicted construction traffic noise levels compared with predicted future traffic noise levels in the absence of construction traffic on the L1202. These increases would be considered an imperceptible impact and moderate negative impact, respectively.

For properties located along the L1204 between An Srath Mór (Srahmore) and Bellanaboy Bridge, the predicted increase in traffic noise levels due to construction traffic ranges from 0.9dB to 3.3dB (dependent upon proximity to the road), which would be considered as imperceptible and minor negative impacts, respectively.





Legend

- < 45.0 dB(A)
- 45.0 - 50.0 dB(A)
- 50.0 - 55.0 dB(A)
- 55.0 - 60.0 dB(A)
- 60.0 - 65.0 dB(A)
- 65.0 - 70.0 dB(A)
- > 70.0 dB(A)

Predicted Construction Noise Levels (Daytime)

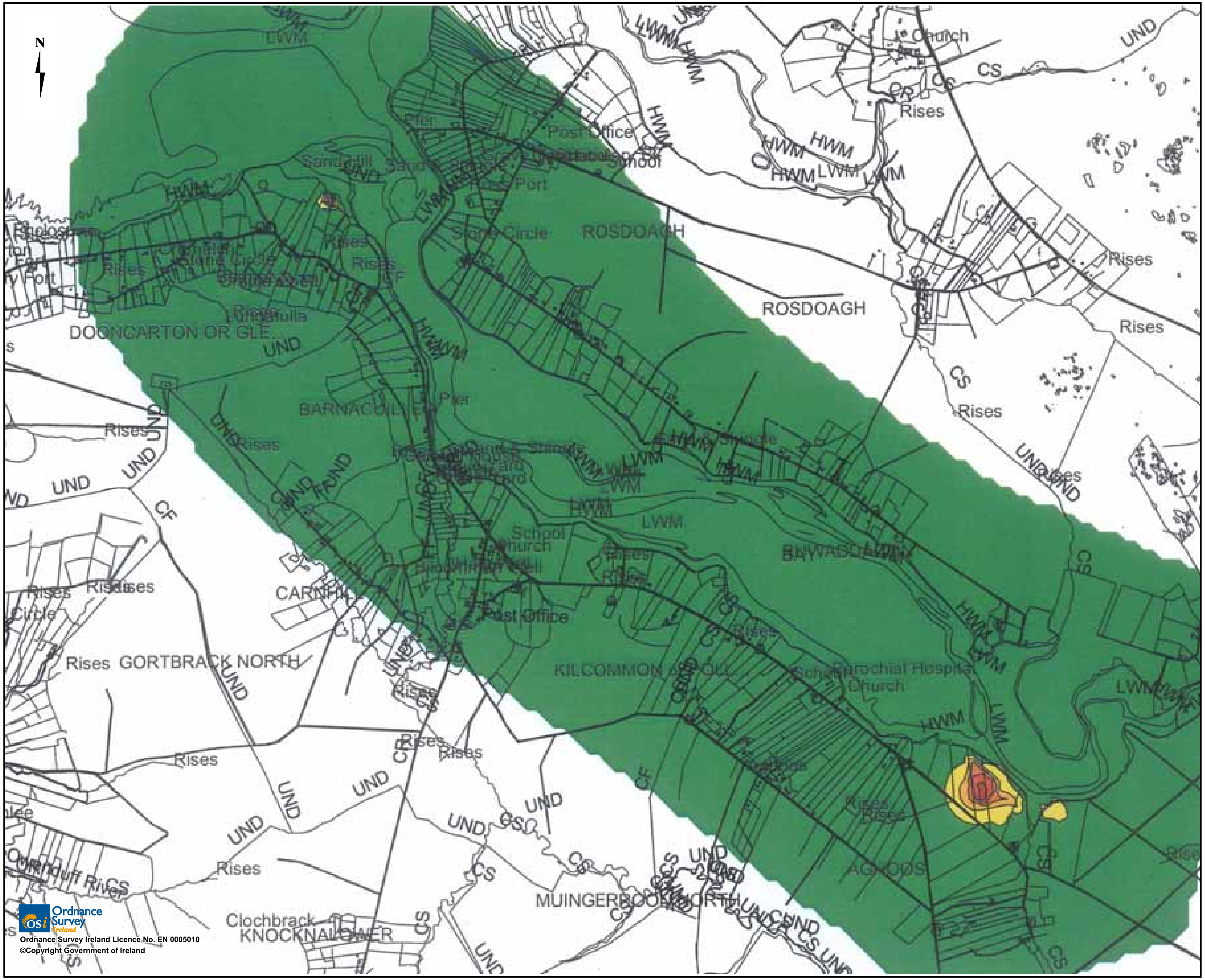
Figure 9.2a

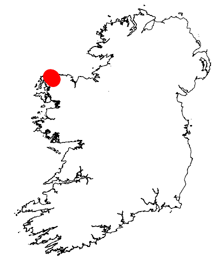
File Ref: COR25MDR0470Mi2458R01
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS





Legend

- < 45.0 dB(A)
- 45.0 - 50.0 dB(A)
- 50.0 - 55.0 dB(A)
- 55.0 - 60.0 dB(A)
- 60.0 - 65.0 dB(A)
- 65.0 - 70.0 dB(A)
- > 70.0 dB(A)

Predicted Construction Noise Levels (Night-time)

Figure 9.2b

File Ref: COR25MDR0470Mi2459R01
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

Table 9.8: Predicted Construction works Daytime Noise Levels at Noise Sensitive Locations during Construction Phase

Noise Sensitive Receptor	Measured Baseline Ambient Level dB L_{Aeq}	Measured Baseline Background Level dB L_{A90}	Predicted Note1 Construction Noise level dB L_{Aeq}	Difference between Baseline L_{Aeq} & Predicted Level dB L_{Aeq}	Cumulative Note 2 Noise level dB L_{Aeq} & L_{Aeq}	Impact Rating (L_{Aeq})	Difference between Baseline L_{A90} & Predicted Level dB L_{Aeq}	Cumulative Note 2 Noise level dB L_{Aeq} & L_{A90}	Impact Rating (L_{A90})	Compliance with NRA Assessment Criteria (65dB(A)
N1	44.1	38.3	48.2	+4.1	49.6	Minor	+9.9	48.6	Moderate	✓
N2	48.8	30.9	50.9	+2.1	53.0	Not Significant	+20.0	50.9	Severe	✓
N3	46.5	38.6	45.7	-0.8	49.1	No change	+7.1	46.5	Moderate	✓
N4	---	---	43.2	---	---	---	---	---	---	✓
N5	43.0	27.8	35.4	-7.6	43.7	No change	+7.6	36.1	Moderate	✓
N6	46.5	34.9	37.8	-8.7	47.0	No change	+2.9	39.6	Minor	✓
N7	38.0	30.6	36.8	-1.2	40.5	No change	+6.2	37.7	Moderate	✓
N8	43.2	37.8	35.7	-7.5	43.9	No change	-2.1	39.9	No change	✓
N9	49.2	40.4	34.9	-14.3	49.4	No change	-5.5	41.5	No change	✓
N10	41.9	31.3	35.5	-6.4	42.8	No change	+4.2	36.9	Minor	✓
N11	51.9	40.0	32.8	-19.1	52.0	No change	-7.2	40.8	No change	✓
N12	48.8	31.1	34.2	-14.6	48.9	No change	+3.1	35.9	Minor	✓
N13	44.6	28.5	34.8	-9.8	45.0	No change	+6.3	35.7	Moderate	✓
N14	43.9	37.4	35.8	-8.1	44.5	No change	-1.6	39.7	No change	✓
N15	40.3	33.1	36.1	-4.2	41.7	No change	+3.0	37.9	Minor	✓
N16	42.8	31.9	37.1	-5.7	43.8	No change	+5.2	38.2	Minor	✓
N17	58.7	32.6	38.4	-20.3	58.7	No change	+5.8	39.4	Moderate	✓
N18	41.5	33.4	43.1	+1.6	45.4	No change	+9.7	43.5	Moderate	✓
N19	48.6	35.9	48.3	-0.3	51.5	No change	+12.4	48.5	Major	✓
N20	46.5	28.7	53.2	+6.7	54.0	N/A Note3	+24.5	53.2	N/A Note3	N/A Note3

Note 1: Noise level at sensitive receptor as a result of construction plant only.
Note 2: Addition of Measured Baseline Level and Predicted Construction noise. dBs are logarithmic values, therefore cannot be added together arithmetically as is done for linear values.
Note 3: N20 is a vacant property, owned by SEPIL and is not a noise sensitive receptor as such. Therefore, impacts at this property have not been assessed.

Table 9.8: Predicted Construction works Daytime Noise Levels at Noise Sensitive Locations during Construction Phase (continued)

Noise Sensitive Receptor	Measured Baseline Ambient Level dB L_{Aeq}	Measured Baseline Background Level dB L_{A90}	Predicted Note1 Construction Noise level dB L_{Aeq}	Difference between Baseline L_{Aeq} & Predicted Level dB L_{Aeq}	Cumulative Note 2 Noise level dB L_{Aeq} & L_{Aeq}	Impact Rating (L_{Aeq})	Difference between Baseline L_{A90} & Predicted Level dB L_{Aeq}	Cumulative Note 2 Noise level dB L_{Aeq} & L_{A90}	Impact Rating (L_{A90})	Compliance with NRA Assessment Criteria (65dB(A)
N21	49.9	33.1	23.9	-26.0	49.9	No change	-9.2	33.6	No change	✓
N22	62.8	37.9	17.7	-45.1	62.8	No change	-20.2	37.9	No change	✓
N23	57.1	28.6	20.8	-36.3	57.1	No change	-7.8	29.3	No change	✓
N24	47.9	35.9	25.7	-22.2	47.9	No change	-10.2	36.3	No change	✓
N25	57.9	38.8	29.8	-28.1	57.9	No change	-9.0	39.3	No change	✓
N26	63.5	38.0	27.7	-35.8	63.5	No change	-10.3	38.4	No change	✓

Note 1: Noise level at sensitive receptor as a result of construction plant only.
Note 2: Addition of Measured Baseline Level and Predicted Construction noise. dBs are logarithmic values, therefore cannot be added together arithmetically as is done for linear values.

The results indicate that the predicted daytime construction noise level associated with site works will not exceed the NRA assessment criteria for construction works or the 65dB(A) limit as applied to the terminal construction works, but as expected will rise significantly above (>3dB(A)) existing baseline levels at a number of properties in the area. There will be a minor negative short-term impact at N1. It should be noted that N1 represents a monitoring point near the proposed LVI compound at Gleann an Ghad (Glengad) and there is no property located at this point. In this regard, it is considered that there will be no significant impact on sensitive receptors in the area based on the existing ambient (L_{Aeq}) noise levels.

As shown in Column 10, the results indicate that the predicted noise levels will have minor to moderate significant negative short-term impacts at twelve locations (N1, N3, N5, N6, N7, N10, N12, N13, N15, N16, N17, N18, a major significant negative short-term impact at one property (N19) and a profound significant negative short-term impact at one property (N2) based on the existing background (L_{A90}) noise levels in the area.

As shown in Column 6, the predicted cumulative noise levels are expected to range between L_{eq} 40.5dB(A) and 63.5dB(A), although it should be noted that whereas the cumulative level of 40.5dB(A) at the sensitive receptor N7 is attributable to the predicted construction noise level, the cumulative level at the sensitive receptor N22 of 62.8(A) is based on the existing ambient noise level. In reality it is anticipated that noise levels as a result of construction works will be lower as it is highly unlikely that all the items of machinery modelled will be in operation simultaneously. It must also be borne in mind that these elevated noise levels are short-term impacts for the duration of the construction phase.

In absolute terms the predicted noise levels would not be considered excessive for construction works. However, considering the existing low baseline noise level the perceived impact will be significant (>3dBs) with a profound significant negative (>15dB(A)) impacts at one property. The tolerance for elevated noise levels during construction is generally increased if it is known that the works are to be completed within a short-term time frame.

Table 9.9: Predicted Construction works Night-time Noise Levels at Noise Sensitive Locations during Construction Phase

Noise Sensitive Receptor	Measured Baseline Ambient Level (Night-time) dB L_{Aeq}	Measured Baseline Background Level (Night-time) dB L_{A90}	Predicted Note1 Construction Noise level (Night-time) dB L_{Aeq}	Difference between Baseline L_{Aeq} & Predicted Level (Night-time) dB L_{Aeq}	Cumulative Note 2 Noise level (Night-time) dB L_{Aeq} & L_{Aeq}	Impact Rating (L_{Aeq})	Difference between Baseline L_{A90} & Predicted Level (Night-time) dB L_{Aeq}	Cumulative Note 2 Noise level (Night-time) dB L_{Aeq} & L_{A90}	Impact Rating (L_{A90})	Compliance with EPA & WHO Assessment Criteria (45dB(A))
N2	39.5	25.0	36.8	-2.7	41.4	No change	+11.8	37.1	Major	✓
N7	47.3	42.1	20.6	-26.7	47.3	No change	-21.5	42.1	No change	✓
N13	34.6	26.6	22.1	-12.5	34.8	No change	-4.5	27.9	No change	✓
N15	34.7	26.0	25.0	-9.7	35.1	No change	-1.0	28.5	No change	✓
N20	37.9	22.6	43.8	+5.9	44.8	N/A Note 3	+21.2	43.8	N/A Note 3	N/A Note 3
N21	38.7	23.4	12.9	-25.8	38.7	No change	-10.5	23.8	No change	✓

Note 1: Noise level at sensitive receptor as a result of construction plant only.
Note 2: Addition of Measured Baseline Level and Predicted Construction noise. dBs are logarithmic values, therefore cannot be added together arithmetically as is done for linear values. Results are based on night-time data from 24hour baseline measurements and predicted night-time construction noise levels.
Note 3: N20 is a vacant property, owned by SEPIL and is not a noise sensitive receptor as such. Therefore, impacts at this property have not been assessed.

The results indicate that the predicted night-time construction noise levels associated with site works will not exceed the EPA or the WHO assessment criterion of 45dB(A) for night-time noise levels at any of the noise sensitive receptors, but as expected will temporarily, rise significantly above (>3dB(A)) existing background noise levels, with no significant impact on sensitive receptors in the area generally, based on the existing ambient (L_{Aeq}) night-time noise levels. The results indicate that the predicted night-time noise levels will have a significant negative short-term impact at one property (N2) based on the existing background (L_{A90}) night-time noise levels in the area. However, it is noted that both the predicted construction noise level and the predicted cumulative construction noise level during the construction phase will be within the EPA and WHO guidelines criterion of 45 dB(A) for night-time noise levels.

The predicted cumulative noise level is expected to range between L_{eq} 34.8dB(A) and 47.3dB(A) based on the measured ambient levels. However, it should be noted that in both instances the predicted cumulative noise level is primarily attributable to the existing ambient night-time noise levels given that the existing ambient levels are 34.6dB(A) at the sensitive receptor N13, and 47.3dB(A) at the sensitive receptor N7 respectively. The corresponding predicted construction noise levels are 22.1dB(A) at N13 and 20.6dB(A) at N7. It should also be noted that the predicted night-time construction noise levels are short-term impacts.

In absolute terms the predicted night-time construction noise levels would not be considered excessive for construction works. Considering the existing low baseline noise level the perceived impact will be significant (>3dBs) at one property. However, the predicted night-time construction noise level at all properties is considered acceptable given that the levels are within the EPA and WHO guidelines levels.

Table 9.10: Predicted Construction Traffic Noise Levels at Noise Sensitive Locations during Construction Phase

Noise Sensitive Receptor	Measured Baseline Ambient Level (Daytime) dB L_{Aeq}	Measured / Calculated Note1 Baseline L_{den} Level (day, evening, night) dB L_{den}	Predicted Note2 Construction Traffic Noise level (2011 DS) (Daytime) dB L_{Aeq}	Difference between Baseline L_{Aeq} & Predicted Level (Daytime) dB L_{Aeq}	Cumulative Note 3 Noise level (Daytime) dB L_{Aeq} & L_{Aeq}	Impact Rating (L_{Aeq})	Total Cumulative Note 4 Construction Noise and Construction Traffic Noise level (Daytime) dB L_{Aeq}	Compliance with NRA Assessment Criteria (65dB(A))
N1	44.1	43.1	42.1	-2.0	46.2	No change	50.3	✓
N2	48.8	52.2	52.3	+3.5	53.9	Minor	55.7	✓
N3	46.5	45.5	57.1	+10.6	57.5	Major	57.7	✓
N4	---	---	---	---	---	---	---	✓
N5	43.0	42.0	52.5	+9.5	53.0	Moderate	53.0	✓
N6	46.5	45.5	40.5	-6.0	47.5	No change	47.9	✓
N7	38.0	56.0	40.8	+2.8	42.6	Minor	43.6	✓
N8	43.2	42.2	40.7	-2.5	45.1	No change	45.6	✓
N9	49.2	48.2	54.5	+5.3	55.6	Minor	55.7	✓
N10	41.9	40.9	43.0	+1.1	45.5	Not significant	45.9	✓
N11	51.9	50.9	51.5	-0.4	54.7	No change	54.7	✓
N12	48.8	47.8	52.2	+3.4	53.8	Minor	53.9	✓
N13	44.6	44.2	53.3	+8.7	53.8	Moderate	53.9	✓
N14	43.9	42.9	43.5	-0.4	46.7	No change	47.1	✓
N15	40.3	44.9	42.3	+2.0	44.4	Minor	45.0	✓
N16	42.8	41.8	42.5	-0.3	45.7	No change	46.2	✓
N17	58.7	57.7	64.4	+5.7	65.4	Moderate	65.4	✓
N18	41.5	40.5	44.2	+2.7	46.1	Minor	47.8	✓
N19	48.6	47.6	63.7	+15.1	63.8	Major	64.0	✓
N20	46.5	45.0	59.2	+12.7	59.4	N/A Note 5	60.4	N/A Note 5

Note 1: L_{den} noise level calculated based on 24-hr noise data used for N2, N7, N13, N15, and N20, L_{den} noise level calculated based on 15-minute short period noise surveys for other noise sensitive locations.
Note 2: Noise level at sensitive receptor as a result of construction traffic only.
Note 3: Addition of Measured Baseline Level and Predicted Construction noise. dBs are logarithmic values, therefore cannot be added together arithmetically as is done for linear values.
Note 4: Addition of Measured Baseline Level and Predicted Total Construction noise (traffic and site related constriction works). dBs are logarithmic values, therefore cannot be added together arithmetically as is done for linear values.
Note 5: N20 is a vacant property, owned by SEPIL and is not a noise sensitive receptor as such. Therefore, impacts at this property have not been assessed.

Table 9.10: Predicted Construction Traffic Noise Levels at Noise Sensitive Locations during Construction Phase (continued)

Noise Sensitive Receptor	Measured Baseline Ambient Level (Daytime) dB L_{Aeq}	Measured / Calculated Note1 Baseline L_{den} Level (day, evening, night) dB L_{den}	Predicted Note2 Construction Noise level (Daytime) dB L_{Aeq}	Difference between Baseline L_{Aeq} & Predicted Level (Daytime) dB L_{Aeq}	Cumulative Note 3 Noise level (Daytime) dB L_{Aeq} & L_{Aeq}	Impact Rating (L_{Aeq})	Total Cumulative Note 4 Construction Noise and Construction Traffic Noise level (Daytime) dB L_{Aeq}	Compliance with NRA Assessment Criteria (65dB(A))
N21	49.9	51.8	54.5	+4.6	55.8	Minor	55.8	✓
N22	62.8	61.8	63.0	+0.2	65.9	Not significant	65.9	✗
N23	57.1	56.1	60.0	+2.9	61.8	Minor	61.8	✓
N24	47.9	46.9	38.0	-9.9	48.3	No change	48.3	✓
N25	57.9	56.9	60.0	+2.1	62.1	Not significant	62.1	✓
N26	63.5	62.5	57.6	-5.9	64.5	No change	64.5	✓

Note 1: L_{den} noise level calculated based on 24-hr noise data used for N2, N7, N13, N15, and N20, L_{den} noise level calculated based on 15-minute short period noise surveys for other noise sensitive locations.
Note 2: Noise level at sensitive receptor as a result of construction traffic only.
Note 3: Addition of Measured Baseline Level and Predicted Construction noise. dBs are logarithmic values, therefore cannot be added together arithmetically as is done for linear values.
Note 4: Addition of Measured Baseline Level and Predicted Total Construction noise (traffic and site related constriction works). dBs are logarithmic values, therefore cannot be added together arithmetically as is done for linear values.

The results indicate that the predicted construction traffic noise level on its own will not exceed the NRA assessment criteria for construction works or the 65dB(A) limit as applied to the Terminal construction works, but as expected will temporarily, rise significantly above (>3dB(A)) existing baseline levels. The predicted cumulative noise level incorporating the construction traffic noise levels and the baseline ambient noise levels indicate that the NRA criterion of 65dB(A) $L_{eq,\ 1hour}$, will be exceeded slightly at one property, N22, situated in close proximity to the junction of the R313 and the L1204. The predicted construction noise level at this property, which is attributable to construction traffic, is 63.0dB(A) and is therefore within the NRA assessment criterion of 65dB(A). However, the existing ambient noise level at this property was measured at a level of 62.8dB(A) L_{eq} and it is as a result of this baseline noise level that the cumulative noise level during the construction phase will be raised slightly above 65dB(A). It should be noted that the construction traffic noise levels have been predicted using the heaviest volume of traffic, which is expected to occur during Month 2 of the overall 26-month construction programme; therefore, construction traffic levels during the remainder of the construction period would be expected to be lower at this receptor.

The results also indicate that the predicted construction traffic noise levels will have a minor significant negative short-term impact at eight properties (N2, N7, N9, N12, N15, N18, N21 and N23); a moderate significant negative short-term impact at three properties (N5, N13 and N17); and a major significant negative short-term impact at two properties (N3 and N19) based on the existing ambient (L_{Aeq}) noise levels in the area.

The predicted construction traffic noise levels and indeed the predicted total cumulative construction noise levels, which incorporate the existing ambient noise with both the predicted site works and construction traffic noise levels, are within the NRA assessment criteria of 65dB(A) at all of the noise sensitive receptors, with the exception of N22 as described above.

9.4.2.1 Ecologically Sensitive Receptors

The potential impacts on fauna (avian and non-avian) resulting from increased noise levels are discussed in Chapters 12 and 14. Potential impacts on fish are provided in Chapter 13 and 14.

9.4.3 Construction Phase – Vibration

The level of vibration attributable to HCV traffic on an uneven road surface would be considered to be more significant than that attributable to shallow pile driving works that may be required for construction works.

As a vehicle travels along a road, vibration can be generated in the road and subsequently propagate towards nearby buildings. Such vibration is generated by the interaction of a vehicle's wheels and the road surface and by direct transmission through the air of energy waves (sound waves). Some of these waves arise as a function of the size, shape and speed of the vehicle, and others from pressure fluctuations due to engine and exhaust noise generated by the vehicle. It has been found that ground vibrations produced by road traffic are unlikely to cause perceptible structural vibration in properties located near well-maintained and smooth road surfaces. Road traffic vibration levels can therefore be largely minimised by maintenance of the road surface.

There will be no significant sources of vibration during reinstatement.

9.4.4 Construction Phase – Groundborne Noise and Vibration from Tunnelling

The closest residential properties to the tunnelling works, which are likely to experience the highest levels of vibration from tunnelling, are located close to the narrowest part of the mouth of the Bay on the road between Poll an tSómais (Pollatomish) and Gleann an Ghad (Glengad) (such as property BQ07, see Appendix A2), at a distance of approximately 240 metres or more from the location of the tunnel. The highest predicted vibration velocity in the ground at a location representative of these residential properties is predicted in the 16 Hz 1/3 octave band and reaches a value of 1.8 µm/s. In terms of a PPV, taking account of the vibration throughout the 10 Hz to 100 Hz range, this corresponds to a value in the range 0.01 to 0.02 mm/s. Comparing this value with Table 9.3 indicates that this is a level that is considerably below the threshold of human perception for vibration. The baseline vibration surveys showed background vibration velocities were generally lower than the range 0.175 – 0.275 mm/s. Therefore, the predicted vibration from tunnelling is also an order of magnitude lower than recorded background velocities outside residential properties.

The magnitude of vibration in the ground is attenuated by the mass-loading of the building when it enters the building via the foundations. Furthermore, the dynamic response of a suspended floor will amplify vibration such that the vibration in the vertical direction is greater in the middle of the floor than at its edges. Both effects are frequency dependent, site specific, and can depend upon the soil properties of the ground, the design and construction of the building and the vibration characteristics of the source. However, the combined dynamic amplification due to both effects is unlikely to increase the vibration levels in the ground by more than 1.5 times. On this basis, the vibration level on suspended floors within houses in between Poll an tSómais (Pollatomish) and Gleann an Ghad (Glengad) during the pass-by of the TBM is at a level likely to be significantly less than the threshold of human perception for vibration.

The corresponding predicted groundborne noise level is 9 dB $L_{Amax,S}$. It can be seen that such a level is well below the significance criterion of 35 dB $L_{Amax,S}$ and would be inaudible within any residential property.

9.4.5 Operational Phase - Noise

There will be no continuous operational noise generated by the proposed development. The traffic generated by the security and regular maintenance will be negligible in comparison to existing traffic on the road network and will not impact adversely on the local noise environment. Approximately once every five years there will be inspection and maintenance at the LVI, which will involve the use of construction plant. In the unlikely event of an emergency shutdown of the valve, there will be a temporary increase in noise levels in the immediate vicinity of the LVI.

9.4.6 Operational Phase - Vibration

There will be no discernible vibration impacts during the operational phase of the development.

9.5 MITIGATION MEASURES

Mitigation measures to minimise the potential noise and vibration impacts anticipated to result from the construction of the proposed development are discussed in Sections 9.5.1 – 9.5.4.

9.5.1 Construction Phase - Noise from Terrestrial Works

Mitigation measures, as outlined in BS 5228, *"Noise and Vibration Control on Construction and Open Sites,"* will be employed on-site during construction. These measures will include the following:

- With the exception of the 24-hour, 7-day tunnelling works construction activities, normal working hours will be 0700-1900 hours Monday to Friday and 0700-1600 hours on Saturdays. Some additional work may be required outside these hours e.g. inspection, testing and commissioning activities. Night-time security will patrol the temporary compounds and working areas. Apart from the tunnelling works construction activities, Sunday working will be avoided where possible, but cannot be entirely excluded. Aside from the tunnelling works, construction activities outside of normal hours will only take place outside of normal hours after prior consultation with Mayo County Council and the notification of local community.

- A dedicated 3m tall noise attenuation barrier will be installed around the perimeter of both the Tunnelling works launch pit at na hEachú (Aghoos) and the reception pit at Gleann an Ghad (Glengad). This noise attenuation barrier has been incorporated into the noise prediction model.

- Plant machinery with low inherent potential for generation of noise and/or vibration will be selected. All construction plant and equipment to be used at the site will be modern equipment and will comply with the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations.

- Regular maintenance of plant will be carried out in order to minimise noise produced by on-site operations. The regular and effective maintenance of plant can play an important role in reducing noise emissions. In particular, attention will be paid to the lubrication of bearings and the integrity of silencers. Silencers and engine covers will be maintained in good and effective working order.

- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the works.

- Compressors will be of the "sound reduced" models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.

- Machines, which are used intermittently, will be shut down or throttled back to a minimum during those periods when they are not in use.

- All plant and machinery that will be used during the construction works, including generators and pumps, will be housed within proprietary acoustic enclosures. Power packs and tunnelling works plant and machinery will also be housed within self-contained acoustic enclosures, designed to reduce noise emissions at source. These mitigations measures will be incorporated into the contract documents for the contractor(s) appointed to undertake the construction works and are in addition to the noise attenuation barriers which will be provided for the tunnelling compounds at na hEachú (Aghoos) and Gleann an Ghad (Glengad).

- Training of drivers to ensure smooth machinery operation/driving, and to minimise unnecessary noise generation.

- A maximum speed limit of 60km/hr on all haul routes (with the exception of the section of the L1202 from na hEachú (Aghoos) to Gleann an Ghad (Glengad)) will be imposed for HCVs and drivers will be instructed to maintain as far as possible the distances between vehicles. A maximum speed limit of 40km/hr will be imposed for HCVs on the section of the L1202 from na hEachú (Aghoos) to Gleann an Ghad (Glengad). A Traffic Management Plan will be put in place to minimise congestion (see Appendix E).

9.5.2 Construction - Vibration from Terrestrial Works

It is anticipated that the levels of vibration generated by construction activities on land will be below the criteria specified in the standards, outlined in Section 9.2.2 of this report.

It is recommended that a structural survey be undertaken on any receptors, which may be susceptible to vibration impacts, prior to construction works beginning.

If necessary, vibration measurements will be undertaken at a number of monitoring points, in agreement with Mayo County Council during the construction phase. This would help to ensure that rock breaking or piling activities during constructions works for the onshore pipeline would not give rise to nuisance in the vicinity. If vibration-monitoring results were to indicate that levels were approaching standard limits, the rate and force at which rock breaking and piling was being undertaken would be reduced to ensure that vibration levels were reduced to acceptable levels. Given the degree of control that can be exercised for these works, it is considered that these works can be carried out with minimal nuisance for sensitive residential dwellings in the vicinity of the site.

9.5.3 Construction Phase – Groundborne Noise and Vibration from Tunnelling

- As there are no significant impacts from vibration or groundborne noise from tunnelling anticipated, no mitigation measures will be required.

9.5.4 Construction Phase – Commissioning Works on Land Associated with Offshore Pipeline

- As outlined previously, the commissioning works associated with the offshore pipeline are not part of the subject application for the onshore pipeline but have been considered in terms of their cumulative impacts. The commissioning plant will be located on land in the LVI compound for a period of approximately one to two weeks. A description of these works is only included in this section for reference but have been considered with regard to potential noise impacts regardless. It should be noted that the compressor plant and generators used in commissioning of the offshore pipeline will be enclosed in sealed containers to minimise noise during commissioning activities. However, current information in respect of the pre-commissioning of the offshore pipeline indicates that this activity would need to restricted due to elevated noise levels arising from the nitrogen generating plant and associated compressors. If, however, further noise attenuation measures can be identified and proven to reduce noise levels to an acceptable target, it is proposed to carry out this work on a 24-hr basis. Should further noise attenuation not be available, this activity will be curtailed, and not carried out during the period 22:00 – 07:00.

9.5.5 Monitoring

A programme of noise and vibration monitoring at sensitive receptors will be detailed prior to works beginning. This will allow for a constant review of noise and vibration levels generated by the construction works and will highlight the need for further mitigation measures should they be required.

9.5.6 Operational Phase - Noise

Residents of the nearest receptors will be notified well in advance prior to any major maintenance works at the LVI, or if the LVI pipeline restart system needs to be operated.

9.6 RESIDUAL IMPACT

Once the development is operational there will be no significant residual noise or vibration impacts from on land works. The only noise to be generated by the development during operations will be from weekly visits to the LVI, and any maintenance works. The additional traffic generated by this activity will be negligible in comparison to the existing traffic flows.

There will be no discernible vibration impacts during the operational phase of the development.

10 LANDSCAPE & VISUAL IMPACT ASSESSMENT

10.1 INTRODUCTION

The purpose of this chapter is to describe the landscape and visual impacts associated with the proposed development.

This chapter outlines the methodologies used to assess potential landscape and visual impacts and describes the potential impact, including the residual impact, and provides details on mitigation measures.

As the onshore pipeline, including its associated services and the outfall pipeline will be buried throughout its length there will be no permanent impact on the landscape. The proposed Landfall Valve Installation (LVI) at Gleann an Ghad (Glengad) will contain above ground features, which have the potential for landscape and visual impacts and these are discussed in the following sections. Works associated with the construction and reinstatement phases will also result in landscape and visual impacts but these will generally be non-permanent and confined to the construction and reinstatement phases.

This assessment was undertaken by RPS. A report on the Landscape and Visual Impact Assessment is provided in Appendix I. The lighting design for the Aghoos tunnelling compound was undertaken by Kevin Cleary and Associates Ltd.

10.2 METHODOLOGY

The landscape and visual assessment methods are derived from the '*Guidelines for Landscape and Visual Impact Assessment'* (The Landscape Institute and Institute of Environmental Management & Assessment, 2002) and the then Department of the Environment and Local Government '*Landscape and Landscape Assessment Guidelines'* (June, 2000). The landscape has been appraised to allow it to be described and classified into landscape character areas that in turn enable the categorisation of landscape quality. The capacity of a landscape to accept change of the type proposed is then assessed. The key landscape components are landform, vegetation and historical and cultural components. Landform relates to topography, drainage characteristics and geology. Historical and cultural components include historic landscapes, protected structures, conservation areas and historic designed landscapes. Vegetation plays an important role in how the landscape and visual resources of an area are viewed and is an integral component of a landscape character.

Assessment was undertaken through the analysis of up to date digital copies of OSI Discovery Series raster and OSI vector maps and aerial photography (2004, 2006, 2008 & 2009), in conjunction with layout plans for the LVI and pipeline route drawings of the proposed development (see Appendix A4). Site visits were undertaken during spring 2010 to assess the existing environment and the landscape and visual impacts associated with the proposed development. An assessment was also undertaken of the construction layout plan outlined in Chapter 5 Figure 5.2 to assess the temporary potential impact associated with the construction phase.

Existing visual resources were established along with sensitive receptors, i.e. residential properties, scenic viewpoints and visitor amenity areas. The proposed development was then applied to this landscape and visual baseline and potential impacts predicted.

A review of the County Mayo Development Plan 2008–2014 and other relevant statutory documents was undertaken to establish if there are any relevant landscape related designations that may influence the assessment within the study area.

10.2.1 Landscape Assessment Criteria

Landscape assessment criteria include landscape sensitivity, magnitude of landscape resource change and significance of landscape impact, as outlined in the following sections 10.2.1.1 – 10.2.1.3.

10.2.1.1 Landscape Sensitivity

Landscape sensitivity is used to establish the capacity of the landscape to accommodate the type of development proposed and is defined as follows:

High Highest/Very Attractive landscape quality with highly valued or unique characteristics susceptible to relatively small changes.

Medium Good landscape quality with moderately valued characteristics reasonably tolerant of changes.

Low Ordinary/Poor landscape quality with common characteristics capable of absorbing substantial change.

10.2.1.2 Magnitude of Landscape Resource Change

Direct resource changes on the landscape character of the study area are brought about by the introduction of the proposal and its effects on the key landscape characteristics. The following categories and criteria have been used:

High Total loss or alteration to key elements of the landscape character, which result in fundamental change.

Medium Partial or noticeable loss of elements of the landscape character.

Low Minor alteration to elements of the landscape character.

10.2.1.3 Significance of Landscape Impact

The level of significance of impact on landscape character is a product of landscape sensitivity and the magnitude of change in landscape resource as indicated in Table 10.1.

Table 10.1: Significance of Landscape Impact.

Magnitude of landscape resource change	**Landscape Sensitivity**		
	Low	**Medium**	**High**
No change	No change	No change	No change
Low	Slight	Slight / moderate	Moderate
Medium	Slight / moderate	Moderate	Moderate / Substantial
High	Moderate	Moderate / Substantial	Substantial

10.2.2 Visual Assessment Criteria

Visual assessment criteria include viewer sensitivity, magnitude of visual resource change and significance of visual impact as outlined in the Sections 10.2.2.1 - 10.2.2.4.

10.2.2.1 Viewer Sensitivity

Viewer sensitivity is a combination of the sensitivity of the human receptor (i.e. resident; commuter; tourist; walker; recreationist; or worker) and the quality of the view experienced by the viewer.

High e.g. users of an outdoor recreation feature which focuses on the landscape; valued views enjoyed by the community; tourist visitors to scenic viewpoint; occupiers of residential properties with a high level of visual amenity.

Medium e.g. users of outdoor sport or recreation which does not offer or focus attention on landscape; occupiers of residential properties with a medium level of visual amenity.

Low e.g. regular commuters, people at place of work; occupiers of residential properties with a low level of visual amenity.

10.2.2.2 Magnitude of Visual Resource Change

The magnitude of change in visual resource or amenity results from the scale of change in the view with respect to the loss or addition of features in the view and changes in the view composition, including proportion of the view occupied by the proposed development. Distance and duration of view must be considered. Other infrastructure features in the landscape and the backdrop to the development will all influence resource change.

High Total loss or alteration to key elements/features/characteristics of the existing landscape or view and/or introduction of elements considered totally uncharacteristic when set within the attributes of the receiving landscape or view.

Medium Partial loss or alteration to key elements/features/characteristics of the existing landscape or view and/or introduction of elements that may be prominent but not necessarily substantially uncharacteristic when set within the attributes of the receiving landscape/view.

Low Minor loss or alteration to key elements/features/characteristics of the existing landscape or view and/or introduction of elements that may not be uncharacteristic when set within the attributes of the receiving landscape/view.

No change Very minor loss or alteration to key elements/features/characteristics of the existing landscape or view and/or introduction of elements that are not uncharacteristic when set within the attributes of the receiving landscape/view.

10.2.2.3 Significance of Visual Impact

Significance of visual impact can only be defined on a project-by-project basis responding to the type of development proposed and its location. The principal criteria for determining significance are magnitude of visual resource change and viewer sensitivity, as described previously.

Table 10.2 illustrates significance of visual impact as a correlation between viewer sensitivity and magnitude of visual resource change.

Table 10.2: Significance of Visual Impact

Magnitude of visual resource change	Visual Sensitivity		
	Low	**Medium**	**High**
No change	No change	No change	No change
Low	Slight	Slight / moderate	Moderate
Medium	Slight / moderate	Moderate	Moderate / Substantial
High	Moderate	Moderate / Substantial	Substantial

10.2.2.4 Zone of Visual Influence

The visual assessment is assisted by the production of a Zone of Visual Influence (ZVI). The ZVI is the area within which views of the proposed development during construction and operation can be obtained. The extent of the ZVI is determined primarily by the topography of the area. The ZVI is a tool used to determine the study area for the landscape and visual impact assessment and does not represent a prediction of impacts. The ZVI is refined by field studies to indicate where relevant buildings, woodlands, hedges or other local features obscure visibility from the main roads, local viewpoints/landmarks, settlement, etc. and it is through such field studies that prediction of visual impacts takes place within the ZVI.

The worst case scenario ZVI for the proposed development will relate to the construction stage of the project. This ZVI is illustrated in Figure 10.1.

A series of representative viewpoints have been selected within the ZVI to illustrate typical views towards the components of the development during construction and operation stages.

Further details on the methodology, Landscape Assessment Definitions, Visual Assessment Criteria and Terminology are provided in Appendix I.

10.3 EXISTING ENVIRONMENT

The study area is located on the north-western coast of County Mayo. The study area for the purpose of the landscape and visual appraisal covers the area of landscape and visual setting that has potential views of the proposed development (i.e. the ZVI). Due to the open nature of the landscape and the coastal setting, the study area covers an extensive area. The juxtaposition of rounded uplands and coast results in a dramatic and overall scenic landscape.

The western facing coastline has extensive and sheltered bays that extend much further inland than those on the north coastline of County Mayo. The small village of Ros Dumhach (Rossport) is located on a peninsula between two bays over looked by rounded uplands to the north (Cnoc an Ghairtéil (Garter Hill) 159m ASL[1]) and to the southwest (Dún Ceartáin (Dooncarton) 250 m ASL). A sandy estuarine landscape that has established at the mouth of the Glenn na Muaidhe (Glenamoy) River is visible at low tide around these bays (Sruwaddacon Bay, Curraunboy Bay).

The landscape inland from the coast predominantly consists of open bog and moorland that has a windswept appearance. Trees are more or less absent and the open nature of this landscape combined with elevated rounded hills results in extensive views from a number of locations. Coastal roads, particularly south and south west of Ros Dumhach (Rossport) provide elevated views along the coast and across the bays.

10.3.1 Landscape Character

The distinctiveness of the landscape character in the study area has resulted in the identification of one overall landscape character area as part of this assessment, namely ‘Coastal Undulating Open Moorland’.

The predominant landscape in this region is a gently undulating rounded grassland landscape that is extremely open due to the lack of topographical features and tall vegetation. The landscape has a smooth appearance that offers extensive and panoramic views along the coast and bays. The proximity to the coast results in an exposed and rugged landscape. High rounded upland hills of Dún Ceartáin (Dooncarton) and Cnoc an Ghairtéil (Garter Hill) sweep down to the coast in dramatic fashion and provide an attractive background for views across bays and inlets. Sruwaddacon Bay extends inland from Broadhaven Bay to the Glenamoy River with a rocky shoreline that changes in appearance to sandy estuary at several locations. Duneland and sandy beaches are located west of Ros Dumhach (Rossport). Field systems are defined by a combination of ditches and post and wire fences, as hedgerows are almost completely absent. On the eastern end of Sruwaddacon Bay large tracts of commercial forestry are found that appear incongruous in this smooth and natural landscape. Farmsteads and rural housing are scattered throughout this landscape and increase in frequency around Ros Dumhach (Rossport), Na hEachú (Aghoos) and Poll an tSómais (Pollatomish).

The Coastal Undualting Open Moorland landscape has been assessed as part of this landscape and visual impact assessment as of ‘Very Attractive’ Landscape Quality as it is of high value nationally and can be described as highly scenic. This landscape character area has a high sensitivity to change.

[1] Above sea level

Zone of Visual Influence

Intermediate Zone of Visual Influence

Viewpoint Location

Angle of View

Construction Stage Zone of Visual Influence & Viewpoint Locations

Figure 10.1

File Ref: COR25MDR0470Mi8001A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

10.3.2 Landscape Designations - County Mayo Development Plan 2008 - 2014

A review of the County Mayo Development Plan 2008 – 2014 has established that there are a number of landscape policies relating to the study area.

EH-LC 1: It is an objective of the Council to recognise and facilitate appropriate development that has regard to the character and sensitivity of the landscape to ensure that development will not have a detrimental effect on the existing or future character of a landscape. Further, development must have regards to the effects on views from public realm towards sensitive or vulnerable features and areas.

EH-LC 2: It is an objective of the Council that all development in the county shall be considered in the context of the policies set out for four Landscape Protection Policy Areas defined in the Landscape Appraisal for County Mayo (see Map 9 of the Development Plan).

The study area lies within one of the Landscape Protection Policy Areas, namely Policy Area 1 – Montaine Coastal Zone. Policy Area 1 covers the northern most portion of County Mayo. Policy Area 1 is described as a visually distinct area in Mayo as it incorporates two dramatic landscape attributes; a steep and rugged shoreline and mountains rising immediately above. Such attributes are stated as making the setting desirable for visitors and sensitive to inappropriate development.

The Development Plan includes a Landscape Sensitivity Matrix for impact of different types of development on these Landscape Protection Policy Areas. Wind Farms, Power Lines and Communication Masts are all identified as having a high potential to create adverse impacts on the existing landscape character of Policy Area 1. Road Projects, Rural Dwellings, Industrial/Commercial, Quarrying and Forestry are all stated as having medium potential to create adverse impacts on Policy Area 1 landscape character. Such developments are stated as likely to be clearly discernible; however, the Development Plan states that with careful siting and good design the significance and extent of impacts can be minimised to acceptable levels.

EH-VP 1: It is an objective of the Council to ensure that development does not adversely interfere with views and prospects and the amenity of places and features of natural beauty or interest when viewed from the public realm. The Development Plan lists views and prospects worthy of protection (see Map 10 of the Development Plan).

It is a policy of the Council to ensure that all proposals have regard to potential effects on views from the public realm towards sensitive features or areas. The Development Plan has as Appendix 10 a Landscape Appraisal of the County. The landscape appraisal identifies Landscape Character Units by mapping physical units, appearance and characterisation of the county landscape. Each unit is described in terms of its defining landscape characteristics. Critical Landscape Factors are identified that have a bearing on robustness or sensitivities within each unit. Finally, four Landscape Protection Policy Areas have been identified in the Development Plan by grouping the Landscape Character Units.

The County Mayo Landscape Appraisal has subdivided the study area into two Landscape Character Units, namely Area B - North West Coastal Moorland and Area D - North Coast Plateau.

10.3.2.1 North West Coastal Moorland

This landscape is described as low-lying bog that lies between the western coastline and the Nephin Beg Range to the east. It is further described as having an exposed and moorland appearance throughout. The topography in this landscape is smooth. The key land uses are said to be mainly livestock production on peat bog. Forestry, natural grasslands and transitional woodland scrub are said to occur in patches. The Critical Landscape Factors are listed as ‘Smooth Terrain’ and ‘’Low Vegetation’. ‘Smooth Terrain’ is stated as a characteristic of this landscape that allows vistas over long distances. In such terrain distances can appear shorter and development closer or larger causing a disproportionate visual impact. ’Low Vegetation’ is described in this landscape as consisting of moorland and bog type grasses that contribute to the long distance visibility when combined with the smooth terrain.

A review of the County Mayo Landscape Appraisal has established that the Coastal Undulating Open Moorland Landscape Character Area established as part of this landscape and visual impact assessment is broadly consistent with the North East Coastal Bog landscape unit.

This landscape character area has a high sensitivity to change.

10.3.2.2 North Coast Plateau

This landscape character unit consists of a thin strip of coastline that extends along North County Mayo. The appraisal describes this unit as abrupt with a combination of pasture and moorland on seaward slopes above sea cliffs that provide vistas to the sea to the north. The principal land uses are stated as dominated by natural grasslands with occasional pasturelands. The Critical Landscape Factors are listed as 'Elevated Coastal Vistas' 'Smooth Terrain' and 'Low Vegetation'. With regards to 'Elevated Coastal Vistas' the R314 is identified as skirting the coastline in an east to west direction. Stunning vistas from elevated roads are available for considerable distances along this coastline. The appraisal states that the main concern for features such as coastlines is to avoid penetration by development that will interrupt and reduce the integrity of such elements. 'Smooth Terrain' is stated as a characteristic of this landscape that allows vistas over long distances. In such terrain distances can appear shorter and development closer or larger causing a disproportionate visual impact. 'Low Vegetation' is described in this landscape as consisting of moorland and bog type grasses that contributes to the long distance visibility when combined with the smooth terrain. The Coastline within this landscape has been identified as 'Vulnerable'.

10.3.2.3 Scenic Routes and Protected Views

A series of scenic routes have been identified for protection in the Development Plan. The County Road (L1202) around Dún Ceartáin (Dooncarton) from the R314 at Barr na Trá (Barnatra) to a point approximately 2km west of the R314 at Béal an Ghoile Theas (Bellagelly South) overlooking Broadhaven Bay and Sruwaddacon Bay is designated as a scenic route. The R314 from Barr na Trá (Barnatra) to Gleann na Muaidhe (Glenamoy) is also designated as a Scenic Route.

A series of protected views are also designated along the scenic routes. The protected views are identified as 'Highly Scenic or Scenic Views' in the Development Plan. A Highly Scenic View is located on the County Road north of Dún Ceartáin (Dooncarton) overlooking Broadhaven Bay and east towards Ros Dumhach (Rossport) and Sruwaddacon Bay. Two Scenic Views are also identified from the same County Road one west of Poll an tSómais (Pollatomish) looking east across Sruwaddacon Bay towards Ros Dumhach (Rossport), and one east of Poll an tSómais (Pollatomish) also looking east across Sruwaddacon Bay.

10.3.3 Visually Significant Vegetation

Due to the nature of the open windswept moorland and bog landscape that is predominant in the study area there are few areas of tall visually significant or protected trees or other vegetation. Occasionally trees have been planted around a house and such trees standout in an otherwise smooth grassland and bog vegetated landscape. Similarly, several areas of commercial forestry laid out in angular grid patterns appear unnatural in the landscape around the eastern end of Sruwaddacon Bay. Grassland is the dominant vegetation cover. Sand dunes are a prominent vegetation type at the headland at Gleann an Ghad (Glengad) and the mouth of Sruwaddacon Bay.

10.3.4 Settlement

The majority of housing in the study area consists of scattered single rural houses. Houses tend to be located on either side of existing Regional and County roadways. With distance from such roads houses are extremely scarce. Higher densities of houses are found around the village of Ros Dumhach (Rossport) and Poll an tSómais (Pollatomish) and Na hEachú (Aghoos). Rural houses are generally in open locations with extensive views available from the majority of properties on either side of Sruwaddacon Bay for example.

10.4 POTENTIAL IMPACTS

During the operational stage of the project, the Landfall Valve Installation (LVI) and 0.5m high markers, which will be installed at boundary locations and at major points of changes in direction to indicate the route for future monitoring, (see Chapter 4) will be the only above ground elements associated with the proposed development. Temporary works associated with the construction phase will result in the most visible aspects of the proposed development, but these will be temporary term in nature. Night time lighting was designed for the Na hEachú (Aghoos) tunnelling compound so as to provide lighting of an adequate standard to facilitate the undertaking of necessary construction operations safely and effectively. Lighting was also designed to minimise possible light pollution to the human and ecological environment. The design considered the following areas of the tunnelling compound:

- Starting pit area
- Stringing area
- Access roads
- High structures

As part of the design process, relevant international codes of practice have been considered.

10.4.1 Impacts during Operation

10.4.1.1 Landscape Character Impacts

The LVI will become a new but non-prominent feature of this landscape (see photomontages in Appendix A3). It is located approximately 50m from the landfall in Gleann an Ghad (Glengad) and has been set down in a 'dished' area approximately 3m below existing ground level. The careful siting of the installation at reduced ground levels results in low levels of change in landscape resource (see Chapter 4).

The landscape in which the facility is located is expansive; a fact that also helps to reduce the potential landscape impact of the new features as with distance from the site of the LVI, its influence on the landscape is significantly reduced by the lack of prominent feature and it will be lost in the wider landscape.

The route crosses an area of existing commercial forestry, therefore an unplanted strip 14m wide along the route of the pipeline in forestry will be a new feature in the landscape resulting from the proposed development. However, such strip clearings are a frequent feature of commercial forestry and despite this being a long-term feature no significant landscape impacts will result.

Overall, following reinstatement and completion of construction activities there will be slight to no change in levels of landscape impact during the operational stage (see Table 10.1).

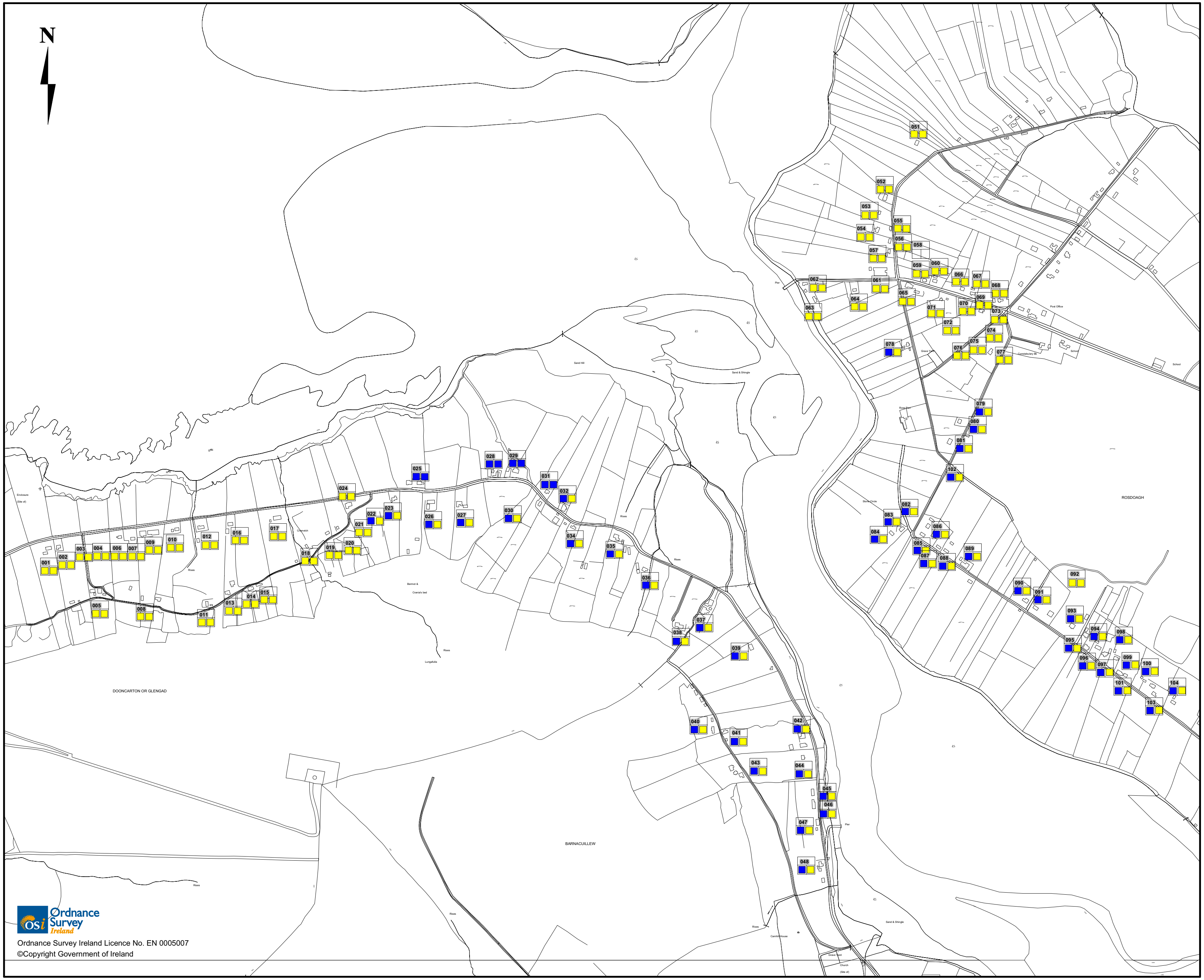
10.4.1.2 Visual Impacts

An assessment has taken place of all residential properties with a potential view of the LVI during the operational stage. The predicted operational stage visual impacts for residential properties are illustrated in Figures 10.2a-c and summarised in Appendix I.

With regard to visual impacts during the operational stage the reinstatement works will blend the disturbed areas into the surrounding landscape and no visible changes in visual amenity will occur from protected views, scenic routes or residential dwellings. The LVI at Gleann an Ghad (Glengad) will not be a prominent feature due to its location at a reduced ground level. Fencing around the facility will be partially visible (see Photomontage Viewpoint 2 and 3 in Appendix A3). Elevated views from Dún Ceartáin (Dooncarton) will be available at a distance of approximately 1km looking down onto the LVI from where the access laneway may appear distinctive from adjacent vegetated areas.

Following reinstatement and completion of construction activities there will be slight to no change in visual impacts during the operational stage around the site of the LVI.

Table 10.3 summarises the visual impact of the proposed development on the viewpoints identified on Figure 10.1 (see photographs and photomontages in Appendix A3 in Volume 2 of the EIS) during the operational phase.



Property Reference ##

Operational Stage Visual Impact

Residual Visual Impact

- No Impact
- Slight Negative Impact
- Moderate Impact
- Substantial Impact
- Slight Positive Impact

Operational Stage Residential Visual Impacts

Figure 10.2a

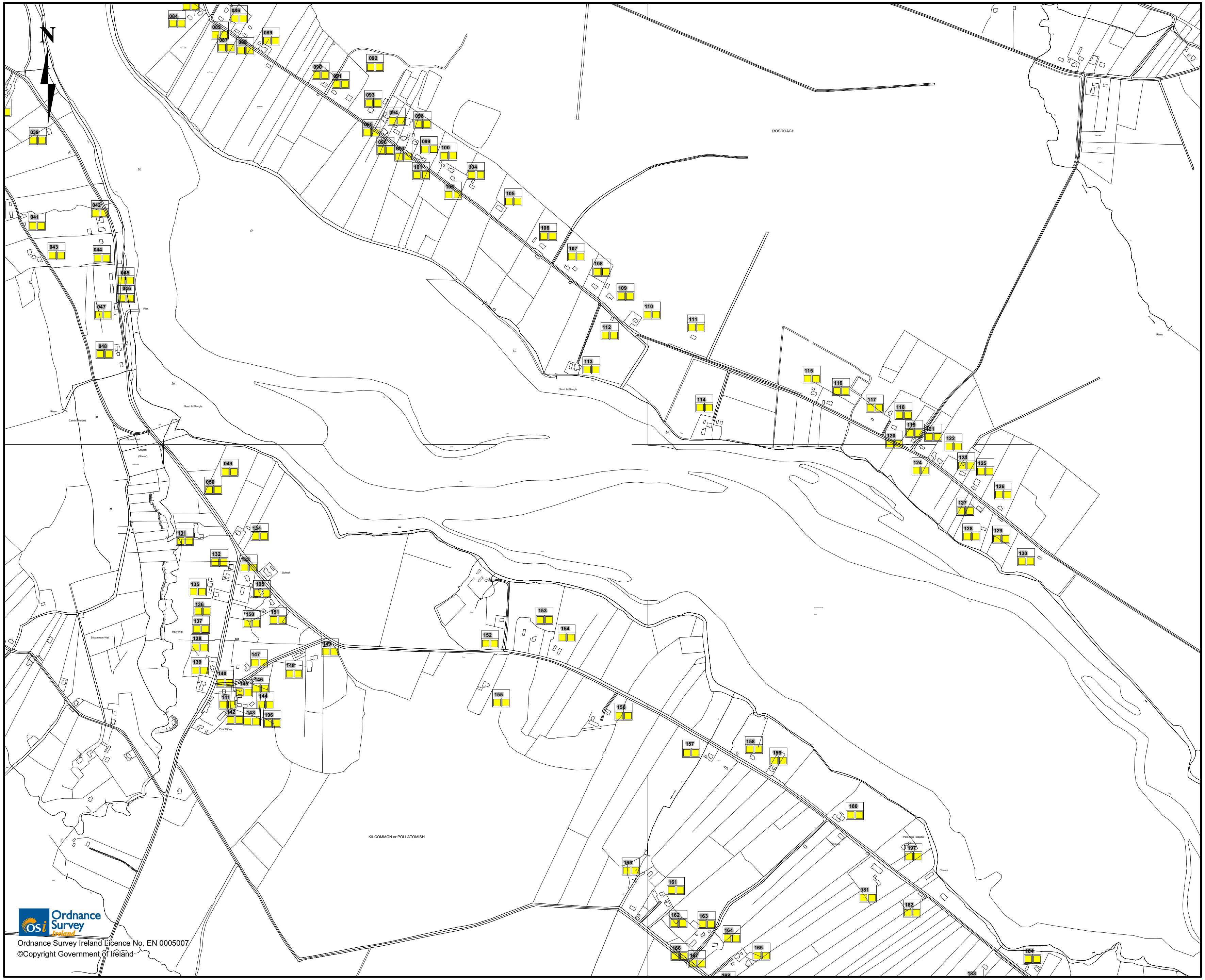
File Ref: Rev02 COR25MDR0470Mi8014

Date: February 2009

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS



Property Reference ##
Operational Stage Visual Impact
Residual Visual Impact

- No Impact
- Slight Negative Impact
- Moderate Impact
- Substantial Impact
- Slight Positive Impact

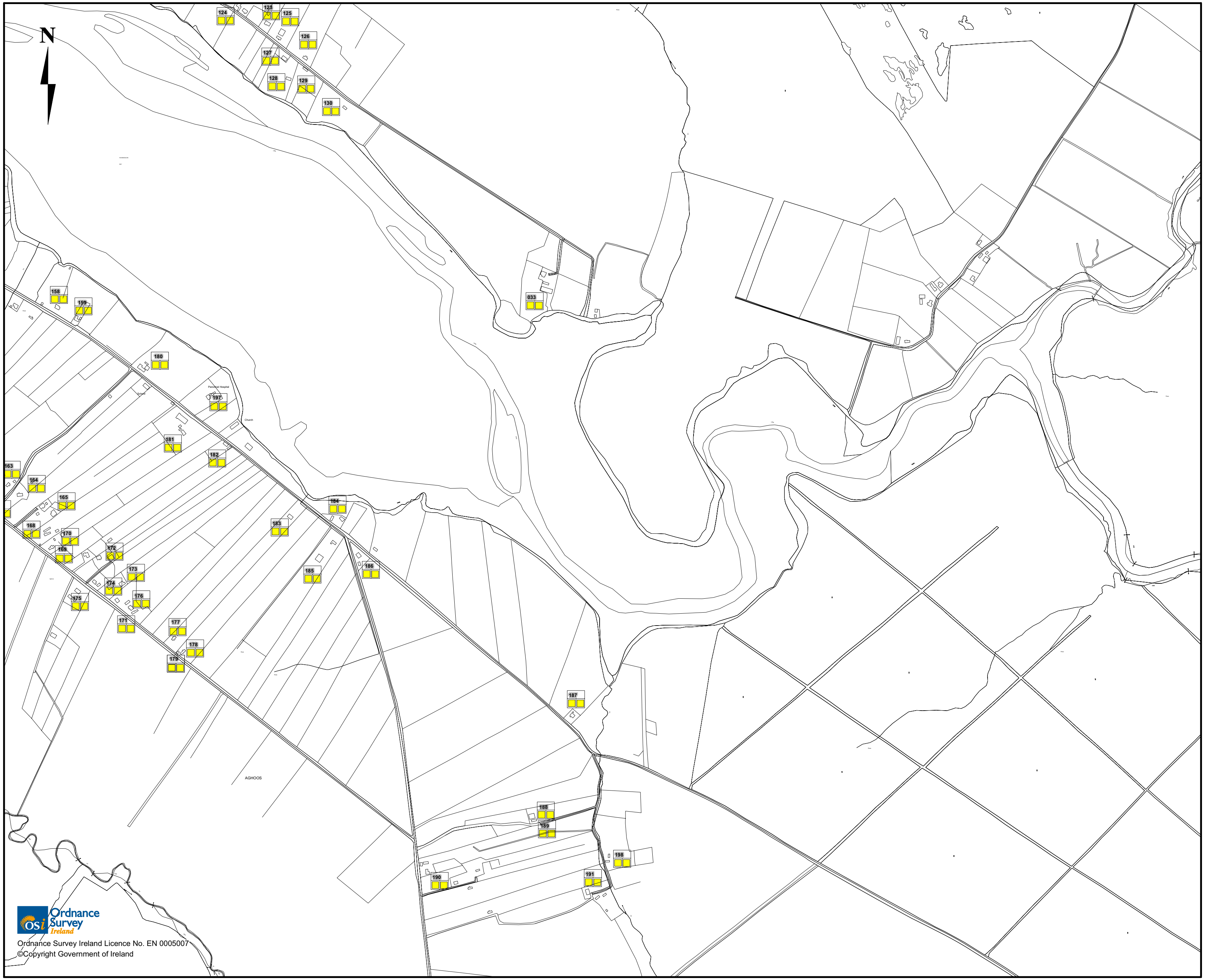
Operational Stage Residential Visual Impacts

Figure 10.2b

File Ref: COR25MDR0470Mi8014A03
Date: May 2010

Corrib natural gas

RPS



Property Reference ##
Operational Stage Visual Impact
Residual Visual Impact

No Impact
Slight Negative Impact
Moderate Impact
Substantial Impact
Slight Positive Impact

Operational Stage Residential Visual Impacts

Figure 10.2c

File Ref: COR25MDR0470Mi8014A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

Table 10.3: Summary of visual impacts of the LVI (see viewpoints 1-5 in Appendix A3).

Operation				
	Viewpoint	**Viewer sensitivity**	**Magnitude of change**	**Significance of Visual Impact**
1	View east from County Road L1202 See Viewpoint 1 - Photomontage	High	Low	Moderate Negative
2	View northwest from County Road L1202 See Viewpoint 2 - Photomontage	High	Low	Moderate Negative
3	South from Local Road to Rinroe Point	High	No Change	No Change
4	View west from Ros Dumhach (Rossport)	High	No Change	No Change
5	View west from Local Road across Sruwaddacon Bay	High	No Change	No Change

10.4.2 Impacts during Construction

The principal sources of landscape and visual impact during the construction stage include:

- Temporary vegetation removal and reinstatement;
- Temporary ground disturbance – temporary stockpiles, material storage and tunnelling and site compounds;
- Temporary movement of construction related traffic in the landscape; and
- Temporary tunnelling compound at Na hEachú (Aghoos) (in place for approximately 26 months).

Construction along the route will mostly result in a temporary linear trench cut through the landscape at Gleann an Ghad (Glengad) and from Na hEachú (Aghoos) to the Terminal at Béal an Átha Buí (Bellanaboy). A temporary working area along the route will require to be temporarily fenced off. Various types of mobile plant will be required to excavate the trench and lay the pipeline. Temporary stockpiles of excavated material will be created. Temporary access tracks and temporary site compounds will be required (see Chapter 5). Existing vegetation cover (predominantly grassland) and field boundaries will be removed during construction and reinstated on completion of pipe laying. Generally, on completion of reinstatement, temporary fences will be removed and the land returned to the previous land use. Between Gleann an Ghad (Glengad) and Na hEachú (Aghoos) the pipeline route will be tunnelled approximately 4.9km, most of which will be underneath Sruwaddacon Bay. However, some in channel works in the form of a temporary intervention pit may be required if problems are encountered during these trenchless crossings, though this is considered to be very unlikely (see Chapter 5). While all temporary compounds will be required to be lit at night to some degree, the tunnelling compound at Na hEachú (Aghoos) will require the most illumination at night time. There will be a temporary 3m high palisade fence securing the temporary working area for the construction works on land. There will be a temporary 3m high non-transparent noise barrier around the perimeter of the Aghoos tunnelling compound and stringing area. The use of appropriate lighting and non-transparent fencing will reduce light spread.

10.4.2.1 Landscape Character

An assessment of the significance of the impact of the proposed development during construction on the landscape character area described in Section 10.3.1 has been completed and is presented in Appendix I and summarised here.

This landscape character area has been identified as having high landscape sensitivity. Overall, the predicted magnitude of change in landscape resource is high. Therefore, the predicted significance of landscape impact for the Coastal Undulating Open Moorland Landscape Character Area during the construction stage will be Substantial Negative. The landscape impacts will be temporary / short term in nature.

It is critical that disturbed ground is reinstated with the same vegetation as was in place before the development construction activities. The time span for vegetation to fully recover in disturbed areas will be short term in duration (one to seven years) and will vary depending on the vegetation type. Improved and semi-improved grasslands areas will generally re-establish to a level not discernible from adjacent grass areas within one year.

10.4.2.2 Visual Impacts

The assessment of the existing visual environment and the impact of the proposed development and its various component parts on visual receptors has established that there will be potential visual impacts during construction that will effect protected views and views from a scenic route. A 'Highly Scenic View' from the County Road L1202 is designated across Broadhaven Bay towards Ros Dumhach (Rossport). This view will have the construction activity at the LVI highly visible at Gleann an Ghad (Glengad). The access for construction vehicles to the site compounds for the LVI and the tunnelling compound is off the County Road (L1202) and fencing at the entrance and along the access track will be particularly prominent from the County Road due to proximity. Further, the tunnelling compound at Na hEachú (Aghoos) will also be prominent and will also be illuminated at night time so that construction works associated with the tunnelling activities can be carried out. All visual impacts from lighting will be temporary/short term in duration. The viewer sensitivity is high. Overall the magnitude of visual impact is high. Therefore, the predicted significance of construction stage visual impact for the "Highly Scenic View" from County Road (L1202) is Substantial Negative. However, the impacts will however be temporary / short term in nature.

An assessment has taken place of all residential properties with a potential view of the construction stage activities associated with the proposed development. The predicted construction stage visual impacts for residential properties are illustrated in Figures 10.3a-c.

10.4.2.3 Night time Lighting at Aghoos Tunnelling Compound

The predicted lighting spill effect on the area surrounding the tunnelling compound at Na hEachú (Aghoos) is illustrated in Figure 1.5 in Appendix I. The spill light level on a horizontal plane diminishes to less than 1.0 lux at a distance of approximately 25m from the compound perimeter, and at the shore of Sruwaddacon Bay and the Leenamore inlet, the measureable light spill will be zero. For reference purposes, bright moonlight measures about 0.3Lux.

10.4.3 'Do Nothing' Scenario

The do nothing scenario would result in the open landscape character that has been identified as highly scenic and having a high landscape sensitivity remaining unaltered.

10.5 MITIGATION MEASURES

10.5.1 Landscape Aims and Objectives

10.5.1.1 Landscape Aims

- The physical and visual integration of the proposed development and associated features into surrounding landscape.
- Reinstatement of pre-existing vegetation cover, earth banks and existing landscape features.

10.5.1.2 Objectives

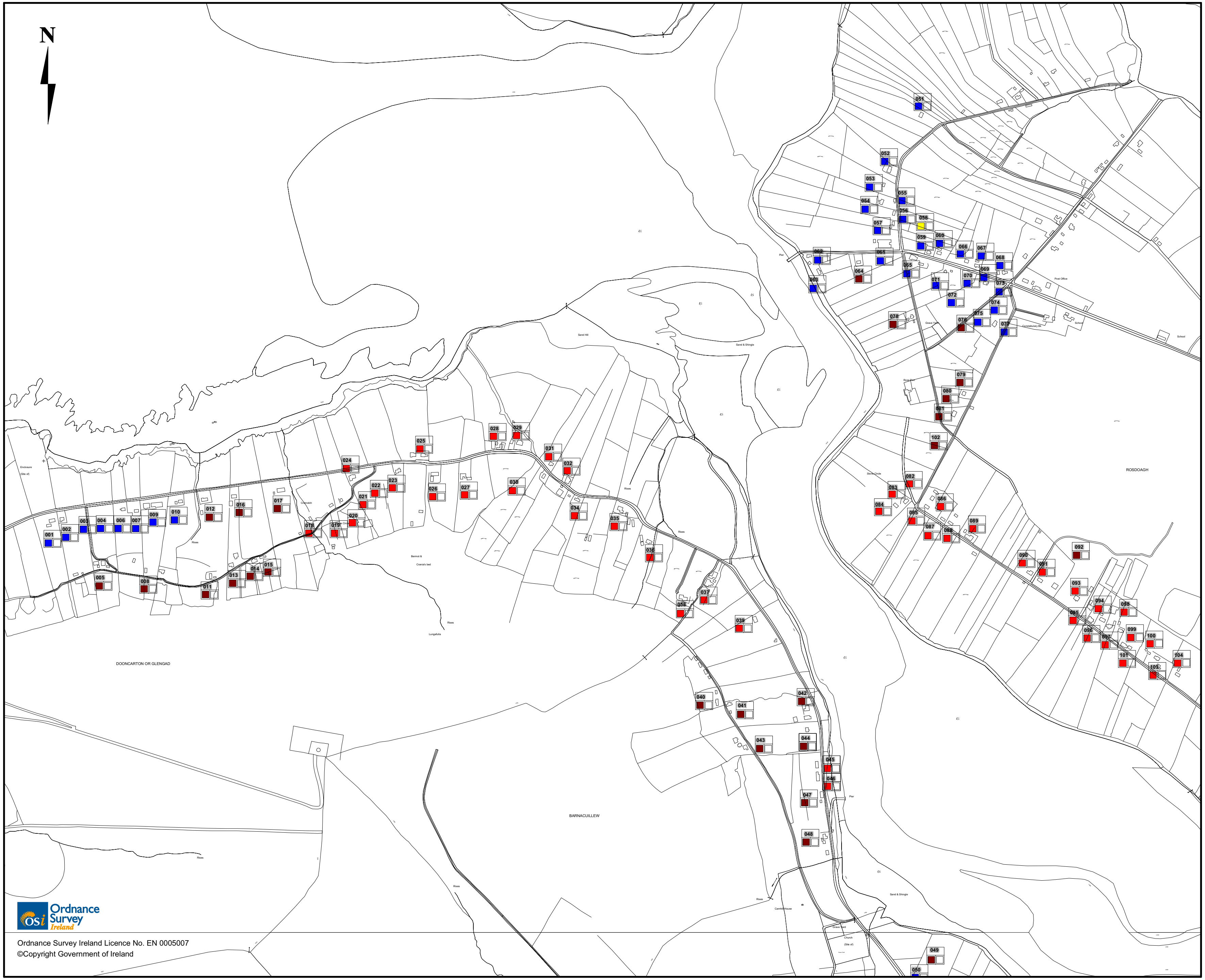
- Retention of the existing vegetation and earth banks to field boundaries as far as possible. Stripped topsoil and peat removed will be preserved and topsoil and peat materials will not be stored longer or at greater depths than recommended best practice (see also Appendix J1 Section 6, Mitigation).

- Careful tree felling is required within the commercial forestry areas to avoid unnecessary wind blow effects. Replacement planting along new edges may reduce the potential for wind blow to occur.

- Temporary tunnelling and site compounds and fencing used during the construction phase will be chosen to integrate into the surrounding landscape, where possible.

- Generally, tree and shrub planting will be inappropriate in this open exposed landscape setting.

- Construction areas will be kept tidy at all times.



Property Reference

Construction Stage Visual Impact

No Impact
Slight Negative Impact
Moderate Impact
Substantial Impact
Slight Positive Impact

Construction Stage Residential Visual Impacts

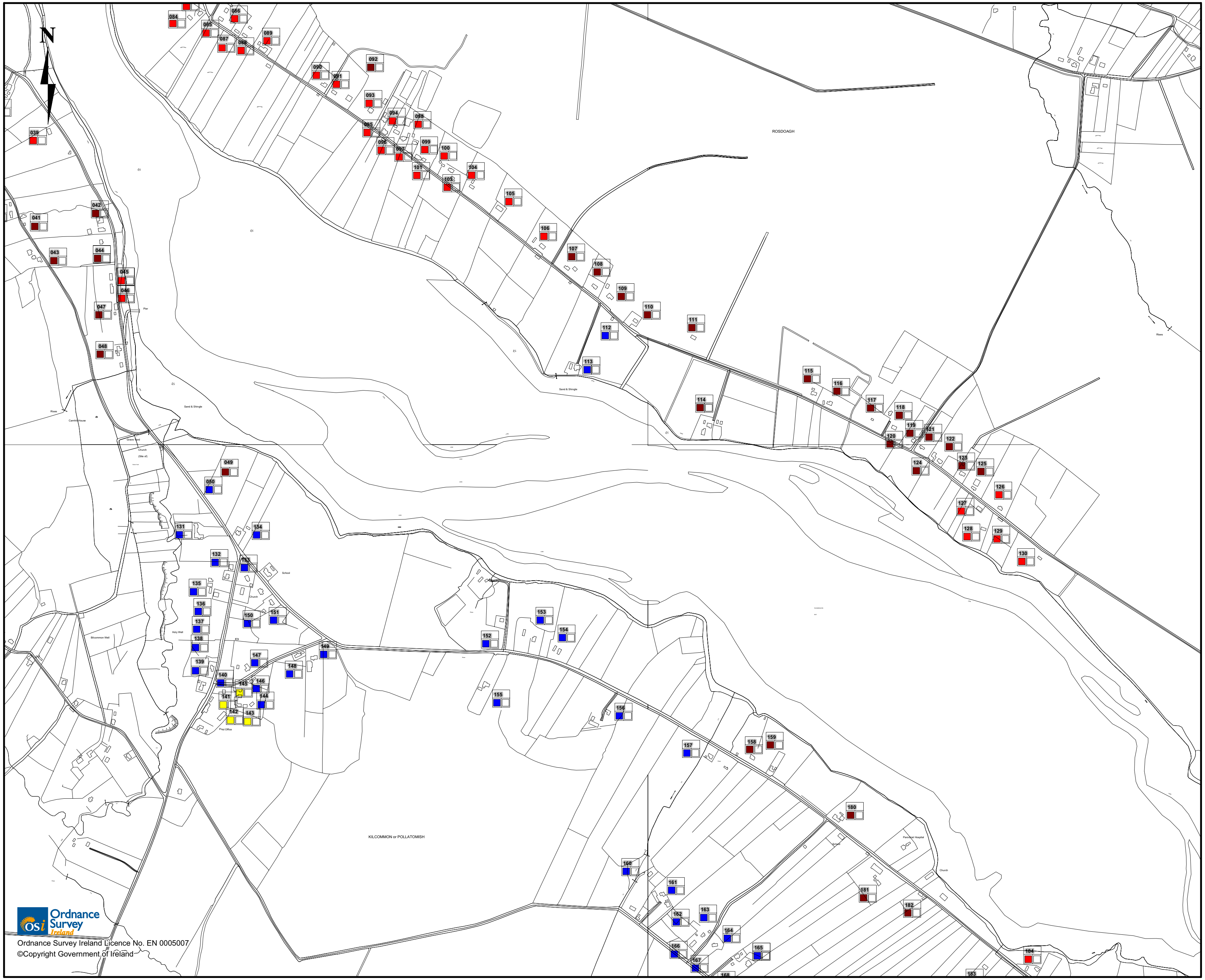
Figure 10.3a

File Ref: Rev02 COR25MDR0470Mi8002
Date: February 2009

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS



Property Reference ##

Construction Stage Visual Impact

- No Impact
- Slight Negative Impact
- Moderate Impact
- Substantial Impact
- Slight Positive Impact

Construction Stage Residential Visual Impacts

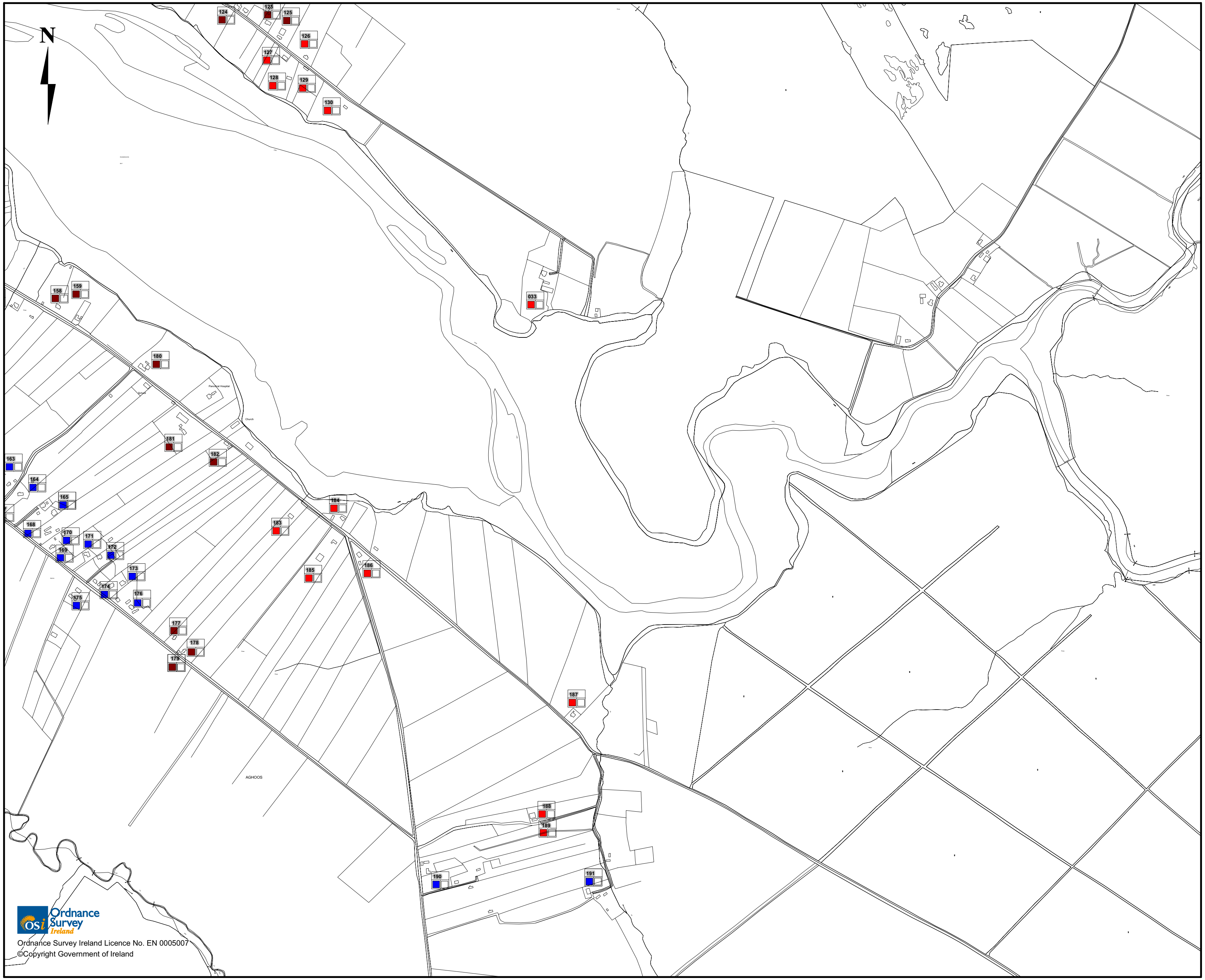
Figure 10.3b

File Ref: Rev02 COR25MDR0470Mi8003
Date: February 2009

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS



Property Reference ##

Construction Stage Visual Impact

- No Impact
- Slight Negative Impact
- Moderate Impact
- Substantial Impact
- Slight Positive Impact

Construction Stage Residential Visual Impacts

Figure 10.3c

File Ref: Rev02 COR25MDR0470Mi8004
Date: February 2009

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

- All reinstated vegetation will be monitored for two years post construction or as long as is deemed appropriate (see Appendix J1 for outline details of the proposed measures for vegetation restoration in modified blanket bog habitats at Na hEachú (Aghoos)). As a biodiversity enhancement measure it is proposed to plant native scrub species at Aghoss in order to increase habitat and species diversity. Native species which would be appropriate, and have been recorded in the wider area on peaty substrates include: *Salix aurita* (Eared Willow); *Salix caprea* (Goat Willow) and *Salix cinerea* sub sp oleifolia (Grey Willow) (see also Appendix J1). *Ulex europeaus* (Gorse) is recommended for planting in suitable places, for example at road margins (see landscape plan in Figure 1.4 in Appendix I).

10.5.1.3 Specific Landscape Mitigation (SLM)

SLM 1:

Although temporary in duration substantial visual impacts have been predicted for a large number of properties with views of both the construction of the LVI and the pipeline at Gleann an Ghad (Glengad) and Na hEachú (Aghoos). Temporary 3m high screening to minimise visual intrusion from construction traffic and activities is recommended at key locations. The use of green protective fencing will reduce the visibility of construction activities that take place in close proximity to dwellings. The colour of buildings and structures within the tunnelling compounds at Gleann an Ghad (Glengad) and Na hEachú (Aghoos) should be carefully selected to reduce visual impact. Lighting of temporary working areas and site compounds during periods of darkness will be minimised where possible. The use of appropriate lighting and non-transparent fencing will reduce light spread.

SLM 2:

The existing access laneway to the LVI is visually prominent when viewed from the elevated slopes of Dún Ceartáin (Dooncarton). It is recommended that the natural regeneration of the laneway be hastened by the use of a mixture of gravel and peaty material under the guidance of a landscape architect and the Project Ecologist.

10.5.2 Night time Lighting Mitigation

To minimise lighting spill from the Aghoos Tunnelling Compound, the following measures will be taken:

- Carefully selected lanterns for light control and containment performance
- Lighting will be directed towards the interior and baffle plates will be positioned behind the lights along the site perimeter
- Surfaces within the compound will be of a dark colour, where possible
- Lighting will be switched off when not required
- Green lighting will be used on high structures, e.g. crane at the starting pit, to minimise potential impacts to birds.

10.6 RESIDUAL IMPACTS

After reinstatement and establishment of the previous vegetation cover the buried pipeline and areas of excavation will blend in with the existing landscape. Satisfactory reinstatement of disturbed landscapes will result in no residual landscape impacts.

Existing views will be returned for all properties along the route. The LVI will not be a prominent feature in the landscape at the headland at Gleann an Ghad (Glengad) due it is low-lying nature and design mitigation measures. No significant visual impacts are predicted for properties with a potential view across the location of the restored LVI. Clearings within commercial forestry will remain but these are common features in such plantations and no significant landscape or visual impacts will result.

11 MATERIAL ASSETS

This chapter describes the potential impacts on material assets as a result of the construction and operation of the proposed onshore pipeline and identifies mitigation measures to ameliorate these impacts. For the purposes of this assessment, potential impacts on the following aspects were considered:

- Agricultural and non agricultural properties;
- Development potential and property values;
- Land-use, properties and structures;
- Major utilities (electricity supply, telecommunications, water supply);
- Waste management; and
- Raw materials.

Where relevant, impacts on material assets such as the road network and designated conservation areas are more appropriately described in other chapters of this EIS. Table 11.1 highlights chapters that are relevant to Material Assets.

Table 11.1 Chapters Relevant to Material Assets

Chapter	Title	Assets
5	Construction	Natural Environment and Cultural Assets
6	Community	Cultural Assets of a Social Type
7	Traffic	Road Infrastructure
8	Air Quality and Climate	Terrestrial and Aquatic Environment
9	Noise and Vibration	Terrestrial and Aquatic Environment
12	Terrestrial Ecology	Terrestrial Flora and Fauna
13	Freshwater Ecology	Freshwater Flora and Fauna
14	Marine Ecology	Marine Environment
15	Soils, Geology and Hydrogeology	Natural Resources
16	Archaeology, Architecture and Cultural Heritage	Cultural Assets

11.1 AGRICULTURAL ASSESSMENT AND DEVELOPMENT POTENTIAL

An assessment was undertaken on the impact of the proposed development on both agricultural and non-agricultural related properties and the development potential of these lands.

11.1.1 Methodology - Agricultural Properties

Desktop surveys, field surveys and discussions with landowners were carried out to assess the potential impact on agriculture in the area. The surveys and discussions assessed a number of factors including:

- The current agricultural practice taking place on the lands in and around the proposed development; and
- The level of management currently practiced.

The following publications and documents were considered in undertaking this assessment:

- NRA, 'Guide to Process and Code of Practice for National Road Project Planning and Acquisition of Property for National Roads', March 2003;

- Central Statistics Office (CSO), Census of Agriculture, 2000;

- Ordnance Survey of Ireland (OSI), 1:50,000 and 1:2,500 scale maps; and

- Aerial Photography (2004 and 2006).

The potential effects of the proposed development on agriculture are primarily related to the type of farming practised in the area and the intensity that the enterprise is farmed. The proposed development may affect different farm enterprises as follows:

- Drystock – Drystock farming (sheep, beef and sucklers) is the most common farm enterprise in the vicinity of the proposed route. The animals associated with this enterprise type are generally of a quiet disposition. These animals normally do not require moving on a daily basis.

- Horse - Horses, particularly thoroughbred horses, are of a more nervous disposition than other stock types and are prone to stress caused by unaccustomed noise. There are no farms specialising in breeding horses on the proposed pipeline route, but a number of farms do have sport horses. Construction activities may cause stress due to associated noise levels.

- Forestry – Forestry in the vicinity of the pipeline route near the Terminal site will require clear felling prior to construction. After construction, no replanting of forestry will be allowed within a 14m wide permanent wayleave. Access to forestry plantations will be affected by the proposed pipeline route on a temporary basis.

Table 11.2 shows the classifications for different levels of significance that an impact may have on agricultural material assets. These guidelines are broadly based on the EPA (2002) '*Guidelines on the Information to be contained in Environmental Impact Statements*'; and the EPA (2003) 'Advice *notes on Current Practice (in the preparation of Environmental Impact Statements)*' with reference specifically to agricultural enterprises.

Table 11.2 Criteria used for the agricultural impact assessment of material assets (agriculture, and forestry).

Significance of Impact	Criteria
Not significant	The material asset is not affected by the development or the development may encroach slightly on a boundary causing a slight inconvenience.
Minor	Development causes a small inconvenience but does not require a significant change in current management of the material asset. Mitigation would overcome any problems.
Moderate	Development causes a degree of landtake or severance that will cause a change in the management of the material asset or an increase in labour charges or machinery costs. Mitigation measures should overcome most difficulties.
Major	The impact on the material asset would require a significant change in management practices with associated costs due to severance, land take or loss of buildings. This level of impact would require considerable mitigation measures and not all difficulties would be overcome.
Severe	Management of the material asset can no longer continue. No mitigation measures would overcome the impact and allow any operations to continue.

In addition, the proposed development will have an effect on a small area of peatland where turf cutting is practised. Turf cutting will be impacted where construction has disturbed the ground. Access to turf plots will also be affected during construction of the proposed onshore pipeline.

11.1.2 Methodology - Development Potential and Property Values

An assessment of development potential of the study area has been carried out. Development potential is the potential for an area both to accommodate new development, in this instance primarily residential development, and associated with this, the considered likelihood of securing a Grant of Planning Permission from the Planning Authority. The price of undeveloped land reflects in part its potential to successfully attract permission for new development thereon, which in turn depends upon its ability to accommodate such development. On the other hand, the price of an existing dwelling property might reflect the inability of other sites in its vicinity to be developed, thereby limiting housing supply in an area, particularly if that area has a demand for development. Other factors that influence property values include qualitative elements such as an area's attractiveness, remoteness or proximity to local services and community facilities.

A consideration of the development potential of an area therefore is somewhat qualitative and is based upon consideration of external factors, such as development policies and guidelines, and internal factors, such as land quality and suitability, provision of physical infrastructure or its potential provision, and/or the location, type and intensity of existing development in an area.

Consideration and assessment of the potential impact the proposed development may have on property values (residential and possible sites) in the area was carried out by a qualified and experienced Auctioneer from Connaught.

This entailed the following methods:

- Discussions with local Auctioneers and Estate Agents;
- Discussions with Estate Agents in catchment areas of existing Bord Gáis Éireann pipelines throughout Ireland;
- Discussions with Estate Agents and Valuers in Holland working in catchments areas of high pressure and untreated gas pipelines;
- Questionnaires to Irish and Dutch Estate Agents; and
- Site visit to Holland to examine at first hand local markets close to high pressure and raw gas pipelines.

11.2 EXISTING ENVIRONMENT

11.2.1 Agriculture

There are 12,537 farms in County Mayo, utilising approximately 274,560 hectares (CSO 2000). The average farm size is 21.9 hectares. The majority of agricultural lands in County Mayo are involved in specialised beef production. Fifty three per cent of farms in County Mayo are currently participating in the Rural Environmental Protection Scheme (REPS) administered by the Department of Agriculture, Fisheries and Food (DAFF).

The proposed onshore pipeline is approximately 8.3km long. Approximately 4.9km of the proposed route is tunnelled. Of the remaining 3.4km, approximately 0.5km is routed through privately owned land parcels. Most of these lands, which are of good agricultural quality for the region, are in grass and are used for drystock grazing. Approximately 0.5km of the proposed route is through peatland which is used for rough grazing and some turf cutting, and approximately 0.2km is through reclaimed peatland. Approximately 2.2km is through forestry.

11.2.2 Development Potential

The rural housing policies of the Mayo County Development Plan 2008-2014 (Section 4.16) are very clear in respect of development within rural areas such as the study area. Site requirements which must be met to ensure a Grant of Permission for new dwelling development include satisfactory drainage and traffic safety. Minimising permanent visual impact is also of importance in high amenity areas, particularly on land between a coast road and that coastline, and especially if that coast road is designated as a scenic route. Also of considerable importance is the requirement that planning applications for housing in rural areas must contain a clear demonstration that the applicant has a legitimate right to build within such area, such as a family relationship to the property site, or an established linkage with the area. Therefore, having regard to all these factors, it does not follow that all undeveloped land within an area has the potential to be developed, whether by consequence of its physical characteristics, its location and setting, or by matters of land ownership and tenure.

The development potential of lands can also be constrained by issues relating to the need to provide reservations or exclusion zones associated with the provision of new infrastructure in an area. Often such reservations are associated with a particular Development Plan policy for the provision of new infrastructure in situations where that infrastructure may not be developed for some period of time. For example, a road construction objective, without any specific detail of alignment, or along an indicative alignment, may require the control of development of lands within a wider corridor of that indicative alignment, in order not to constrain eventual provision of any final road alignment; however, the specific alignment of that road may not be determined for some time subsequent to the identification of the wider indicative corridor. Generally, following identification of the specific route of that road, and the necessary wayleave landtake for its construction, the other lands of the indicative corridor outside the specific wayleave revert to their previous development capability, unless specifically prevented from doing so as a consequence of the operation of that infrastructure, for example due to severance from an access point, noise and vibration issues, or similar.

This is also the case with a gas pipeline route, as proposed in this instance. The identification of this route, and any identified necessary temporary and permanent exclusion areas, will function as a temporary or permanent constraint to development potential – subject to the lands within those identified exclusion areas being otherwise appropriate to accommodate development, having regard to the constraints detailed above. The extent of permanent exclusion from future development is defined by the area of the on-land permanent pipeline wayleave – in this case the width of the permanent wayleave is generally 14 metres (and 20m wide in peatland and forestry). Furthermore, potential development in close proximity to a gas pipeline must be controlled on the grounds of public safety, with exclusion areas normally calculated in reference to current pipeline design safety codes. This constraint to development will also occur, for a temporary period, within the identified temporary working area required for construction of the Corrib Onshore Pipeline.

The determination of the development potential of an area in consequence of a proposed infrastructure development is most appropriately based upon the more technical appraisal of potential i.e. where proximate development could safely occur, having regard to technical guidelines. The wider issue of property values in an area includes less tangible issues, such as public and potential purchaser perception, despite whether such perception is accurate.

In the context of all the above, it is considered that the development potential of lands along the proposed route is very limited. Having regard to Statutory and National planning policy, it is considered that development will be strictly controlled within designated conservation sites, such as candidate Special Areas of Conservation (see Chapter 12), or indeed in non-designated habitats containing EU Annex species.

It is also considered unlikely that development will be permitted on backland locations at any significant remove from public roads, which would otherwise require the extension of road and other infrastructure serving such backland development. In addition, the Statutory Plan states that development will be prohibited where horizontal or vertical sight distance is inadequate to allow a safe access from the development or where the creation of a new access near existing junctions or accesses would interfere with the safety and free flow of traffic on the road. Proximity to a road is thus not in itself sufficient to ensure the development potential of a site.

In this regard it is an objective of the Statutory Development Plan to develop infill sites in small towns and other settlements as a means of providing additional housing. The general strategy is to encourage development into settlements where there is a basic nucleus of functions, rather than allowing the more unsustainable spread of development away from existing settlements. This includes appropriate backland development within existing villages, in order to ensure a sustainable cluster form. However, such backland development cannot always equally be applied to linear settlements, such as along a road, where no such clustering of development can be established.

Arising from this policy to target development into existing settlements, the fact that a site might adjoin a local road is not in itself sufficient to ensure its development potential. In this context, there is no considered significant development potential along the L1202 coast road between that area where the onshore pipeline crosses the local road north of the Gas Terminal at Béal an Átha Buí (Bellanaboy), westwards to the vicinity of the settlement of na hEachú (Aghoos), Poll an tSómais (Pollatomish) and beyond to Gleann an Ghad (Glengad).

11.2.2.1 Property Values

Values of houses in County Mayo in general increase in closer proximity to centres of population for reasons including higher demand, better employment opportunities, better range of amenities and facilities, etc.

Good quality, modern four bedroom bungalows in the study area would up to the end of 2006 have had an average value of approximately €250,000, presuming good views and a standard ½ acre site. Good quality, three bedroomed bungalows/single storey houses in the area on similar sites would have had an average value of approximately €200,000.

This would be roughly in line with other rural areas of County Mayo and the west of Ireland in general. The possible diminution in values of houses in the area because of distance from population centres would be more or less balanced upward because of pleasant views of the sea, river, lake and mountains in the project area.

Residential values in the study area over a 10-year period up to the end of 2006 rose on average 300% and this is in line with other parts of County Mayo and the west of Ireland in general. However, due to a variety of influences on the Irish economy since 2007, the market both locally and nationally has softened. Houses are at present harder to sell and in some cases values have fallen 30 to 40% from the values of late 2006.

Sales of sites for residential development are very limited due to policies for restriction on such development contained in the Mayo County Development Plan 2008-2014, as detailed previously. These policies are consistent with the provisions of the Rural Housing Guidelines for Planning Authorities published by the Department of the Environment, Heritage and Local Government. Where a new site is considered appropriate to accommodate a dwelling development, it is generally issued with a condition restricting occupation in the short and medium terms to the owner of the dwelling, being the Applicant for the Permission. This presumes against sites being developed for commercial gain but rather for local need.

Special attention has been paid in this assessment to sale trends in the study area. Since 2007 a number of properties remain unsold. A number of possible reasons exist for this, including unrealistic price guides, and the national trend of slowdown in property sales.

11.3 POTENTIAL IMPACTS

11.3.1 'Do Nothing' Scenario

11.3.1.1 Agriculture

If the proposed development did not proceed current agricultural practice would remain unchanged in the onland area of the proposed onshore pipeline development at Gleann an Ghad (Glengad) and na hEachú (Aghoos).

11.3.1.2 Development Potential and Property Values

If the proposed development did not proceed, the development potential of the area would remain unchanged subject to any revision of the National or County Development Plan.

If the proposed development did not go ahead property values would continue to fluctuate in line with county/country levels.

11.3.2 Agriculture

11.3.2.1 Landtake and Severence

Whilst every effort has been made to minimise the impact on agriculture, approximately 5 hectares of privately owned good quality agricultural land in Gleann an Ghad (Glengad) will be removed from production for a short term during the construction and reinstatement stage of the proposed development. Approximately 17 hectares of agricultural land used for rough grazing in na hEachú (Aghoos) will be removed from production for a short term during the construction and reinstatement stage of the proposed development

Fencing will be required during the construction stage, which will be maintained, as appropriate, during reinstatement. More detail on the types of fencing to be used is provided in Chapter 5.

Approximately 0.5 hectares of farmland will be required for the LVI (and permanent access road) at Gleann an Ghad (Glengad). This land is in the ownership of SEPIL.

Approximately 4.0 hectares of forestry will not be replanted within the permanent wayleave along the proposed route.

A number of land parcels in Gleann an Ghad (Glengad) will be severed during construction of the proposed development on a short term basis. Access to forestry blocks will be affected during construction of the proposed development on a short term basis.

11.3.2.2 Other Potential Impacts

Noise associated with construction can be an issue with certain types of livestock such as horses. But as horses are regularly seen grazing alongside construction sites in this country the impact is unlikely to be significant.

Livestock are at risk to eye irritations from high levels of wind blown dust particles.

There will be an increase in traffic during the construction phases of the proposed development, which has the potential to cause nuisance to agricultural traffic.

Field drainage systems currently in situ may be disturbed and in places disabled during construction. This disturbance may lead to wet or flooded fields during spells of wet weather, with farm productivity potentially reduced.

The construction of the proposed onshore pipeline development may disturb water supplies for livestock in fields and properties in Gleann an Ghad (Glengad).

Pipeline construction is a linear development and therefore has the potential for carrying disease between fields and farms.

11.3.3 Development Potential

Potential impact from the proposed onshore pipeline on development potential can clearly only occur where such development potential actually exists. Having regard to designated conservation sites and habitats in this area, as well as the statutory policies and guidelines for development in rural areas, it is considered that such potential only occurs within the settlement areas of Gleann an Ghad (Glengad) / Poll an tSómais (Pollatomish) and na hEachú (Aghoos), along the L1202, rather than directly along the alignment of the proposed onshore pipeline, which is set adjacent to the coastline some distance from the public road. It is not considered that the proposed development will have any impact upon the existing development potential – primarily infill development – along the linear extent of the existing settlements.

The proposed development requires the removal from use of one existing habitable dwelling, situated on the L1202 coast road in the townland of na hEachú (Aghoos). This property is in the ownership of SEPIL and as such there is no impact upon the development potential of a third party.

11.3.3.1 Property Values

As this is a linear development, the potential impact will vary at different locations during the construction stage. The construction of the proposed development will have a moderate, temporary negative effect on the saleability of residential properties if they were to be offered for sale during the course of construction of the development. This potential impact will affect properties within sight of the proposed works or located along roads, which have construction traffic passing back and forth on a daily basis, or where normally scenic views are temporarily obstructed by construction activity.

Research carried out in Holland indicated there are no significant changes in the environmental character or loss of amenity associated with the operation of high pressure and 'raw' gas pipelines and associated facilities. Similarly, in Ireland there are no significant changes in environmental character or loss of amenity due to the development and operation of existing gas pipelines.

There may be a perceived impact that living close to the proposed development may affect property values. Once construction is completed, the property market will gradually return to normal trends, similar to whatever trends may be experienced at a provincial and national level, with house prices determined by demand and supply. Demand is expected to remain consistent for the limited supply of quality properties within this scenic coastal location.

11.4 MITIGATION MEASURES

11.4.1 Agriculture

The following measures are proposed to mitigate against the potential impacts identified in Section 11.3.

11.4.1.1 Landtake & Severance

- Permanent landtake, permanent loss of areas for harvesting timber and temporary loss of areas for grazing or grass harvesting will be dealt with by compensation. Matters of compensation do not form part of the EIS.
- All agricultural lands will be re-instated to pre-construction conditions subject to the agreement of the landowners. In designated conservation sites, reinstatement will be subject to approval of NPWS (see Chapter 12).
- Where necessary, suitable stock proof temporary fencing will be erected for the duration of construction, which will include re-instatement.
- Where any fences, walls or hedges are damaged they will be made stock proof immediately, where necessary. Any necessary permanent restoration of fences, walls, drains or land will be completed as soon as practicable after work has concluded.
- During the construction stage the contractor will be instructed that any gates used by them are closed so as to prevent animals from straying.
- Existing accesses to property, including homes, farms and forestry blocks will, where practicable, be maintained during construction, otherwise reasonable temporary access will be provided.

11.4.1.2 Other Mitigation Measures

- Discussions will take place with landowners who are concerned that noise levels, dust or traffic interference from construction is causing a disturbance to their stock. Mitigation measures regarding traffic, air and noise are outlined in the Chapters 7, 8 and 9 of the EIS.

- All drainage likely to be affected or disturbed during the construction phase will be identified and reinstated quickly and properly. Any damage to crops and soils by flooding will be rectified and/or compensated.

- Any disruption to water supply will be reinstated immediately or an alternative source supplied until the source is reinstated.

- All machinery coming from outside Ireland will be cleaned and disinfected on entry to the country.

- When required, machines will be sprayed with appropriate disinfectant prior to arrival on site. The contractor will verify to the Agricultural Liaison Officer (ALO) that this has been done.

- The ALO will liaise with the local District Veterinary Office (DVO) to establish the location of any restricted herds along the route of the proposed development. The liaison will continue on a regular basis throughout the construction and reinstatement periods.

- Where the ALO has been informed of a restricted herd along the route, all machinery and personnel will be disinfected appropriately before leaving the land concerned. The number of accesses across the working strip will be reduced to one in the case of lands having restricted herd status. The contractor will arrange for disinfectant mats/baths to be replenished with disinfectants, as required.

- In the event of an outbreak of a serious Class A Disease, the project will be subject to such operational restrictions as are imposed by the Department of Agriculture, Fisheries and Food.

11.4.2 Development Potential and Land Values

As noted in Section 11.3, it is considered that there is no development potential along the specific route of the proposed onshore pipeline, or those coastline backlands to the north of the alignment of the L1202. Development potential will continue to occur within the existing linear roadside settlements of the area, and in particular, along the L1202 coast road. As such, no potential impact arises in this respect, and thus no mitigation measures are necessary.

The proposed development will result in the removal from use of one house in the area of na hEachú (Aghoos), which is in the ownership of SEPIL (see Section 11.3.3), No mitigation measures are required to reduce such impact on the development potential and land value of this area.

11.5 RESIDUAL IMPACT

11.5.1 Agricultural

The proposed development will have a minor, long term residual impact at the LVI due to loss of land for production. The proposed development will have a moderate, long term residual impact on forestry production within the permanent wayleave. The residual impact on the remaining lands used for grazing and grass production will be short term and minor.

11.5.2 Development Potential

There will be no significant impact on development potential, having regard to the specific alignment of the proposed onshore pipeline development – at some remove from the existing L1202 coast road, and having regard to the fact that development potential is effectively restricted to infill and other development along the roadside settlements thereon.

11.6 NATURAL AND OTHER RESOURCES

An assessment was undertaken of the impact of the proposed development on the infrastructure (including utilities and waste management) and raw materials in the vicinity of the proposed onshore pipeline route. The potential impact assessed is that which is considered most likely to occur during the construction phase. There will be no significant impact during the operation phase.

11.6.1 Methodology

A desktop assessment was carried out to determine the infrastructure and utilities in the study area. With regard to utilities information, the following service providers were consulted to obtain details of their services within the area of the proposed development:

- Electricity Supply Board;
- Eircom; and
- Mayo County Council.

Quantities of resources to be used during the construction phase were also estimated.

11.6.2 Existing Environment

11.6.2.1 Utilities

Electricity Supply

The electricity supply network in the vicinity of the proposed route predominantly consists of overhead cables. The network may run underground at certain locations, particularly where a service enters a private dwelling. There are locations where the proposed pipeline will have to traverse the existing overhead/underground electricity supply network.

Telecommunications

The telecommunications network in the vicinity of the proposed route predominantly consists of overhead cables. The network runs underground at certain locations. There are locations where the proposed pipeline may have to traverse the existing overhead/underground telecommunications network.

Water Supply

The water supply on the southern side of Sruwaddacon Bay is fed by a group water scheme which is supplied from Carrowmore Lake. The water supply system in the area is made up of small bore pipe work, which mainly follows the road network. Water supply sources will be protected from any potential effects of the proposed construction phase of the development by implementing a Surface Water Management Plan, Pollution Control Plan, Waste Management Plan and Hazardous Substance Management Plan included in the EMP as outlined in Chapter 5 of the EIS.

Sanitary Services

It is understood that each property has its own individual on-site wastewater treatment system in the area of the proposed route.

Lighting

Public lighting exists close to settlement clusters and is typical of similar rural areas in Ireland. There is no public lighting in the areas close to the proposed site compounds in Gleann an Ghad (Glengad) and na hEachú (Aghoos) including the site of the tunnelling compound at na hEachú (Aghoos).

11.6.2.2 Waste Management

The management of wastes arising in County Mayo, which is part of the Connacht Region, follows national waste policy and is described in the Regional Waste Management Plan. The current Plan runs from 2006 to 2011 and aims to reduce the amount disposal to landfill through an increase in recovery and recycling options. The Regional Waste Management Plan contains extensive policy objectives for the management of key waste streams including household waste, commercial waste, construction and demolition wastes and priority waste streams. Each Local Authority in the Region is responsible for implementing the objectives of the Plan in their functional area and ensuring that the sustainable strategy for managing wastes is delivered.

There are a number of permitted waste management facilities in the region which could accept the types of waste material generated from the construction works, most of which will be inert waste. There are restrictions on how much inert waste each of these facilities can accept, depending on their waste permit/licence.

11.6.2.3 Raw Materials

Raw materials required during construction of the proposed onshore pipeline will be sourced from local suppliers, where suitable, this may include the use of stone from local quarries and general construction materials. There are a number of quarries in the locality from which material such as stone can be sourced. However some specialised materials that cannot be sourced locally, such as the pipeline, services and the concrete segments to be used in the tunnel, will be imported.

11.6.3 'Do Nothing' Scenario

11.6.3.1 Utilities

If the development does not proceed there will be no impact on existing utilities in the area.

11.6.3.2 Waste Management

If the development does not proceed there will be no waste generated.

11.6.3.3 Raw Materials

If the development does not proceed no raw materials will be required.

11.6.4 Potential Impacts

11.6.4.1 Utilities

The potential for the proposed development to impact or interrupt utility supply has been assessed. There is limited potential for interaction between the local utilities and the construction of the proposed onshore pipeline, and therefore the potential for interruption to local utility supplies is limited.

It is expected that all utilities in the area will remain operational for the duration of the construction period. Any utility affected by the construction of the onshore pipeline will be quickly reinstated and made fully operational without delay. Due to the alignment of the proposed route, the proposed onshore pipeline generally avoids local utilities. However, care will be exercised at locations such as site entrances from the L1202 and at the point where the proposed pipeline crosses the L1202.

Electrical Supply:

In general the proposed construction works will be self contained with respect to power. Power will be provided as follows:

- Electrical requirements for construction, e.g. for tunnelling, welding, site lighting, heating of site offices, will be provided by diesel generators.

- All construction plant and machinery will be powered by diesel engines. It is estimated that approximately 9,000 litres of diesel will be required daily to power generators associated with the tunnelling works.

During operation, electrical power will be required on a permanent basis for the instrumentation and control systems, lighting, CCTV and the intruder detection system at the LVI. This will be provided through a connection to the local electricity grid at Gleann an Ghad (Glengad). The LVI will also be fitted with an uninterruptible power supply (UPS) and connection point at which a mobile generator can be connected to provide power during periods when the network is down.

Telecommunication

There is an existing telecommunication connection at the Terminal site which will be used throughout construction of the proposed onshore pipeline. If required, a link will be established to include the site compounds in na hEachú (Aghoos) and Gleann an Ghad (Glengad).

Water Supply

Water will be required for certain activities, such as cleaning plant and machinery and portable lavatories/welfare facilities, throughout the construction process. Water will be sourced from the Terminal site or the tunnelling compound in na hEachú (Aghoos) for these requirements. Cleaning of plant and machinery will take place in designated areas where runoff will be contained.

Significant amounts of water will be required for the construction of the tunnel. Water required for the construction process will be sourced from the Terminal site. Rainwater harvesting will also be carried out at the tunnelling compound in na hEachú (Aghoos) and reused, where possible, during construction.

If any additional water should be required, it is proposed to source this from the local water treatment works operated by Mayo County Council at Barnatra.

The proposed management of water requirements for the tunnelling project are detailed further below.

<u>Water for tunnelling</u>

A drilling fluid consisting of a mixture of bentonite and water is required for the tunnelling process (see Chapter 5). This mixture will need to be replenished on a continuous basis.

Although the bentonite slurry will be continuously recycled and reused, it is estimated that an average of 150m^3 of fresh water per day will need to be introduced into the system to compensate for losses. It is proposed that the primary source of this water will be from rainwater harvested within the tunnelling compound. Additional quantities of water will be sourced from the Terminal site, if required.

Water is also required for producing the grout used to seal the annulus between the outside wall of the tunnel and the excavated surface of the surrounding ground and the grout used to fill the tunnel following installation and hydrostatic testing of the proposed pipeline.

<u>Water for hydrostatic testing</u>

Once the proposed pipeline and services have been installed, the pipeline will be filled with freshwater for a pressure test, called a hydrostatic test (see Chapter 5). It is estimated that approximately 2,500m^3 of water will be required for the hydrostatic testing. It is proposed that this water is sourced from the Terminal site and/or rainwater harvesting at the tunnelling compound at na hEachú (Aghoos). Additional water quantities, if required, will be sourced from the water treatment plant in Barnatra.

Lighting

During construction, lighting of temporary working areas and site compounds during periods of darkness will be minimised to that necessary for security and safety reasons. However, as tunnelling will be continuous, night-time lighting will be required at the tunnelling compound, pipe stringing area and associated access roads in Na hEachú (Aghoos).

Lighting will be installed at the LVI site for the operational phase, however the site will not normally be lit. Lighting will only be required if non-routine activities take place during hours of darkness. There will be no other permanently installed lighting along the proposed pipeline route.

11.6.4.2 Waste Management

The majority of waste materials generated during construction will be inert. Small quantities of hazardous waste will be generated, but will be managed carefully and disposed of to suitably licensed waste facilities in line with best practice. Potentially hazardous materials will be managed according to a Hazardous Substance Management section of the Waste Management Plan, which will be included in the EMP for construction.

The following waste streams will arise from construction:

Non-Hazardous Solid Wastes

The bulk of non-hazardous waste streams generated on the project are the arisings from the tunnelling process, surplus peat displaced during the stone road construction in forestry and peatlands as well as construction related waste associated with the demobilisation of site compounds.

<u>Tunnelling Material</u>

The proposed tunnelling works will generate materials predominantly made up of rock cuttings and stone, sands and gravels, with lesser quantities of silts and other residual materials.

The excavated tunnelling materials will be pumped from the cutting head of the tunnel boring machine (TBM) to the start pit in na hEachú (Aghoos) where they will pass through a separation plant. A drilling fluid consisting of a suspension of bentonite in water will be used to aid the pumping of materials from the TBM.

Having passed through the separation plant it is expected that a large portion of the materials, with the exception of silts, can be classified as a Class 1 material in accordance with the NRA Design Manual for Roads and Bridges (DMRB), Specification Series 600 Earthworks i.e. as suitable material for granular fill structures. The recovered materials will be segregated and stockpiled in areas designated for this purpose adjacent to the separation plant. These storage areas will be sized to ensure they can adequately cater for the amount of material arising from the tunnelling process.

The recovered excavated material is estimated to contain a residual concentration of 0.4 per cent bentonite (by weight). As bentonite is a natural material the trace quantities in the excavated tunnel materials are not considered as a contaminant, a view confirmed with the EPA (see Appendix S4).

Inert materials generated from the tunnelling works will be managed sustainably and in accordance with best practice as set out in National and Regional Waste Policy. The strategy for the management of materials generated from the tunnelling process will be in accordance with waste policy as follows:

1. Reuse On-Site;
2. Reuse Off-Site;
3. Recovery Off-Site; and
4. Disposal Off-Site.

Where possible, these materials will be reused during construction of the proposed onshore pipeline. Areas of the development where it is proposed to reuse this material include:

- Pipe stringing area;
- Stone road;
- Pipe bedding; and
- Permanent access road to LVI.

Materials generated by the tunnelling works not required for the onshore pipeline construction could be utilised in local construction projects. Should it not be possible to identify such projects, the material could be used in local quarries for landscaping or land remediation purposes, or processed for subsequent recovery. Material which cannot be reused on-site or reused or recovered off-site at a suitable location/facility will be disposed of at an appropriately authorised waste facility, such as a municipal or inert waste landfill.

Potential options for off-site management of materials arising from the tunnelling process are evaluated further in Appendix S4.

It is estimated that 68,000m^3 of material will arise from the tunnelling process. In addition, it is estimated that 7,000m^3 of rock cuttings and stone will arise from the construction of the LVI. It is expected that at least 35% of these materials can be reused during construction of the Corrib Onshore Pipeline. Silts and clays have limited reuse potential and are expected to require disposal at an EPA Licensed facility.

Bentonite

Spent bentonite recovered at the end of the tunnelling process is estimated at approximately 200m^3 in total. This is likely to require disposal if an alternative use for this material is not identified and, if so, will be disposed of in an appropriately licensed landfill facility (see Appendix S4).

Peat

As set out in Chapter 5 peat will be excavated from the tunnelling compound site at na hEachú (Aghoos), and along the pipeline route in areas of peatlands and forestry.

It is estimated that up to 75,000m^3 of surplus peat will be generated and disposed of at the Srahmore Peat Deposition Facility (see Volume 3 of this EIS).

Approximately 15,000m^3 of the peat removed at the tunnelling compound in na hEachú (Aghoos) will be stored on site and reused to reinstate the area after construction.

In the areas of forestry, where the pipeline is proposed to be constructed within a stone road, it is proposed to store excavated peat separately within the temporary working area by ‘side casting’ and spreading where necessary. Any surplus peat will be removed from the temporary working area and deposited at the Srahmore Peat Deposition Facility.

In the area of blanket bog east of the Leenamore River, the upper layer of peat will be turved and the turves stored locally on bog mats before being used for reinstatement. Surplus peat will be removed to An Srath Mór (Srahmore).

Additional Construction Related Material

Additional materials will be generated on the project through demobilisation and reinstatement of the site compounds and the temporary working area. The materials generated from this process will include the following;

- Surface dressing / tarmacadam from the tunnelling compound and the stringing area in na hEachú (Aghoos); and

- Some stone material from site compounds and the stone road.

These materials will be removed off site for reuse, recovery or disposal at a licensed facility. It is estimated that approximately 45,000m^3 of these types of waste materials will arise.

<u>Other</u>

Other non-hazardous solid wastes that will arise throughout the construction phase of the proposed onshore pipeline include those outlined in the Table 11.3.

Table 11.3 Other types and sources of non-hazardous solid waste

Waste Type	Source
Green Waste	Shrub / hedge clearance, waste bog mats.
Scrap Metal	Pipe ends or off cuts, swarf (from bevelling).
Paper and Cardboard	Packaging, office waste.
Food Waste	Site canteens.
Plastic	Packaging, HDPE pipe cut offs, geotextile / geogrid.
Miscellaneous	Litter and general Construction & Demolition waste.

These will be collected/contained and transferred to a designated area on-site where they will be stored in separate containers/areas for collection by a local waste contractor for recycling, reuse or disposal. Each collection from the site will be carried out by an appropriately permitted waste operator and transferred to an appropriately licensed or permitted waste facility. A record of each collection will be retained.

It is anticipated that these wastes can be managed with minimum difficulty and potential for environmental impact.

Non-Hazardous Liquid Wastes

Non-hazardous liquid wastes include:

- Sanitary waste (from portable lavatories/welfare facilities);

- Water from washing/cleaning facilities, water run-off from the construction site; and

- Water used during hydrostatic testing.

<u>Sanitary Waste</u>

Welfare facilities and portable lavatories will be made available for staff at all site compounds and at key locations within the temporary working area, if necessary. These facilities will include tanks for storing sanitary waste.

No treatment or discharge of sanitary waste will occur on site. Sanitary waste will be collected on a regular basis by an appropriately permitted waste operator and transferred to an appropriately licensed or permitted waste facility for treatment.

The quantities of sanitary wastes arising from the site compounds will be directly related to the number of people on site.

Water

Water recovered from tunnelling spoil

An average of 150m^3 of fresh water is required on a daily basis during tunnelling operations. The separation process for tunnelling spoil is estimated to produce an average of 50m^3 of wastewater per day requiring disposal. The remaining 100m^3 will be used during tunnelling operations (see Chapter 5). Wastewater will be disposed of at a licensed wastewater treatment facility.

Water for hydrostatic testing

It is proposed that the used hydrostatic test water will be filtered and disposed of offshore via the water outfall pipe in consultation and agreement with relevant statutory bodies, including the Department of Communications, Energy and Natural Resources.

Hazardous Wastes

A Hazardous Substance Management section will form part of the Waste Management Plan included in the EMP for construction.

It is expected that only small quantities of hazardous waste will be generated during construction. Potential hazardous wastes include waste oil/fuel, contaminated materials such as rags and consumable machine/plant items such as filters.

In the event of a contaminant spill, used spill kit materials, i.e. absorbent pads / granules and oil booms as well as recovered contaminated soils will be classified as hazardous waste.

Hazardous waste generated on site will be placed in a sealable container and stored in a designated and appropriately bunded area prior to collection. Hazardous waste will be collected by an authorised carrier of hazardous waste and disposed of or treated at an appropriately licensed facility.

Spent radio isotopes generated from radiographic examinations of pipe welds will be retained by the specialist contractor and disposed of in accordance with the terms of their licence from the Radiological Protection Institute.

Waste Generation during Operational Phase

There will be no waste material generated during the operational phase of the proposed development apart from that arising from routine maintenance carried out at the LVI. Waste generated from these activities will be minimal and will be disposed of accordingly.

11.6.4.3 Raw Materials

The sourcing of raw materials during the construction of the proposed onshore pipeline will have a potential imperceptible impact on the quantities of natural and other resources available. The quantities of raw materials required for the development will be minimised, where possible, through the reuse of materials generated during construction.

There will be minimal requirement for raw materials during the operational phase of the development.

Natural Resources

Stone material will be used to construct temporary access roads, temporary working areas and compounds, as well as the stone road proposed for areas of the route traversing blanket bog and forestry. Where possible, material excavated from the tunnel and the LVI site will be used to construct the onshore pipeline. Stone material will also be sourced from local quarries. It is estimated that approximately 120,000m^3 of quarry stone will be required for the construction of the proposed onshore pipeline (see Appendix R).

Bentonite for tunnelling will be imported and mixed with water on-site to the required consistency. It is estimated that up to approximately 4,000m^3 of bentonite will be required. The quantity of bentonite required will be minimised through the recycling of drilling fluid. Bentonite will be treated as a hazardous material and will be stored and handled within a contained unit. As set out previously, surplus bentonite following completion of tunnelling will be removed and disposed of at a licensed landfill facility.

Water will be required for a number of activities carried out during construction, such as tunnelling operations, hydrostatic testing, welfare facilities and washing / cleaning plant and machinery.

Other Resources

Concrete will be required throughout construction e.g. at the LVI, for construction of parts of the tunnelling compounds such as the start and reception pit, continuous grouting of the tunnel annulus during tunnelling activities, and final grouting of the tunnel bore. Concrete will also be required for road crossings. Concrete will be delivered to site as readymix in the initial stage of construction, i.e. during site compound set-up. Cement will be delivered and mixed on site for use as grouting material.

Poured concrete will be contained on site and run-off to nearby watercourses will be avoided. Waste concrete is classified as a construction and demolition waste and will be transported to an appropriately licensed facility for recycling or disposal.

Concrete segments for the tunnel lining will be manufactured off site and delivered to the tunnelling compound in na hEachú (Aghoos), when required.

Engineering materials (including bog mats, geotextiles/geogrid steel sheet piles and other piling systems) will also be imported.

11.6.5 Mitigation Measures

11.6.5.1 Utilities

The following mitigation measures will be implemented to prevent or minimise impact on utility supplies:

- All utilities will be identified prior to construction. Liaison with the relevant authority and utility company will be carried out to establish the exact location of all utilities in the vicinity of the onshore pipeline route. Up-to-date drawings will be obtained and a site visit with the relevant party will be carried out if deemed necessary.

- In the event that any utilities will be disrupted, advance notice will be given and approval for the works to proceed will be received from the relevant authority or utility company in advance of construction. If required, alternative or replacement utility services will be provided.

- The contractor carrying out the works will have knowledge of the types of utilities that will be encountered during construction.

- Utility locating devices will be used, where necessary, during construction of the onshore pipeline.

- Safe digging practices will be used when working around underground utilities.

- Suitable precautions will be taken in the vicinity of overhead cables, i.e. warning signs and installation of ‘goal posts’ where necessary, i.e. at areas such as entrances to site compounds in Gleann an Ghad (Glengad) and na hEachú (Aghoos).

- A 24 hour emergency contact number for the relevant authority or utility company will be readily available on site.

- A Utilities Management Procedure will be included in the EMP for construction.

11.6.5.2 Electricity

- Diesel generators will provide power on site. Diesel fuel will be managed carefully to ensure that the risk of spillage is minimised. The management of diesel will be included in the EMP for construction.

11.6.5.3 Water

- The use of water during the construction process will be controlled and minimised, where possible.

- Where possible, water will be sourced from the Terminal site or from rain water harvesting at the tunnelling compound in na hEachú (Aghoos). Alternatively, water can be tankered in from other sources (e.g. water treatment plant).

- Water run off will be managed in accordance with a Surface Management Plan and Pollution Control Plan which will be included in the EMP for construction.

11.6.5.4 Lighting

- Lighting of temporary working areas and site compounds during periods of darkness will be minimised, where possible.

- There will be a number of high structures within the tunnelling compound in na hEachú (Aghoos) which will be equipped with beacon lights to alert low-flying birds to their presence. The beacons shall emit green light, as this is deemed by ornithology experts to have less effect on migratory birds' navigation systems (see Chapter 12).

- Portable lighting units will be positioned in such a way as to minimise glare and potential to impact on the local community and ecology of the area (see Chapter 12).

11.6.5.5 Waste Management

- A project specific Waste Management Plan will form part of the EMP for construction. The Waste Management Plan will encourage waste minimisation, segregation, reuse and recycling principles to be adopted on the project where possible.

- The Waste Management Plan will reflect the preferred options for managing materials generated during construction as outlined in the Materials Management Plan (see Appendix S4).

- A Hazardous Substance Management section will be included in the Waste Management Plan.

- A policy of recycling and reuse will be encouraged throughout construction, particularly in the case of material arisings from the tunnelling process and construction of the LVI and the use of drilling fluid for the tunnelling process.

- If materials cannot be reused during construction they will be exported off site for reuse or recovery, where possible.

11.6.5.6 Raw Materials

- Raw materials will be sourced locally where possible.

- Raw materials will be managed in accordance with the EMP for construction.

- Procurement management systems will be implemented to prevent over or under-supply of materials required for the construction of the onshore pipeline.

- The sustainable use of natural resources will be encouraged throughout the construction process.
- Consideration will be given to the use of existing temporary facilities in the Terminal site, where possible.

11.6.5.7 Sustainable Construction

Consideration will be given to the sustainable sourcing of all materials. As the proposed development is located in a rural part of North West County Mayo, materials such as diesel will be sourced from local suppliers. The reuse of materials arising from the tunnelling process on the Corrib Onshore Pipeline project offers sustainability advantages over sourcing road / bedding materials from quarries. By reusing suitable materials where possible, there will be less construction traffic and less demand on local quarries. Any surplus materials arising from the tunnelling process and materials arising during demobilisation and the reinstatement process (mainly stone) has potential for reuse in other construction projects. Further details are provided in Appendix S4.

Bentonite used for the tunnelling process will be recycled within a closed system during the tunnelling process thereby minimising the quantity used.

Fresh water is required for the tunnelling process. It is proposed to collect rainwater at the tunnelling compounds to reduce the quantity of water that will be transported to the site by road tanker. Likewise, the drilling fluid will be recycled as much as possible to reduce the requirement of fresh water during tunnelling operations.

Energy management systems will be put in place, as well as general good office and site compound practises, to ensure the efficient use of lighting, electricity, ventilation, etc.

11.6.6 Residual Impact

It is anticipated that that there will be no significant residual impact on natural and other resources.

PREFACE TO SECTION C – NATURAL ENVIRONMENT

To assess the potential impacts of the proposed development on the natural environment, the following impact assessments have been undertaken:

1. Terrestrial Ecology (see Chapter 12)
    a. Terrestrial Habitats
    b. Flora & Fauna
    c. Birds (aquatic and terrestrial)
2. Freshwater Ecology (see Chapter 13)
    a. Freshwater Habitats (including water quality)
    b. Freshwater Flora & Fauna
    c. Migratory Fish (including salmonids)
3. Marine Environment (see Chapter 14)
    a. Marine Habitats
    b. Benthic Environment
    c. Marine Fisheries & Mammals
    d. Hydrodynamics of Sruwaddacon Bay
4. Soils & Geology (see Chapter 15)
    a. Geology
    b. Geotechnical environment
    c. Hydrogeology
    d. Hydrology
    e. Peatland Hydrology

The marine environment, which relates to areas that fall below the high water mark and are influenced by the tidal flows is discussed in Chapter 14. The terrestrial environment above the high water mark (habitats and constituent species of fauna and flora) is described in Chapter 12. Salt marsh is included in the terrestrial habitat descriptions in Chapter 12, as are intertidal habitats as they relate to birds. Fish that use the marine environment are described in Chapter 14 but further details, in particular on migratory fish, are outlined in Chapter 13 along with details on the ecology of freshwater streams traversed by the proposed route. Chapter 15 provides details on hydrogeology and the flow of water in peatlands.

As the terrestrial, marine and freshwater environments are not mutually exclusive, but interact with each other to a greater or lesser extent they cannot be considered alone.

The proposed route traverses terrestrial habitats at Gleann an Ghad (Glengad), tunnels under the intertidal and marine habitats of Sruwaddacon Bay, and traverses a short section of intertidal habitat at the Leenamore River inlet; all of which lie within the Glenamoy Bog Complex cSAC[1].

Otters, which occur in terrestrial, marine and freshwater habitats are considered in Chapter 12, while salmon is considered in the freshwater ecology impact assessment (Chapter 13). Both are Annex II species, but salmon is listed on the Natura site Standard Data Form as a qualifying species for the Glenamoy Bog Complex cSAC. In addition Sruwaddacon Bay lies within the Blacksod Bay/Broadhaven pSPA[2] and Blacksod Bay and Broadhaven Ramsar site. Furthermore, the mouth of Sruwaddacon Bay borders the Broadhaven Bay cSAC. As a result, due regard has been given to the provisions of Article 6 of the Habitats Directive in undertaking the above assessments. A Natura Impact Statement for the Corrib Onshore pipeline is provided in Appendix P.

The following sections provide details on the impacts addressed in the aforementioned assessments and discuss the designated conservation sites traversed by/adjacent to the proposed development. Those designated conservation sites located along and adjacent to the proposed route are shown on Figures C.1 – C.3, while the NPWS site synopses for these sites are provided in Appendix J. Relevant National and European wildlife legislation pertaining to these sites and protected species known to occur along the proposed route are also discussed.

IMPACT ASSESSMENT

Specialists undertaking the above impact assessment studies for this EIS have had the benefit of early involvement in this study. This has allowed specialists to predict how the natural environment will interact with the proposed development so that, where possible, potential significant adverse impacts have been avoided through the consideration of alternatives (see Chapter 3) including alternative routes to avoid areas of environmental sensitivity and alternative construction methods. These specialists have worked with the designers on the development of construction methods in order to avoid and reduce potential impacts that may arise.

The impact assessments contained in section C, in general, refer to both potential impacts and residual impacts. Potential impacts refer to those likely impacts, predicted by the specialists, which may occur as a result of the construction (including commissioning) and operation of the proposed development. The residual impacts are those impacts that occur after the recommended mitigation measures have been implemented. In addition each specialist has assessed the ‘do nothing’ impact. As there is potential to impact on designated conservation sites, ‘worst case’ scenario impacts have also been examined.

The potential and residual impacts on the natural environment have been assessed using various definitions of impact significance e.g. slight, moderate, major.

- The Terrestrial Ecology Assessment uses a combination of the NRA criteria, specifically adapted ecological criteria for Ecological Impact Assessment (EcIA), and the impact magnitude and duration as set out in the EPA Guidelines for Environmental Impact Statements.

- The Freshwater Ecology and the Soils & Geology Assessment (including hydrogeology & hydrology and peatland hydrology) generally refer to the criteria used by the NRA in their assessment of impacts, while

- The Marine Ecology Assessment uses the glossary of impacts outlined in the EPA Guidelines for Environmental Impact Statements.

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[1] At the time of writing this EIS, the Glenamoy Bog Complex is a candidate Special Area of Conservation.

[2] At the time of writing this EIS, the Blacksod Bay/Broadhaven is a proposed Special Protection Area.

Each chapter assesses the potential impacts broadly as follows:

- Chapter 12 considers impacts on habitats and species, including certain intertidal elements (areas of salt marsh), birds feeding in intertidal areas and marine areas, and otters.

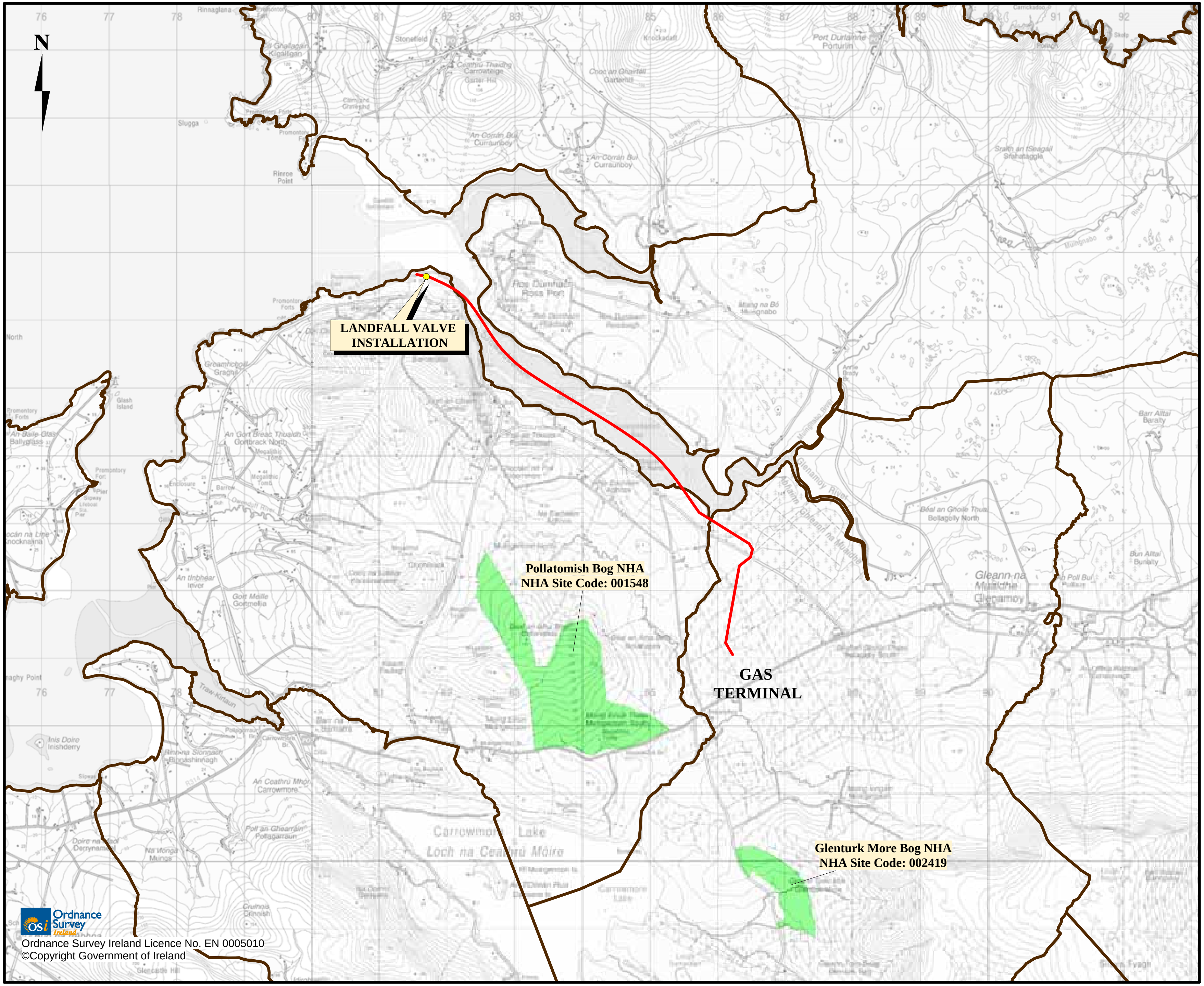
- Chapter 13 considers the impact on Sruwaddacon Bay in terms of impact on the migratory fish, and the freshwater ecology in the streams traversed by the proposed route.

- Chapter 14 considers the marine environment including fish, food sources for birds feeding in intertidal areas and the impact on the habitats and hydrodynamics of the bay.

- Chapter 15 considers the impact of the proposed development on drainage and stability.

Consequently a range of potential impacts have been considered for each of the aforementioned aspects. Therefore, in order to fully identify the range of key potential impacts on the natural environment these have been summarised in Table 18.1 (see Chapter 18).

As discussed above, the impact assessments have considered potential impacts arising from the construction (including commissioning) and operational phases of the proposed development. Potential impacts arising from the decommissioning of the proposed development (see Section 4.7) have been considered in this EIS. Depending on the required decommissioning plans at the time of project completion these are expected to be negligible if services remain in situ or in line with those impacts outlined for the construction phase. Either way, a decommissioning plan will be prepared to ensure that the operations will comply with all international and national legislation relevant to decommissioning at that time. This would include a review of best practice for decommissioning, and will include an environmental appraisal of the proposed decommissioning methods. Decommissioning plans will be subject to regulatory approval at the relevant time.



LEGEND:

Proposed Route

Townland

National Heritage Area (NHA)

Natural Heritage Areas (NHAs) (Indicative only) within 5 km of the Proposed Pipeline

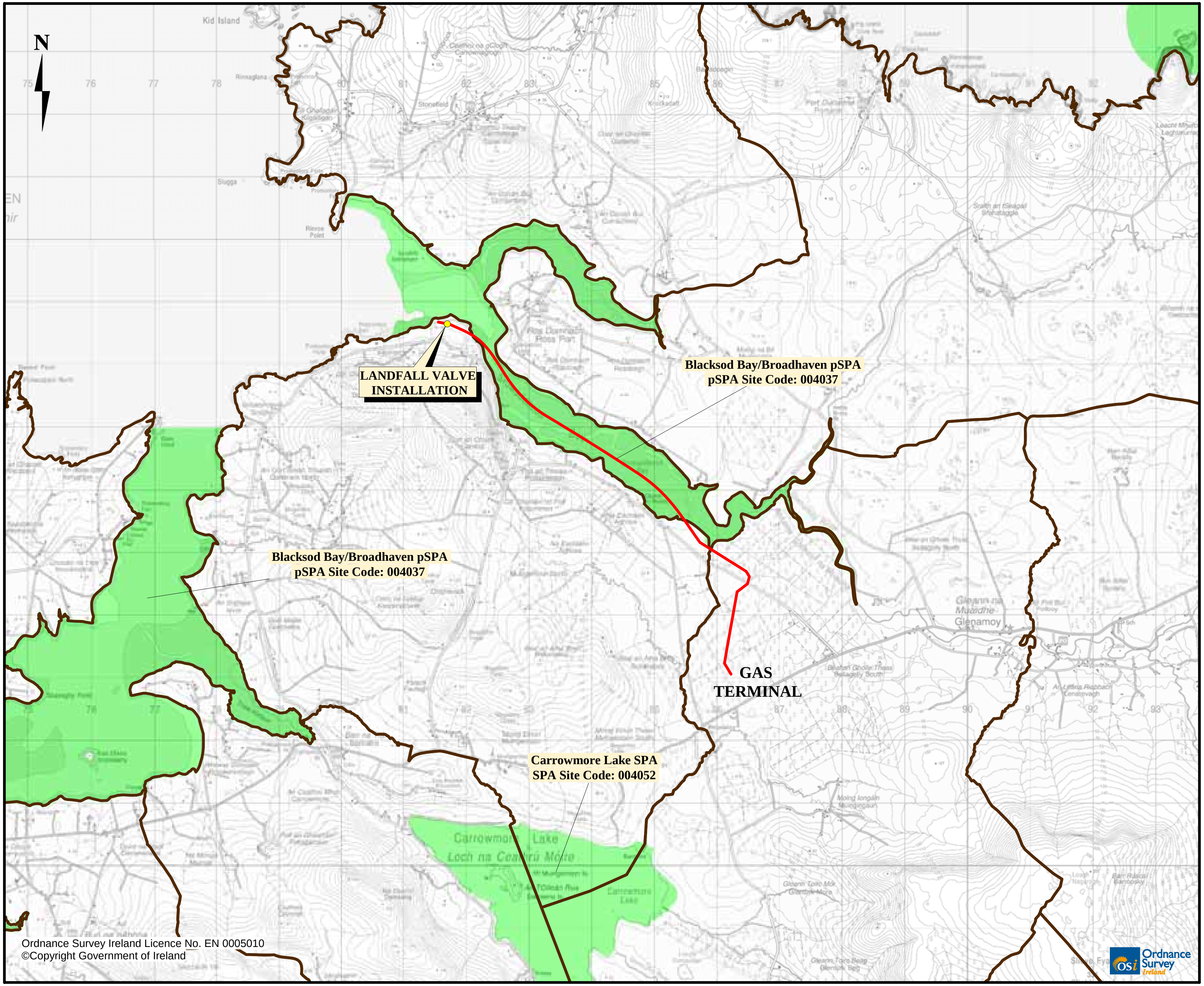
Figure C1

File Ref: COR25MDR0470Mi2152A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS



LEGEND:

- Proposed Route
- Townland
- Special Protection Area (SPA)

Special Protection Area (SPA) (Indicative only)

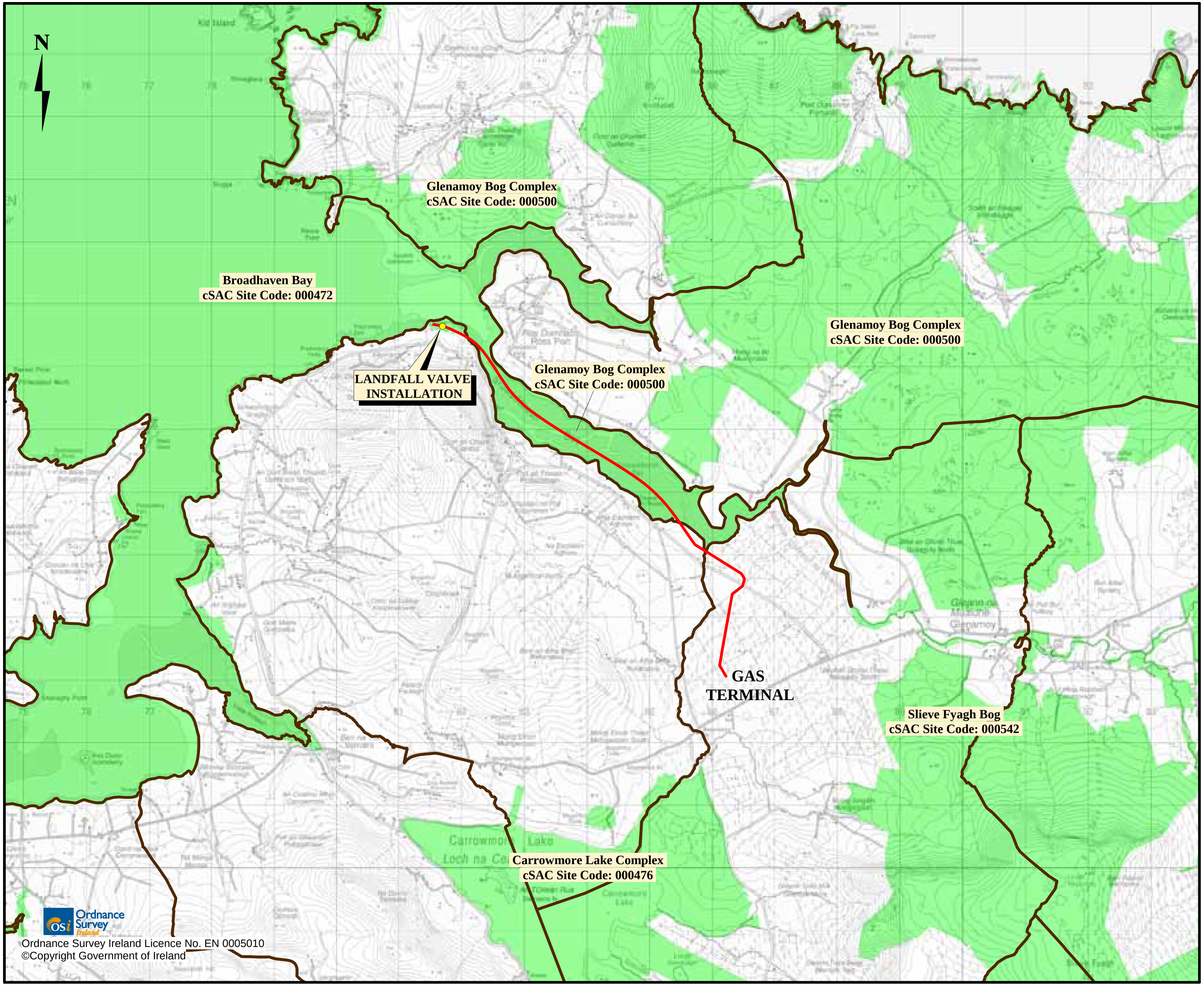
Figure C2

File Ref: COR25MDR0470Mi2153A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS



LEGEND:

Proposed Route

Townland

Candidate Special Areas of Conservation (cSAC)

Candidate Special Areas of Conservation (cSAC) (Indicative only)

Figure C3

File Ref: COR25MDR0470Mi2151A03
Date: May 2010

CORRIB ONSHORE PIPELINE

LEGISLATIVE BACKGROUND

The following Irish and international legislation was considered in the assessment on the natural environment:

- European Communities (Natural Habitats) Regulations, 1997 (S.I. No. 94 of 1997);
- European Communities (Natural Habitats) (Amendment) Regulations, 1998 (SI 233 of 1998) and 2005 (S.I. 378 of 2005);
- Wildlife Act, 1976;
- Wildlife (Amendment) Act, 2000; and
- Flora Protection Order 1999 (SI No. 94 of 1999).

The Wildlife and Amendment Acts, 1976 and 2000, their associated statutory instruments (including the Flora Protection Order) and Natural Habitat Regulations (for SACs) are implemented and controlled by the National Parks and Wildlife Services (NPWS) of the Department of the Environment, Heritage and Local Government (DoEHLG). NPWS is also responsible for the designation of conservation sites.

EU Directive 92/43/EEC, on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive), was transposed into Irish law by means of the Natural Habitat Regulations, 1997 and (Amendment) Regulations, 1998 and 2005. This enabled the designation of candidate Special Areas of Conservation (cSAC) under Article 3 of the directive as part of the Natura 2000 network. This network comprises Annex I habitats – ‘natural habitat types of community interest whose conservation requires the designation of Special Areas of Conservation’ and the habitats of Annex II species – ‘animal and plant species of community interest whose conservation requires the designation of Special Areas of Conservation’. In addition, the Directive states that: ‘The Natura 2000 network shall include the special protection areas classified by the Member States pursuant to Directive 79/409/EEC’.

Article 6.3 of the Habitats Directive states that ‘any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives’. The proposed development is not directly connected with the management of any designated conservation sites. Consequently an assessment in accordance with Article 6 has been undertaken (see Appendix P – Natura Impact Statement).

Special Protection Areas (SPAs) are designated under Directive 79/409/EEC on the Conservation of Wild Birds (the Birds Directive). Under the Directive, Ireland is obliged to protect the habitats of birds, which are vulnerable to habitat change or to low population numbers. Aspects of habitat protection are in the context of pollution, deterioration of habitat and disturbance. This Directive is implemented in Ireland under Statutory Instrument (1985) and is encompassed by the Wildlife and Amendment Acts (1976 and 2000).

‘Ramsar’ refers to an international convention, which was ratified by Ireland in 1985, in relation to wetland sites. The Convention has its roots in the protection of wetland wildfowl and for many sites it is species-associated. More recently Ramsar has taken on the more all-encompassing wetland habitat approach, which in the context of the EU falls in line with site protection under the Habitats Directive. International conventions such as Ramsar are effectively recommendations to countries to implement certain protection measures.

The Ramsar convention has no statutory basis itself, but it is operated through either EU or national legislation. In this case the EU Birds Directive and EU Habitats Directive through the Wildlife and Amendments Acts (1976 and 2000). There is a reporting requirement by the statutory agency, in this case NPWS.

Ramsar requires that 'wise-use' be carried out throughout. Part of this is the EIA process. If at the end of that process it was considered that there would be significant damage then NPWS has to report same to the Ramsar Convention Bureau. Essentially Ramsar is in line with the concept of sustainable development rather than absolute protection.

GLENAMOY BOG COMPLEX – CANDIDATE SPECIAL AREA OF CONSERVATION (SITE CODE 000500)

This is a very large, extensive and complex site, comprising a wide range of habitats including blanket bog and hard and soft coastal habitats. Lowland atlantic blanket bog dominates the site. It is internationally important in terms of its vegetation composition and is a listed Annex I habitat under the EU Habitats Directive; intact, active growing blanket bog is a priority Annex I habitat. Some areas of cSAC blanket bog are of lesser quality in habitat terms, as a result of afforestation, turf cutting - manual and mechanical and their associated management practices, which often result in drainage and "edge" effects. The more floristically important and intact areas occur in the north east of the cSAC, in some of the less accessible area of the complex where *Drepanocladus vernicosus* (a moss) and *Saxifraga hirculus* (Marsh saxifrage) occur. *Petalophyllum ralfsii (*Petalwort*)* is present at Garter Hill. These three species are listed in Annex II of the EU Habitats Directive and are also on the Flora Protection Order (SI 94 of 1999). The nationally rare moss *Homalothecium nitens* also occurs in this site. The *c*SAC also supports Annex species of birds (EU Birds Directive) and mammals as well as nationally important populations of other sea birds.

The NPWS site synopsis concludes: 'This site is of immense ecological importance because of the presence of a number of EU Annex I habitats, including two priority habitats - blanket bog and machair. It supports populations of an Annex II species, Annex II plant species and six Annex I Birds Directive species. It also has nationally important populations of other seabirds. Despite serious damage to parts of the site in recent years, large areas remain in good condition'. This site also includes Sruwaddacon Bay and the small bay north of Ros Dumhach (Rossport); both are included within the Blacksod Bay/Broadhaven pSPA. It is a shallow tidal inlet off Broadhaven Bay Marine cSAC and is of special importance for its wintering wildfowl populations, which feed on the intertidal sand/mud flats. It forms an integral part of the Glenamoy River salmonid fishery. The cSAC has recently been extended to include the Glenamoy and Muingnabo Rivers and many of their tributary streams.

Qualifying EU habitats and species, as listed on the Natura 2000 Standard Data Form for the Glenamoy Bog Complex cSAC, are outlined in Table C.1. The pipeline does not traverse any qualifying habitat. The listed fish species, *Salmo salar* (atlantic salmon), migrate through Sruwaddacon Bay (March-May period and July/August period). None of the three qualifying species of flora occur in any of the habitats crossed by the proposed route. Of the bird species, *Pluvialis apricaria* (Golden Plover) very occasionally feeds on the intertidal areas. *Falco columbarius* (Merlin) and *Pyrrhocorax pyrrhocarax (*Chough) are known to occur in the wider locality.

Table C.1: Qualifying EU habitats and species for the Glenamoy Bog Complex cSAC.

Annex I Habitat types:	**Species:**
7130 Blanket bog (* active only) 4010 Northern Atlantic wet heaths with *Erica tetralix* 1230 Vegetated sea cliffs of the Atlantic and Baltic Coasts 5130 Juniper communis formations on heaths or calcareous grasslands 7150 Depressions on peat substrates of the Rhynchosporion 7140 Transition mires and quaking bogs 3160 Natural dystrophic lakes and ponds 21A0 Machair (* in Ireland)	**Fish listed on Annex II of the Habitats Directive:** *Salmo salar* - Salmon
	Plants listed on Annex II of the Habitats Directive *Petalophylum ralfsii* – a liverwort *Drepanoclados vernicosus* – a moss *Saxifraga hirculus* – Marsh Saxifrage
	Birds listed on Annex I of the Birds Directive *Branta leucopsis* – Barnacle Goose *Hydrobates pelagicus* – Storm Petrel *Falco columbarius* – Merlin *Falco peregrinus* – Peregrine Falcon *Pluvialis apricaria* – Golden Plover *Pyrrhocorax pyrrhocarax* – Chough

BROADHAVEN BAY CANDIDATE SAC (SITE CODE 000472)

The site was known as the Blacksod/Broadhaven pSPA prior to the site review during the 1990s and subsequent cSAC designation. Sections of these sites are now incorporated into three cSACs, namely Mullet/Blacksod Complex, Broadhaven Bay cSAC and the Glenamoy Bog Complex cSAC.

This site is of high conservation importance owing to the presence of several habitats that are listed on Annex I of the EU Habitats Directive: large shallow bays, intertidal sand flats, reefs, marine caves and salt marshes. In addition it has ornithological importance for breeding and wintering birds.

This site, although not traversed by the proposed onshore pipeline route, lies adjacent to Sruwaddacon Bay.

BLACKSOD BAY / BROADHAVEN PROPOSED SPA (SITE CODE 004037)

This site is of high ornithological importance for its excellent diversity of wintering waterfowl and for the nationally important populations of five species that it supports. Of particular note is the usage of the site by over 3% of the national Ringed Plover population. It is also of importance as a breeding site for terns and gulls, especially the localised Sandwich Tern. It is of note that seven of the species that occur regularly are listed on Annex I of the EU Birds Directive, ie. Great Northern Diver, Red-throated Diver, Golden Plover, Bar-tailed Godwit, Sandwich Tern, Common Tern and Arctic Tern.

Suwaddacon Bay is part of this large pSPA and the proposed pipeline will be tunnelled underneath it for approximately 4.8km.

It is understood that the Blacksod Bay / Broadhaven pSPA boundaries are currently under review (information received from NPWS, 2008 onwards). Unlike more recently designated SPAs there is no formal site citation, i.e. the 'Intention to designate' notice which lists the species for which the site was designated. However, the site synopsis lists species for the site as a whole and includes numbers of birds of international and national importance. From the information received from NPWS, it is understood that the currently proposed interests for the re-designated SPA are as follows:

- The site qualifies for designation as an SPA for: Ringed Plover, Bar-tailed Godwit and Sandwich Tern;

- Great Northern Diver, Common Scoter, Dunlin and Light-bellied Brent Goose are all to be listed as species of special conservation interest for the site.

From recent consultations with NPWS (2010), it is understood that, as part of the redesignation process, pSPA boundaries are being re-defined. Whereas formerly the Mean High Water Mark was taken to be the boundary, the proposed new mapping will be to the nearest definable land feature and will include any wetland habitat, (eg. salt marsh). It is further understood that non-wetland areas will only be included if there is a site specific reason to do so.

RAMSAR BLACKSOD BAY / BROADHAVEN (RAMSAR SITE CODE 844)

Designated in 1996 the site covers 683 ha. and is described in the annotated list of Ramsar sites as follows: "composite of diverse marine and coastal habitats that includes vast dune systems and extensive areas of dune grassland with saltmarshes occurring in sheltered bays and inlets. The grasslands are of considerable botanical importance. The site also includes several brackish lakes important to various species of breeding waders, large numbers of wintering waterbirds of various species, and internationally important numbers of Brent geese". Sruwaddacon Bay is part of this site.

DESIGNATED CONSERVATION SITES IN THE WIDER LOCALITY

Designated conservation sites within approximately 5km of the proposed route, and including those traversed, are listed in Table C.2 below along with approximate distances from the nearest point on the proposed route. Those sites not traversed by the proposed route are described in Appendix J where their site synopses (from NPWS) are also given.

Table C.2: Designated Conservation Sites located within approximately 5km of the Proposed Pipeline Route.

Designation	Site Name	Site code	Approximate distance (km) from the nearest point on the proposed route
Special Area of Conservation (cSAC)	Glenamoy Bog Complex	500	0
	Carrowmore Lake Complex	476	1.7
	Slieve Fyagh Bog	542	2.7
	Broadhaven Bay	472	200m west of the landfall
Special Protection Areas (pSPA)	Blacksod Bay/Broadhaven	4037	0
	Carrowmore Lake	4052	3.0
Natural Heritage Area (NHA)	Glenturk More Bog	2419	3.5
	Pollatomish Bog	1548	1.8
	Ederglen Bog	2446	>5
Ramsar site	Blacksod Bay and Broadhaven	844	0

12 TERRESTRIAL ECOLOGY

12.1 INTRODUCTION

This chapter summarises the findings of the assessment relating to the potential impacts of the proposed development on ecology in terms of the terrestrial habitats present and their constituent plant and vertebrate faunal species. It should be read in conjunction with the Ecological Impact Assessment technical report (Appendix J(1)).

An ecological impact assessment (EcIA) was undertaken by Ecological Advisory and Consultancy Services (EACS) and specialist associates. The habitats present are described along with their current status and an evaluation of their scientific interest and conservation value. Potential impacts, including those on adjoining areas, are evaluated. The findings have been used to identify mitigating measures to reduce the impacts and appropriate mitigation or remedial measures are recommended. The Ecological Impact Assessment Report including a full bibliography is provided in Appendix J(1).

In view of the nature of the proposed development and that the pipeline is buried throughout its length, the majority of potential impacts on terrestrial ecology are associated with the construction of the proposed development.

Details on designated conservation sites including the legislative context are provided in the Preface to Section C. Designated sites in the wider locality are described in Appendix J(1).

12.2 METHODOLOGY

The approach and methodology to the Ecological Impact Assessment has been undertaken with due regard to the EPA Advice Notes on Current Practice (2003); EPA 'Guidelines on the Information to be contained in Environmental Impact Statements' (2002); and the Institute of Ecology and Environmental Management's Guidelines for Ecological Impact Assessment (IEEM, 2006) and with reference to the National Roads Authority Guidelines (NRA) for ecological impact assessment (Revision 2, 2009). Due regard is also paid to the provisions of Article 6.3 of the EU Habitats Directive (see Preface to Section C; and Appendix P, Natura Impact Statement (NIS)).

The methodology for this assessment included the following:

- vegetation and faunal surveys (avian and non-avian);
- mapping of habitats, faunal signs and observations;
- collection of data on presence of, and/or potential for, protected plant species; particular attention was paid to the likely occurrence of habitats listed in Annex 1 of the EU Habitats Directive (EU 1992); also to the possible occurrence of plant species and habitats which are considered to be rare or scarce in both a national and local context;
- collection of data on the presence of, and/or habitat potential for, protected species of non-avian fauna; and
- collection of data on the presence of birds, including breeding and migratory species.

A large body of data has been accumulated during previous, and ongoing, studies in connection with the Corrib Gas project. In addition, information was sought and collated from statutory and non-statutory consultees from 2000 to date. This included assimilating information on nearby designated conservation sites, and protected species of flora and fauna. Full details of the data sets considered as part of this assessment are provided in Appendix J.

This information helped define the development and ensure that the design and construction of the proposed development avoids or minimises adverse impacts.

12.2.1 Survey Limitations

Dense vegetation cover, such as found within areas of coniferous plantation and gorse scrub, places a constraint on surveying for badger setts, holts, etc. at any season. In addition to pre-construction surveys these areas will require monitoring during vegetation clearance.

12.2.2 Habitats and Vegetation - Field Surveys

Walk over field surveys were undertaken from July to September 2007 and in 2008. Habitat and vegetation features were noted, as were the plant species present. Areas which had previously been subject to walkover and/or baseline surveys were verified in 2007 and 2008 where access was available. Walkover surveys were also undertaken at na hEachú (Aghoos) in 2010, including a small area which had not been accessible in 2008. In addition, parts of the route at Gleann an Ghad (Glengad) have been subject to frequent monitoring inspections and annual botanical surveys from 2001 to, and including, 2007.

The methodology to be used for baseline vegetation survey was discussed and agreed with National Parks and Wildlife Service (NPWS) personnel early in the consultation process, and follows the standard approach for ecological evaluation and impact assessment. The 'Domin' method of species' frequency assessment was used in baseline surveys in 2001. This method was also used to describe quadrats[1] at the Leenamore River inlet and na hEachú (Aghoos) during the 2008 vegetation surveys (Appendix J(1), Appendix 16. Further details of the Domin method for vegetation survey may be found in Appendix J(1).

Habitat and vegetation type mapping is based on field surveys undertaken in 2007, 2008, 2010; and from 2001 to 2006. Habitat mapping is provided in Appendix J(1).

12.2.3 Non-Avian Vertebrate Fauna Surveys

Various faunal studies have been undertaken in the area since 2002, including surveys of the proposed route, and a survey to re-assess otter activity in the Sruwaddacon Bay area in February and March 2010. Details are given in Appendix J(1). Surveys included a thorough search along the entire shoreline of Sruwaddacon Bay within the intertidal zone along the proposed route and, where possible, a width of approximately 100m was surveyed along the proposed route, depending upon the nature of habitats present. The presence of mammals is indicated principally by their signs, such as dwellings, feeding signs, or droppings - though direct observations are also occasionally made. Surveys also included search for habitats suitable for amphibians and reptiles. Observations made during other surveys are included in the results.

A specialist bat survey was conducted on 6th and 7th September 2007. Accessible structures adjacent to the route which showed potential as roosting sites were surveyed during daylight hours. A survey for potential bat roosts in trees along or adjacent to the proposed route was also undertaken during daylight hours. The presence of bats is indicated principally by their signs, such as staining, feeding signs, or droppings - though direct observations are also occasionally made. An additional bat survey was conducted at locations on the north side of the Bay in August 2008.

Other fauna surveys and monitoring have been conducted in the vicinity of the pipeline route at the Bellanaboy Bridge Gas Terminal site, including bat surveys. Further details of these are provided in Appendix J(1).

12.2.4 Bird Surveys

Bird surveys have been undertaken in the area of Sruwaddacon Bay since 2002 to investigate bird activity in the wider locality. This assessment is based on the large body of data resulting from the studies to date, which include field surveys conducted between 2007 and 2010; and previous bird surveys of the area (2002 to 2007). The surveys include a series of aquatic surveys, including a post breeding season survey (2007), several winter season surveys between 2007 and 2010; as well as post breeding terrestrial bird surveys of the wider area, and dedicated Sand Martin monitoring surveys at Gleann an Ghad (Glengad) from 2008 to 2009.

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[1] A quadrat is a defined sample area, usually square, and in this case generally 2m x 2m.

Standard bird census techniques and survey protocol were used (Institute of Environmental Assessment 1995, Sutherland 1996, Bibby *et al.* 2000). Appropriate optics were used throughout the survey. Field surveys were undertaken when weather conditions were suitable for such work (*i.e.* no rain, light winds (< Beaufort Force 4) and good visibility). Further details on these surveys and the methodology used are provided in Appendix J(1).

The reports of the many bird surveys undertaken within the general area since 2002 were also examined as part of this assessment. These included breeding surveys along the original approved pipeline route and at the Bellanaboy Bridge Gas Terminal site; general overwintering surveys; and targeted Brent goose surveys (2003 to 2007), Corncrake surveys and monitoring at the Sand Martin colony at Gleann an Ghad (Glengad) (see Figure 12.1 below). Further details of these reports are provided in Appendix J(1).

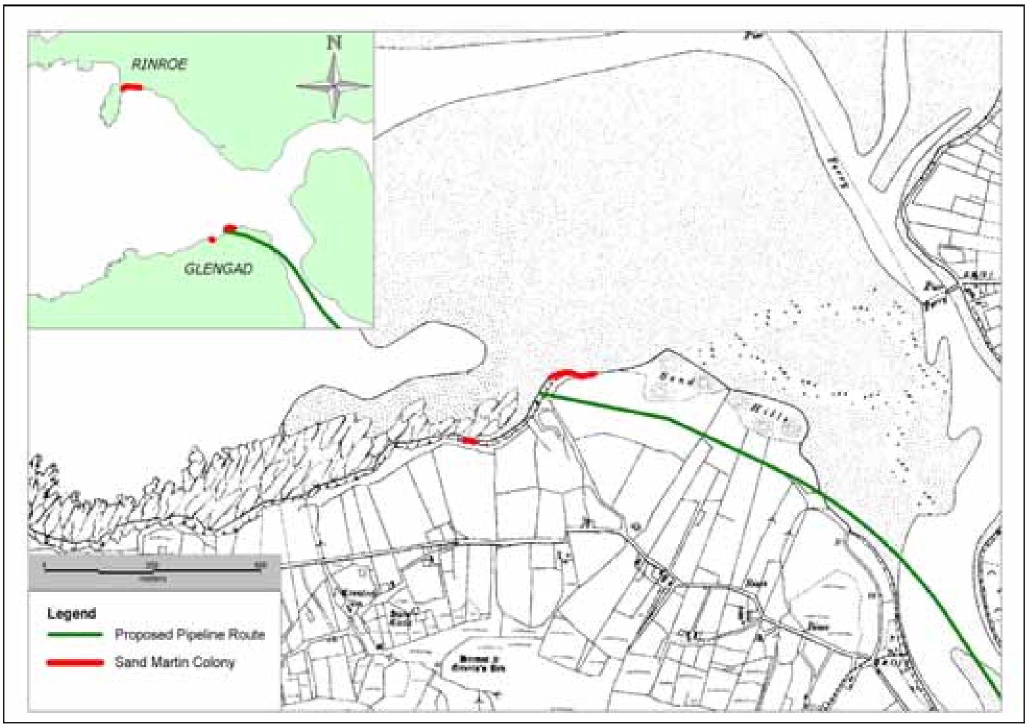


Figure 12.1: Location of Sand Martin Colonies at Gleann an Ghad (Glengad) and Rinroe

12.3 EXISTING ENVIRONMENT

The following sections provide a summary description of the habitats and vegetation, flora and fauna and birds along the proposed route (and where relevant adjoining habitats). More detailed descriptions are provided in Appendix J(1).

12.3.1 Habitats and Vegetation

Approximate chainages are given in the following route description, and in Table 12.2, as an indication of location rather than an exact line of definition between habitat types. This is because the interface between most habitat types is generally a gradual one, with one vegetation type merging into another.

12.3.1.1 Route Description

The following is a description of the habitats along and adjacent to the proposed route and includes those under which the proposed tunnel will pass.

Gleann an Ghad (Glengad) (83.400 to 84.050)

The landfall is on the westerly shore at Gleann an Ghad (Glengad) where the low cliff is of glacial till. Part of the cliff comprises the section which has been cut several times and finally reinstated once the offshore pipeline had been installed in 2009.

A sand martin colony is located in the soft cliffs to the north and north east of the landfall at Gleann an Ghad (Glengad).

This area has been subject to topsoil stripping several times between 2002 and 2009, and was fully reinstated following the completion of offshore pipeline works in autumn 2009. Currently this area comprises mostly bare soil, but the vegetation is starting to regenerate. The LVI and LVI site compound (SC1) will be located in this area.

Continuing eastwards, the pipeline route lies in improved agricultural grassland, which is regularly grazed by sheep. Some of this area now also comprises bare soil with regenerating vegetation following the offshore pipeline works in 2008 and 2009.

The improved and semi-improved grassland through which the route passes is located at the south-western boundary of Glenamoy Bog Complex SAC 500, within the SAC buffer zone, but the route avoids the highly mobile dune system and associated fixed dune grasslands to the north. The area to the south of the dunes has been in the past, and is still, subject to intensive grazing by cattle and sheep. Gaynor (2001) noted that this has led to the development of 'dry' grassland which, although it maintains floristic elements of its 'dune' origins, it is essentially an enriched (improved) grassland community.

To the north of the route there is evidence of rubbish having been dumped in the dune grasslands in the past: the remains of a car were noted in 2001 to 2003, and currently an old (apparently domestic) rubbish dump is being exposed by erosion.

The agricultural lands become wetter towards the eastern half of the Gleann an Ghad (Glengad) section. The vegetation here is a mosaic of wet, rushy improved grassland, dominated by *Juncus effusus* (soft rush) and *Juncus articulatus* (Jointed rush); and some marshy areas associated with a small stream which flows in a north easterly direction. The vegetation varies considerably depending on the moisture content of the substrate.

The site compound (SC2) for the tunnel reception pit will be located in an area dominated by wet rushy, grassland, part of which is within the SAC. Most field boundaries along this part of the route comprise post and wire fences, with earthen (sod) banks in places.

The marshy area was described in 2001 as being dominated by rushes, common sedge and star sedge. A high proportion of wetland herbs are present and include water horsetail (*Equisetum fluviatile*), yellow flag (*Iris pseudacorus*), marsh ragwort (*Senecio aquaticus*), marsh marigold (*Caltha palustris*), marsh willowherb (*Epilobium palustre*) and bog pimpernel *(Anagallis tenella*).

Progressive degradation of the wet grassland and marshy area has been noted from observations since 2002. This may be a result of grazing and trampling by cattle, or tracking by farm vehicles. Rushes, particularly *Juncus effusus* (Soft rush), are far more abundant now than in 2001.

The *Juncus* and *Iris* dominated areas merge into the small area of salt marsh at the Gleann an Ghad (Glengad) side of the lower estuary crossing. Since 2005 this area of salt marsh has become degraded from run off from above and in places deeply rutted from tracking vehicles. This has led to the encroachment by soft rush. There is no longer a defined boundary to the landward side of the salt marsh which is species poor and dominated at the estuarine edge by *Glaux maritima* (Sea milkwort) and *Puccinellia maritima* (Common saltmarsh-grass).

Sruwaddacon Bay (84.050 to 88.640)

The intertidal sand and mud flats within the route at the Gleann an Ghad (Glengad) side of the estuary have little vegetation, though to the north of the route is an area of accretion upon which salt marsh vegetation is becoming established. The estuarine and intertidal habitats of Sruwaddacon Bay are described in Chapter 14, Marine Environment.

South of Sruwaddacon Bay (88.640 to 91.720)

Continuing under the southern shore of Sruwaddacon Bay the proposed tunnel passes beneath a narrow fringe of saltmarsh (Ch. 88.640 to 88.645), and a short section of undesignated blanket bog which is recovering from apparently past overgrazing. From chainage 88.690 the pipeline route is under, and from chainage 88.770 through an area of undesignated heavily eroding blanket bog with old cutover areas in parts. The Aghoos tunnelling compound (SC3) will be in this location.

The peat erosion is particularly severe between chainages 88.850 to 89.110, with 50 to 70% bare peat surface evident in places. The surface here is very fragmented and uneven, with deep peat hags (erosion channels) and exposed pine stumps. The surface vegetation is dominated by grass species such as *Nardus stricta* (Matt grass), a species which is characteristic of heavily overgrazed areas on acid substrates. Pockets of dense Gorse (*Ulex europeaus*) scrub are present here. The pipeline stringing area will be located in this area. Near the road, are sections of old cutover which have been almost completely cutaway in the past, resulting in shallow peat and modified vegetation. The pipeline stringing area will extend into wet, agricultural grassland - dominated by rushes - which slopes down towards the Leenamore River.

The route then crosses the Leenamore River, a small tidal inlet with an intact fringe salt marsh, mainly on its eastern shore. The salt marsh comprises small areas of two types of salt-marsh vegetation namely tall vegetation, dominated by the rush *Juncus maritimus* and tightly grazed vegetation dominated by the saltmarsh grass *Puccinellia maritima.* The adjacent bed of Sruwaddacon bay is quite stony and is dominated by a variety of brown seaweeds (*Fucus* sp.). The salt marsh vegetation at this location is described in more detail in Appendix J(1).

Wet rushy grassland habitat dominates the small sloping fields on the eastern side of the Leenamore inlet. These small fields have been grazed tightly by livestock in the past. Gorse scrub is present in places and along some field boundaries.

Between chainages 89.350 to 89.540 there is a short section of approximately 190 metres of undesignated more or less intact blanket bog (PB5/PB3). Erosion is continuing in places, especially towards the shore of the Bay, north of the route. The blanket bog vegetation at this location is described in more detail in Appendix J(1). The pipeline route then enters a coniferous plantation, crosses the L1202, and skirts a small area of non-designated blanket bog which occupies a triangle between the south side of the road and the forest edge.

The route then passes along a section of bog mat and stone road through the clear-felled conifer plantation to the Bellanaboy Bridge Gas Terminal.

The main habitats, which occur along and adjacent to the proposed route are summarised in Table 12.1, including those under which the tunnel will pass. They are classified in accordance with the scheme outlined in the ‘Guide to Habitats in Ireland’ (Fossitt, 2000) and the Joint Nature Conservancy Council Phase 1 habitat survey methodology (JNCC, 1993). Their affinity to EU Annex habitats is also shown. Approximate chainages are given in Table 12.2 as an indication of location rather than an exact line of definition between habitat types. This is because the interface between most habitat types is generally a gradual one, with one vegetation type merging into another.

Descriptions of the habitat and vegetation types encountered along the route are provided in Appendix J(1). Plant nomenclature follows: Stace (1995 and 2010) for most vascular plants; Cope and Gray (2009) for grasses; common names are also after Scannell and Synnott (1987) and Webb (1996); Smith (2004) for mosses, Smith (1991) and Paton (1999) for liverworts and Dahl (1968) for lichens.

12.3.2 Evaluation of Scientific Interest

Habitat evaluation is in accordance with the IEEM (2006) and broadly follows the NRA ‘Guidelines for Assessment of Ecological Impacts’ (2004), but taking habitat quality into consideration also. It is based on the level of designation, presence of Annex habitats and the following criteria: extent, diversity, naturalness, rarity, fragility, typicalness, recorded history, position, potential value and intrinsic appeal. An evaluation of the habitat types encountered on the route is summarised in general terms in Table 12.3. Habitat frequency of occurrence is indicated by percentage with the exception of earthen (sod) banks, streams, drainage channels and man made surfaces such as roads etc. Further details on habitat evaluation are given in Appendix J(1).

EU Annex Habitats

When an Annex I habitat is present within a designated area it is given a value of international ecological importance under the NRA Guidelines method of evaluation of habitats. However, under other methods of evaluation, habitat quality is also taken into consideration. Where a habitat has been degraded or modified, resulting in vegetation change, the evaluation reflects this. Thus, in the case of the salt marsh at the eastern side of Gleann an Ghad (Glengad) where physical changes have resulted in vegetation change to an extent where the habitat classification is marginal, it is evaluated as being of national/International rather than simply 'international'.

Where an EU Annex I non-priority habitat type occurs outside a designated site it is ranked as being of national importance, e.g. the 190 metres of recovering eroded blanket bog at na hEachú Aghoos which is classified as PB5/PB3. It is proposed that these habitats will be treated as though they are designated and legally protected. See Table 12.3.

12.3.2.1 Plant Species and the Flora Protection Order (FPO)

Desk study and consultations confirmed that no rare species of plant, including those on the current Flora Protection Order 1999 (SI No. 94 of 1999) are known to occur along the route of the proposed development at present. Neither were any FPO species found during the surveys carried out from 2001 to 2010.

Furthermore, it is considered that the habitats present on the proposed route are not suitable for any of the protected plant species listed as occurring within the Glenamoy Bog Complex cSAC.

Table 12.1: Summary of habitat types occurring on and near the proposed route, showing their affinities to EU Annex habitats and the JNCC Phase 1 classification

Guide to Habitats in Ireland (Fossitt, 2000) Habitat (code)	Equivalent EU Annex 1 Habitat and (code no.)	Equivalent JNCC Habitat and (code)
Improved agricultural grassland(GA1)	None	Improved grassland (B4)
Wet grassland (GS4)	None for wet grassland dominated by *Juncus effusus*	Marsh/marshy grassland (B5)
Marsh (GM1)	None	Marsh/marshy grassland (B5)
Lowland blanket bog (PB3)§	Blanket bog* (7130) and Depressions on peat surfaces of the Rhynchosporion (7150)	Blanket bog (E1.6.1)
Cutover bog (PB4)	Depressions on peat surfaces of the Rhynchosporion (7150)	Wet modified bog (E1.7)
Eroding blanket bog (PB5)	None	Wet modified bog (E1.7)
Scrub (WS1)	None for *Ulex europaeus* scrub	Scrub (A2)
Conifer plantation (WD4)	None	Coniferous plantation (A1.2.2)
Recently felled woodland (WS5)	None	Recently-felled coniferous woodland (A4.2)
Earth banks (BL2)	None	Earth bank (J2.8)
Eroding/upland rivers (FW1)	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation (3260)	Oligotrophic running water (G2.3)
Drainage ditches (FW4)	None	Mesotrophic running water (G2.2)
Estuaries (MW4)	Estuaries (1130)	Brackish running water (G2.6)
Muddy sand shores (LS3)	Mudflats and sand flats not covered by sea water at low tide (1140).	Mud/sand (H1.1)
Tidal rivers (CW2)	Estuaries (1130)	Brackish running water (G2.6)
Lower salt marsh (CM1)	Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (1330)	Saltmarsh (H2)
Upper salt marsh (CM2)	Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (1330)	Saltmarsh (H2)
Sedimentary sea cliffs (CS3)	None	Soft cliff (H8,2)
Sedimentary sea cliffs (CS3) – (north-facing to the north of the landfall †)	† Corresponds “loosely” to Vegetated sea cliffs of the Atlantic and Baltic Coasts (1230)	Soft cliff (H8,2)
Embryonic dunes (CD1)	Embryonic shifting dunes (2110)	Open dune (H6.8)
Fixed dunes (CD3)	Fixed coastal dunes with herbaceous vegetation (“grey dunes”) (2130)*	Dune grassland (H6.5)
Buildings and artificial surfaces (BL3)‡	None	Built up areas (J3.6)

* indicates EU Annex 1 priority habitat;
§ in this case, formerly heavily grazed lowland blanket bog which shows signs of good recovery (PB5/PB3);
† Refer to habitat evaluation in Appendix J section 4;
‡ this includes man made surfaces including the bog mat and stone roads at the Béal an Átha Buí (Bellanaboy) end of the route.

Table 12.2: Habitats present along the proposed route showing approximate chainages

Route Sections	Chainage		Main habitat(s)	Comment
	From	To		
Landfall and Onshore habitats at Gleann an Ghad (Glengad)	83.38	83.40	Upper shore line and reinstated sedimentary cliff	The landfall.
	83.400	83.825	Improved agricultural grassland (prior to the offshore pipeline landfall works in 2008 and 2009)	Immediately to the east of the landfall soft cliff lies an area of formerly relatively species poor improved grassland. Lies within the SAC. Reinstated in September 2009, this area comprises mostly bare soil and the vegetation is starting to regenerate. The LVI and LVI site compound (SC1) will be located in this area.
	83.825	83.900	Improved agricultural grassland and wet, rushy grassland.	A mosaic dominated by wet, rushy grassland. Boundaries of these vegetation types merge and so are not well-defined. Some of this section of the route lies within the SAC. Site compound SC3 will be located in an area of wet, rushy / improved grassland.
Tunnel	83.900	88.770	The tunnel will pass underneath the following habitats	
	83.900	84.025	Improved agricultural grassland; wet, rushy grassland and marsh	A mosaic of improved grassland, wet, rushy grassland and marshy areas dominated by *Iris pseudacorus* (Yellow Flag). Boundaries of these vegetation types merge and so are not well-defined. Some of this section of the route lies within the SAC.
	84.025	84.050	Lower salt marsh	The boundary between the marshy areas and the salt marsh is not clearly defined. Part of the SAC, the salt marsh is very species poor, with increased growth of rushes in recent years.
	84.050	88.640	Estuary and intertidal	Sruwaddacon Bay (SAC/SPA)
	88.640	88.645	Saltmarsh	Narrow fringe on southern shoreline
	88.645	88.690	Recovering lowland blanket bog (undesignated)	Formerly eroding blanket bog.
	88.690	88.770	Heavily Eroded blanket bog (undesignated)	Aghoos tunnelling compound (SC3) in this location
Onshore habitats from na hEachú (Aghoos) to Béal an Átha Buí (Bellanaboy)	88.770	91.720		
	88.770	88. 850	Heavily Eroded blanket bog (undesignated)	Aghoos tunnelling compound (SC3) in this location
	88.850	89.110	Severely eroded blanket bog with some old cutover (undesignated)	Heavily grazed in the past, the surface is broken by deep erosion channels Some old cutover present at the extreme SE of the pipe stringing area in this location. Occasional small patches of Gorse scrub and along sides of drains in places.
	89.110	89.200	Wet grassland	
			Scrub	Gorse scrub along lower field boundary
	89.200	89.260	Inlet and Salt marsh	Saltmarsh occurs as a narrow fringe along the shore of the inlet. Leenamore River crossing
			Scrub	Small patches of Gorse scrub
	89.260	89.350	Wet grassland	
	89.350	89.540	Recovering eroded blanket bog (undesignated)	Formerly eroding blanket bog with a cover of bare peat generally between 10 and 20%
	89.540	91.720	Coniferous forestry (of varying age class, including clear felled; and also includes artificial surfaces (public road, bog mat and stone roads etc.)	This includes the route section through the clear-felled conifer plantation to the north of the terminal. Ends at Bellanaboy Gas terminal

Table 12.3: Summary of Habitats showing their Ecological Significance and Frequency of Occurrence

Habitat	Approximate Percentage occurrence	Ecological value
Low cliff at landfall	0.1	Low, locally important
Improved grassland	5.1	Low, locally important
Mosaic of improved grassland and wet, rushy grassland	3.1	Low, locally important
Mosaic of: improved; wet, rushy grassland and marsh (tunnel)	1.5	Low to Moderate Locally important
Salt marsh (includes Leenamore inlet and that tunnelled underneath at Gleann an Ghad (Glengad))	0.5	Nationally/Internationally important
Estuary and intertidal (tunnel)	55.5	Internationally important
Scrub	<0.1	Low, locally important
Heavily Eroded blanket bog (undesignated)	1.9	Moderate to High, Locally Important
Severely eroded blanket bog and old cutover (undesignated)	3.1	Low to Moderate Locally important
Recovering eroded blanket bog (undesignated)	2.8	Nationally important
Conifer plantation (including recently felled areas, and artificial surfaces)	26.2	Low, locally important
Sod bank boundaries	-	Low, locally important
Freshwater streams	-	Low, locally important

12.3.3 Fauna (Non-Avian)

The coastal and estuarine portions of the area provide the principal faunal habitats of interest present on site. The proposed route also includes areas of blanket bog habitat, coniferous plantation, improved grassland; wet, rushy grassland, and also small pockets of scrub habitat. The vertebrate fauna of the area may be summarised as being typical of the various habitats, with a good representation of common and ubiquitous species.

A list of Irish mammalian, amphibian and reptilian species is provided in Appendix J(1), along with their adjudged status in the area. Signs of faunal species of interest observed during surveys from 2002 to 2008 have been mapped and are discussed in detail in Appendix J(1).

12.3.3.1 Otter

Otter surveys from 2002 have revealed otter signs along all coastal and estuarine portions of Sruwaddacon Bay and also along the adjacent freshwater reaches of the Glenamoy and Muingnabo Rivers to the east. The 2010 survey also revealed use of all the Bay area by otters, much as had been identified in previous surveys. Survey of the Bay area west of Rossport Pier in 2010 identified considerable otter activity in that area. Otters undoubtedly use many of the small streams and rivers that enter the Bay for washing also.

In surveys prior to 2010 many shoreline caves used by otters were identified as resting places or as potential holts and these are included on the fauna mapping in Appendix J(1). Otter use of many such shoreline caves was confirmed in 2010 survey during which 52 shoreline caves were noted, many of which served as occasional otter resting places (with bedding and/or spraints present within or just outside the entrances). These small caves situated along the coastline have been formed by coastal erosion. Only 3 holts were identified, two of which were considered to be active (of these two, the one at Gleann an Ghad (Glengad) was considered to be an occasional holt, with some evidence of use of this burrow by foxes also). None of the three holts identified could be confirmed as active breeding holts at time of survey in early 2010.

Despite intensive searches close to the shore, with some searches into the adjoining hinterland, no certain principal, or natal, otter holts have been found. The holt at Gleann an Ghad (Glengad) is in use by otters on occasion; it has some potential as a breeding holt, though it is in an unusually exposed location for a breeding holt. The holt will be monitored for activity prior to, and during, construction.

The mapping for the 2010 survey distinguishes between shoreline caves and otter holts. Signs of otters were also noted on the western side of Broadhaven Bay, opposite Sruwaddacon Bay, near Ballyglass Pier, indicating their presence in the greater area. The survey area (in 2007 to 2008 surveys) included a significant stretch of the Aghoos River where a potential otter holt and a number of otter sprainting sites, including fresh spraints and an otter smear were identified.

Further details on otter activity in the area from all surveys are given in Appendix J(1) along with details of holts, resting places, spraints and the otter diet. Holts identified and other signs of otter activity (spraints, feeding signs, footprints and paths) have been mapped (see Appendix J(1)).

12.3.3.2 Badger

Badgers are known to be present in the wider Bay area generally.

Badger footprints and foraging signs were observed in earlier surveys. Foraging signs were found at the edge of the coniferous plantation (east of na hEachú (Aghoos)). In December 2008, badger rooting was identified at na hEachú (Aghoos) just west of the Leenamore River, with badgers foraging on the improved pasture field there. No signs of badger feeding were found within the modified blanket bog habitats present along the proposed route. A badger sett had previously been found closer to na hEachú (Aghoos) village. In February 2010, badger foraging signs were found next to the shore between na hEachú (Aghoos) and Poll an tSómais (Pollatomish). The strong mammal paths observed along many parts of the shore have been created by otters and foxes in the main, but badgers are probably using these paths also.

Several badger setts have been identified in the area, though no main breeding sett has been found in the wider area. Previously, a main sett was present at the north-west of the Terminal site, but this has been inactive in recent years. An active badger sett is known on the north side of the Bay, though signs of badgers foraging along the coast on the north side of the Bay were few.

From surveys conducted in relation to the Gas Terminal it is known that a main badger sett and several smaller setts are present within or close to that location. Badgers are known to range over much of the area of the Gas Terminal site and their activity also extends to the south of the R314, Béal an Mhuirthead (Belmullet) to Gleann na Muaidhe (Glenamoy) road. Post construction faunal surveys in connection with the Mayo to Galway Gas Pipeline (BGE, in 2010) to the south of the R314 between Béal an Átha Buí (Bellanaboy) and Glenturk, have shown that there is continuing badger activity in that area.

Setts identified, and other signs of badger activity (feeding signs, latrines, and paths) have been mapped. Further details of badger activity are provided in Appendix J(1).

12.3.3.3 Bats

During the bat detector survey in September 2007, three bat species were recorded. However, only a few individual bats were encountered during the study. No potential bat roosts were identified and the lack of mature trees in the area means that there are few opportunities for tree roost sites.

A soprano pipistrelle was detected foraging along hedgerows near na hEachú (Aghoos) Church and at Béal an Átha Buí (Bellanaboy). A common pipistrelle was recorded in the area of Béal an Átha Buí (Bellanaboy) during a previous study at the Gas Terminal site. Whilst no detections were made during the 2007 survey, two individuals were detected on the north side of the Bay in August 2008. Leisler's bat, which forages over agricultural landscapes, scrub and woodland was detected foraging over the bay from various locations. It was also recorded south of Béal an Átha Buí (Bellanaboy) along the main R314 road. A single *Myotis* sp. bat was heard briefly between na hEachú (Aghoos) and Poll an tSómais (Pollatomish) – probably a distant Daubenton's bat.

Although not encountered during the 2007 survey, a single brown long-eared bat *Plecotus auritus* was recorded on the north side of the Bay in August 2008.

A list of bat species along with their adjudged status in the area; further information on bat ecology and species descriptions is provided in Appendix J(1). Bat detector "sightings" are mapped (see Appendix J(1) Fauna figures.

12.3.3.4 Other Mammalian Species

A list of other mammalian species is given in Appendix J(1), and indicates their status in the study area. Species known to occur in the area are: brown rat, long-tailed fieldmouse, pygmy shrew, fox, rabbit, Irish hare, pine marten, American mink and red deer.

Fox *Vulpes vulpes* signs are present and frequent in the Bay area. Active rabbit *Oryctolagus cuniculus* burrows are present (and frequent) within and adjacent to the sand dune system to the north of the route at Gleann an Ghad (Glengad), but signs were infrequent or absent elsewhere. The Irish hare *Lepus timidus hibernicus* is present in the area and signs of this species were observed both within the Sruwaddacon Bay area and north of the Bellanaboy Bridge Gas Terminal site. The pine marten *Martes martes* has increased its range across Ireland and is now known to be present in north Co. Mayo (O'Mahony *et al.*, 2005). Presence of this species has been confirmed (sightings and droppings) in various surveys at the Terminal site and they are expected to be present within the coniferous plantation along the route.

No signs of either the grey squirrel *Sciurus carolinensis* or the red squirrel *Sciurus vulgaris* were observed in any of the studies in the area.

No signs of hedgehog were noted but this species is wide-ranging and is certain to be present. The Irish stoat *Mustela erminea hibernica* is wide-ranging and may occur in the area, but no evidence was noted in surveys carried out for this assessment.

American mink *Mustela vison* are known to have spread to Co. Mayo in recent years. No signs were found during earlier surveys, but two mink scats were identified in the Bay area in 2010; one scat was found midway along the northern shore, and another on the north shore at the eastern end of the estuary.

The Common (Harbour) seal *Phoca vitulina was* recorded during the marine mammal surveys in 2005 (CMRC, 2005); and during monitoring in 2007 (Collins, C. 2007) in the estuarine approaches, on sandbanks and shorelines at estuary mouth, in the estuarine channel and on shore line opposite Rossport Pier. The nearest noted location in the same report for Grey seal *Halochoerus grypus* was near Rinroe, while in 2007 this species was observed in the estuarine channel to the west of Rossport Pier. During the 2009/2010 winter bird surveys Common seal were noted hauled out on the shore and on sand banks at the western end, and towards the mouth, of Sruwaddacon Bay.

12.3.3.5 Amphibians and Reptiles

The common frog *Rana temporaria* was observed at several locations. There are no large ponds or pools along the proposed route but several drains were confirmed frog breeding sites; a number of other drains in this area are considered to be potential breeding grounds. These are mapped (see Appendix J(1)). The species is a common prey of otters, foxes, possibly badgers also, as well as other predators.

The common newt *Triturus vulgaris* is not expected in the area and no suitable ponds or pools were found.

The common lizard *Lacerta vivipara* is a common species, but difficult to observe. It is reported locally in the area, especially on the drier, heather dominated sections of cutover bog although no observations were made.

12.3.3.6 Overall Assessment of the Area in Terms of Non-avian Fauna

The potential of the habitats to support species of fauna may be summarised as follows:

Sruwaddacon Bay is utilised by otters, an EU Annex II and IV (Habitats Directive) species. The river supports salmonid populations which are listed on Annex II of the EU Habitats Directive (see also Chapter 13).

A number of small streams flow in to Sruwaddacon Bay or into the Glenamoy River. These provide corridors for otter movements and may also serve an important role as washing places for otters. Almost all streams and larger watercourses were found to be marked by otters where they entered the bay. The Aghoos River is a small river that feeds directly into the Carrowmore Lake cSAC and is used by otters on a regular basis. The various watercourses contribute to the fauna of the area and may be considered as varying in value from Low Local Importance to High Local Importance.

Habitats that are considered to be of Low Local Importance in terms of non-avian fauna: improved grasslands provide forage for common species, such as fox, small mammals are: wet grasslands; blanket bog habitats; coniferous plantation (offers cover but provides very poor foraging habitat for faunal species and do not offer roosting opportunities for bats); field boundaries (scrub and earthen banks) and pockets of scrub provide minor wildlife corridors, cover and foraging grounds in the area for common faunal species and breeding and nesting habitat for some mammalian species.

12.3.3.7 Faunal Species of Conservation Interest

A number of mammalian species are protected under the Wildlife Act and Amendment Acts (1976 and 2000), some of which are known to be present or may be expected to occur occasionally. These include: otter, badger, pine marten, Irish stoat pygmy shrew, hedgehog, and Irish hare. Most of these species may be considered as common species and ubiquitous through much of the Irish countryside. Once relatively scarce, the pine marten has become widespread over much of Ireland. Red deer are occasional in the area.

The following are considered as species of conservation interest (Red Data Book; Whilde, 1993): otter, badger, pine marten, Irish hare, pipistrelle bats, Daubenton's bat, Leisler's bat, and brown long-eared bat. Threatened species include the whiskered bat and Natterer's bat (not expected on site).

All bat species are protected under the Wildlife Act (1976) and Wildlife Amendment Act (2000) and are listed under Annex IV (EU Habitats Directive). Bats are also protected under the Bern Convention (1982) and the Bonn Convention (1979). Bats are not numerous in the Sruwaddacon Bay area - due to the relatively poor foraging habitats in the area and lack of shelter and vegetation cover in the locality.

Badgers are common in Ireland, with an average density nationwide of approximately 0.5 social groups per km^2 (Smal, 1995). Badgers would have far lower densities in upland and blanket bog dominated areas such as in the vicinity of the proposed route.

Otter is a high priority species. The Wildlife (Amendment) Act (2000) protects all types of otter holts and also their resting places. It is listed under Annex II and IV of the EU Habitats Directive. It is also listed as requiring strict protection in Appendix II of the Bern Convention. A species action plan for the otter in Ireland was recently published by NPWS (2008). Otters are widespread in Ireland and their presence can be confirmed on most watercourses in the country (Smal, pers. obs.) but little is known of their densities either on freshwater systems or coastal habitats.

Common and Grey Seal are also protected under the Wildlife Acts and both are listed on Annex II of the EU Habitats Directive.

The common lizard, common frog, and the smooth newt are all protected species under the Wildlife Acts. The common frog is a *Red Data Book* species, but it is common in most Irish habitats. Further details with regard to individual species are given Appendix J(1).

12.3.4 Birds

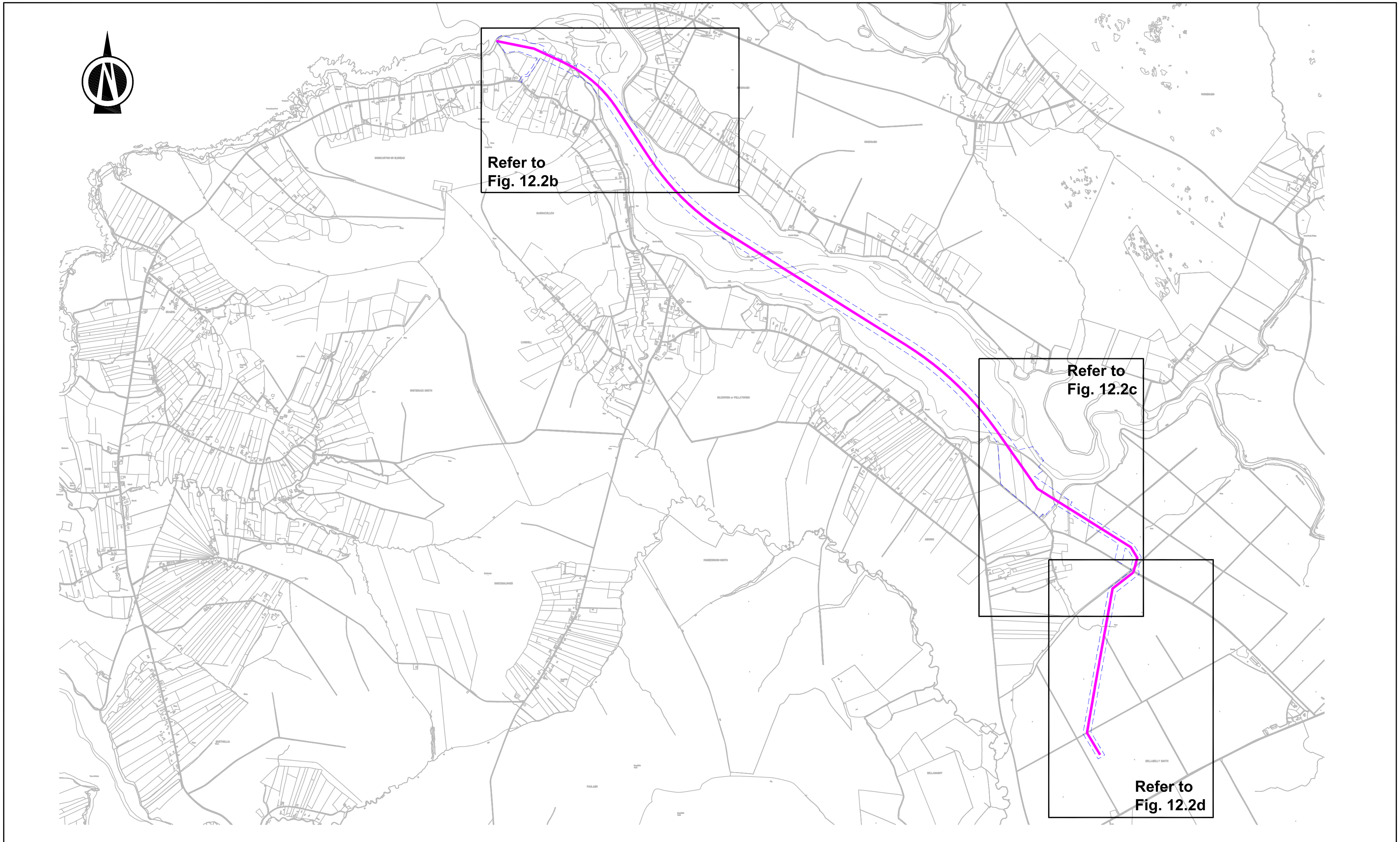
The following sub-sections provide a summary of the results of bird surveys undertaken in 2008/2009 and, previous years. Count areas and observation points used during the surveys are provided in Appendix J(1) and Figures 12.4 and 12.5.

Details of the survey results and desk study are provided in Appendix J(1) along with the scientific and common names of all bird species recorded, bird survey count data, summary tables, schedules and peak counts.

12.3.4.1 Aquatic Bird Studies

A total of 66 bird species have been recorded by aquatic studies in the vicinity of the proposed route. Only one species, Light-bellied Brent Goose, exceeded the threshold of nationally important numbers (i.e. 1% of the estimated National Population). In recent winters peak counts of over-wintering Light-bellied Brent Geese have on occasion exceeded internationally important numbers (>200 individuals).

Further details of the aquatic bird survey results are given in Appendix J(1), including preliminary count results from the Winter Bird and Brent Goose monitoring surveys from October 2009 to March 2010.



Legend:

Proposed Pipeline Route

Temporary Working Area

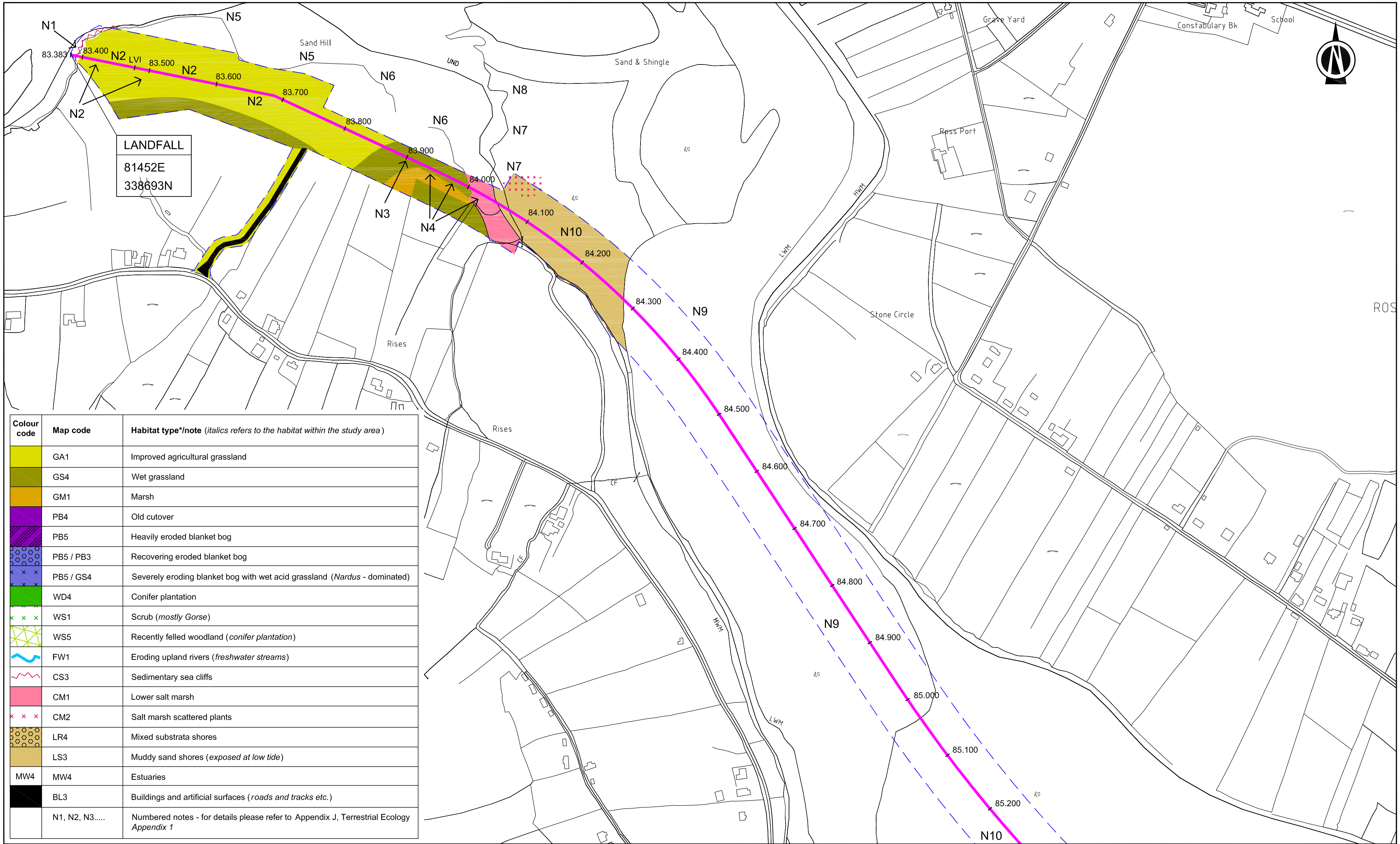
Habitat Mapping

Figure 12.2a - Overview of Habitats

CORRIB ONSHORE PIPELINE

File Ref: COR25MDR0470FG12.2_Habitats Sheet 1 RevA03

Date: May 2010



Colour code	Map code	Habitat type*/note (*italics refers to the habitat within the study area*)
	GA1	Improved agricultural grassland
	GS4	Wet grassland
	GM1	Marsh
	PB4	Old cutover
	PB5	Heavily eroded blanket bog
	PB5 / PB3	Recovering eroded blanket bog
	PB5 / GS4	Severely eroding blanket bog with wet acid grassland (*Nardus* - dominated)
	WD4	Conifer plantation
	WS1	Scrub (*mostly Gorse*)
	WS5	Recently felled woodland (*conifer plantation*)
	FW1	Eroding upland rivers (*freshwater streams*)
	CS3	Sedimentary sea cliffs
	CM1	Lower salt marsh
	CM2	Salt marsh scattered plants
	LR4	Mixed substrata shores
	LS3	Muddy sand shores (*exposed at low tide*)
MW4	MW4	Estuaries
	BL3	Buildings and artificial surfaces (*roads and tracks etc.*)
	N1, N2, N3.....	Numbered notes - for details please refer to Appendix J, Terrestrial Ecology *Appendix 1*

Legend:

Proposed Pipeline Route

Temporary Working Area

Habitat Mapping

Figure 12.2b - Sheet 1 of 3

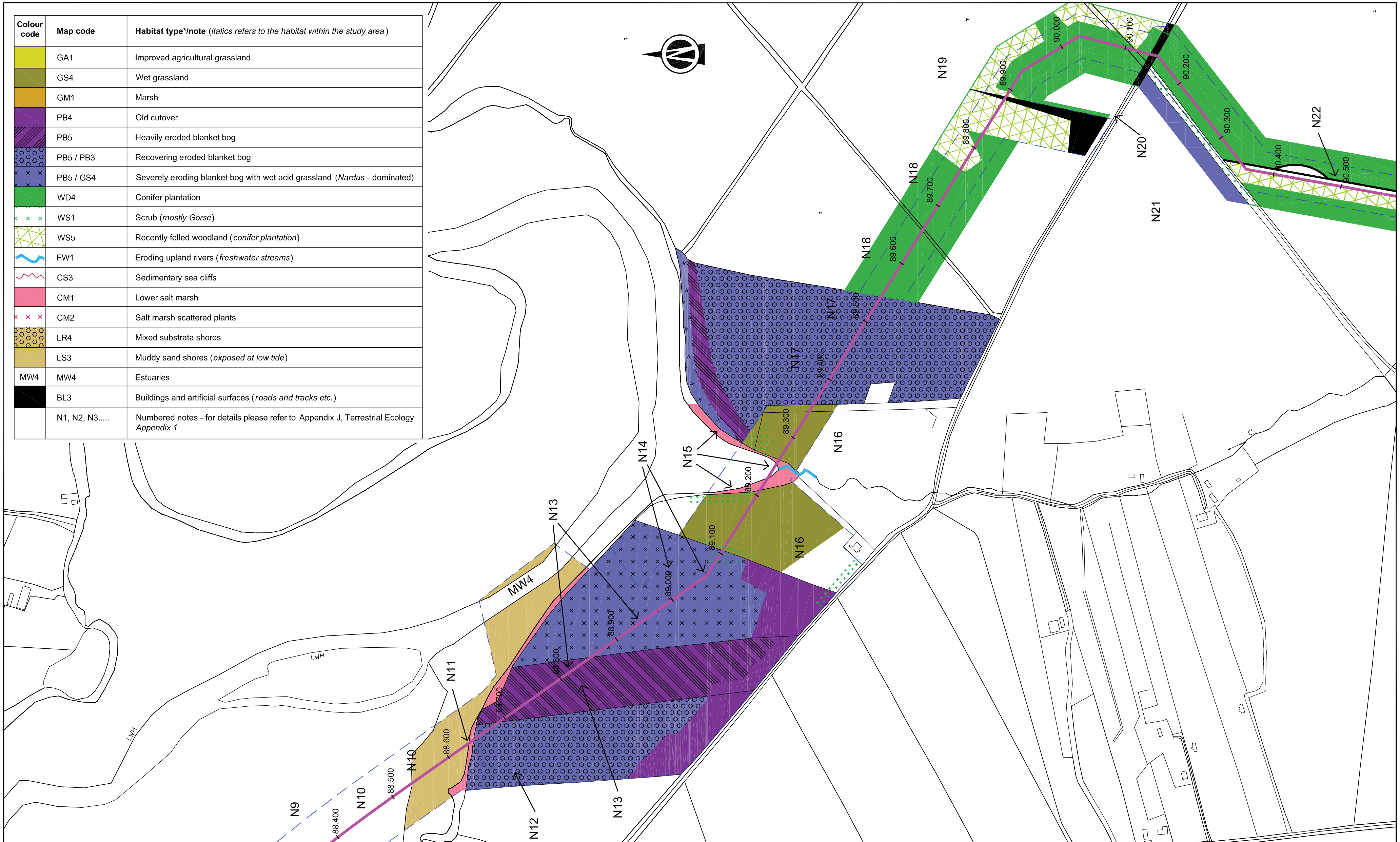
CORRIB ONSHORE PIPELINE

File Ref: COR25MDR0470FG12.2_Habitats Sheets 2-4 RevA03
Date: May 2010

Corrib natural gas

RPS

Colour code	Map code	Habitat type*/note (*italics refers to the habitat within the study area*)
	GA1	Improved agricultural grassland
	GS4	Wet grassland
	GM1	Marsh
	PB4	Old cutover
	PB5	Heavily eroded blanket bog
	PB5 / PB3	Recovering eroded blanket bog
	PB5 / GS4	Severely eroding blanket bog with wet acid grassland (*Nardus* - dominated)
	WD4	Conifer plantation
	WS1	Scrub (*mostly Gorse*)
	WS5	Recently felled woodland (*conifer plantation*)
	FW1	Eroding upland rivers (*freshwater streams*)
	CS3	Sedimentary sea cliffs
	CM1	Lower salt marsh
	CM2	Salt marsh scattered plants
	LR4	Mixed substrata shores
	LS3	Muddy sand shores (*exposed at low tide*)
MW4	MW4	Estuaries
	BL3	Buildings and artificial surfaces (*roads and tracks etc.*)
	N1, N2, N3.....	Numbered notes - for details please refer to Appendix J, Terrestrial Ecology Appendix 1



Legend:

Proposed Pipeline Route

Temporary Working Area

Habitat Mapping

Figure 12.2c - Sheet 2 of 3

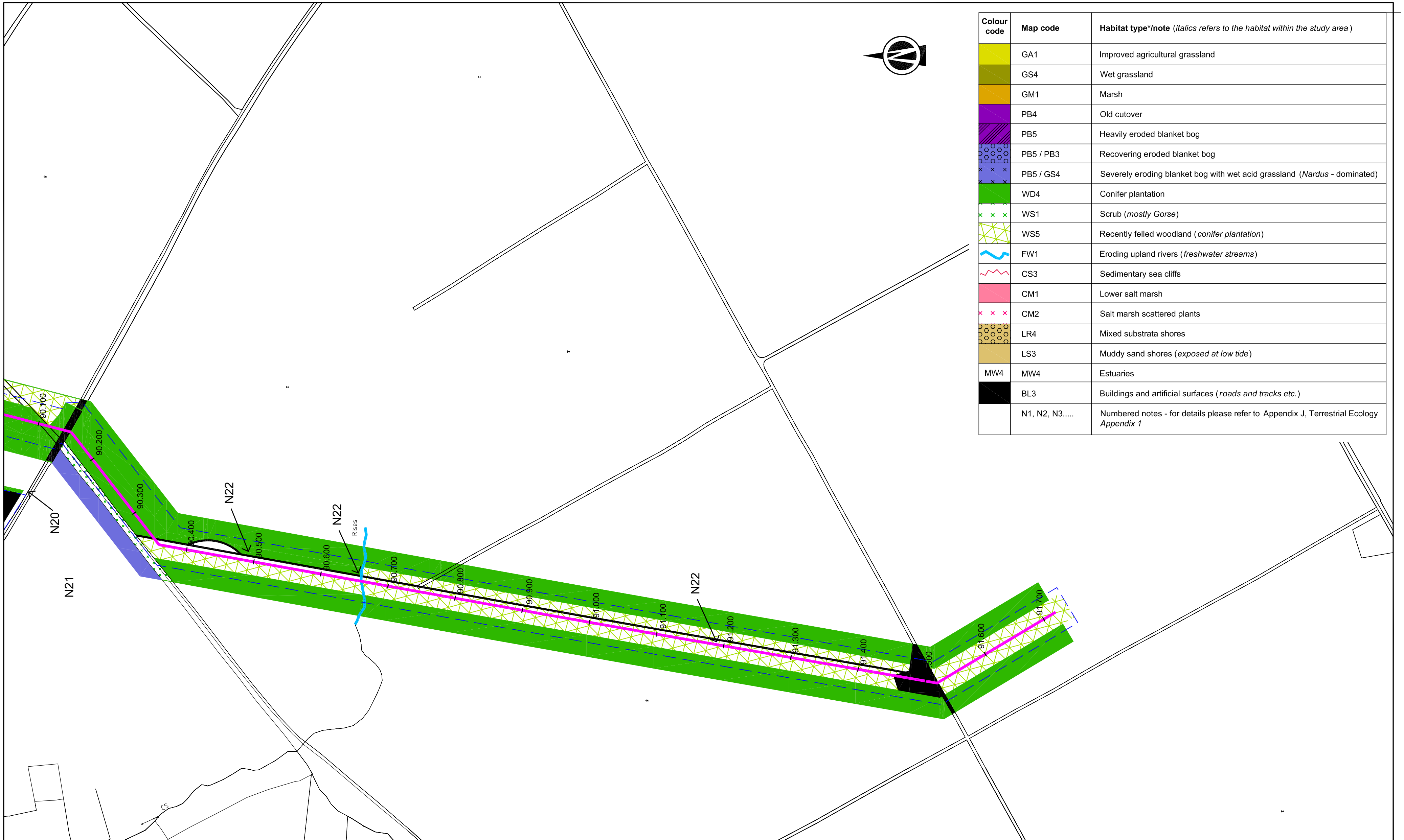
CORRIB ONSHORE PIPELINE

File Ref: COR25MDR0470FG12.2_Habitats Sheets 2-4 RevA03

Date: May 2010

Corrib natural gas

RPS



Colour code	Map code	Habitat type*/note (*italics refers to the habitat within the study area*)
	GA1	Improved agricultural grassland
	GS4	Wet grassland
	GM1	Marsh
	PB4	Old cutover
	PB5	Heavily eroded blanket bog
	PB5 / PB3	Recovering eroded blanket bog
	PB5 / GS4	Severely eroding blanket bog with wet acid grassland (*Nardus* - dominated)
	WD4	Conifer plantation
	WS1	Scrub (*mostly Gorse*)
	WS5	Recently felled woodland (*conifer plantation*)
	FW1	Eroding upland rivers (*freshwater streams*)
	CS3	Sedimentary sea cliffs
	CM1	Lower salt marsh
	CM2	Salt marsh scattered plants
	LR4	Mixed substrata shores
	LS3	Muddy sand shores (*exposed at low tide*)
MW4	MW4	Estuaries
	BL3	Buildings and artificial surfaces (*roads and tracks etc.*)
	N1, N2, N3.....	Numbered notes - for details please refer to Appendix J, Terrestrial Ecology *Appendix 1*

Legend:

Proposed Pipeline Route

Temporary Working Area

Habitat Mapping

Figure 12.2d - Sheet 3 of 3

CORRIB ONSHORE PIPELINE

File Ref: COR25MDR0470FG12.2_Habitats Sheets 2-4 RevA03
Date: May 2010

Corrib natural gas

RPS

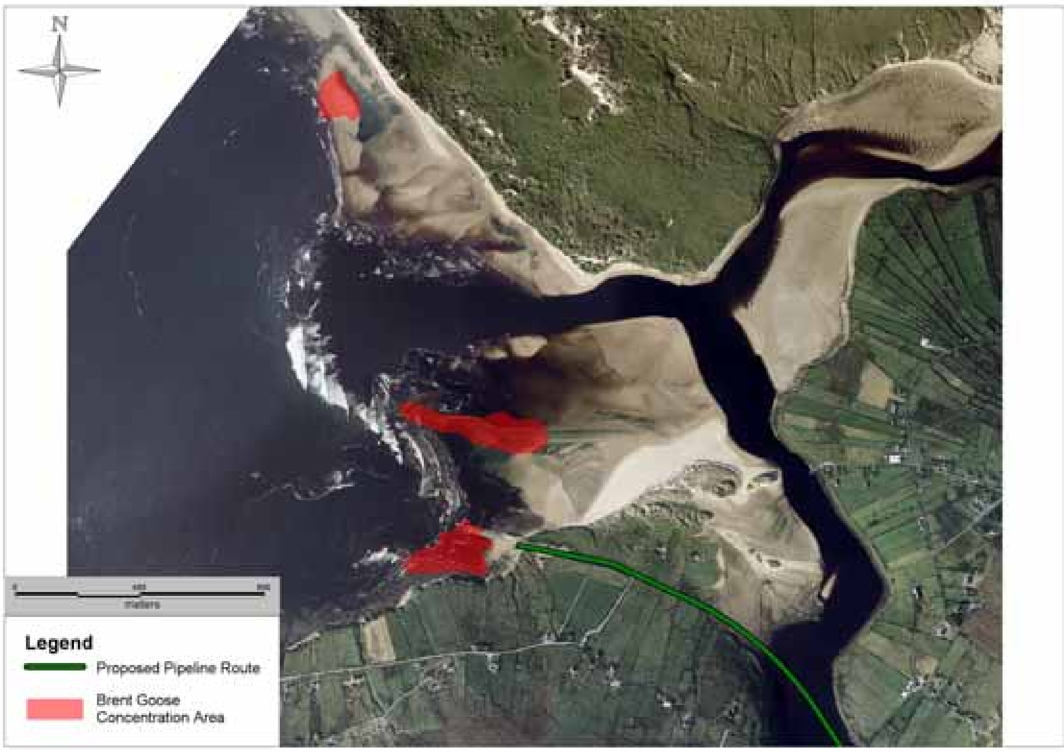


Figure 12.3: **Main feeding areas for Brent Geese**

Plate 12.1: Brent Goose feeding area to the north of the landfall at Gleann an Ghad (Glengad).

Plate 12.2: Brent geese in the Gleann an Ghad (Glengad) feeding area to the north of the landfall.

12.3.4.2 Terrestrial Bird Studies

A number of terrestrial bird studies have been carried out since 2002.

A total of 47 species have been recorded during terrestrial based studies in the area of the proposed route.

Chough were recorded on several occasions during winter surveys of Sruwaddacon Bay in 2002 and 2003 (Arnold 2005d). These sightings took place in the outer bay and along the southern shores of the middle and inner bay.

No Corncrakes were recorded during dedicated surveys, although suitable habitat was noted in parts of the study area. Historical records of breeding Corncrakes in the general area are given in Appendix J(1). Data received from BirdWatch Ireland shows no recent Corncrake records for the study area.

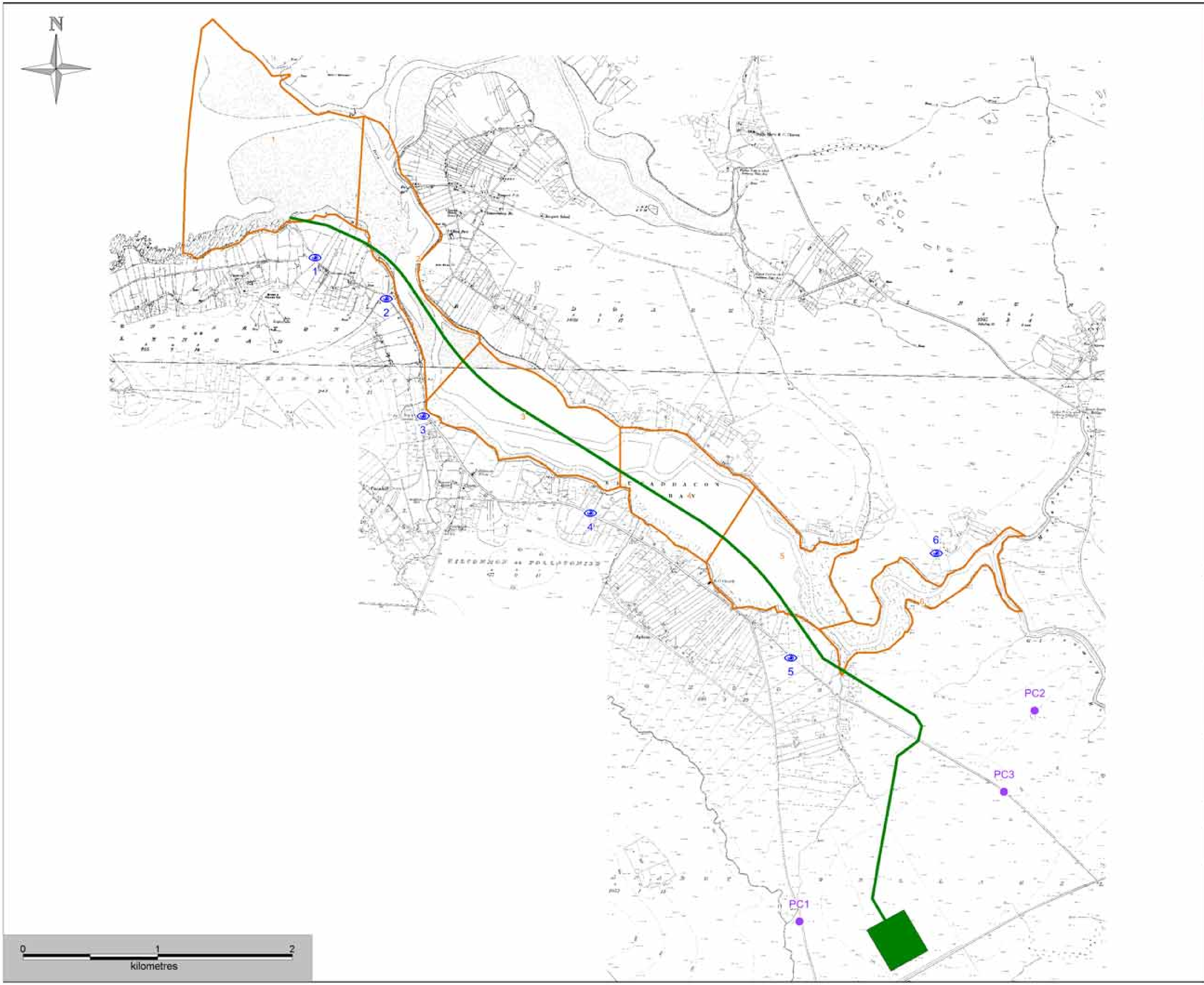
A breeding colony of Sand Martins, a summer visitor, is located in the soft cliff at Gleann an Ghad (Glengad) to the north of the landfall and was first studied in 2002. Two discrete 'sub-colonies' were identified during the 2008 monitoring survey visits. Colony A (the "original colony") is located 30 m north of the proposed pipeline landfall see Figure 12.1 above) while Colony B is located some two hundred metres to the south west of the landfall. In total 48 active Sand Martin burrows were recorded at Gleann an Ghad (Glengad) in the 2008 breeding season. Activity was sporadic in many of these burrows, with some evidence of a proportion of the population producing multiple broods judging from the activity observed at individual burrows over an extended series of site visits. It was judged that at least 30-50% of the active burrows may have had more than one nesting attempt during the 2008 breeding season. Colony A was active from early May to mid-August, while Colony B was active from early June to mid/late August.

In the 2009 breeding season, a total of three Sand Martin Colonies were identified. Colony A and Colony B were existing colonies located at Gleann an Ghad (Glengad), while Colony C was located at Rinroe Strand and was substantially larger in size than had been observed in this area in 2008.

A total of 67 *viable* Sand Martin burrows were recorded during the 2009 breeding season surveys at Gleann an Ghad (Glengad). Colony monitoring showed that 35 of these burrows were active on at least one of the survey visits. That indicates an overall burrow occupancy rate of 52% of available burrows. A total of 51 viable burrows were recorded in Colony A, 16 viable burrows were available in Colony B and 56 viable burrows were available in Colony C in the 2009 breeding season. Burrow occupancy (i.e. percentage of viable burrows that were occupied) at Colony A was 65% and burrow occupancy in Colony B was 25%.

There is no evidence to suggest that the local Sand Martin breeding population in this area has declined. Conversely, it would appear that this Sand Martin population has expanded, taking advantage of larger expanses of suitable nesting habitat for colony development. At the end of the 2009 breeding season a total of 118 viable burrows were available to Sand Martins in the outer Sruwaddacon Bay area, compared to 80 (68 at Gleann an Ghad (Glengad) and 12 at Rinroe) in the 2008 season (FTC, 2009). Furthermore, breeding success appeared to be relatively high at Gleann an Ghad (Glengad) – at least in the latter half of the breeding season – with chicks/fledglings recorded at many of the burrows in both Colony A and Colony B, and high activity levels (indicating chick provisioning) at many other burrows. This would indicate that the Sand Martins which chose to nest at these locations were successful, and did not appear to be affected by the landfall construction activities in 2009.

Previous Sand Martin surveys carried out in the 2005 breeding season had recorded 37 apparently occupied nests (3 more than was recorded in 2004). These active burrows were located in the area now referred to as Colony A, i.e. the original colony.



Legend

- Survey Area
- Vantage Point
- Proposed Pipeline Route
- Point Count
- Terminal

Date	21/04/10
Name of Client	Ecological Advisory and Consultancy Services (EACS), for Shell E&P Ireland Ltd.
Name of Job	Corrib Onshore Pipeline EIS
Title of Figure	Aquatic Survey Areas & Terrestrial Bird Point Counts
Scales Used	1 : 30,000 @ A3
Figure No.	12.4
Rev	B

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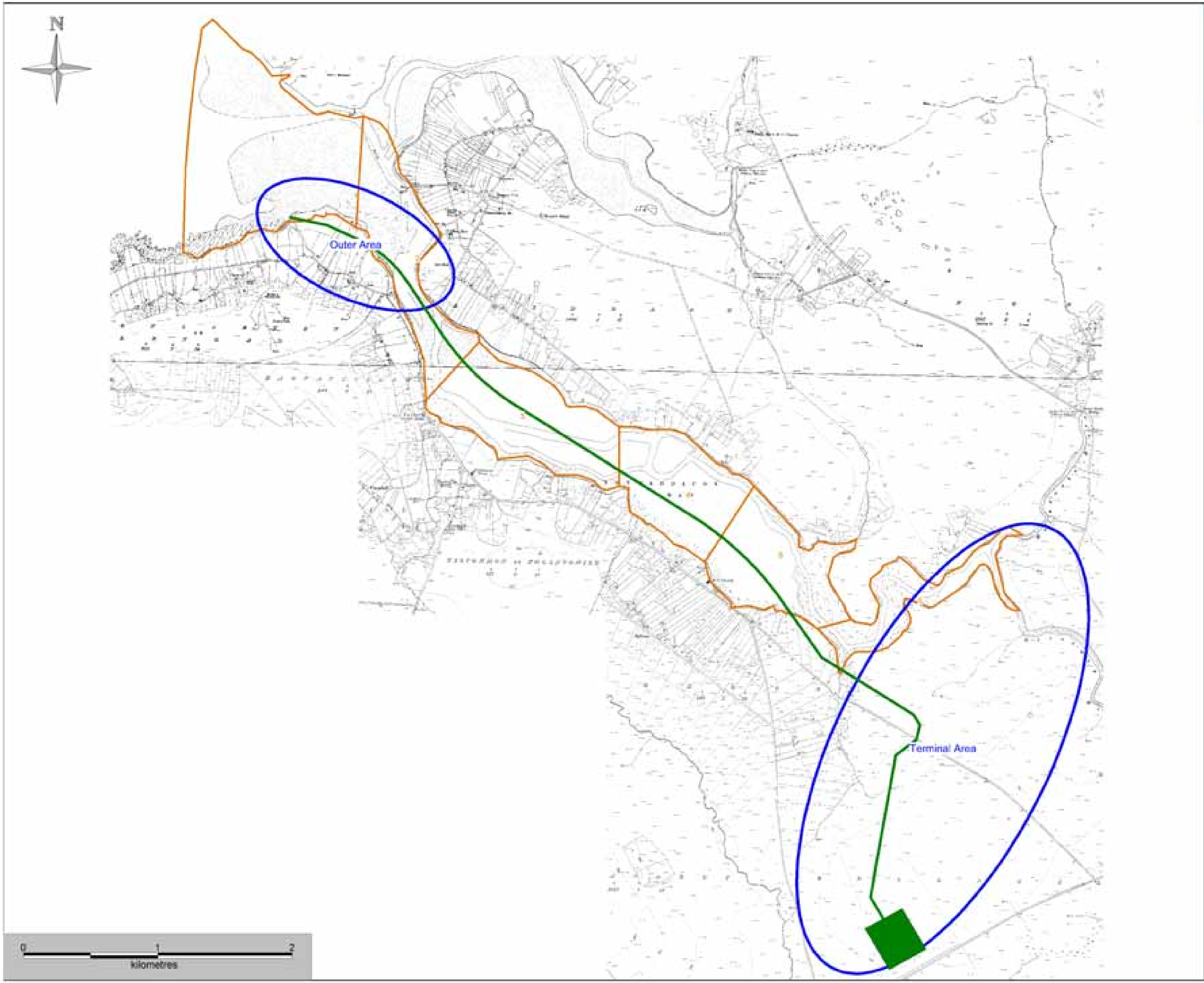
CE08-048-03, Figure 12.5, Count Sections Used for Desktop Terrestrial Review, Rev C



Legend

- Proposed Pipeline Route
- Count Section
- Terminal

Date	27/04/10
Name of Client	Ecological Advisory and Consultancy Services (EACS), for Shell E&P Ireland Ltd.
Name of Job	Corrib Onshore Pipeline EIS
Title of Figure	Count Sections Used for Desktop Terrestrial Review
Scales Used	1 : 30,000 @ A3
Figure No.	12.5
Rev	C

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12.3.4.3 Overall Assessment of the Area in Terms of Birds

The overall bird community is typical of the habitats described above.

The post breeding and winter season bird studies show that bird diversity and numbers in the vicinity of the proposed route are low. The relatively low bird diversity and numbers are also reflected in previous bird studies of the general area. Species that were recorded in highest numbers in these studies and previous studies were flocking species such as Light-bellied Brent Goose, Black-headed Gull, Great-black-backed Gull, Common Gull and Oystercatcher. Curlew were also consistently recorded in moderate numbers (typically 50-80 birds).

It is interesting to note that all the studies show a general trend of the 'outer section' of Sruwaddacon Bay holding the highest number of bird species in comparison to the middle and inner sections.

A comparison of the terrestrial bird species carried out in the vicinity of the pipeline less straightforward owing to the restriction of land access available in the 2007 field study, however the results of surveys conducted in 2008 were in line with earlier assessments. The point count locations used in the 2007 field study are largely representative of the area in the vicinity of the Gas Terminal (i.e. conifer plantation and blanket bog habitats. It is worth noting that previous terrestrial bird studies recorded the vast majority of terrestrial bird species in the vicinity of the Bellanaboy Gas Terminal.

Breeding Sand Martins at Gleann an Ghad (Glengad) appear to have expanded their range during the 2008 and 2009 breeding seasons, with two sub-colonies now located at Gleann an Ghad (Glengad) and one colony located at Rinroe Strand. At least 35 Sand Martin burrows were recorded as active in the 2009 breeding season.

12.3.4.4 Evaluation of Scientific Interest of Birds

Most bird species are protected under the Wildlife Acts, barring those regarded as pest species, and for those considered as game species (where they may be hunted under conditions). Under the Wildlife (Amendment) Act, 2000 it is an offence to disturb their breeding or resting places.

Only one species, Light-bellied Brent Goose, exceeded the threshold of nationally important numbers (i.e. 1% of the estimated National Population). It should be noted that recent apparent increases in Light-bellied Brent Goose numbers in Ireland (40,000 from 20,000 - per. com. K. Colhoun) indicate that the threshold for internationally important numbers may increase from 200 to 400 (1% of the International Population). However, recent consultations with BirdWatch Ireland indicate that the next revision is likely to be in 2012, with a mean peak of 350.

None of the other waterbird species recorded by the post breeding study exceeded the threshold of nationally important numbers (i.e. 1% of the estimated National Population). Overall, bird diversity and abundance is relatively poor.

A total of 47 species have been found by terrestrial based studies in the area of the proposed route. Overall, bird diversity and abundance is considered relatively low. The lack of mature 'woody' vegetation outside of the coniferous plantation characterises the coastal nature of the terrestrial parts of the study area. It also explains the lack or scarcity of many nationally common terrestrial bird species.

A total of 66 bird species have been recorded during aquatic studies in the vicinity of the proposed route.

Several species of high conservation concern (i.e. Annex I and/or Red listed species) were recorded by the field studies in the vicinity of the route; Bar-tailed Godwit, Chough, Curlew, Common / Arctic Tern, Golden Plover, Great-northern Diver, Hen Harrier, Little Tern, Lapwing, Shoveler, Red-throated Diver, Sandwich Tern, Little Egret, Black-headed Gull, Herring Gull, Redshank, Whooper Swan and Peregrine Falcon. Most of these species normally occurred in very low numbers (i.e. <10) and only from time to time. Common /Arctic Tern and Sandwich Tern have occurred occasionally in small numbers, with the former observed in 2002 and the latter in 2002 and 2007. Of all the high priority species, only Curlew and Black-headed Gull are present in any numbers throughout the year. Both species can be found widely both in the aquatic and adjoining terrestrial habitats throughout the year with peak numbers typically occurring in the winter.

Light-bellied Brent Goose is an Internationally important migratory species, listed under Annex II of the Birds Directive, the Bern Convention and the Bonn Convention. It is an Amber listed species (BoCCI, Lynas, 2007), and it is a species of special interest for the Blacksod Bay/Broadhaven SPA.

Other bird species recorded by all studies are either of medium conservation concern or of no conservation concern in Ireland. A list of all species together with their conservation status is given in Appendix J(1).

12.4 POTENTIAL IMPACTS

The following sections address the potential impacts during the construction, commissioning, and the operational phases of the proposed development. In addition the ‘do nothing’ scenario and ‘worst case’ scenario are also addressed. For the purposes of the ecology impact assessment, potential impacts associated with the LVI are addressed separately (see Section 12.4.2.4 and 12.4.3.2).

Potential impacts on habitats and species are summarised in sections 12.4.2 and 12.4.3 while the predicted level of post construction impacts are outlined for the short term and long term in Section 12.7. Further discussion on these impacts is provided in Appendix J(1).

Criteria for assessing impact level have been derived from those set out in Appendix 4 of the NRA discipline - specific EcIA Guidelines criteria, and expanded in order to be able to address issues such as habitat quality. Terminology for impact significance and duration follows that set out by the EPA (2003) in its generic guidelines. These criteria are outlined in Appendix J(1). The impact magnitude described in the following sections is negative unless otherwise stated as being positive or neutral. Where the impact is stated as being localised, it refers to the immediate area of impact.

12.4.1 ‘Do Nothing’ Scenario

The proposed development is situated in a relatively remote area of north-west Co. Mayo where landuse is mainly forestry and agricultural.

If the development were not to proceed, the habitats crossed by the proposed route would remain as they are, with current landuse practices continuing.

There is little pressure on land for development in the area apart from some pressure for one-off housing in the countryside. There are no expected large-scale changes in the area. Thus, it would be expected that the area would undergo only minor changes in a ‘do-nothing’ scenario.

In a ‘do nothing’ scenario, the local fauna and bird communities will continue to be subject to disturbance, displacement and habitat loss impacts through land use activities including agriculture, commercial forestry, turf cutting and natural sediment movements within the dynamic intertidal and marine environment.

12.4.2 ‘Worst Case’ Scenario

Worst case impacts arise in the event of failure of mitigation measures. In the event that mitigation measures fail it is possible that a pollution incident could have significant negative impacts on terrestrial habitats. However, such impacts would be localised spatially. In the event that reinstatement of habitats is unsuccessful, this would lead to vegetation change and likely indirect affects on dependent faunal species, however, such impacts would be localised to the temporary working area and, at worst, immediately adjacent habitats.

An exceptional pollution event as a result of sediment run off or chemical pollutants into aquatic or wetland (peatland) habitats could result in significant impacts on wildlife therein, or downstream.

The implementation of the mitigation measures outlined in Section 12.5 will ensure that such worst case impacts are avoided.

12.4.3 Construction Phase

In order to be able to assess the potential impacts of the proposed development, the construction plan, which shows the extent of the development including proposed key construction areas, has been examined along with construction methodologies outlined in Chapter 5. As discussed above, construction methodologies have been developed in consultation with ecological experts to avoid and/or minimise potential impacts (see Chapter 5). Therefore the description of potential impacts in the following sub-sections relate to those potential impacts resulting from the proposed construction methods. Construction phase impacts are those associated with all stages of construction, including: fencing, construction activities – including associated construction compounds, pipe stringing areas etc; and reinstatement activities.

The method of construction onshore will vary according to the ground conditions and habitat type. The principal construction method for terrestrial habitats will be conventional spread techniques, though treatment of the surface vegetation will vary. In the unlikely event of problems being encountered during tunnelling underneath Sruwaddacon Bay, or in the case of an emergency, an intervention pit may be required. Other crossings such as those for streams and the Leenamore river (inlet on the southern shore of Sruwaddacon Bay) will be by open cut construction methods.

Potential impacts on habitats and species are considered below. Further details are given in Appendix J(1). Table 9 in Appendix J(1) summarises the potential and predicted impact levels for habitat types and species which occur along the proposed route.

Recommendations for mitigation, including habitat reinstatement for the various habitat types, are outlined in Section 12.5 below.

12.4.3.1 Habitats

In addition to the information provided in the following sections on individual habitats, Table 12.4 below outlines the extent of habitat loss or disturbance, both temporary and permanent resulting from the proposed development. The extent of habitat loss has been estimated on the basis of the information provided by the Habitat Mapping and the area to be disturbed within the temporary working areas, pipeline stringing areas, site compounds and temporary access roads.

In most cases part of the temporary site compounds lie within the temporary working area so therefore only that part of the compound that lies outside the temporary working area has been quantified in Table 12.4

Landfall and Gleann an Ghad (Glengad) Terrestrial Section

Improved grassland and wet, rushy, improved grassland will be subject to standard spread techniques i.e. excavation, backfilling, etc within temporary working area. The larger, *Iris* - dominated marshy area to the east and salt marsh will not be subject to impact because the pipeline tunnel will pass beneath them. Consequently, impacts will be confined to improved grassland, and wet, rushy improved grassland. Impacts will include temporary loss of habitat, and habitat disruption during construction. Impacts associated with site compound, SC1 and SC2 are expected to be temporary /short term.

Impacts are expected to be direct, localised and moderate during construction. See below for impacts associated with the LVI itself.

Plate 12.3 Improved agricultural grassland at Gleann an Ghad (Glengad) prior to landfall construction activities in 2008 (facing west towards Broadhaven Bay)

Recovering Eroded Blanket bog - undesignated (Ch. 89.350 to 89.540)

Recovering eroded blanket bog is considered to be an EU Annex I habitat (PB5/PB3). It is nevertheless modified to some degree and is valued as being of National importance. The main impacts on blanket bog are associated with compaction and hydrology (see also Chapter 15 of EIS).

The most critical effect of compaction is on the roots of the vegetation. Compaction can cause an oxygen deficit around the roots which in turn leads to die back and surface vegetation change. Compaction is also associated with surface water-logging which also results in species change, often resulting in dominance by rush species and a loss of typical blanket bog species.

The potential impact of hydrological change is a concern, especially in the context of a linear feature such as a pipeline. Without mitigation, a buried pipeline might effectively function as a field drain, resulting in water egress from the bog, drying and long term permanent change in habitat. For this reason precaution against sub-bog drainage will be put in place (see 6 Mitigation below. (See also Chapter 15).

Another potential impact is interference with chemical balance, for example as a result of the importation of non-chemically compatible materials such as stone. This could result in permanent vegetation change.

Specialised construction methods have been developed with ecological input for construction in blanket bog habitats in order to minimise any potential impact, but at the same time to ensure the effective construction and safety of personnel during construction. The proposed methodology includes the installation of a stone road and the need for turving in the 190 metre section of recovering blanket bog at na hEachú (Aghoos) (ch. 89.350 to 89.540). Turving involves removal of the upper active vegetation layer in the form of large turves, approximately 2m x 1m x 0.5m deep, which are then stored within the temporary working area. At the end of construction the bog surface will be carefully reinstated with these turves. Full details of the proposed methodology are provided in Chapter 5.

Potential impacts resulting from the proposed construction methodologies on recovering blanket bog traversed by the proposed route are expected to be temporary, direct, localised and moderate.

Plate 12.4: Removing turves in intact blanket bog habitat traversed by the Bord Gáis Mayo to Galway Gas Pipeline in the Glenturk More Bog NHA.

Eroding Blanket bog (undesignated)

Construction methodology in these areas will be standard spread techniques, i.e. without the removal of the vegetation layer as turves. The surface layer, including the scraw, will be removed and stored pending reinstatement. An outline of the proposed methodology to enable vegetation regeneration and restoration is set out in Section 6 of Appendix J(1).

Construction phase impact levels are expected to be short term, direct, localised and moderate.

Cutover Blanket bog (Undesignated)

Cutover is present on a small part of the pipeline stringing area. Other areas of cutover will be used as storage areas for surface layer peat removed from the construction compound, where construction methodology in these areas will be standard spread techniques without the removal of the vegetation layer as turves.

Construction phase impact levels are expected to be short term, direct, localised and moderate.

Salt Marsh

Construction of the Leenamore River crossing will disturb some salt marsh. At this location a turving technique similar to that described for blanket bog will be employed. This type of habitat is vulnerable particularly because of the friable nature of the substrate and relatively low coherence of the vegetative layer. Salt marsh is an EU Annex 1 habitat and it has to be valued according to its Annex status, with impact level assessed accordingly. The salt marsh at Gleann an Ghad (Glengad) will not be subject to impact because the pipeline tunnel will pass underneath it.

The potential impact level on salt marsh affected during construction is expected to be direct, temporary, localised and moderate.

Plate 12.5: Typical fringe salt marsh, dominated by *Puccinelia* spp. and *Glaux maritima*

Intertidal Habitats

The use of the tunnel between Gleann an Ghad (Glengad) and na hEachú (Aghoos) will avoid impacts to intertidal habitats. The potential impacts on intertidal habitats of an intervention pit, if required in a worst case scenario, are described in Chapter 14 of this revised EIS. Potential impacts on species of fauna using the intertidal habitats are discussed below.

In the unlikely event that an intervention pit were required at the western end of the Bay in the intertidal zone, any access to the foreshore will avoid the developing salt marsh (see Note 7 Habitat map sheet 1), and the occasional bird feeding and loafing area near that location.

Earthen (Sod) Bank Boundaries

Some earthen (sod) bank field boundaries may need to be dismantled during construction. Such impacts are expected to be temporary, localised Slight Negative

Scrub (Gorse)

During construction the removal of scrub will result in short term loss of habitat. In habitat terms the potential impact is considered to be temporary, localised and slight. The potential impact of this is mainly associated with faunal species and is considered in Section 12.4.2.2.

Conifer Plantations

The loss of habitat as a result of tree felling within the temporary working area of the proposed pipeline will result in localised, slight impact in habitat terms. The main impact is that associated with habitat loss for fauna and is considered in Section 12.4.2.2.

EU Annex habitats - General

The area of Glenamoy Bog Complex cSAC EU Annex habitats to be disturbed during construction of the pipeline will be confined to a 40m working area for the approximately 50m crossing of the Leenamore River inlet and is extremely localised in the context of the area of the designated site as a whole and the Annex habitat types present therein.

Disturbance to the undesignated recovering Annex I blanket bog habitat (PB5/PB3) at na hEachú (Aghoos) will also be confined to a 40m working width for the 190m stretch of pipeline through this area.

No impact on annexed habitats outside the immediate area of construction activities is anticipated.

Soft Coastal Habitats – Sediment Movements

As shown on Pipeline Alignment Sheet 1 of 6 (See Appendix A), the LVI site compound (SC1) and the tunnel reception compound (SC2) do not impact directly upon either the salt marsh or the dune system at Gleann an Ghad (Glengad). The proposed development will have no impact upon sediment movement in and around the existing or developing dune and salt marsh habitats.

In the unlikely event of an intervention pit being required, any access required to the foreshore will avoid the developing salt marsh and the dune system. Therefore, the proposed development will have no impact on the rates of sedimentation and erosion.

It should be noted as outlined in Chapter 14, that Sruwaddacon Bay is a dynamic system providing a transitional zone between the freshwater riverine flow and the fully marine environment of Broadhaven Bay. The entire estuary is continuously swept by semi-diurnal tides. Given the natural variability and dynamic nature of the estuary, constantly changing patterns of sedimentation and erosion are expected – as have been observed in recent years for example, with sand accretion leading to the developing foredunes on the northern side of the main dune system; and the developing salt marsh to the north of the wayleave (Habitat sheet 1, Note 7).

Table 12.4: Quantification of temporary and permanent habitat disturbance resulting from the Corrib Onshore Pipeline development

Habitat description	Area (m2)	Description of works	Comment
Reinstated sedimentary cliff and foreshore	400	LVI drainage	Temporary disturbance (is within the cSAC)
Improved agricultural grassland	440	LVI footprint	Permanent change (is within the cSAC)
	894	LVI side slopes	Temporary disturbance (is within the cSAC)
	629	LVI hard standing	Temporary disturbance (is within the cSAC)
	4,500	TWA/SC1	Temporary /short term disturbance (is within the cSAC)
	2,190	Access road to LVI	Permanent change (1,177m^2 is within the cSAC)
	11,400	TWA between SC1 and SC2	Temporary disturbance (9,995 m^2 is within the cSAC)
Mosaic of improved agricultural grassland and wet ,rushy, grassland	3500	TWA/SC2	Temporary / short term disturbance (626m^2 is within the cSAC)
Wet grassland, marsh, salt marsh and estuarine habitats	n/a	Tunnel	Temporary disturbance only if an emergency intervention pit is required
Lower salt marsh and intertidal estuarine at Leenamore River	2,026.87	TWA	Temporary disturbance
Scrub (mostly Gorse)	400	TWA	Some permanent loss of Gorse scrub within 14m permanent wayleave
Wet, rushy, grassland at na hEachú Aghoos/Leenamore	7, 200	TWA	Temporary disturbance
Heavily eroded blanket bog	23,964	TWA/SC3	Short term disturbance
Old cutover	27,012	Peat storage areas	Short term disturbance
Severely eroding blanket bog with wet acid grassland (*Nardus* – dominated)	20,643	TWA/Pipeline stringing area	Temporary /short term disturbance (PSA includes some wet, rushy grassland)
Eroding upland rivers (freshwater streams)	-	TWA	Temporary disturbance
Recovering eroded blanket bog	7,600	TWA	Temporary disturbance
Conifer plantation	30,091.93	TWA	Permanent change of habitat
Recently felled woodland (conifer plantation) including artificial surfaces	53,860.57	TWA	Temporary disturbance
	4,000	SC4	Temporary disturbance
Buildings and artificial surface	10,000	SC5	Short term disturbance

12.4.3.2 Fauna (Non-Avian)

Wildlife along the proposed pipeline route is expected to be affected by disturbance during the construction of the proposed development across the existing open countryside and within Sruwaddacon Bay. Temporary loss of foraging areas and breeding habitat may temporarily displace certain species. Mitigation measures are recommended to ameliorate these impacts. Potential impact levels are summarised below.

Habitat Loss, Fragmentation and Disturbance

Along the proposed route, the affected habitats may be considered within the context of the principal habitat types referred to earlier.

- Intertidal sands, mudflats and salt marsh provide foraging habitat for otters, foxes, and avian species. Foraging of some species will be affected in the vicinity of construction. Salt marsh also serves as a wildlife corridor for the movement of mammals along the shore. Construction impacts are expected to be localised, temporary, slight to moderate depending upon the species.

- No significant impacts are expected on the fauna of the dune system and associated habitats at Gleann an Ghad (Glengad). Foraging of some species will be affected in the immediate vicinity of construction works. This will result in potentially temporary, localised, slight impacts during construction.

- Loss of habitats and associated disturbance within the agricultural grassland areas are expected to have a temporary / short term, localised imperceptible or slight impact. There will be impacts on common and ubiquitous species. There will also be loss of foraging habitat for species such as badgers, and other common species. These agricultural habitats are common in the area, and there are expected to be Imperceptible to Slight Negative impacts on fauna.

- Loss of scrub and earthen bank boundaries will affect both birds and mammals as a result of some loss of foraging habitat and also through loss of commuting routes. During construction these are expected to be localised, temporary and slight.

- The coniferous plantations provide limited foraging and breeding habitat for a number of mammalian and avian species. Foraging of some species will be affected in the vicinity of pipeline construction. During construction these are expected to be localised, temporary and slight.

- Blanket bog habitats provide breeding habitat for amphibian species and foraging habitat for some mammalian and avian species. During construction impacts would be expected to be localised, temporary and slight.

Specific potential impacts on fauna include:

Common Species

There may be some mortality of small common species during construction. Protected species such as pygmy shrew and hedgehog may be directly impacted. There are limited ways to protect such species and they are common in Ireland. Potential impacts may be considered as imperceptible or neutral.

Many species will move away from the areas of disturbance, returning after habitat re-instatement to use the affected areas much as before. These species would include red deer, Irish hare, Pine marten, Irish stoat etc., as well as non-protected species such as fox.

Seals

See Chapter 14 for potential impacts on seals.

Badgers

Badgers are active on both sides of Sruwaddacon Bay, in particular the portion of the route between the Terminal site and the southern side of the bay.

The proposed development will entail minor loss of foraging habitat for this species for a short period only. Badgers may attempt to cross open pipeline trenches, especially in the area to the north of the Terminal. There are not however, expected to be any long-term significant impacts on badgers present in the general locality. Badgers are expected to persist in the locality in numbers as at present.

However, badgers are at some risk of falling into open trenches during construction.

Potential impacts on badgers during construction are therefore expected to be temporary and slight. Pre-construction surveys will be completed to check for any further badger setts that may be impacted on by the proposed development.

Otters

Short-term impacts on otters are to be expected. Otters use all of the Bay area as foraging habitat and there are numerous resting places along the shores of the Bay. One occasional holt is present in the Gleann an Ghad (Glengad) area - to the south west of the landfall.

The foraging range of individual otters will undoubtedly be affected to some extent during construction works. Machinery and disturbance could reduce otter access to some portions of their range, which may have implications for food availability for otters during this period – which may be more critical for female otters with young. Such impacts are expected to be Slight to Moderate.

Otters can be relatively tolerant of disturbance, but will undoubtedly be affected by the construction of the pipeline in the short term – mainly through localised disturbance. Otters occur on watercourses in urban areas and become tolerant of human activity. Given the nature of the development, it is considered that otter populations and their use of the Bay area will not be significantly affected in the long-term, provided that any holts with otters present are not directly impacted.

As with badgers, otters may attempt to cross open pipeline trenches. The Bay area is expected to return to its existing condition after works are completed and habitat reinstatement has restored the small area of affected shorelines and habitats to much as before. The food supply of otters is likely to return to existing conditions over a relatively short period of time.

Impacts on otters are expected to be temporary slight negative, to potentially moderate negative during construction.

Plate 12.6: One of many small caves used by otters as resting places (otter spraint at entrance)

Bats

Few bats were recorded in the study area.

Bat species within the survey area are not expected to be affected by either the construction phase or subsequent existence of the proposed pipeline across the existing landscape. Loss of vegetation and temporary loss of habitat during construction will not affect bat populations to any measurable extent. Construction works would have little or no impact on bat movements in the Bay area and will not affect foraging habitats for bats in the area to any measurable extent.

Potential impacts on bats during construction are expected to be temporary Neutral or Imperceptible Negative.

Amphibians and Reptiles

Frogs are present and common in some localities in the study area, notably in bog habitats at the south-east of the pipeline route. There are several, confirmed frog breeding sites as well as additional potential frog breeding sites. Some of these will be directly impacted by the development. Mitigation measures will be required in these areas to ameliorate impacts on amphibians. Potential impact levels on amphibians will be temporary and slight negative during construction.

Impacts on the common lizard may be temporary and slight and some mortality may occur during construction works.

Potential Impacts on Wildlife in Surrounding Areas

The proposed development is expected to have an imperceptible impact on the wildlife in surrounding areas. The pipeline temporary working area is narrow and impacts will be limited to those addressed above. There is no indication that impacts on fauna will extend beyond the vicinity of the pipeline and the Bay area. Impacts would not be expected to be of any higher magnitude than those discussed above.

12.4.3.3 Birds

It should be noted that, when assessing impact levels on qualifying bird species and species of special conservation interest for the cSAC and pSPA, the impact magnitude on a designated site of international importance and the species of importance to that site cannot be given a value lower than Moderate when following discipline-specific guidelines (i.e. EcIA guidance, NRA and IEEM), even though the likelihood for disturbance may be extremely low, and the potential impact of a highly localised and temporary - even transient nature. (See Appendix J 1, Table 7). Under the EPA generic impact assessment guidelines however, such an impact would be classified as imperceptible or slight.

Potential impacts on birds include habitat loss or degradation; and disturbance as result of the presence, movement and noise generated by personnel and machinery associated with the construction works.

It must be noted that, with the exception of site compounds, the temporary working area in terrestrial habitats is narrow and the nature of pipeline construction, with habitat reinstatement, ensures that the impacts will be highly localised both spatially and temporally.

The proposed segment-lined tunnelling method of construction under the Bay will avoid disruption to the important estuarine habitats for birds.

Potential impacts on birds fall into several categories; they are discussed in more detail in Appendix J(1), and include:

- **Habitat loss and degradation**
    - Terrestrial bird habitats

There is the potential for the construction of the pipeline onshore to disturb and degrade habitats for birds, either temporarily or in the longer term. On land the pipe-laying will involve earthworks and this involves a risk of habitat damage and wider impacts such as those caused by run-off, hydrological changes and pollution of surface or ground water. Any habitat changes leading to a loss or deterioration of nesting and/or feeding habitat will result in a temporary (short term in the case of SC3), slight negative impact.

- Estuarine and intertidal habitats

  The habitats of greatest importance traversed by the pipeline route are within the Natura 2000 designated intertidal areas of Sruwaddacon Bay. The potential impacts on intertidal habitats of an emergency intervention pit, if required in a worst case scenario, are described in Chapter 14.

  The construction, operation and decommissioning of such a pit would, depending upon its location, have the potential to cause loss of / disturbance to food sources for aquatic birds; contamination of estuarine waters / sediments (see Chapter 14); disturbance to sedimentation patterns; and potential for disturbance and/or displacement, habitat degradation; and local disturbance to feeding or roosting birds in the immediate vicinity of the pit. In a worst case scenario, if an intervention pit were to be required, the potential impacts on birds, might be expected to be temporary, slight/moderate (depending upon location) and localised.

- **Disturbance** – lighting, construction noise and vibration
  - Light – the impact of artificial light during the construction process has the potential to impact upon the movement, distribution, and activity of birds. The potential impacts are anticipated as being temporary to short term (in the case of SC3), localised slight to moderate negative impact.
  - Noise – the construction noise associated with the various compounds along the onshore pipeline route also has the potential to negatively impact upon the bird community locally. The potential impacts are anticipated as being temporary to short term (e.g. in the case of SC3), localised, moderate negative.
  - Noise and vibration from the tunnelling operation: this is described in more detail in Appendix J1. In summary, given the low level of the worst case scenario for vibration caused by the TBM, the potential for disturbance of birds or their benthic prey would appear to be highly localised (spatially and temporally) in extent, and moderate negative at most. If there were to be perceptible impacts associated with the passage of the TBM under any area of the Bay the chances of the potential impacts on birds or their prey are unlikely to be anything other than highly localised and temporary. Impacts on benthic fauna are discussed in Chapter 14.
- **Indirect sources of disturbance** – There are potential interactions between the disturbance factors above and there are a number of additional potential impacts which may also impact upon the birds in the area. These include the movement of people and vehicles – traffic and construction activities. Increased collision risk from light arrays, fences, cranes etc. Such impacts would be expected to be temporary, slight to moderate and highly localised.

Potential impacts on the qualifying species and species of special conservation interest for the pSPA and cSAC considered in further detail in Appendix J(1).

Landfall Valve Installation (LVI)

During construction, there will be temporary loss of habitat in areas adjacent to the landfall valve installation, including the side slopes and site compound SC1. In addition, there will be permanent loss of habitat at the small footprint of the landfall valve installation (approximately 20m x 22m), and along the access road (2190m^2).

These works will all be located in areas of improved agricultural grassland of low ecological value, though much of this area is currently bare soil - having been reinstated in 2009.

An excavation will be necessary in the reinstated cliff to enable construction of the drainage outfall. Construction impacts are expected to be localised, direct, moderate, and temporary in all but the footprint area of the LVI and the access road where it will be permanent.

The landfall valve installation is located immediately to the south of an active Sand Martin colony (Colony A) at Gleann an Ghad (Glengad) and within 200m of another, smaller Sand Martin colony (Colony B). Studies since 2002 have shown that the birds return each year and use the same burrows for breeding. They usually arrive in late April/early May and depart in September. The LVI is not expected to impact on Sand Martin feeding behaviour as they forage over a wide area in the locality.

It should be noted that construction activities on the cliff and causeway in 2002, 2008, and 2009 did not appear to interfere with the Sand Martins and they appeared to feed (on the wing) normally and undisturbed, and bred successfully. At that time a foreshore exclusion zone was also set up such that no personnel or vehicles were allowed on the foreshore below the colony. (See Mitigation measures).

Potential impacts associated with disturbance by human presence might be expected, however Sand Martins are a species which is extremely tolerant of noisy activities and is known to nest in noisy sand quarries. Impacts on the Sand Martin colony are therefore expected to be temporary Imperceptible to Slight Negative and Neutral in the long term.

12.4.3.4 Other Potential Impacts

No impact on habitats within designated conservation sites outside the immediate area of construction activities is anticipated.

No impacts are anticipated as a result of local road maintenance.
Potential impacts resulting from the spread of invasive species are discussed in Appendix J(1).

Plate 12.7: Young Sand Martins in burrow at Gleann an Ghad (Glengad) from (Arnold, 2005)

12.4.4 Operational Phase

12.4.4.1 Pipeline Wayleave

No impacts are anticipated during the operational phase in connection with the onshore pipeline.

After construction and reinstatement the level of 'traffic' at the wayleave will be restricted to occasional routine walkover inspections. These would not be expected to have any significant impacts on habitats present or local wildlife.

12.4.4.2 Landfall Valve Installation (LVI)

There will be a small permanent loss of habitat at the footprint of the landfall valve installation (approximately 20m x 22m) and along the access road. This will be located in an area of improved agricultural grassland of low ecological value. Impacts are expected to be long term, localised, direct, and moderate.

Normal operation of the LVI will not have any impact upon wildlife using the area, including the occasional otter holt and the Sand Martin colony close by. The facility will not require illumination during night-time.

Regular monitoring checks at the LVI will involve one or two individuals with a small vehicle or jeep and are not expected to impact on species using the site any more than current agricultural activities impact on the area.

If works or servicing is required at the LVI at any stage, then this may temporarily disturb faunal species for the duration of the work, but no lasting impact is expected.

12.5 MITIGATION MEASURES

The following sections provide summary details on the mitigation measures proposed to ameliorate against those potential impacts outlined in Section 12.4. A full description of the proposed mitigation measures are provided in Appendix J(1).

12.5.1 Habitats and Vegetation

12.5.1.1 Habitat Protection and Reinstatement

Improved agricultural grassland and wet, rushy improved grassland (including cSAC Habitats at Gleann an Ghad (Glengad))

Fencing will be put in place to protect the Annex 1 dune grassland located north of the proposed pipeline route (see Section 12.3). The topsoil removed will be carefully stored (separately from the sub-soil).

Whilst the fields have been agriculturally improved some are nevertheless within the SAC and in order to prevent the pollution of the native gene pool by alien genotypes no imported seeds will be used. There is a sufficient seed bank within the top soil and it will be allowed to re-vegetate naturally as previously. Surface drainage will be put in place at the time of reinstatement to prevent water logging where appropriate.

Blanket Bog Habitats (Undesignated)

Recovering Eroded Blanket Bog (undesignated)

The 190m section of undesignated recovering eroded blanket bog (PB5/PB3) at na hEachú (Aghoos) will be treated as though it were designated. (See Chapter 5 for full details of proposed construction methodologies and Chapter 15 Peatland Hydrology and Appendix M). The following measures will apply:

- The top vegetated sod (i.e. living layer of the bog) will be excavated to a depth of at least 50 cm, thus allowing for full protection of the roots. This layer should be kept viable by irrigation if necessary because blanket peat is prone to shrinkage and drying. The longer the period of storage (i.e. time between excavation and reinstatement), the higher the likelihood of damage and less successful reinstatement.

- The turves (vegetated sod-peat) will be stored separately from the amorphous humified peat and in a single layer.
- There will be provision for the continual monitoring of turve storage during construction.
- There will be minimal delay between construction and reinstatement of this route section and every effort will be made to minimise the length of time.
- The replacement of turves (vegetated sod-peat) is the final stage of construction. They will be packed firmly over a regulation layer of peat. Any gaps will be as small as possible and hand packed with peat scraw as the process is being done.
- Peat plugs will be placed at intervals within the stone road and in the trench to prevent the pipeline acting as a large field drain and having adverse effects on the hydrology of the bog (see Chapter 15)
- Where the stone road is installed, enough peat will be left in place over the mineral layer into which the stone can be pressed thus reducing the potential for lateral and lengthways water flow (a measure requested by NPWS for the Bord Gáis Mayo to Galway gas pipeline construction in blanket peat at Upper Glencullin in 2006.
- Measures to avoid compaction:
  - Reduce vehicle movement to a minimum
  - Low ground pressure vehicles will be used when setting out the site prior to the haul road (floating or stone) being put in place.
  - Fencing will be put in place to prevent encroachment and damage to the bog outside the working width.
- To avoid chemical change, any imported stone will be sourced locally.
- Following reinstatement, a fence will be maintained to protect the reinstated section until there is strong vegetation growth and the turves have “knitted” together properly.
- A “no grazing” régime will be in place over the initial post-reinstatement period and for a minimum period of three years thereafter.
- Post construction monitoring will be carried under the post construction monitoring programme for as long as deemed necessary by the project ecologist, in consultation with other peatland experts. The duration of monitoring will ultimately depend upon the speed of reinstatement.

As a result of experience on the Bord Gáis Mayo to Galway gas pipeline at Upper Glencullin, the following are known to be key to successful reinstatement:

- Utmost care will be taken to ensure that turving is done slowly in order to maintain the integrity of the turves, as far as is practically possible. If due care is exercised at the turving stage, then there is greater potential for a good reinstatement.
- Storage, care and meticulous reinstatement of turves is key to the success or otherwise of habitat recovery.
- Measures to restore natural drainage and surface water flows will be implemented. (See Chapter 15 and Appendix M).

Anderson (2003[2]) notes that sand mixed with peat is sometimes packed between turves in order to promote plant growth between the turves. However, from experience at Upper Glencullin it would appear that where mineral "soil" from broken rock exists, then *Juncus effusus* will take hold (increasingly so in 2008 at the eastern upper end of Glencullin where there were no turves for reinstatement). The introduction of sand into any gaps is not therefore recommended.

Depth of Turves

The depth of turves lifted at Upper Glencullin, and proposed for this section of the Corrib onshore pipeline, is in line with practice elsewhere (Anderson, 2003) where depths vary from 4-5cms (i.e. seed bank layer only on poor heath) to 100cm. on rich organic soils. Anderson reports on turves in peat habitats (heaths and moors) being generally in the order of 15 to 25 cm. and she notes that in a wetland situation (sedges and rushes) the turf depth was between 50 and 80cms, depending upon rooting depth. The deeper the turves, the greater likelihood of vegetation recovery, especially in a blanket bog situation where water retention is vital.

Eroded and Cutover Blanket Bog (undesignated)

There is no requirement to lift turves in the heavily and severely eroded, or cutover areas; nor would it be feasible because of the extremely uneven surface. However, in the interest of local biodiversity, the aim in reinstatement is to maintain an undulating profile to provide varying micro-habitats for colonising plant species.

Outline details for habitat reinstatement and vegetation restoration are given in Appendix J(1).

Salt Marsh

The following measures will be implemented at the crossing of the Leenamore River inlet.

Turves will be taken and stored carefully in a single layer either on bog mats or at the edge of the shoreline. They will be protected and, if stored on bog mats, will be watered regularly with sea water. The salt marsh will be reinstated by carefully replacing the turves evenly.

At the eastern end of the bay where the peat bank/salt marsh interface is steep, it will be re-profiled.

Intertidal Habitats (refer to Figure 12.2)

Protection of the algal, shingle and gravel beds

In the unlikely event that an intervention pit is required in the intertidal zone at the western end of the Bay, measures will be implemented to protect the intertidal areas to the north of the route at the western side of the estuary - i.e. south - east of the dune system at Gleann an Ghad (Glengad). This area is an occasional feeding ground for waders and is used as an occasional roost by over-wintering Light-bellied Brent Geese, particularly in strong westerly gales. These measures include: a commitment to avoid this area as far as possible; but if it has to be disturbed then it will be reinstated and re-profiled using the stored shingle/gravel. All works will be agreed with the environmental officer and Project Ecologist in consultation with NPWS.

Protection of the developing new salt marsh (approximately north of chainage 84.00)

Sediment accretion is resulting in the development of a new salt marsh and embryonic sand dunes (Habitat mapping, Notes 7 and 8), both Annex habitats under the EU habitats Directive, at the eastern side of the Gleann an Ghad (Glengad) dune system north of the proposed route. In the unlikely event that an intervention pit is required at the western end of the Bay no vehicular movements in the intertidal zones outside the working width will be permitted.

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[2] Anderson, P. 2003 *Habitat translocation – a best practice guide*. CIRIA for the Highways Agency London; and Anderson, P. 2003 *A review of habitat translocation* CIRIA

Please see Chapter 14 for intertidal habitats at the Leenamore River inlet crossing.

Sod (Earthen Bank) Boundaries

Earthen (sod) banks, will be carefully dismantled with the surface sods being stored separately and fully reinstated manually post construction. Those earthen (sod) banks which do not require to be dismantled within the temporary working area will be fenced off to protect them from construction traffic.

Post construction monitoring will be undertaken as part of the ecological monitoring programme to monitor the recovery of the reinstated sod banks. The duration of monitoring will depend upon the speed of their recovery.

Scrub

As a biodiversity enhancement measure it is proposed to plant native scrub species at na hEachú (Aghoos) in order to increase habitat and species diversity. In due course such planting will provide faunal refuge and food (insects) for bird and non-avian faunal species. Species which would be appropriate, and have been recorded in the wider area on peaty substrates include: *Salix aurita* (Eared willow); *Salix caprea* (Goat Willow) and *Salix cinerea subsp.* oleifolia (Grey willow).

The native gorse species on site is *Ulex europeaus* (European Gorse) and is recommended for planting in places, for example at road margins. This species had been present on road margins in the areas prior to recent road widening.

Further details are given in Chapter 10, Landscape and Visual Assessment.

Conifer Plantations

Where feasible native willow species will be planted at the edges of the wayleave through areas of coniferous plantation. It is noted that no tree or scrub planting is possible in the 14m wide wayleave over the pipeline itself.

Construction Areas and Protection of Habitats

No works will be undertaken outside of the temporary working area shown on Figure 5.2 without prior consultation with the Project Ecologist.

Road Maintenance Works

Should any road maintenance works be required, road margins will be inspected prior to maintenance works commencing in order to target appropriate mitigation measures if necessary.

Invasive Plant Species

In the event that invasive plant species (e.g. *Rhododendron ponticum)* are found to be present within the reinstated area then necessary measures will be taken to remove them, in accordance with accepted best practice appropriate to the habitat on which they are present. If such species are found to occur within the working area prior to construction, they will be removed and destroyed in accordance with accepted best practice for the particular species involved.

12.5.2 Non-Avian Fauna

Standard mitigation measures (as set out below), as would apply to any large-scale development, will be adopted in the construction of the proposed development. These include limiting season of disturbance to trees and vegetation (see also under birds below) and in order to reduce impacts on breeding species, to provide for habitat replacement, and measures to reduce pollution and sedimentation into water bodies and watercourses during the construction phase.

Best practice will be adhered to throughout. Specific measures are required, principally to protect otters, badgers and frogs on site. They also include provision for pre-construction surveys and monitoring, during and post-construction. A full description of proposed mitigation is set out in Appendix J(1), including Tables 10a and 10b.

Badger and Otter

Some mitigation measures are common to both badger and otter so are considered jointly below. Species-specific measures are shown accordingly:

- A pre-construction survey within the temporary working area and including an area, to approximately: 50 - 100m either side of the centre line for otters; and 30m either side of the centre line for badger, will be undertaken within 1-3 months prior to construction. (The optimal survey period is from December to April).

- Areas of dense vegetation affected by the development which could not be thoroughly searched will require monitoring by appropriate experts during vegetation clearance. These include the route sections in coniferous plantations south of the Bay, and dense gorse scrub near the Leenamore River inlet

- The appropriate season for checks on holts for breeding activity would be from April through to September/October. Any holts/setts identified in the pre-construction survey to be directly impacted will require evacuation/removal by zoological experts under licence from NPWS prior to construction taking place - for humanitarian consideration.

- Construction works in close proximity of active setts/holts or principal otter foraging areas will be limited to daylight hours where feasible.

- During construction, open trenches will provide ramps for otters and badgers and other wildlife to escape.

- At known otter or badger crossing points, gaps will be left at the base of any fencing to allow access for wildlife species across the pipeline route.

- The tunnelling site works compounds (S2 and S3) should be fenced with fully wildlife proofed fencing so as to prevent larger mammals from entering these compounds and then not able to exit.

- Fencing along the access road at Gleann an Ghad (Glengad), and around the LVI works compound should be provided with mammal gates at intervals.

- Visual screening of works close to holts or principal areas of otter activity may be considered appropriate during the works.

Bats

Pre-construction surveys will include inspection of the route for potential bat roosts such as any mature trees along or close to the route.

Frogs

Amphibians present within all of the affected portions of the route will be removed prior to construction proceeding and placed into alternative suitable habitats in the locality (under appropriate licence from NPWS). Where practical in the context of construction, water levels will be maintained in the drains (used by frogs). Habitat reinstatement will re-create the former channel and drain systems so that frogs may use these post-construction. Where feasible, artificial breeding pools will be created within unaffected portions of wetland habitats adjacent to the route where practical

Other Species

There are no specific mitigation measures recommended for other faunal species.

12.5.3 Birds

Potential impacts of the pipeline project on the local birds can be minimised by implementing the following mitigation measures.

- Acoustic screening barriers will be installed on the boundary of the site compounds at na hEachú (Aghoos) and Gleann an Ghad (Glengad). Noise monitoring will be carried out throughout the construction process and take into account the bird usage areas as sensitive noise receptors. Noise contours are shown in Appendix 17, Figures 17.1 and 17.2.

- Lighting in site compounds will be directed downwards and be designed to minimise light leakage outside the working area. Lighting will be designed in such a manner that only areas crucial for works and security purposes will be lit. At SC3 the light level reaching the foreshore will be no more than the light intensity of the order of a full moon (0.3lux). The finish of all structures and materials will be designed to minimise reflected glare. Large structures and uprights will have green lighting designed to minimise impact on birds while reducing collision risk with these structures. See Appendix 17.3 for light contours and Chapter 10 for details of the lighting design proposals for SC3.

- The acoustic screening barriers at na hEachú (Aghoos) and Gleann an Ghad (Glengad) will also provide additional mitigation against light spillage outside the compound.

- Intensive bird monitoring will be continued throughout the construction period and regular reports will be submitted to NPWS detailing the bird community present and contrasting findings with recent pre-construction survey results. In addition, the feasibility of monitoring nocturnal bird distribution and abundance during the period of tunnelling operations, and while the Aghoos compound (SC3) is in place, will be investigated.

- Good working practices will prevail throughout construction and post construction monitoring of the route. For example, machinery, equipment, fuel and other materials associated with the development will be stored appropriately (e.g. bunded fuel tanks).

- Litter and other waste material will also be stored and disposed of appropriately. This will minimise the potential risk of damage or pollution to birds and their habitats.

- Any environmentally hazardous material used during construction works will be carefully stored. An environmental management plan will be fully implemented that applies best practice on minimising the risk of pollution of soils, surface or ground-waters.

- The tunnel arisings will only be spread or stored in areas where there will be no degradation of existing habitats for birds. In the event of surplus excavate, the feasibility of constructing a suitable sand-bank for nesting Sand Martin at a suitable location in the locality will be explored.

- The greatest numbers and diversity of species of elevated conservation importance occur in the vicinity of the development from October to April. Therefore in the unlikely event that an intervention pit is required within the Bay during this time, detailed method statements will be prepared, which will outline measures to avoid and minimise the potential impact on birds. Pre -construction monitoring will be undertaken immediately prior to works to inform these method statements. Such works will only be undertaken with prior agreement with NPWS.

- Where feasible, vegetation clearance will be undertaken outside the breeding bird season which extends approximately from March to August inclusive.

- Measures for the protection of the Sand Martin colony are described below in connection with construction of the landfall valve installation.

- Where feasible, the construction activity and movement of vehicles in the vicinity of the compounds will be minimised during night-time hours. Construction of the compounds, until the acoustic screening is in place will take place during daylight hours only.

- The settlement ponds at na hEachú (Aghoos) will be covered by wire or plastic mesh of small enough mesh size to prevent access to birds.

- A walkover of the on-land portions of the route will be undertaken prior to construction in order to survey the birds. This will ensure that any site specific issues in relation to avifauna will be highlighted before construction. It will also allow tailored mitigation measures to be undertaken in light of any new issues which may have arisen in the interim. This walkover will be undertaken by a suitably qualified expert. Following the field visit, and prior to construction, the grassland areas in the temporary working area will be mown, if deemed appropriate, in order to discourage ground nesting birds from attempting to breed on the temporary working area.

- In order to minimise the impact of habitat loss and deterioration on the local birds, appropriate habitat reinstatement (re-vegetation and planting of native scrub species) will be undertaken as part of the development. The need and design of such a programme will be assessed by a suitably qualified expert in consultation with the project ecologist.

During and post construction monitoring will be conducted in accordance with the monitoring programme to be drawn up by the project ecologist in consultation with NPWS and will include a biennial survey of the temporary working area and surrounding habitats to assess the bird population.

12.5.4 Landfall Valve Installation

12.5.4.1 Protection of the Sand Martin Colony

The following mitigation measures will be implemented:

- An exclusion zone will be defined above and behind the colony such that no construction activities affect the existing burrows or threaten the stability of the cliff in which the burrow are situated.

- No personnel, traffic and construction activities will be permitted between the LVI footprint boundary and the cliff-top directly above the colony.

- Protection fencing will be in place before any work commences.

- A wide foreshore exclusion zone will be set out to prevent any activity on the foreshore below and in front of the burrows which may deter normal behaviour and could result in lowered breeding success.

- Any stock-piled soil will be netted to prevent birds from making nest burrows therein.

- The width of exclusion zones will be decided in consultation with NPWS.

12.5.4.2 Landscaping and Re-vegetation

The following measures are proposed and will be incorporated into the method statements for reinstatement (see Chapter 5):

- The topsoil removed from the footprint will be carefully stored (separately from the sub-soil). These soil heaps will be covered with netting to prevent sand martins from making burrows in them.

- Following construction this topsoil will then be used on the slopes of the facility, which will then be left to revegetate naturally. It is proposed therefore that no seed or topsoil will be imported into the cSAC in order to prevent the introduction of non-native genotypes which could result in the genetic pollution of the local plant populations, also to protect against the introduction of pest species.

- To aid topsoil stability and grass growth, a geotextile membrane will be laid on the slopes of the facility.

12.5.5 Monitoring

A monitoring programme will be devised by the project ecologist in consultation with NPWS to address all issues associated with habitats and species. This will include pre-construction, during construction and post construction monitoring. The contractor will be made aware of the programme and schedule for mitigation.

Where sensitive and / or designated habitats have been reinstated, monitoring will be necessary. The intervals and duration of monitoring will be agreed in consultation with NPWS. Route sections which require habitat monitoring post construction include:

- The landfall, LVI and tunnelling compound areas at Gleann an Ghad (Glengad).

- Other cSAC sections of the route at Gleann an Ghad (Glengad); and the nearby sand dune system Annex I habitats which lie outside the working area; including the developing salt marsh and embryonic dunes.

- The shore lines, salt marsh and intertidal zones at, and in the vicinity of, the Leenamore inlet.

- Non-designated blanket bog habitats at na hEachú (Aghoos).

- Areas of biodiversity enhancement at na hEachú (Aghoos).

The purpose of monitoring is to assess the recovery of the habitat after reinstatement. It is particularly important in the early stages post reinstatement so that, in the event that habitat recovery is not progressing as expected, early indicators can be picked up and remedial action taken.

The extent and details of the faunal (avian and non-avian) monitoring will be included in the monitoring programme to be drawn up by the project ecologist in consultation with NPWS.

Monitoring recommendations in relation to non - avian fauna are summarised in Tables 11a and 11b of Appendix J(1). Requirements for bird monitoring are summarised in Section 12.5.3 above.

The purpose of the post-construction monitoring for fauna is to assess the activity of vertebrates of conservation interest in relation to the base-line (and pre-construction) surveys, to report on possible negative or positive impacts, and to recommend additional mitigation or ameliorative measures that would restore or enhance the habitat quality for these species within the area of the development site.

The Project Ecologist will be advised of any changes in construction schedule or methodology that might affect proposed mitigation and the monitoring programme.

12.5.6 Fencing

Method statements will be set out for fencing in sensitive habitats and where species mitigation measures are required. Fencing will be carried out in accordance with mitigation set out for habitats and species. Fencing will not proceed until pre-construction mitigation measures are in place where required.

12.5.7 Method Statements

Method statements for construction will include details of mitigation and reinstatement in relation to sensitive habitats and protected species. They will be drawn up in consultation with NPWS through the Project Ecologist.

12.6 RESIDUAL IMPACTS

Residual impacts are summarised in sections 12.7.1 – 12.7.4 and in Table 9 in Appendix J(1). The terminology for impact duration is in accordance with the EPA Guidelines (2003). Long term significant impacts are not expected because of the nature of pipeline construction and the fact that, with the exception of the landfall valve installation footprint, habitats can be reinstated.

12.6.1 Habitats

Landfall and Gleann an Ghad (Glengad) (Improved agricultural grassland and wet, rushy improved grassland).

Predicted impacts are expected to be slight in the short term and neutral in the long term. The landfall valve installation (LVI) is considered separately below at 12.7.4 below.

Blanket Bog Habitats at na hEachú (Aghoos) (Undesignated)

Blanket bog habitats are expected to take longer than others to recover, so a short to medium term, moderate impact magnitude is expected. However, from experience with intact cSAC blanket bog reinstatement using turves and subsequent post construction monitoring on the Bord Gáis Mayo to Galway Gas Pipeline, given careful reinstatement and the application of best practice throughout the construction phase, it is considered that blanket bog vegetation should recover after a few years; possibly in the short term rather than medium term.

With successful reinstatement the impacts are predicted to be slight to moderate in the medium term, reducing to neutral or imperceptible in the long term.

In the eroded and cutover areas, where the vegetation layer will not be removed as turves, restoration of vegetation cover might be expected to take longer than in the turved areas. With successful management of vegetation restoration, the impacts are predicted to be moderate in the short term, reducing to imperceptible in the long term.

Salt Marsh

With successful reinstatement the impact level is expected to be slight to moderate in the short term, and becoming neutral or imperceptible in the long term.

Intertidal Habitats

Residual impacts on intertidal habitats, other than salt marsh, at the Leenamore River inlet are described in Chapter 14.

Residual impacts resulting from the requirement for a temporary intervention pit are described in Chapter 14.

Sod (Earthen) Bank Boundaries

Careful dismantling and reinstatement should result in the impact on sod banks being slight in the short term and neutral in the long term.

Scrub (Gorse)

With some habitat restoration the impact on scrub is expected to be moderate in the short term and neutral to slight in the long term. The planting of native scrub, including gorse will result in an overall neutral, or slight positive, impact in the long term.

Conifer Plantations

The duration of this impact will be permanent where trees are required to be felled and no re-planting permitted over the centreline of the pipeline. However this must be put in the context of local forest management which has seen extensive clear-felling of large areas of mature conifer plantation in recent years. By its nature it is a transient man-made habitat. The clearance of trees for the pipeline development is viewed as an extension of the forest management in the area, as the mature trees would be due for felling in rotation.

The planting of native scrub species such as willow, and gorse as referred to above, will compensate for the loss of tree cover to some extent, and should offset the loss of habitat by increasing local biodiversity, resulting in a neutral, possibly slight positive, impact in the long term.

12.6.2 Non- avian Fauna

The proposed development will incur short-term impacts on various faunal species. Most of these can be considered as neutral, imperceptible or slight negative. Impacts on otters in the bay area in the short term are likely to be localised, moderate. The overall impacts of the proposed pipeline scheme on the fauna in the locality may be considered as neutral in the medium to long-term. There are not expected to be any long-term significant impacts on species of conservation interest present on site such as otters, badgers, bats, frogs etc. provided that mitigation measures are implemented as recommended.

Given best practice design and operation of the proposed development, without pollution incidents, with recommendations included within this EIS incorporated, and with accompanying mitigation and remedial measures included, the residual impact of the development on fauna are expected to be neutral or imperceptible.

If habitat enhancement, such as artificial ponds, can be provided at na hEachú (Aghoos) as part of the reinstatement programme to create suitable habitat for frogs and smooth newts (which might be present in the general locality), this would result in neutral, or potentially slight positive in the long term.

12.6.3 Birds

For birds, post construction, with the successful implementation of mitigating measures, the residual impacts are expected to be generally neutral.

Habitat reinstatement and enhancement would potentially lead to an increase in the quality of certain terrestrial habitats as a resource for nesting and feeding birds in the medium term, resulting in a possible slight, positive residual impact.

Overall, given the narrow width of the working area, the proposed mitigation measures and the availability of similar habitats to those that will be directly affected, it is unlikely that there will be any significant effects on the wider local avian community.

Overall the potential residual impacts on birds would be slight or imperceptible in the short term, neutral in the long term. There would be no long terms impacts on the wider local avian community.

12.6.4 Landfall Valve Installation (LVI)

The construction of the LVI will result in loss of habitat on the footprint of the facility and the access road for the duration of the operational phase. Prior to landfall construction works, the habitat present was improved agricultural grassland of low ecological value - a commonly occurring habitat both adjacent to the working area and in the wider locality. Although there will be slight loss of foraging habitat for birds and small mammals, it is expected that in the long term - with likely further agricultural improvement in the locality - the residual impact will be slight.

In addition, the provision for naturally regenerated grassland areas on the slopes of the facility and on level areas will compensate to some extent, for the loss of the pre-existing grassland. The residual impact in vegetation and faunal terms and also in the context of the present function of this area as a buffer zone within the cSAC, is expected to be slight.

In the short term impact level is expected to be moderate for the footprint of the LVI, but imperceptible to slight for other areas associated with the LVI. Long term impacts are expected to be slight to moderate (LVI footprint) and imperceptible to slight for reinstated areas.

13 FRESHWATER ECOLOGY

13.1 INTRODUCTION

This chapter summarises the freshwater ecological impact assessment carried out for the proposed development by Aquatic Services Unit (ASU). The scope of the study included a desk and field based assessment of the freshwater habitats and associated species, both freshwater and migratory, such as Atlantic salmon and lamprey species.

The key areas of potential impact of the proposed development on freshwater resources relate to the construction and commissioning phases, as no impacts will arise once in operation. Consultation was also undertaken with relevant bodies/individuals.

This assessment describes the existing freshwater environment, the methodology used for assessment, potential and residual impacts identified and makes recommendations for mitigation measures to avoid/minimise these impacts.

The full report (including bibliography) on the Freshwater Ecology Assessment is presented in Appendix K. Details on designated conservation sites and the legislative context are provided in the Preface to Section C of the EIS.

13.2 METHODOLOGY

The methodology employed for this freshwater ecological assessment comprised the following elements;

- A desk study which examined all available data and reports on freshwater resources along the proposed route of the pipeline, including examination of the occurrence of legally protected Habitats Directive, Annex II freshwater species[1].
- Consultation with the following:
  - The North Western Regional Fisheries Board (NWRFB);
  - The Marine Institute;
  - The Central Fisheries Board (CFB);
  - National Parks and Wildlife Service (NPWS);
  - Salmon Research Agency; and
  - Local Angling/Fisheries organisations.
- A field study of rivers and streams along the proposed route in early September 2007 and in January 2008, September 2008 and November 2008.

13.2.1 Field Study

Points at which the proposed pipeline would have the potential to cause impacts on rivers and streams were identified using the 1:50,000 Discovery Series Ordnance Survey Maps No. 22 and 23 and using aerial photography of the Study Area (2008).

[1] Protected under the EU Habitats Directive and include Atlantic Salmon (*Salmo salar*); Freshwater Pearl Mussel (*Margaratifera margaratifera*); White-clawed crayfish (*Austropotamobius pallipes*) and Lampreys (3 species).

The proposed pipeline crosses a total of three streams / rivers (Sites 3, 4 and 5) and is tunnelled for 4.6km underneath Sruwaddacon Bay (Site 2) as outlined in Table 13.1 and illustrated on Figure 13.1. In addition, a stream (Site 1) located east of the landfall at Gleann an Ghad (Glengad) was sampled and assessed, as it lies within the temporary working area, although it is not anticipated that any works will occur in this area. These crossing points were chosen as the assessment/sampling locations for the field study.

Table 13.1 Location and description of watercourses traversed by crossings along the proposed route.

Crossing Point/ Sampling Site No.	Approximate Chainage	Location/Townland	Brief Description
1	84.05	Just east of the landfall at Barr na Coilleadh (Barnacuille)	A small first order[2] stream close to outer Sruwaddacon Bay. This stream will not be crossed by the pipeline.
2*	84.05.-88.65	Sruwaddacon Bay	Sruwaddacon Bay is the migratory route for salmon and seatrout in and out of the Glenamoy and Muingnabo Rivers.
3	89.25	Leenamore River	A small second order[3] stream draining to the southeast corner of Sruwaddacon Bay, known locally as the Leenamore.
4	90.15	Na hEachú (Aghoos)	A first order stream close to the roadside about 0.5km east of the most downstream crossing of the Leenamore River.
5	90.7	Na hEachú (Aghoos)	A small first order stream/drain ~0.7km north of the Bellanaboy Bridge Gas Terminal site.

* This Site is a marine site and is also addressed in Chapter 14.

The following assessments were carried out as part of the fieldwork for this assessment:

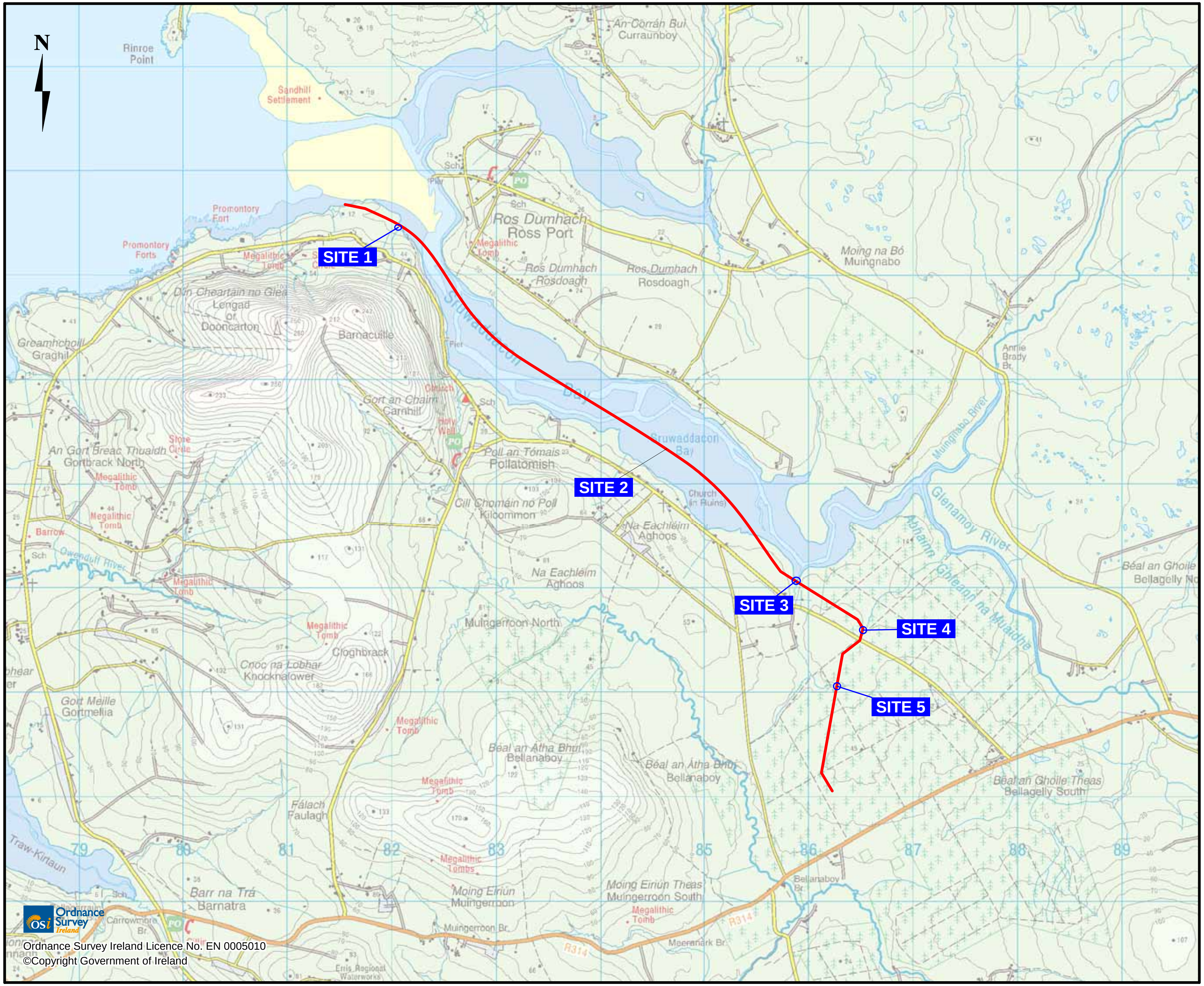
- **Habitat assessment:** The quality of the habitat was assessed with regard to its suitability as habitat for invertebrate and plant communities as well as for supporting fish population.

- **Water Quality Assessment:** Biological sampling was carried out to determine the water quality of the site and was classified in accordance with the EPA Biological River Classification System (Q-values).

- **Aquatic flora assessment:** Assessment of in-stream vegetation.

- **Assessment of fish stocks:** Fish stocks were not directly assessed (by electrofishing) on the small watercourses because they were too small to warrant it (i.e. Site 1, 4 and 5) and Site 3 is estuarine. In the latter case, an assessment relied on historical electrofishing data (Aquens 2002, 2003) and an assessment of habitats was used to determine the fisheries value of the sites.

[2] A first order stream is one at or close to the head of a catchment or sub-catchment which has not yet been joined by other tributaries.
[3] A second order stream is formed by the joining of two first-order streams



LEGEND:

Proposed Route

Watercourse crossings/ Freshwater ecology sampling sites

Figure 13.1

File Ref: COR25MDR0470Mi2123A03
Date: May 2010

CORRIB ONSHORE PIPELINE

13.3 EXISTING ENVIRONMENT

The study area for the proposed route is confined to Sruwaddacon Bay and the rivers and streams, which drain to the bay. The most prominent of these watercourses are the Glenamoy and Muingnabo Rivers, both of which enter the head of the bay. Sruwaddacon Bay and the lower sections of the Glenamoy and Muingnabo Rivers are all part of the Glenamoy Bog Complex Special Area of Conservation (see Preface to Section C of this EIS). Sites 1, 3, 4 and 5 are all of minor ecological importance within the wider study area, however, Sites 1 and 3 lie within the SAC. Site 2, which also lies within the SAC, is an important migratory route for Annex II species, Atlantic salmon in particular (see Preamble to Section C). The existing environment is described in more detail in the following sections in terms of the information retrieved from the desktop (including consultation) and field study.

13.3.1 Desktop Study

13.3.1.1 Protected Species

Just one Annex II species has been reported by the Central Fisheries Board (CFB) and Marine Institute from the general study area, namely Atlantic salmon (from the Glenamoy and Muingnabo Rivers). Of the other aquatic Annex II species, the brook lamprey (*Lampetra planeri*), which is non-migratory, is the only lamprey species to have been recorded with certainty in the wider study area i.e. in the Bellanaboy River (Poole *et al.*, 2005). However, there have been reports of unidentified lampreys in one of the small streams crossed by the route, namely the Leenamore River (Site 3) (Aquens, 2003) at a point about 200m upstream of the proposed crossing. This species is likely to be brook lamprey also but could possibly be river lamprey (*L. fluviatilis*) as they are very difficult to tell apart when immature. The CFB did not record any lamprey from their surveys undertaken in October 2006 near the confluence of the Muingnabo and Glenamoy Rivers in upper Sruwaddacon Bay.

The freshwater pearl mussel has not been recorded in the area (according to the national database for the species (pers. comm. Dr. Evelyn Moorkens) and were it to be present, it would tend to be confined to larger rivers and streams in deeper, silt-free waters, indicating that within the study area they would only be possible in the freshwater reaches of the Glenamoy and Muingnabo Rivers, i.e. they would not occur in any of the small streams traversed by the proposed route. Furthermore they do not occur in estuarine waters and so would not be present in Sruwaddacon Bay.

The white-clawed crayfish was not encountered during current or previous fieldwork in the study area and is almost certainly absent given the unsuitable soft-water, non-alkaline conditions. No sea lamprey (*Petromyzon marinus*) were found and none have been reported by the NPWS or the NWRFB or local anglers.

13.3.1.2 Water Quality

Biological water quality is monitored by the Environmental Protection Agency (EPA) and includes survey data for the Muingnabo and Glenamoy Rivers within the Study Area (Hydrometric Area 33) but not for minor streams, which will be crossed by the proposed route. Results available are summarised in Table 13.2. It is clear from the EPA data that despite some water quality impairment, these two rivers are eminently suitable for salmonids.

Table 13.2: Biological Water Quality Information reported by the EPA for the Muingnabo and Glenamoy Rivers.

GLENAMOY RIVER -EPA River Code	Location	1990	1994	1997	1999	2002	2005	2008
0020	Br. N Gleann Chalraí (Glencalry)	-	-	-	-	4-5	4	4-5
0050	Br. S.E. of Bun Alltaí (Bunalty)	4-5	3-4	4-5	4-5	4	4-5	4-5
0100	Glenamoy Bridge	4-5	3-4	4-5	4-5	4-5	4	4
MUINGNABO RIVER - EPA River Code	**Location**	**1990**	**1994**	**1997**	**1999**	**2002**	**2005**	**2008**
0100	S.W of Sraith an tSeagail (Srahataggle)	4-5	-	-	-	-	-	4
0140	0.6km u/s Annie Brady's Bridge	-	-	-	-	3-4	-	-
0150	0.3km u/s Annie Brady's Bridge	-	4	3-4	4	-	4	-

Note: Q5, 4-5, 4: Unpolluted Q3-4: Slightly polluted

In general, in the absence of point sources of pollution and intensive agriculture over most of the study area, it would be expected that most of the small watercourses within the study area would have satisfactory water quality, i.e. at worst slightly polluted (Q3-4), but generally better than this.

13.3.1.3 Fisheries Information

Glenamoy River

The Glenamoy River (Plate 13.1) is the most important river within the study area for both salmon and seatrout production and is the only river consistently fished with rod and line (pers. comm. NWRFB). In the Glenamoy River, spawning takes place outside of the study area from about 200m downstream of the Post Office at Gleann na Muaidhe (Glenamoy) Village all the way upstream, where there are extensive stretches of suitable habitat throughout the system, none of which will be impacted by the proposed development. Below Gleann na Muaidhe (Glenamoy) Village, the river mainly comprises holding and nursery areas for salmon and trout, the most important of which is located at the mouth of Sruwaddacon Bay in a deep bend in the river situated upstream of Rossport Pier and seaward of Pollatomish Pier. Elsewhere within Sruwaddacon Bay the channel is considered too shallow to hold many fish (pers. comm. NWRFB). In contrast to nearby Carrowmore Lake the Glenamoy River is a late river, with adult salmon concentrated here between the second week of June into September. This fishery normally didn't catch salmon until the second week in June even though the licence covered the period May 12th to July 31st. Since a ban was imposed on driftnetting on 1st January 2007, there are signs of more fish returning into the system in 2007 (pers comm., NWRFB). Two drift net licences, which operate at the mouth of Sruwaddacon Bay, have been suspended until further notice.

The fish counters installed by the NWRFB on the outfall from Carrowmore Lake indicate that the smolt[4] run (salmon and seatrout) is finished by the second week in May. Investigations undertaken in the Glenamoy River in spring 2009 showed that the peak smolt run occurred in mid to late April, while in 2010 no smolts had been recorded by the middle of the first week in May (pers comm. NWRFB). The later run in 2010 is thought to relate to the very cold weather in the first 2 months of 2010, which would have slowed the development of the smolts in combination with low water levels in the Glenamoy in April. The timing of seatrout returns is less well defined than that of the salmon but the peak of the seatrout run into Sruwaddacon Bay is roughly mid June to mid July and during this period Pollatomish Pier is a popular angling location, although they are fished from the shore in many places throughout the bay, where the channel is accessible (pers. comm. NWRFB).

[4] Smolts are juvenile salmon or seatrout, usually around 2 years old, which have altered physiologically while still in freshwater to allow them to migrate into saline waters.

The Glenamoy Community Angling Association, which has around 40 active members, controls angling on the Glenamoy River and the association also issues permits to visiting anglers.

Plate 13.1: Glenamoy River looking downstream from Glenamoy Bridge about 5km upstream Sruwaddacon Bay.

Muingnabo River

Limited electrofishing data is available for the Muingnabo River, but what is available indicates the presence of trout (pers. comm. Salmon Research Agency). Despite the likelihood of suitable spawning areas for salmon and trout based on the rivers hydromorphology, it is clear from discussions with the NWRFB that this river is more important for trout and seatrout than salmon. Some limited angling is believed to take place in the lower reaches (pers comm. NWRFB), just upstream and downstream of Annie Brady's Bridge (Plate 13.2). Up until a few years ago, poaching nets were regularly taken from the river indicating its reasonable productivity.

Plate 13.2: Muingnabo River looking downstream from Annie Brady's Bridge and about 3km upstream of Sruwaddacon Bay.

13.3.2 Field Study

A summary of the results of the field assessment is presented in Table 13.3. The results are presented in full in Appendix K.

Table 13.3: Summary of the results yielded from the field study of watercourses traversed by the proposed route.

Crossing / Sampling Site (Irish National Grid Reference)	Q-Value Rating	Aquatic Flora	Habitat Description	Importance / Classification (Based on field assessment of sites)
1 (F82063 38465)	Q3-4	*Montia fontana* (Blinks) present marginally	Very little wetted channel, so that both diversity and numbers of fish likely to occur would be low. For this reason, and the fact that the stream was immediately upstream of the seashore, it was decided not to electro-fish it.	Low ecological value. This stream runs into the Glenamoy Bog complex SAC.
2	N/a	N/a	Marine Habitat (See Chapter 14).	High Ecological Value as Migratory Route for Salmon and Seatrout. Lies within the Glenamoy Bog Complex SAC
3 (F85880 35062)	Q 4-5, 10m up-stream*	Devoid of in-channel flora at crossing point, *Fontinalis* (moss) upstream, *Fucus* (brown seaweed) downstream	Moderate to slow flow glide, coarse (angular cobble substrate).	Low to moderate ecological value. Probably used by eel, and intermittently by trout; gobies immediately downstream. This stream runs into the Glenamoy Bog Complex SAC and the crossing point for the pipeline is within the SAC.
4 (F86477 34520)	Q4	*Potamogeton sp*. and *Callitriche stagnalis* present at water surface	Very slow-flow, canal-like stream with typical macroinvertebrate types present (water beetles, damselfly larvae, water boatmen etc.).	Moderate to low ecological value; unsuitable at the crossing site for salmonid fish or lamprey, although these could be present further downstream. Lies outside the Glenamoy Bog Complex SAC.
5 (F86258 34069)	N/a	In-stream vegetation at crossing point, some Flote grass (*Glyceria* sp.) and Water starwort (*Callitriche stagnalis*) immediately upstream.	Very small flow over soft organic (peat) substrate; overgrown with bankside vegetation so that the channel was not visible. Too small and unsuitable habitat for electrofishing.	Low ecological and fisheries value at the site; trout, eel and lamprey known from further down in the catchment (Leenamore River). Lies outside the Glenamoy Bog Complex SAC.

*Estuarine influence at the proposed route crossing point thus unsuitable for Q-rating. Instead Q-value rating was undertaken 10m upstream of the proposed crossing point.

13.4 POTENTIAL IMPACTS

The methodologies used to determine the magnitude of the impacts outlined in the following section take into account the guidelines given by the EPA and the NRA in their publications:

- *Guidelines on the information to be contained in Environmental Impact Statements (EPA 2002);*
- *Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA 2003);*
- *Environmental Assessment and Construction Guidelines (NRA 2004-2010); and*

The assessment of potential impacts have been broadly based on the criteria for assessment of impacts in aquatic systems as outlined in Tables 13.4 and 13.5.

Table 13.4: Qualifying criteria used for rating water courses.

Rating	Qualifying Criteria	Qualifying Criteria
A	Internationally Important	Sites designated or qualifying for designation as SAC or SPA under the EU Habitat or Birds Directive. Major Salmon River Fishery.
B	Nationally Important	Sites or waters designated or proposed as an NHA or Statutory Nature Reserves. Major Trout River fishery. Water bodies with major amenity fishery value. Commercially important coarse fishery.
C	High Value, locally important	Small waterbodies with known salmonid populations or with good potential salmonid habitat. Sites containing any resident or regularly occurring population of Annex II species.
D	Moderate value, locally important	Small water bodies with some coarse fisheries or some potential salmonid habitat. Any water body with unpolluted water (Q-value rating 4-5).
E	Low value, locally important	Artificial or highly modified habitats with low species diversity and low wildlife value. Water bodies with no current fisheries value and no significant potential fisheries value.

Table 13.5: Criteria used for assessing impact level on water courses.

A Sites				
	Temporary	**Short-term**	**Medium-term**	**Long-term**
Extensive	Major	Severe	Severe	Severe
Localised	Major	Major	Severe	Severe
B Sites				
	Temporary	**Short-term**	**Medium-term**	**Long-term**
Extensive	Major	Major	Severe	Severe
Localised	Moderate	Moderate	Major	Major
C Sites				
	Temporary	**Short-term**	**Medium-term**	**Long-term**
Extensive	Moderate	Moderate	Major	Major
Localised	Minor	Moderate	Moderate	Moderate
D Sites				
	Temporary	**Short-term**	**Medium-term**	**Long-term**
Extensive	Minor	Minor	Moderate	Moderate
Localised	Not significant	Minor	Minor	Minor

The key areas of potential impact of the proposed development on the freshwater habitats and associated migratory fish and lamprey species relate to the construction and commissioning phases of the pipeline. Once in operation, there will be no impacts on freshwater resources. The following sections therefore deal with the potential impacts associated with the construction phase and the commissioning/testing phase of the proposed development. A review of the proposed construction methods was undertaken in order to examine the potential impact of the proposed development.

As outlined in Chapter 5, it is proposed to construct underneath Sruwaddacon Bay using a segment lined tunnel which will minimise disturbance of the Bay. However, in the very unlikely event that a temporary intervention pit is required during the construction phase, then there is potential to cause impact to migratory fish (salmon and lamprey). The other sites (Site 1, 3, 4 and 5) will be crossed using an open-cut method where a trench is excavated to install the pipeline, services, etc.

A summary of the potential impacts identified for the construction and commissioning phases of the proposed development is presented in Table 13.10.

There are five principal types of potential impact associated with the proposed construction although only one (the release of suspended solids) is considered the most likely source of impact. These include:

1. Release of suspended solids;
2. Release of contaminants (e.g. cement, oil);
3. Temporary disruption to habitats;
4. Noise from the TBM; and
5. Phosphate mobilisation.

In addition the ‘worst case’ scenario (Section 13.4.2) and the ‘no development’ scenario (Section 13.4.3) are addressed. Furthermore, details on the assessment of the risk of phosphate mobilisation are provided below.

13.4.1 Releases of Suspended Solids

Without mitigation, the excavation of open-cut crossings can generate considerable amounts of suspended sediment. At Site 3 which is located on the foreshore, where the river is subject to full tidal inundation when the tide is in, potential impacts on freshwater life are extremely low and impacts on intertidal or estuarine life are also likely to be low because of the very large dilutions available from the tidal waters. Nevertheless, simple mitigation measures can reduce such siltation very considerably. In the case of Site 4 and 5, because they are located toward the head of their respective small catchments, suspended solids from these sites are potentially more damaging to freshwater life downstream. However, simple mitigation measures can reduce these potential impacts to acceptable levels.

In the very unlikely event that a temporary intervention pit is required within Sruwaddacon Bay, excavation and de-watering of cofferdams can have the potential to give rise to elevated suspended solids, a feature which can also be mitigated. During tunnelling there is a potential risk (albeit very low) of bentonite clay leaking into Sruwaddacon Bay. This would cause an increase in suspended solids in the vicinity of the leaks.

Construction of the tunnel will require a large tunnelling compound at Na hEachú (Aghoos) and a small compound at Gleann an Ghad (Glengad) from which suspended solids could escape into the bay. The Aghoos tunnelling compound will contain the bentonite handling plant which includes separation and recycling facilities, a storage area for tunnelling arisings as well as associated contaminated runoff storage and treatment facilities. Leaks from the surface water drainage system in the compound and/or failure or malfunction of the treatment system has the potential to result in the discharge of suspended solids into the bay with the possibility of adversely impacting migrating salmon if it occurred during the migratory season.

The main potential impacts of excessive suspended solids are (i) smothering of fish spawning beds in rivers and streams, some of which, occur downstream of Sites 4 and 5, (ii) damage to fish gills which if severe enough could result in gill disease and increased levels of mortality and (iii) damage to aquatic macroinvertebrates, which form a food source for fish. Within Sruwaddacon Bay, elevated suspended solids occurring during the passage of smolts could cause them to alter their swimming patterns, which may expose them to greater risk of predation by fish-eating birds. Impacts on adult migratory salmon would be expected to be less likely although in a worst case these might be slowed in their progress up the bay. As indicated above, the risk of all these potential impacts can be considerably reduced by mitigation (see Section 13.5).

13.4.2 Release of Contaminants

13.4.2.1 Cement and Oil

Concrete will be used in the construction of the tunnelling compounds (see Chapter 5) and although unlikely there is a very remote possibility that a spill might reach the shoreline, where the high pH of the cement could cause fish kills. This potential impact is easily mitigated by good engineering practice. Cement grout will be used in the lining of the tunnel and within the tunnel. Given that it is a viscous material and because it will be pumped at low pressure, it is considered a very remote possibility that any will escape up through the sediment overburden to reach the waters of the bay. It will be batched in the Aghoos tunnelling compound within a separate drainage area, the run-off from which will be treated. Therefore, the possibility of adverse impacts from the use of cement grout is expected to be very low. Oil spills from construction vehicles and plant can cause damage to fisheries and the environment. However, such impacts can be easily prevented by suitable mitigation.

13.4.2.2 Commissioning – Hydrostatic Testing

When the pipeline is in place it will have to be filled with water and pressurised to its test pressure. The water will then be discharged at the end of the water outfall pipe offshore. Although, it is considered unlikely, the water may become contaminated during testing e.g. with suspended solids, heavy metals and hydrocarbons from the inside of the pipe, all of which might have a detrimental impact on fish, depending on the concentrations involved if discharged untreated into a receiving water body. However, appropriate treatment can be carried out to mitigate this.

13.4.3 Temporary Disruption to Habitats

The quality of the habitats in terms of spawning, feeding or nursery for fish at Sites 1, 3, 4 and 5 is considered low to moderate. For this reason, the temporary damage to the habitat associated with open-cut crossings can be described as minor. Nevertheless, simple mitigation measures can serve to virtually eliminate this impact.

13.4.4 Noise from the TBM

The tunnel boring machine (TBM) will generate noise as it traverses beneath Sruwadaccon Bay. This noise will be at a level that maybe audible to fish within the bay and therefore has the potential to affect their behaviour. The following section addresses the likelihood of impact to migratory species, in particular the Annex II species Atlantic salmon (*Salmo salar*) and trout (*Salmo trutta*), both of which pass through the bay on their seaward migration as smolts and on their return migrations as adults.

13.4.4.1 Assessing the Sensitivity of Fish to Sound

The sensitivity of fish to sound has been measured experimentally by exposing groups or individuals of a particular species to pure tone sound across a range of frequencies in hertz (Hz) and increasing strengths in decibels (dB) and then assessing their response by the use of specialist behavioural or neuro-physiological testing methods. The output from these experiments are plots of the lowest sound in dB that a fish is sensitive to at each frequency in Hz tested, i.e. its *hearing threshold*. These plots or graphs of hearing threshold in decibels (usually of sound pressure level - SPL) against frequency are known as *audiograms*.

Audiograms of fish are the most widely used tool to assess whether a fish is likely to be able to hear a sound produced anthropogenically in the aquatic environment. By comparing the fish audiogram with the measured or modelled sound output from a given anthropogenic activity across an appropriate range of frequencies, we can judge whether a fish species will be likely to hear these sounds or not. However, there are other complicating factors, in particular the affect of natural background noise which, depending on its frequency range and level may mask anthropogenic sound to a greater or lesser degree.

13.4.4.2 Noise Output from the TBM

Appendix H3 presents the noise output model for the TBM during its passage beneath the Sruwaddacon Bay. Figure 25 from Appendix H3 presents the modelled output at its most conservative, i.e. the highest noise output modelled at high water along the axis of the tunnel. The measurements are of Sound Pressure Level expressed as dB re 1µPa.

This shows that the highest noise output is at the 31.5 Hz frequency with a pressure level in dB re 1 µPa of around 160 within a few metres of the TBM and approximately 145 dB at a distance of 90m. At higher and lower frequencies the dB level is generally lower and declining with distance from the TBM. On average, the sound output within the frequency range modelled (i.e. 1-100Hz) ranges from 160dB to 120dB re 1µPa within about 10m of the TBM, to about 140-120dB re 1µPa at 90m distance. These sound levels are the highest modelled.

If we compare these noise pressure levels with the audiogram of the Atlantic salmon (Hawkins and Johnstone, 1978) we can judge if these sound levels are likely to be audible to that species. The salmon is most sensitive to sound pressure level at 160Hz when it can detect 95 dB re 1µPa. Outside these frequencies its threshold rises so that for example at 100Hz the threshold is about 98 dB re 1µPa, at 50 Hz about 105 dB re 1µPa, at 30 Hz about 107.5 dB re 1µPa, while at the higher end of the spectrum e.g. 300 Hz, the threshold is about 112 dB re 1µPa. Under conditions of low ambient noise, therefore, salmon can be expected to hear the noise from the TBM as this will exceed the salmon's hearing thresholds at all the relevant frequencies.

Table 13.6 below presents the approximate noise output from the TBM at various frequencies including 31.5Hz, which is the frequency at which the highest noise levels are predicted. Also included are the hearing thresholds for the salmon (*Salmo salar*) derived from Hawkins and Johnstone (1978) at those same frequencies and in the final two columns the amount by which the TBM noise exceeds the thresholds both close to the TBM and at 90m.

Table 13.6: Approximate sound pressure levels (SPL) at 0-10m and 90m from the TBM at five frequencies

Frequency	Approximate SPL at 0-10m	Approximate SPL at 90m	Salmon hearing threshold	Exceedence of salmon hearing threshold (at 0-10m)	Exceedence of salmon hearing threshold (at 90m)
(Hz)	(dB re 1µPa)	(dB re 1µPa)	(dB re 1µPa)	(dB re 1µPa)	(dB re 1µPa)
5	143	133	107.5*	35.5	25.5
10	130	125	107.5*	22.5	17.5
31.5	160	145	107.5**	52.5	37.5
50	140	125	105	35	20
100	142	125	99	43	26

* extrapolated from the threshold at 30Hz ** value for 30Hz

Table 13.6 also shows the corresponding hearing thresholds for Atlantic salmon at the same or near frequencies based on the audiogram from Hawkins and Johnstone (1978), as well as the exceedance level of these thresholds by TBM noise at 0-10m and at 90m from the tunnelling face.

While sound in water as it affects animals is generally measured in sound pressure level units (SPL), i.e. dB re 1μPa, it is now known that salmon are more sensitive to particle motion, than pressure, especially at lower frequencies (Knudsen *et al.,* 1992). Furthermore, Knudsen *et al.,* (1992) appear to have been the first authors to measure the avoidance reaction of Atlantic salmon smolts to sound levels expressed in terms of particle motion, in this case particle acceleration, which is expressed as dB re $10^{-5}ms^{-2}$. To facilitate a comparison with the findings of Knudsen *et al.,* (1992), the sound output from the TBM has also been presented as particle acceleration (Appendix H3, Figure 26). These data have been compared with the salmon hearing thresholds (also expressed in units of particle acceleration) at a range of relevant frequencies (Table 13.7). These show that for the TBM the highest levels of exceedence of the thresholds are in the higher frequencies.

Table 13.7: Approximate noise levels in units of particle acceleration at 0-10m and 90m from the TBM at five frequencies

Frequency	**Approximate particle acceleration sound level at 0-10m**	**Approximate particle acceleration sound level at 90m**	**Salmon hearing Threshold**[5]	**Exceedence of salmon hearing threshold (at 0-10m)**	**Exceedence of salmon hearing threshold (at 90m)**
(Hz)	(dB re $10^{-5}ms^{2}$)	(dB re $10^{-5}ms^{2}$)	(dB re $10^{-5}ms^{2}$)	(dB re $10^{-5}ms^{2}$)	(dB re $10^{-5}ms^{2}$)
5	27.5	20	22*	7.5	-2
10	25	15	22*	3	-7
31.5	63	45	22**	41	25
50	45	35	21	34	14
100	55	35	14	44	21

* extrapolated from the threshold at 30Hz ** value for 30Hz

Table 13.7 also shows the corresponding hearing thresholds for Atlantic salmon at the same or near frequencies based on the audiogram from Knudsen *et al.,* (1992) as well as the difference between these thresholds by TBM noise at 0-10m and at 90m from the tunnelling face.

13.4.4.3 Affect of Noise on Salmon

While there has been a reasonable body of work on establishing the sensitivity to sound of various fish species, the implications for the fish of those sounds is less well understood. The analysis presented in Table 13.6 above, suggests that the degree of exceedence of the hearing threshold by the salmon in terms of pressure (Table 13.6) is fairly modest ranging from 22.5 to 52.5 dB re 1μPa in the near field (0-10m) and 17.5-37.5 dB re 1μPa at 90m. In a recent report, Nedwell *et al.* (2007) used data from several sources and a range of species and noise sources to validate a scale with which to assess the likelihood that a given level of noise above the hearing threshold of a fish species would invoke an avoidance reaction (see Table 13.8).

[5] Calculated by Knudsen *et al*., 1992 from the audiograms of Hawkins and Johnstone (1978)

Table 13.8: Criteria for assessing the likelihood that a noise will result in avoidance reactions in fish. (after Nedwell *et al.,* 2007)

Sound level above the species hearing threshold	Effect
Less than 0 dB	None
0-50dB	Mild reaction in minority of individuals, probably not sustained
50-90dB	Strong reaction by the majority of individuals, but habituation may limit effect
90dB and above	Stronger avoidance reaction by virtually all individuals

Using this scale, and comparing it with the figures in the two last columns in Table 13.6 suggests that there exists the possibility of avoidance reactions by some salmon of the TBM noise, particularly in the near field (0-10m). In terms of sound as particle motion (the form to which salmon are considered most sensitive), Table 13.9 compares the level of exceedence of the salmon hearing threshold with levels measured by Knudsen *et al.,* (1992) at which smolts were observed to exhibit a spontaneous *awareness reaction threshold*. This can broadly be described as a state of alertness which precedes an avoidance reaction but the latter would only follow if sound levels were to increase by about another 10 dB re $10^{-5}ms^{-2}$. The data in Table 13.9 suggest that smolts (and adults), would probably not react to the sound output from the TBM, including in the near field (0-10m), as it doesn't reach the required thresholds.

Table 13.9: Approximate noise levels in units of particle acceleration at 0-10m and 90m from the TBM at five frequencies

Frequency	Exceedence of salmon hearing threshold (at 0-10m)	Exceedence of salmon hearing threshold (at 90m)	[7]Salmon hearing Threshold[6]	Awareness reaction threshold measured as dB above the hearing threshold
(Hz)	(dB re $10^{-5}ms^{-2}$)	(dB re $10^{-5}ms^{-2}$)	(dB re $10^{-5}ms^{-2}$)	(dB re $10^{-5}ms^{-2}$)
5	7.5	-2*	22	25±3.5
10	3	-7	22	33±3.6
31.5	41	25	22	~59
50	34	14	21	~61
100	44	21	14	~74

* Negative signs mean that the hearing threshold was not reached at that frequency.

Table 13.9 also shows the corresponding hearing thresholds for Atlantic salmon at the same or near frequencies based on the audiogram from Knudsen *et al.,* (1992), as the levels at the same frequencies which resulted in smolts exhibiting an *awareness reaction threshold* (Knudsen *et al.,* 1992)

Thus, using the Nedwell *et al.,* (2007) assessment scale (Table 13.8), and the data in Table 13.6, which is based on sound pressure levels, it would seem that a proportion of smolts within a distance of less than 90m of the TBM (probably much less), might exhibit an avoidance response from the TBM noise source. However, based on the data from Knudsen *et al.,* 1992, in which the TBM noise is measured as particle acceleration, neither smolts nor adults would be expected to react to the TBM noise expressed (Table 13.7), as these do not exceed reaction thresholds at the frequencies in question (Table 13.9).

[6]Calculated by Knudsen *et al*., 1992 from the audiograms of Hawkins and Johnstone (1978)

Where avoidance reactions have been observed in the laboratory (Knudsen *et al.*, 1992), Atlantic salmon smolts moved rapidly to deeper water in response. This same behaviour was exhibited by smolts of North American salmon species under the same circumstances, and they were additionally observed to move horizontally away from the noise source if they couldn't move into deeper water (Mueller *et al.,* 1998). It is suggested therefore that if smolts do exhibit avoidance reactions in Sruwaddacon Bay they will tend to swim to deeper water and or away from the track of the TBM. In the majority of instances, this should mean that they would simply swim around the source but continue toward the sea and within a few minutes be beyond the avoidance reaction threshold of TBM noise. If on the other hand some smolts were to stop their seaward migration, when current conditions would otherwise permit them to advance (something which is considered very unlikely), then it is important to note that the TBM will only be tunnelling for 20 minutes in every hour, leaving 40 minutes when there will be no noise generated from the TBM. In that time, a smolt could have travelled between 300m and 1200m downstream based on the travel times for smolts reported in the literature (LaBar *et al.*, 1978; Moore *et al.*, 1998). Thus in the unlikely event that TBM noise were to impede the passage either of smolts or adults during tunnelling, the 66% downtime in each hour should be more than adequate to allow groups of adults or smolts to pass beyond the influence of TBM noise every hour.

13.4.4.4 Other Fish Species

Trout were observed by Knudsen *et al.,* 1992 to react in a similar way to noise as salmon smolts, such that the scenario outlined above for salmon smolts should be similar for trout. It is notable that their audiogram indicates that they are less sensitive to sound (pressure) than salmon over the same frequencies (Nedwell, *et al.*, 2006).

Neither river lamprey nor sea lamprey have been recorded within the catchment of Sruwaddacon Bay, however, we cannot definitively rule them out as occurring. No data could be found on the auditory sensitivity of lamprey but the fact that they are very primitive vertebrates, without a swim bladder, would suggest that they have a low sensitivity to sound and therefore are very unlikely to be adversely impacted by TBM noise.

13.4.4.5 Conclusion

The data analysis undertaken would suggest that there is only a small likelihood that salmon (smolts or adults) will exhibit avoidance reactions to noise from the TBM. However, if this were to happen, it is not expected to prevent either the outward migration of smolts or the inward migration of adults. In the extremely unlikely event that salmon would halt their migration because of the noise, then the 40 minutes downtime in the operation of the TBM in every hour would be sufficient to allow smolts and adults to pass beyond the influence of the TBM. It is considered that TBM noise will therefore have negligible adverse impact on salmon and that the impact on trout and lamprey (were they to be present in the bay) would be similarly low.

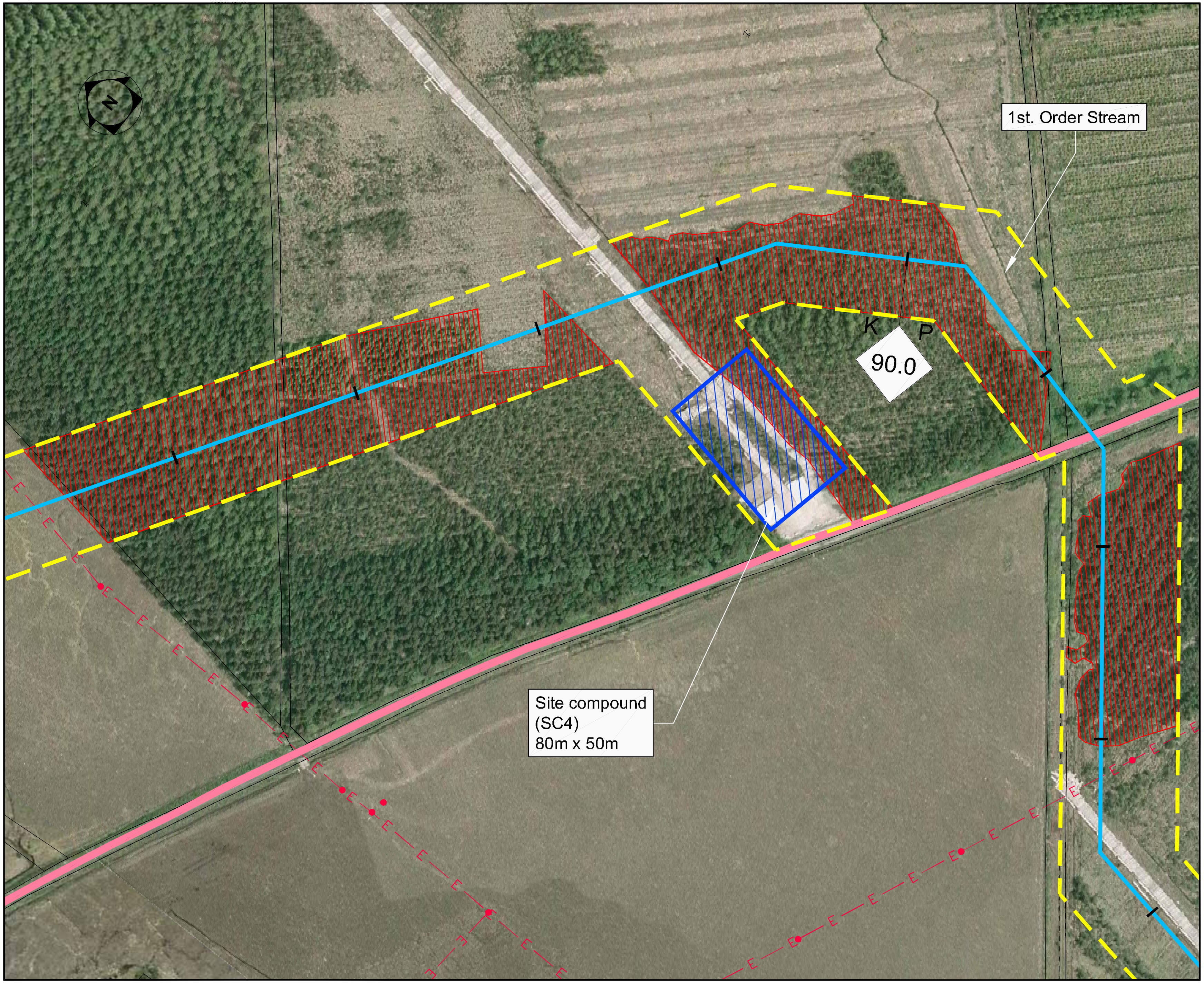
13.4.5 Phosphate Mobilisation

Tree felling is associated with phosphate mobilisation, which can impact on water quality. It is proposed to fell approximately 3ha of trees (in peatlands) as part of the construction of the proposed development (See Figure 13.2). The area to be felled represents 1% of approximately 374ha commercial coniferous forest (in Béal an Ghoile (Ballygelly) South) of non native lodgepole pine, owned and managed by Coillte. When mature, these conifers would be due for felling in rotation. Coillte own approximately 40,350 ha of land in Co. Mayo for forestry.

The main migration pathway whereby phosphate enters surface watercourses is via surface water run-off but it can also be leached from sediment released into watercourse. It is anticipated that the principal source of any phosphate in the area is rock phosphate, which was used as a forestry fertiliser in the area in the past.

In order to ensure that runoff waters from the exposed peat, after felling of the trees, do not result in phosphate contamination of nearby surface water courses, mitigation measures will be put in place. These will include the implementation of sedimentation control, avoidance of works in periods of high rainfall, and the use of the fresh brash mats on machine routes, to avoid soil damage, erosion and sedimentation. Appropriate settlement and filtration methods will be used to reduce sediment emissions from excavated spoil to the watercourse. The Environmental Management Plan (see Chapter 18 of the EIS) will also establish monitoring protocols for sediment control. Furthermore, the topography of the area is relatively flat and therefore it will be easier to control drainage from the site.

No significant water courses exist in the area where tree felling is required. A short section (1m -1.2m wide) of a first order stream exists at chainage 90.15 (see outline of stream in Figure 13.2), the area of which will be felled. This minor stream does not lead to any sensitive fisheries or drinking water sources. This stream and the drainage from the area to be felled discharges directly to the upper tidal reaches of Sruwaddacon Bay via small streams and drainage channels (see Catchment Map in Chapter 15). It should also be noted that these are transitional waters, where phosphate is already naturally present.



Tree Areas to be Felled

Areas of Trees to be felled for Construction of Corrib Onshore Pipeline

Figure 13.2

File Ref: COR25MDR0470Fg 13.2A03
Date: May 2010
Scale: NTS

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

It is anticipated that the risk of phosphate mobilisation and the impact on water quality will be low because of the relatively small size of the area required to be felled, the temporary nature of the works, the implementation of mitigation measures as outlined above and the low sensitivity of the receiving environment.

Conifer felling should be seen in the context of local forest management which has seen extensive (ongoing) clear-felling of large areas of conifer plantation in recent years.

13.4.6 Impact Assessment Summary

A summary of potential impacts is provided in Table 13.10 below.

Table 13.10: Summary of the potential impacts (including likelihood of the occurrence and significance) for both open cut (Sites 3, 4 and 5) and tunnelling (Site 2), in the absence of mitigation.

Crossing /Sampling Site	Nature of the Impact	Importance of the Habitats (according to Table 13.4)	Significance of Impact (according to Table 13.5)	Duration	Likelihood of Occurrence
1*	Damage to habitat and invertebrates	Moderate value, locally important	Not significant	**Temporary	Low
2	Increased risk to smolts from suspended solids between late March and early May	Internationally Important	Major	Temporary	Low
3	Damage to habitat and invertebrates	High value-locally important	Minor	Temporary	Moderate
4	Damage to habitat and invertebrates, damage to spawning beds	High value-, locally important	Minor	Temporary	Moderate
5	Damage to habitat and invertebrates, damage to spawning beds	High value-, locally important	Minor	Temporary	Moderate

* This site is not crossed by the proposed route but lies within the temporary working area. ** Temporary = impact lasting for 1 year or less.

A summary of the mitigation measures recommended for each stream/river crossing of the proposed development are provided in Table 13.11. In addition to these measures detailed method statements will be drawn up and agreed with NWRFB and NPWS prior to undertaking the crossings. Furthermore, works within the above crossings are likely to be supervised by staff from NWRFB. Moreover, a programme of monitoring of suspended solids will be undertaken during the works.

13.4.7 'Worst Case' Scenario

In the event that mitigation measures fail it is possible that certain aspects of the construction activities could have an adverse affect on the habitats and invertebrates.

There is potential for siltation to occur downstream of each crossing if mitigation measures are not carried out. In this case the streambed downstream of each crossing could become blanketed with silt dislodged during trenching. This in turn would decrease the quality of the habitat (which in the case of Site 3 only - comprises gravels, cobbles and coarse sand), by smothering it with finer sediment thus adversely impacting the macroinvertebrates and any fish species present, which would likely migrate out of the affected area until the substrate reverted to pre-construction conditions. Siltation of bottom substrates could also damage spawning beds were these present. It is unlikely that any of these small streams hold significant spawning beds for any species given their small size. However, pockets of spawning gravel for trout probably occur throughout the channel in each case and as Sites 4 and 5 are crossed upstream of their respective watercourses, there is potential for a greater length of downstream channel to be impacted. In these cases special care will need to be taken during construction. In the case of Site 3, because it is both very close to its discharge to the seashore, only 5-10m of channel would be impacted by siltation.

In a worst case scenario, i.e. if a temporary intervention pit is required in or close to permanent low-tide channels, the associated works in Sruwaddacon Bay may produce high suspended solids concentrations for short periods, at least close to the works and especially if works are undertaken in areas where tidal currents are strong (e.g. by the main tidal channels and in the outer bay). If this occurred during times of migration, smolts may alter their swimming behaviour or slow their migration rates, possibly exposing them to greater risk of predation by birds or to increased stress and poorer growth or greater risk of gill damage. Returning adults would be less at risk from predation if their advance up the bay were slowed. It is worth noting however, that salmon still make their upriver spawning migrations annually under natural conditions in some estuaries where high turbidity levels are recorded (e.g. the river Suir with suspended solids levels of up to several hundred milligrams per litre (pers. obs.) and the Severn estuaries, where solids levels of more than a thousand have been noted (Alabaster and Lloyd 1980)). It seems unlikely therefore that returning adults would be prevented from passing the works in Sruwaddacon, although slowing their rate of migration during periods of increased solids washout from the works is possible. In the latter case, significant adverse impacts would be those that would prevent the salmon spawning successfully, as these would affect the species at a population level, rather than at the level of individuals. Such impacts, however, are considered to be very unlikely to occur. Similar risks would be associated with a bentonite breakout, in the unlikely event of one occurring.

13.4.8 ‘No Development’ Scenario

In the absence of the development it is likely that the habitats and water quality along the proposed route would remain unchanged, although both are subject to natural and other anthropogenic variability.

13.5 MITIGATION MEASURES

13.5.1 Aghoos Tunnelling Compound

The tunnelling compound at Na hEachú (Aghoos) will have a large hard standing area containing a bentonite handling plant which will circulate and recycle bentonite slurry throughout the tunnelling process via dedicated hoses to and from the TBM and includes areas for settlement and filtration. The bentonite handling plant is used to separate tunnel arisings from the drilling fluid. A storage area for tunnel arisings will be located adjacent to the bentonite handling plant. The bentonite handling area will include an area for mixing bentonite with water to form slurry.

The compound will also contain a cement grout handling area for storing and mixing cement grout for use in tunnelling operations. This process will be carried out within an area of hard standing.

The bentonite handling area and cement grout handling area will have a separate drainage system from which all run-off will be collected and pumped into a storage tank. Bunding will be used where appropriate. All wastewater from this tank will be directed to a filter press and the solids removed as a cake for licensed disposal. All residual water from this process will be tankered off site for disposal in a waste water treatment plant.

All drainage from areas within the compound, that are not bunded or have their own drainage areas as described, will be directed through a bypass separator for removal of hydrocarbons followed by a settlement lagoon for removal of suspended solids and the installation of a filtration system for removal of finer particles. The settlement lagoon can be used as an additional reserve volume of fresh water for use in the tunnelling process, if required. Any excess water from the settlement lagoon will be treated to an acceptable standard and then discharged to a local drain. In this manner all potentially contaminated drainage will be kept separate from routine, un-contaminated or slightly contaminated run-off.

The construction of the compound has the potential to give rise to solids discharge during peat excavations. However careful construction management, in particular the channelling of all run-off to settlement and filtration, will reduce this risk very considerably.

The above mitigation measures should reduce to negligible the possibility of any impacts occurring from this compound. The most sensitive receptors would be migrating salmon or salmon smolts during their migratory periods.

13.5.2 Tunnelling

Bentonite pressure and rate of usage will be constantly monitored at the tunnelling control area within the Aghoos tunnelling compound in order to detect any change in pressure that might indicate a breakout. If the latter is detected, pumping will immediately cease.

13.5.3 Stream Crossings

Flumes will be used to divert the stream over the stream crossing points in order to facilitate construction of crossings in the dry. This will considerably reduce the amount of silt likely to escape during construction of the crossings.

13.5.4 Intervention Pit

In the unlikely event that an intervention pit will be required this will be enclosed by an inner and outer rectangle of sheet piles to isolate the pit. Spoil excavated from the pit will be placed between the inner and outer sheet-pile walls and any excess brought ashore. If water needs to be pumped from the pit this will be treated by settlement in a settlement tank on board a floatable pontoon alongside the pit.

13.5.5 Timing of Works

As outlined in Chapter 5, it is expected that the construction phase of the Corrib Onshore Pipeline will be carried out over approximately 26 months. Tunnelling underneath the bay may coincide with migrating salmonids in the April-May (smolts) and July - September period (adults). In the very unlikely event of an intervention pit being required within the bay the NWRFB will be notified and consulted in advance. In the event that such works might be required within the sensitive periods, additional mitigation measures such as the monitoring of smolt upstream of the works to allow breaks in the works for the passage of smolt and appropriate filtration of works will be undertaken.

The quality of the habitats in terms of spawning, feeding or nursery for fish at Sites 1, 4 and 5 is of low ecological value, while at Site 3, the Leenamore River (due to its higher flow and larger dimensions) is slightly higher. For this reason, the temporary damage to the habitat associated with open-cut crossings at all streams except the Leenamore River can be described as minor to negligible, with the latter described as minor. Nevertheless, simple mitigation measures will serve to virtually eliminate this impact. These include diversion of stream flow through flume pipes, while excavating the crossings, settlement and filtration of water from the de-watering of trenches, retaining streambed substrate and replacing this after the trench has been back-filled. In any case all works will be undertaken only with the prior agreement of NWRFB.

It is therefore not considered necessary that works in river/stream crossings are undertaken outside of the sensitive seasons. However, it is acknowledged that the implementation of the aforementioned mitigation measures will be of the utmost importance during the works.

Table 13.11: Summary of mitigation measures at each stream/river crossing and at tunnelling compounds.

Crossings	Construction Phase						Commissioning Phase
Stream / River crossings	Divert stream flow through flume pipe, while excavating crossing. (Sites (1*), 3, 4, 5)	Pump-over with in-stream filter material-straw bales or similar. (Site 4).	Settlement and filtration of water from the de-watering of trenches. (Sites (1*), 3, 4, 5)	Retain streambed substrate at crossing and replace after the trench has been back-filled. (Site 3)	Temporary bridging structures for access across the watercourses. (Sites (1*), 3, 4 and 5).	Construction during dry weather. (Sites 3, 4 and 5)	Analyse and if necessary treat hydrostatic test water before discharge to marine waters.
Sruwaddacon Bay Site 2	Use of segment lining tunnelling method.	If a temporary intervention pit is required within the bay all works will be agreed with NWRFB prior to undertaking.	Monitor for smolt upstream of works. Allow breaks in the works for the passage of smolt if necessary.	If a temporary intervention pit is required appropriate filtration systems will be provided for all de-waterings before release to the bay.	Monitoring of suspended solids.	Continuous monitoring of bentonite use in order to detect leaks or breakout.	
Tunnelling Compounds Site 2	Discharge no contaminated water or drilling fluids from the tunnelling works into Sruwaddacon Bay.	Route all run-off from the construction and operation of the compounds through suitable settlement and filtration processes before discharge and monitor the pH and suspended solids / turbidity levels of the discharge.	Install a hydrocarbon interceptor on the run-off from the compound.	Bund all bentonite processing, treatment, storage or batching areas. Use a filter press as part of the treatment system.	Bund all cement handling, or storage areas. Use a filter press as part of the treatment system.	Bund and secure all oil storage and re-fuelling facilities.	

*It is not anticipated that any works will occur at Site 1 however, mitigation measures have been recommended in the event that works are required.

13.6 RESIDUAL IMPACTS

There will be no residual impacts on Freshwater Ecology.

Once the recommended mitigation measures are implemented only minor to negligible impacts on the streams (Sites 1, 3, 4 and 5) can be expected. This will be in the form of minor silt deposition on the streambeds below the crossings. These impacts will be temporary, lasting no more than one year or less in most cases.

Once all necessary mitigation measures are taken in the case of the tunnelling beneath Sruwaddacon Bay and the associated compounds, there will be no residual impacts on migratory salmonids or EU Annex II listed species as a result for the construction and commissioning phases of the project.

14 MARINE ENVIRONMENT

14.1 INTRODUCTION

This chapter describes the potential impacts of the construction and operation of the proposed Corrib Onshore Pipeline on the estuarine and marine environment. Sruwaddacon Bay shown on Figure 14.1 is considered in this impact assessment.

No impacts on the marine environment will occur as a result of the operation of the proposed development. The construction phase however has the potential to impact on the marine environment and therefore a review of the proposed construction methodologies (see Chapter 5) has been undertaken to assess the potential impacts and outline mitigation measures to prevent or minimise these potential impacts.

Sruwaddacon Bay is a dynamic ecosystem providing a transitional zone between the freshwater riverine flow and the fully marine environment of Broadhaven Bay. The entire estuary is continuously swept by semi-diurnal tides. Consequently, a general understanding of the oceanographic and geomorphological conditions within the estuary is required to gain a full understanding of the marine environment along the proposed route, including the route of the tunnel from Gleann an Ghad (Glengad) to Na hEachú (Aghoos).

Sections 14.2 to 14.6 below provide details on the proposed methodology, existing environment, potential impacts and mitigation measures. Oceanography and Hydrography are discussed separately in Section 14.7.

This impact assessment was undertaken by RPS. Further details on survey results, hydrodynamic modelling and bibliography are provided in Appendix L.

Details on designated conservation sites including the legislative context are provided in the Preface to Section C.

14.2 METHODOLOGY

The purpose of the assessment was to gain an understanding of the marine environment along the route of the proposed development through a literature review and consultation (Section 14.2.1) and marine and field surveys (Section 14.2.2). The key objectives of the assessment were to:

- identify habitats or species on, or close to, the proposed route, which are likely to be of commercial, scientific or conservation value;
- investigate the presence of protected species of flora or fauna;
- evaluate the estuary's importance to more mobile marine species including fisheries (resident and migratory) and for marine mammals; and
- evaluate and model the hydrodynamics of the bay in order to understand oceanographic changes caused by different construction methodologies.

14.2.1 Literature Review and Consultation

Information was obtained from the following sources:

- Most existing literature is already represented in the EIS for the Corrib Field Development (2001). This covers both existing published literature relating to the local fisheries, cetaceans and sea mammals and benthic communities within the region, but also site specific survey data carried out as part of the study at that time.

- Marine fish species: Central Fisheries Board METRIC Estuary Investigation of Sruwaddacon Bay 2006 (CFB, 2006).

- Consultation with National Parks and Wildlife Services and North Western Regional Fisheries Board.

- Dedicated survey effort, validated records of incidental sightings and standings from the database maintained by the Irish Whale and Dolphin Group (www.iwdg.ie) performed for the period since the submission of the original EIS (October 2001).

- Marine mammal observation surveys from the coast of Broadhaven Bay in 2001-2002 (O Cadhla *et al*., 2003), 2005 (CMRC, 2006), and during acoustic survey operations in 2008 (OSC, 2008 & Coppock, 2008) along with further observations from within Sruwaddacon Bay and Curraunboy Bay during all geophysical survey operations (Conner, 2007) and the ongoing monitoring programme in Broadhaven Bay (CMRC, 2010).

14.2.2 Marine and Field Surveys

The following marine surveys were undertaken between 2007 and 2010 for the purposes of this impact assessment:

- Marine habitat mapping and benthic ecology of Sruwaddacon Bay area (RSK and Ecoserve, 2007, Wilson, 2007_2 and Wilson 2010_1).

  Information on the marine environment and ecology provided is based on a review of the existing literature and further fieldwork undertaken by Ecoserve and RSK in the summer of 2007 with a further benthic assessment undertaken by Wilson (RPS) at selected sites in the winter of 2007, and more extensively throughout the estuary, in 2010.

  Sub-tidal and inter-tidal field surveys addressed both regional habitat and site-specific benthic communities along the proposed route and were carried out in accordance with habitats assessments by MESH (Mapping European Seabed Habitats) and MNCR (Marine Nature Conservation Review; Connor *et al*., 2004). These results are summarised below (Section 14.3) while details on all survey data are contained in Appendix L.

  The main objectives of the study was to collect information with which to establish an overall description of the inter-tidal (and shallow sub-tidal) environments of the survey sites and from which to detect any potential future changes as a result of construction. The survey was to identify sensitive habitats and species that might be affected by the development or would require special conservation under European legislation (See Preamble to Section C). Furthermore, to assess the size and availability of the flora, macro-invertebrates or fish species that may provide an important food source for over wintering birds within the SPA and larger predatory species (such as otters and seals) that may use the estuary from time to time (see Chapter 12).

  Sites previously surveyed of the upper and lower parts of Sruwaddacon Bay by Aqua-fact in 2000 and Ecoserve in 2001, were revisited by RSK and Ecoserve in 2007 to assess natural variability of these sites during the intervening years. The main body of the bay, however, are covered predominantly by the RSK 2007 study, and the two additional surveys undertaken by Wilson (RPS) in 2007 and 2010.

- Geomorphological survey data (bathymetry and seabed features) from a geophysical survey (Osiris 2007).

  Data acquired by Osiris in 2007 (see Section 14.3 and Chapter 15) as part of the geophysical assessment of Sruwaddacon Bay was further reviewed to provide a geomorphological map of both the inter-tidal and sub-tidal sediments within the bay. Produced from a combination of sidescan sonar reflectivity and bathymetric depth and reflectivity, these techniques can delineate variations in sediment types and physical attributes over the entire site covered by the survey vessel. These data were compared with the ground truthed habitat mapping undertaken on foot and by seabed samples undertaken at the same time by both RSK and Ecoserve in the same year.

- Marine mammal observations within Sruwaddacon Bay during all geophysical survey operations (Osiris and Conner, 2007).

  Data acquired during the Osiris 2007 geophysical assessment of Sruwaddacon Bay estuary was supported by marine mammal observations onsite, and provides important supplementary information as to excursion of marine mammals into Sruwaddacon Bay. The presence of marine mammals were further recorded when observed during other survey operations carried out within the estuary between 2007 and 2010.

- Oceanographic survey undertaken within Sruwaddacon Bay estuary (EGS, 2007) and reworked into an oceanographic overview (Wilson, 2007_1).

  Oceanographic data acquired for the hydrodynamic model validation reviewed and assessed by RPS to provide a broad understanding of tidal flows and levels at various points along the estuary. This provides an idea of operational constraints due to very shallow waters and tidal heights taken into account during other survey works carried out for this assessment and in finding suitable construction methodologies for the proposed pipeline.

- Modelling of the oceanographic data to provide a numerical hydrodynamic model of the Sruwaddacon Bay estuary (HR Wallingford, 2007) and preliminary validation assessment (Wilson 2010_2).

  Hydrodynamic modelling of Sruwaddacon Bay was undertaken by HR Wallingford. The results of this modelling are summarised below (Section 14.7) while the modelling report is provided in Appendix L. A brief validation assessment was carried out using drogue streamlining in the central part of the bay by Wilson in winter of 2010 (Wilson 2010_2).

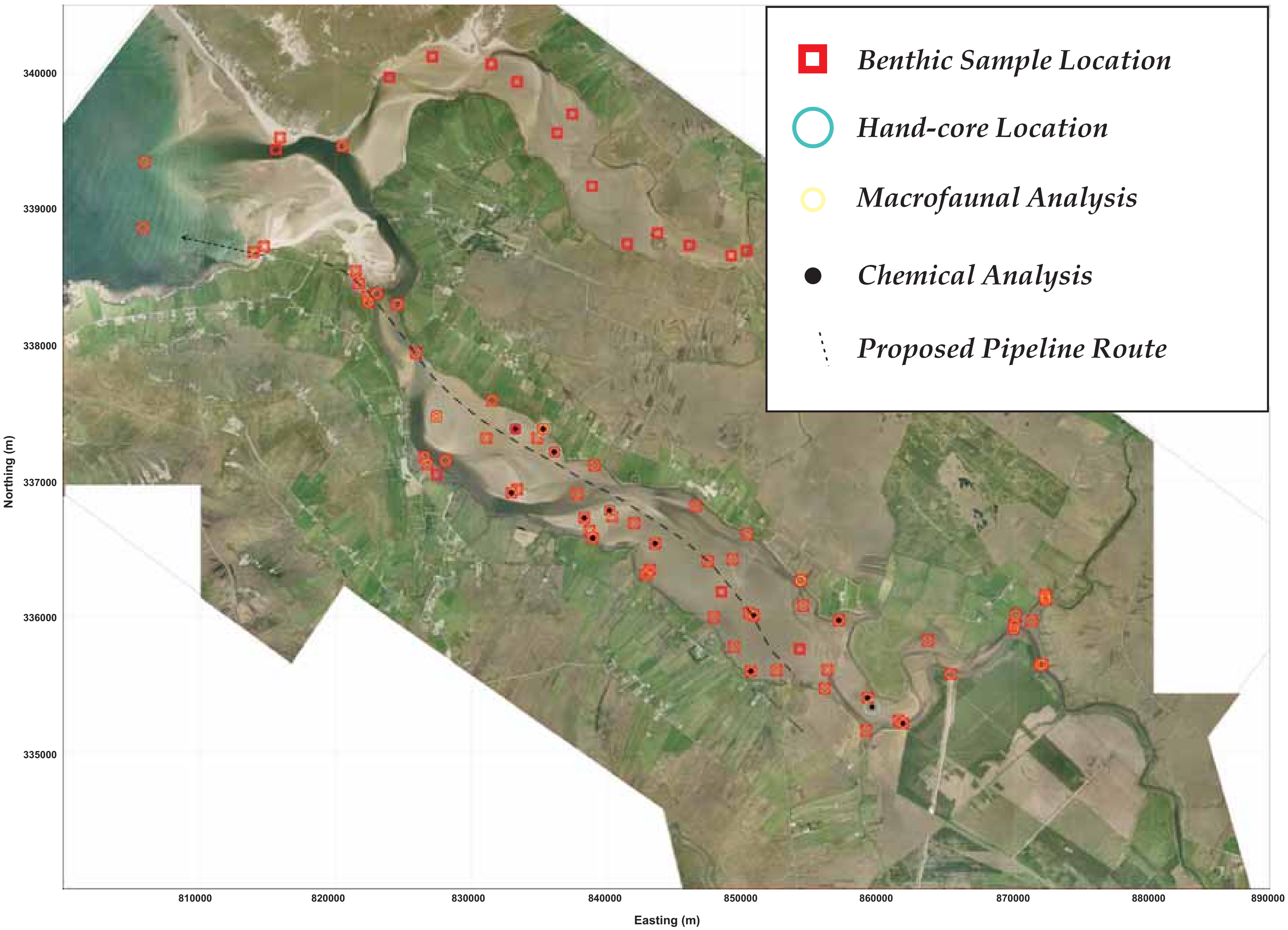
- Baseline Survey of Fish Communities in the Sruwaddacon Estuary 2008 (CFB, 2008).

  A repeated survey of the fish communities of the Sruwaddacon Estuary to assess the springtime use within the estuary, carried out by the Central Fisheries Board. Field operations were completed in May 2008 as per the 2006 METRIC procedures, using the same techniques and equipment as the earlier study.

14.2.2.1 Marine Ecology Surveys

In July 2007, a walkover survey of the inter-tidal areas and the lower Sruwaddacon Bay crossing point, proposed at that time was undertaken by Ecoserve, in line with a previous study at this site by Aqua-fact in 2000 and Ecoserve in 2001. This area represents the initial marine section of the proposed pipeline route as it passes southeast of the Gleann an Ghad (Glengad) landfall. The littoral biotopes were mapped down the shore and quantitative samples taken from each of the principal biotopes. The biotopes were mapped and interpreted using the biotope classification provided by Connor *et al.* (1997). In addition triplicate replicate macro-invertebrate samples were taken at a number of stations using multiple cores (6.5cm diameter) to a depth of 10 cm and a combined survey area of ca.0.09m^2. Samples were passed through a 1 mm mesh sieve and later processed for macro invertebrate identification. These data build on existing samples acquired in the soft sediments taken at both of the previous surveys using similar devices. All samples were sieved using a 1mm aperture mesh with all invertebrates recovered, identified and counted.

Mapping of biotopes along the shore was undertaken using techniques developed by the SensMap project using Emblow *et al*. (1998) and Davies *et al*. (2001). Marine inter-tidal biotope mapping was based on the use of aerial photographs to map the distribution and extent of possible habitat changes and biotopes according to Marine Nature Conservation Review (MNCR; Connor *et al*., 2004). A 'wireframe' map was generated by delineating distinct features from the aerial photograph which were later ground-truthed onsite. Survey operations were generally conducted two hours either side of low water spring tides where possible.



Environmental Sample Positions within the Sruwaddacon Estuary (RSK, 2007 & Ecoserve 2007)

Figure 14.1

File Ref: MDR0470GrEIS007 RevA03
Date: May 2010

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Also in 2007, RSK completed a regional environmental assessment of the entire Sruwaddacon Bay system (including Curraunboy Bay, which is located to the north of Sruwaddacon Bay). All work in the inter-tidal and sub-tidal areas was performed using a GPS positioned hand-held personal data assistant (PDA) with pre-loaded sample locations and possible habitat changes identified using recent aerial photography.

Seabed sampling was undertaken in both the inter-tidal and sub-tidal zones by taking triplicate samples at all stations using a small Van Veen grab sampler (combined area of $0.09m^2$ and a penetration of 10cm). A further sample was acquired and sub-sampled for particle size or chemical analysis. In total, 49 stations were sampled using grabs within the estuary area, as shown in Figure 14.1 (RSK, 2007), along with additional shallow sub-surface core samples at six of the locations. These were acquired using a 1m stainless steel corer with a removable plastic inner sleeve of (inner diameter - 50mm).

Cores were taken on an opportunistic basis to provide a coarse appraisal of homogeneity of near-surface sediments. The densities of the lugworm (*Arenicola marina),* a large macro-invertebrate species which burrows too deep to be effectively sampled using the grab, was also assessed at each location, when surveyed on foot, by carrying out a count of surface casts within a $10m^2$ area (Plate 14.1).

Plate 14.1 *Arenicola marina* beds near Pollatomish Pier.

The very shallow nature and extensive inter-tidal area meant that access to the site by both personnel and vessels, was limited. Consequently survey operations were carried out using a relatively small and easily transportable grab type sampler (Van Veen) which has a surface sample area of $0.03m^2$. This device generally limits penetration to between 5 and 10cm for many of the sites, missing larger animals, such as the lugworm (polychaete species *Arenicola marina*), which are able to burrow deeper. Consequently additional counts of casts were carried out at each sample point to allow for this factor. The aperture mesh size of 1mm used in the macro-invertebrate sampling was chosen to reflect the granular nature of the sediments recovered over much of the estuary. A greater number of macro-invertebrates would have been recovered if a finer 500µm mesh had been employed.

More comprehensive surveys of the sediment macro-invertebrates were carried out within the Srwuaddacon in subsequent years, with samples based on a larger surface areas ($0.25m^2$), a deeper surface penetration (15-20cm depth) and a combination of both coarse and fine aperture meshes (1000 and 500µm; Wilson 2007_1 and 2010_1). These indicated that approximately twice the number of individuals and a few more species are recorded if a finer 500µm mesh is used, although the overall biomass of this proportion is generally only a few percent of the total population due to the smaller size of the animals (Wilson, 2007_2). This was further confirmed by a later survey which was undertaken at 16 sites located throughout the bay in areas of exposed sand banks during periods of low water by RPS within the estuary (Wilson 2010_1). These sites were delineated to reflect areas identified by recent ornithological observations as banks routinely used by over-wintering birds. Sampling was undertaken to reflect both a vertical separation of the surface 5cm from the underlying 5-20cm, as well as a size separation of both 500 and 1000µm for each of these depths. Results showed that whilst 63% of the total macrofauna were recorded above 1mm, this proportion constituted over 91% of the biomass. The proportion of this material available to waders in the surface 5cm was equivalent to an average of 46% of the total fauna recorded by both number and biomass, although a high standard deviation of around 28% showed that this value varied from site to site dependant upon the variability of some larger faunal species (typically the cockle *Cerastoderma edule*, Wilson 2010_1).

In addition to macro-invertebrate analysis, biotopes were mapped based on the methodology used in Wyn *et al.* (2006), principally based on identifying the sediment type and algal characteristics, as well as diversity and abundance of the significant fauna present(RSK, 2007). Biotope notes were recorded directly onto a personal data assistant (PDA), using the device to position the key boundaries between sediment changes identified within the aerial photography, and concentrating in key areas where possible routes may cross the estuary. Provisional classifications of habitats were made in accordance to Connor *et al.* (2004) using a combination of field observations grain size analysis and macro-invertebrate assemblages present. Larger megafauna and epifauna were recorded by examining hard surfaces, looking on the undersides of rocks and seaweeds and by digging small holes and obvious burrows in addition to qualitative counts and biomass measurements (Wilson 2007, 1 and 2010_1).

14.2.2.2 Benthic Survey Data Limitations

Sruwaddacon Bay estuary is a dynamic transitional ecosystem which is continuously swept by the semi-diurnal tidal cycle along its entire length. As such, a general understanding of the oceanographic and geomorphological conditions is required for the whole estuary, in addition to site specific habitats recorded along the proposed route. Whilst the survey was undertaken in accordance with MESH and MNCR standard habitat mapping practices, large areas of generally homogenous environments were classified with relatively few samples, with the possibility of small or subtle variations on some sites remaining unrecorded.

The main benthic survey undertaken in 2007 within the bay exhibited some limitations to the data due to small sample area and shallow penetration where vertical migration of some more mobile species during prolonged periods of sand exposure, may have occurred. This was only likely in areas where the underlying redox discontinuity layer (a depth in the sediment where the aerobic respiration ceases due to the lack of oxygen) was below the depth of the sampler, observed at only one station recorded in an exposed sandbank towards the downstream part of the bay.

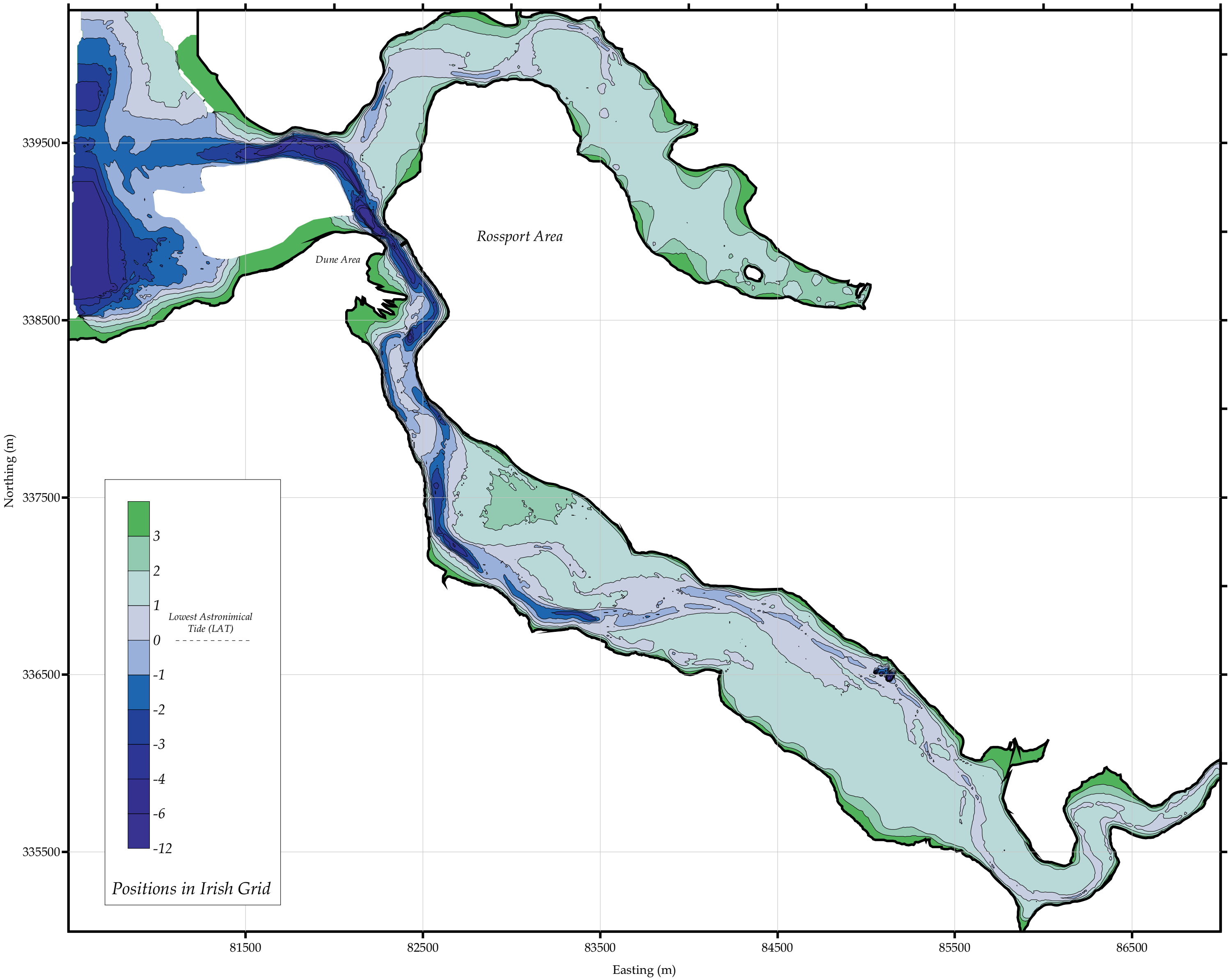
14.3 EXISTING ENVIRONMENT

The following sections describe the existing environment in terms of geomorphology and benthic environment (physico-chemistry and macro-invertebrate community), habitat and biotope in Sruwaddacon Bay, while Sections 14.3.2 and 14.3.3 provide details on the lower and upper estuary. Further details on these aspects are provided in Appendix L.

14.3.1 Sruwaddacon Bay

14.3.1.1 Geomorphology

A geophysical survey of Sruwaddacon Bay (Osiris 2007) was undertaken to provide information on the bathymetry, surface sediments, near surface geology and the presence of metallic contacts within the survey area in order to assist with the selection of a route through or beneath the bay. The results of the survey are discussed for this purpose in Chapter 15 of the EIS. The resulting data were also used to provide geomorphological charts of Sruwaddacon Bay as a whole which forms the physical basis for habitat mapping, as well as showing oceanographic influences on the sediments within the survey area.



Bathymetric Representation of Sruwaddacon and Curraunboy Bays

Figure 14.2

File Ref: MDR0470GrEIS008 RevA03
Date: May 2010

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Geophysical data showed the majority of the estuary to be dominated by marine sands with a clearly defined channel meandering the length of the estuary around extensive sand flats from the neck of the estuary to the confluence of the Glenamoy and Muingnabo rivers. Bathymetric data, acquired using a combination of both marine and terrestrial survey techniques, along with interpolation from aerial photographs showed that a large proportion of the site consisted of shallow sand flats of very shallow depth at high water (see Figure 14.2). These data show that the majority of the sand flats within the bay are found between the +1m and +2m relative to chart datum (CD or the point of the lowest low water tide), meaning that much of the area is exposed around mid-tide (approximately +1.9mCD). Following the course of the channel from the river confluence in the southeast, the main channel periodically fragments and recombines at a number of points with the channels varying from 30 to 100m in width during periods of low water. Additionally, the depth of water within this channel generally ranges from -0.6mCD in the south, to -4.1mCD in the central part of the bay, although there are a number of areas that technically dry out at extreme low water periods (and would be totally dominated by riverine freshwater flows during extreme low water times).

At the constriction, in the western part of Sruwaddacon Bay, two smaller channels merge back into a larger flow approximately 100m across, which is bordered by a build-up of granular sediments along the western side of the shoreline. Here, channel bed levels fall to -5.0mCD, before the channel veers slightly northwest and becomes very narrow (approximately 60m). Here the bed level drops to its deepest point in the system (-11.0mCD). Once past Ros Dumhach (Rossport) Pier on the east bank, the course alters direction to the west at the convergence with the mouth of the Curraunboy Bay, and a bed level rises back to between 0.0mCD and -6.0mCD (average level of -1.5mCD), which is maintained until it enters the eastern part of Broadhaven Bay.

The geomorphological data (a combination of seabed morphology and reflectivity; (see Figure 14.3)), shows the surface geology is dominated by granular sediments. These are a combination of reworked medium to fine marine sands in the central part of the bay, and mixed gravel deposits derived from glacial tills and weathered bedrock deposited at the margins or in areas of stronger current flow.

This is highlighted in the mouth of Sruwaddacon Bay, where the base of the channel is made up of sandy gravels, bordered by bank deposits (mainly gravels and mixed sediments) or gravely sands. Once into the central part of the estuary, the gravel areas are limited to the bank deposits in a thin perimeter, generally 30m to 50m wide, bordering the margins between the mid and high water marks on the foreshore. No rock outcrops were identified within the bay with the exception of those recorded on the eastern bank of the estuary’s northern mouth.

Plate 14.2: Mega-rippled bedforms in lower Sruwaddacon Bay

In addition to sediment variations, a large number of mega-rippled bedforms were recorded over much of the sands (Plate 14.2). These are caused by strong currents or areas of wave action, indicating that the sediments are dynamic and continuously being reworked by the overlying water movement. This produces sediments that are non-depositional environments where silts, clays and very fine sands are continuously winnowed away leaving larger granular sands. The larger, more clearly defined features were recorded close to or within the main channel where current flows are greatest, whilst sandbanks in the southern half of the bay showed generally featureless or very minor rippled bedforms, indicative of lower current speeds. The largest features were recorded on the seaward facing sand bank orientated from E – W (indicative of north –south currents). Here, some of these features had a height of 0.5m and average wavelengths of between 5.0m and 15.0m; easily discernible from aerial photography. A cross-section of these bedforms confirmed a dominant southerly or flooding flow (I.Wilson observations). This is supported by hydrodynamic modelling discussed in Section 14.7.

14.3.1.2 Benthic Environment

Physico-chemistry

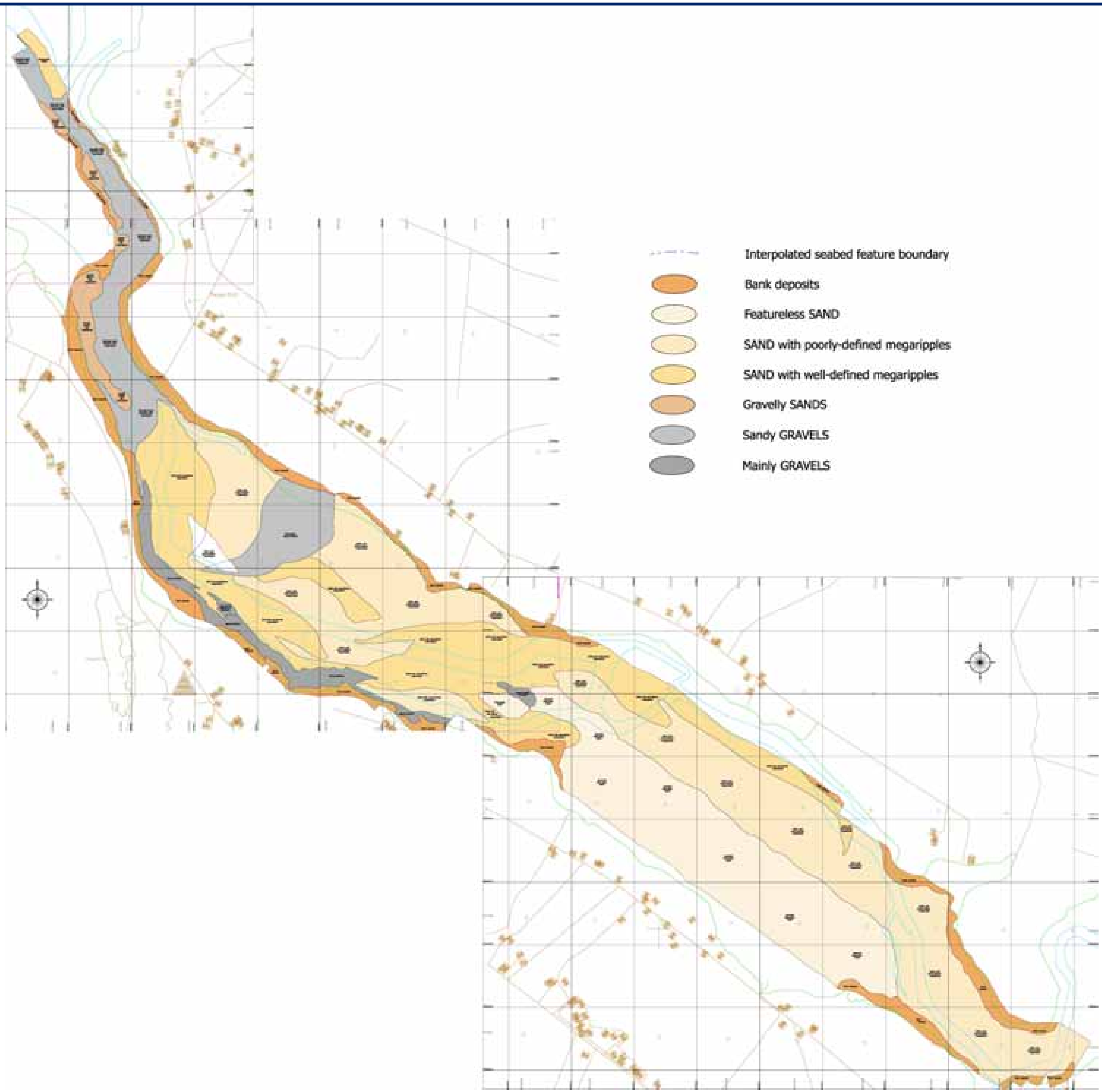
The combined field environmental surveys acquired seabed sediment samples from a total of 62 sample sites within the inter-tidal and sub-tidal areas of Sruwaddacon Bay from the east of Broadhaven Bay to Glenamoy and Muingnabo River confluence (Figure 14.1; RSK 2007, Ecoserve 2007, Wilson 2010_1). Samples acquired were processed for a number of different factors relating to macro-invertebrate, chemical or particle size analysis based on location within the bay or river. Physico-chemical analysis was carried out by the Environment Agency in the UK, accredited to UKAS, whilst the macro-invertebrates were analysed by Hebog Environmental Limited in North Wales, who are members of the NMBAQC quality assurance scheme, and Ecoserve Limited. The survey in 2010 was processed by Benthic Solutions Limited for particle size analysis and macro-invertebrate analysis, both tests accredited within the NMBAQC quality assurance scheme.

Particle Size

Physico-chemical properties of the sediments within Sruwaddacon Bay are discussed in detail within Appendix L. Particle size analysis, carried out on all stations sampled in 2007 and 2010, looked at ten or more size classes and were classified according to Folk (1954) and their relative contents of gravel (>2mm), sand (>63µm to 2mm) and muds (<63µm). Results showed that the vast majority of surface sediments were classified as sand (with grain sizes between 63 and 2000µm) (Figure 14.4). This generally reconciles the seabed features chart (Figure 14.3), which showed a predominance for high energy sands throughout the Bay.

Gravels remained unrecorded in most areas with the exception of sites at the base of the main northern channel or within the bank deposits along the margins of the bay proper, where the bay is bordered by glacial till and/or weathered bedrock deposits at the high water mark. The largest proportion of gravels recorded during the survey was seen at a station within this upper zone (at 71.7% of sediment >2000µm). These larger gravels, support a significant biological community, and further stabilises the upper interstitial material which consequently also shows significant percentages of finer sediments (<63µm).

Throughout the main part of the bay, sediment fines were generally absent or very low, although elevated fines were recorded at a few sites further upstream, within inlets or high up on the shoreline where currents are slow. This pattern of distribution was also reflected in the proportion of total organic carbon (TOC). Often directly associated with the proportions of silts and clays, the TOC levels within the sediments were generally low with the majority of stations recording levels below 1%, falling to below detectable limits (0.01 to 0.1%) at a quarter of sites in the seaward half of the bay. The highest levels of organic carbon (around 2.1%), were recorded high up on the shoreline or within the silty mixed bank deposits, with a moderate level recorded outside of Sruwaddacon Bay in eastern Broadhaven Bay (around 1.5%). The levels of TOC found throughout the survey were lower than might be anticipated for an estuarine environment, where muddy sediments generally carry higher organic loads. Locally, these were lower than levels recorded during a similar survey within the Inner Broadhaven Bay, where most sites recorded levels greater than 2.6% (Aqua-Fact 2004), or in the outer Broadhaven Bay area (RSK 2007_2).



Seabed Features Chart of Sruwaddacon Bay

Figure 14.3

File Ref: MDR0470GrEIS009 RevA03
Date: May 2010

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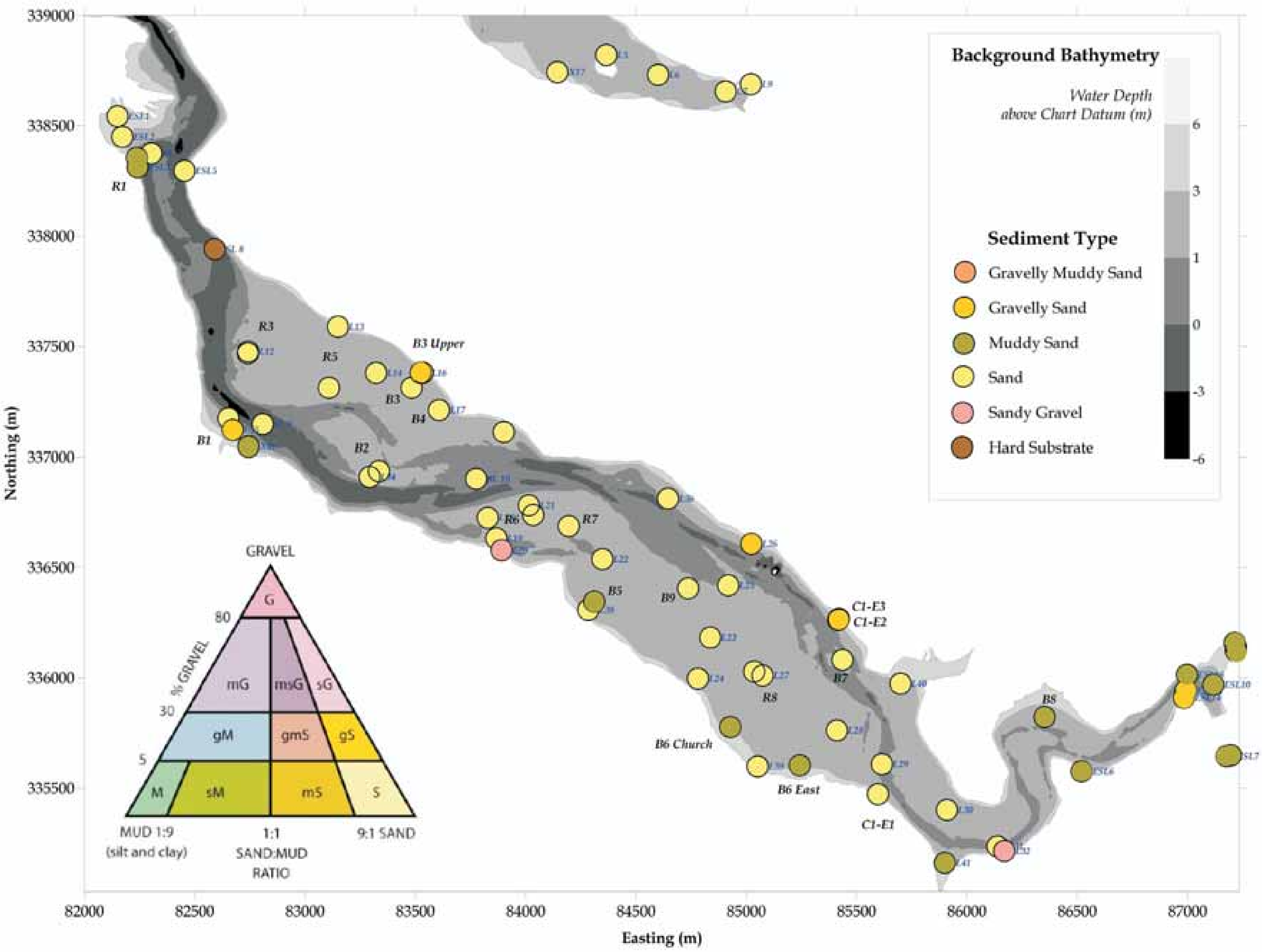
Chemical analysis for sulphides, the product of anaerobic respiration, heavy and trace metals and sediment hydrocarbon were analysed on sixteen surface and three sub-surface samples taken from within Sruwaddacon Bay (RSK 2007). Samples selected for additional chemical analysis were based upon a broad geographical coverage of the main Bay.

Sulphides

The results showed undetectable levels of sulphides at 9 out of the 16 surface stations indicative of well oxygenated surface sediments. Of the remaining 6, the four highest concentrations were recorded high up on the shoreline within mixed sediments, or within the mouth of the Glenamoy River and central part of the estuary.

Heavy and trace metals

For heavy and trace metals, elements of the greater potential for toxicity have been compared with Ecotoxicological Assessment Criteria (EAC) proposed by OSPAR (2000). EACs are defined as concentration levels of a substance above which concern is indicated. Table 14.1 shows a summary of metal results for sites within the bay and a comparison with the EAC limits where relevant. For the most part, all metals recorded within Sruwaddacon Bay recorded relatively low concentration at or below the lower OSPAR EAC limit. This was particularly so for the sediments found within the central sands and at the northern, downstream end of the estuary where currents were strongest. Only stations in the mixed sediments, on the upper foreshore or located within embayments, particularly towards the upper river mouth, regularly indicated elevated levels above those of the rest of the bay, but still within the OSPAR EAC limits.



Surface Sediment Types within the Sruwaddacon and Curraunboy Area (Classified according to Folk (1954), colours as per BGS classification)

Figure 14.4

File Ref: MDR0470GrEIS010 RevA03
Date: May 2010

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Table 14.1: Heavy and Trace Metals within Sruwaddacon Bay

Metal	Range (mg/kg)		
	Sruwaddacon Bay	Lower EAC	Upper EAC
Mercury	<0.05	0.05	0.5
Cadmium	<0.1	0.1	1
Silver	<10	-	-
Copper	<0.1 to 4.03	5	50
Arsenic	1.44 to 11.7	1	10
Lead	1.72 to 13.8	5	50
Chromium	4.11 to 11.7	10	100
Zinc	3.93 to 36.1	50	500
Nickel	0.78 to 6.62	5	50
Tin	<20	-	-
Aluminium	672 to 6,560	-	-
Barium	5.3 to 34.3	-	-
Iron	2,440 to 24,200	-	-
Manganese	<0.05 to 224	-	-
Lithium	1.43 to 15.9mg	-	-

This pattern of distribution reflects the influence of the hydrodynamics and the river on the bay. Areas close to the river show lower current speeds (see Section 14.7) and a greater influence from riverine suspended materials which are deposited high up on the water line and within sheltered inlets and embayments. These mixed and/or finer sediments act as a sink for the low level contaminants that are flushed into the marine system remaining locked within the substrate. Conversely, in the centre of the bay and towards the north, the strong tidal flows rework the sands winnowing away fines and the contaminants that they carry. Statistically, this can be clearly seen with correlations between these chemical parameters (Appendix L), where a clear correlation ($P<0.01$) exists between the matrix metals of aluminium and barium and all of the other physico-chemical properties of the samples with the exception of arsenic and manganese.

The overall concentrations of trace metals recorded in Sruwaddacon Bay were generally of the same order as those recorded within Broadhaven Bay, with the exception of cadmium and copper, which were marginally higher in the open water environment (RSK 2007_2). Concentrations of metals in both Sruwaddacon Bay and Broadhaven Bay are low, reflecting an area which has been subject to relatively little anthropogenic influence.

Total Petroleum Hydrocarbons

Concentrations of Total Petroleum Hydrocarbons (TPH) in the surface sediments were generally quite high ranging from 11.2 to 238 mg/kg. The majority of surface sediments sampled fell below the level of 100ppm, an action level for possible harmful environmental effects, used by regulatory authorities in the UK (i.e. CEFAS). The highest levels of TPH, recorded above this threshold were found in an upper part of the estuary where levels of metals, TOC and sediment fines were also elevated. A significant correlation between TPH and some of the metals and physical sediment parameters indicated that TPH, as a polarised complex organic molecule, had become bound within clays of the depositional environment found at these sites. Nevertheless, the overall TPH recorded during the whole survey were notably higher than compared to previously analysed offshore survey samples (i.e. Broadhaven Bay; which ranged from 5.8 to 13mg/kg, RSK 2007_2). A brief review of the laboratory method (undertaken by the Environmental Agency, UK) revealed that a variation in the way TPH was analysed may have resulted in a broader organic fractions being represented within these results.

A brief assessment of sub-surface sediments within the main part of the bay using shallow cores to a depth 1m, revealed homogenous surface sands at all sites sampled with the exception of one close to the bank deposits, where sub-surface gravels were recorded. This highlights the fact that the coarser substrates recorded along the upper shoreline continue into the bay beneath the surface sand layer.

This is discussed in more detail in Chapter 15. Physico-chemical analysis of the base from these cores equally confirmed a relatively homogeneous environment. Only the metal arsenic recorded marginally higher concentrations than those recorded on the surface with an insignificant maximum of 10.3mg/kg. As with the surface samples, the cores showed a pattern of marginally higher levels within most parameters progressively upstream.

Macrobenthos

The benthic macro-invertebrate community was quantitatively assessed over the whole of Sruwaddacon Bay area using a small grab sampler, small corer or large template in both the inter-tidal and sub-tidal areas. Samples were sieved using either 0.5 or 1mm aperture mesh (RSK 2007, Ecoserve 2007, Wilson 2010_1). Deeper dwelling macro-invertebrates, such as the polychaete lugworm (*Arenicola marina)* were further assessed via additional counts of surface casts within a 10m^2 (RSK, 2007). The diversity and abundance of the biological communities within estuarine soft sediments provides an important source of food for larger predatory fauna (such as birds, fish and some mammals) throughout the year.

In general, the biological abundance and diversity were low, as expected for a higher energy estuarine environment (Elliot *et al.*, 1998), where a predominance of moderately sorted marine sands and few fines provide a relatively homogenous niche for the infaunal community (Figure 14.5). Of the 62 stations analysed for biology within Sruwaddacon Bay, the total abundance of individuals ranged from 11 – 6,272/m^2, although the greatest abundance was recorded at three stations located high up in the estuary which recorded considerable numbers of either the polychaete *Tubificoides benedeni* or oligochaete annelids, thought to be a result of freshwater inputs at those sites, or the crustacean *Corophium volutator*. Low abundances were recorded over the majority of the sand flats (ca. <900/m^2) with very low abundances (<250/m^2) recorded within the sub-littoral channel sites. These reduced populations indicate the high energy sand environment within the channel and increased freshwater influences during low water times. These can be compared to the higher faunal abundances (average number of individuals of 2,850m^2) recorded in Inner Broadhaven Bay, close to Béal an Mhuirthead (Belmullet) by Aqua-Fact in 2004.

Following identification, the biological species from the RSK survey underwent statistical analysis using a variety of univariate and multivariate techniques in order to establish patterns and correlation both within the faunal population and with other environmental variables recorded at each of the stations (Table 14.2 and Figure 14.5). A full list of species along with the results are included in Appendix L.

Table 14.2 Range (Mean) of Univariate Statistics for Macro-invertebrates in Sruwaddacon Bay

Site	No. of Species	No. of Individuals m^2	Pielou's Evenness Index (J')	Shannon-Weiner Diversity (H)	Simpson's Dominance Index (λ)
Outer Bay	9-11(10)	356-689 (522)	0.47-0.82 (0.65)	1.04-1.96 (1.50)	0.21-0.55 (0.38)
Channel lower estuary	2-9 (5.2)	56-700 (222)	0.68-0.99 (0.87)	0.68-1.67 (1.27)	0.21-0.51 (0.34)
Adjacent to the channel	5-7 (5.5)	89-1,911 (575)	0.21-0.97 (0.70)	0.33-1.88 (1.21)	0.16-0.87 (0.43)
Central sands	1-14(7.2)	11-2,344 (837)	0.34-1.00 (0.61)	0-1.89 (1.05)	0.25-1.00 (0.51)
Inlets and sites of mixed sediments	5-14 (8.9)	167-3,556 (1,468)	0.44-0.80 (0.66)	1.02-2.02 (1.40)	0.19-0.59 (0.35)

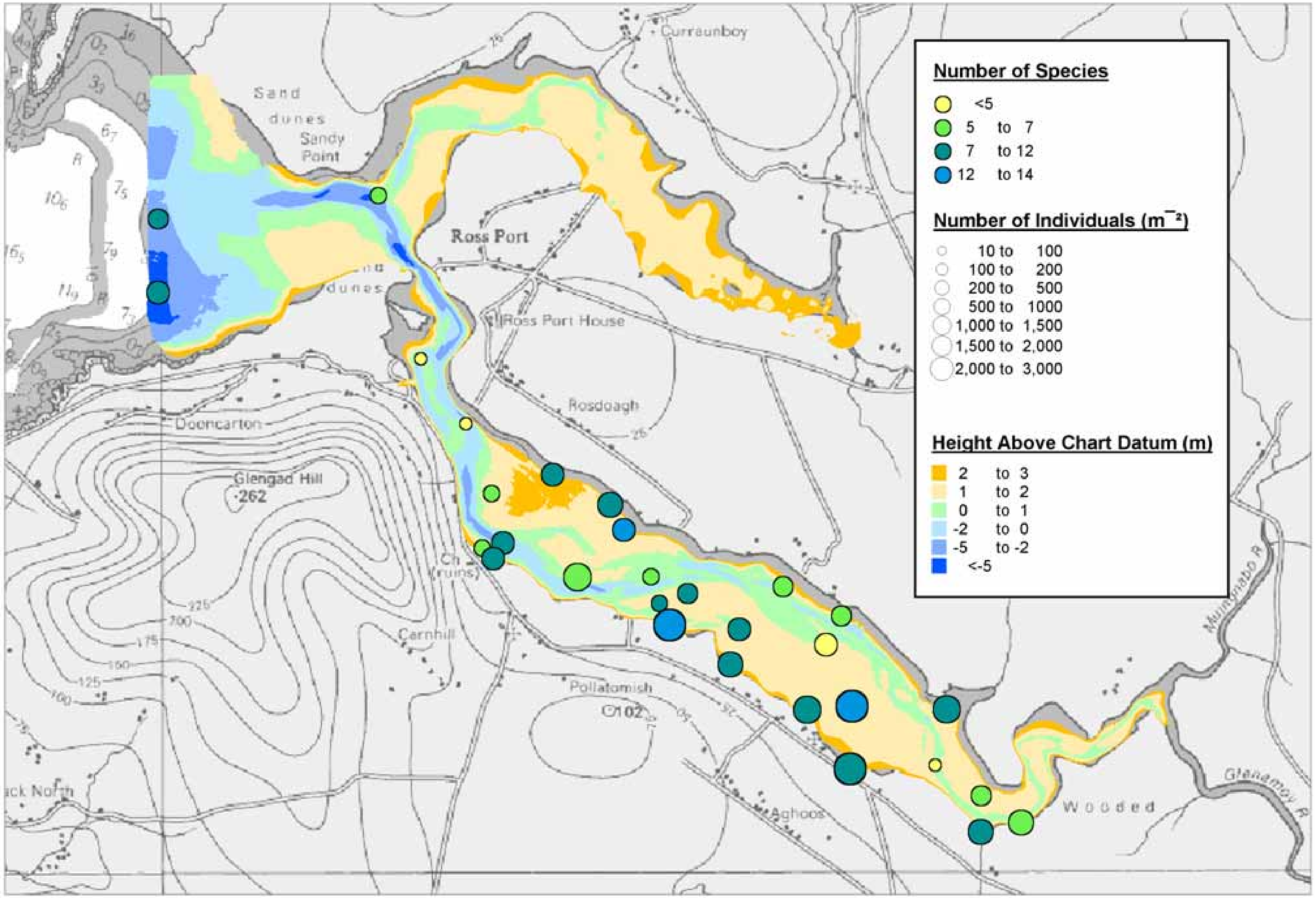
Statistically, the pattern of the macrofaunal community is complicated but generally reflects the sediment type, position relative to the channel and freshwater influences. In general, a pattern of lower diversity and abundance close to the main channel can be seen. In 2007, the species numbers were low (below 12) for the majority of sites with the highest number of species (14) recorded at two stations close to the upper shoreline where the seabed showed mixed sediments. Two stations in the central channel of the upper estuary gave exceptionally low numbers recording only one or two species. These can be compared to the slightly finer sediments recorded within the Inner Broadhaven Bay, which indicated a generally greater richness 4 – 18 species for a sample area a third of the size (Aqua-Fact, 2004). Subsequently, the diversity indices for Sruwaddacon Bay were also very low at the majority of sites. The highest diversity was again found within the mixed sediments high up on the shoreline. A similar pattern was observed in the later detailed study of the main sand banks undertaken by RPS in 2010. This also showed very poor macrofaunal population of <300 individuals/m^2 and a gradient of increased biological numbers in areas where tidal energy is limited, such as the upper parts of the tide and embayments were the proportion with of fines are increased (Wilson 2010_1).

Numerically dominant species were not evenly spread throughout the survey area as they were found to be absent in many of the samples (RSK 2007). Broadly, the biological community reflected the exposed to moderately exposed inter-tidal estuarine sand flats (Elliot *et al*., 1998). The population was dominated by annelid worms, comprising nearly 75% of all animals recorded in 2007 and 61% in 2010. Polychaetes constituted 55% of these with *Ophelia rathkei and* a single spionid, *Pygospio elegans* accounting for 7% and 31% of all individuals, respectively, (although often unevenly distributed). Oligochaete annelids were only recorded in inter-tidal stations, but accounted for fewer than 20% of all individuals, with *Heterochaeta costata* responsible for half. Overall percentages of other faunal groups found included Crustacea at 10% (around 32% of total individuals in 2010) and Mollusca at around 8% (6.5% in 2010). The most abundant crustaceans recorded, were gammaridean amphipods, predominantly of the species *Bathyporeia* and *Urothoe,* or in areas of greater fines, *Corophium* (RSK 2007 and Wilson 2010_1). These are typical characteristics of mobile, fine to medium sands.

In 2007, molluscs as a group, were generally unimportant (not occurring at any of the sub-tidal samples) with the mud snail *Hydrobia ulvae* comprising the vast majority of all individuals, although the occasional edible cockle (*Cerastoderma edule*) constituted the largest infaunal species found during the survey. This general pattern was repeated in 2010, although greater numbers of juvenile cockles were recorded at a number of locations relating to the base of partially eroded channels outside the main current flow. These were also accompanied by elevated numbers of other bivalves *Angulus tenuis* and *Retusa obtuse (Wilson 2010_1)*. Although seasonal variations cannot be ruled out similarities in the results between summer and winter records in 2007 (RSK, 2007 & Wilson 2007_1) showed little variation, suggesting that longer term variations in the faunal population may be to blame. Echinoderms remained unrecorded in any of the samples from both years, reflecting their preference for fully marine conditions.

Relationships between the biological communities of grouped sites were tested using a statistical Bray-Curtis similarity program (PRIMER, 2005). These showed weak clustering of the sites at approximately 30% or less. Therefore these groupings are made up of sites that were generally more dissimilar than similar to each other. This notwithstanding, a review of grouped similarities within the survey area revealed a clear separation between the Inter-tidal sites (cluster A) from those of the sub-tidal sites (cluster B) which were within or close to the main channel at the northern end of the bay (Figure 14.6). Here, the channel stations exhibited species typical of high energy sandy sediments such as the amphipods *Bathyporeia* and *Urothoe* and the polychaetes *Spiophanes bombyx* and *Ophelia rathkei*. The remaining inter-tidal sites were further separated into three sub-clusters which related to position in the bay, freshwater influences or sediments with mixed or significant greater silt/clay components. These sites were characterised by Nereid polychaetes, *Pygospio elegans*, oligochaetes and the gastropod mollusc *Hydrobia ulvae*.

Statistical analyses comparing the clustered groups of sites and other environmental variables showed poor correlations except with the presence or absence of sediments fines (<63μm). No significant correlations were observed between biology and any chemical parameters (i.e. metals, TPH or sulphide).



Species Richness (per site) and Abundance (per m^2)

Figure 14.5

File Ref: MDR0470GrEIS011 RevA03
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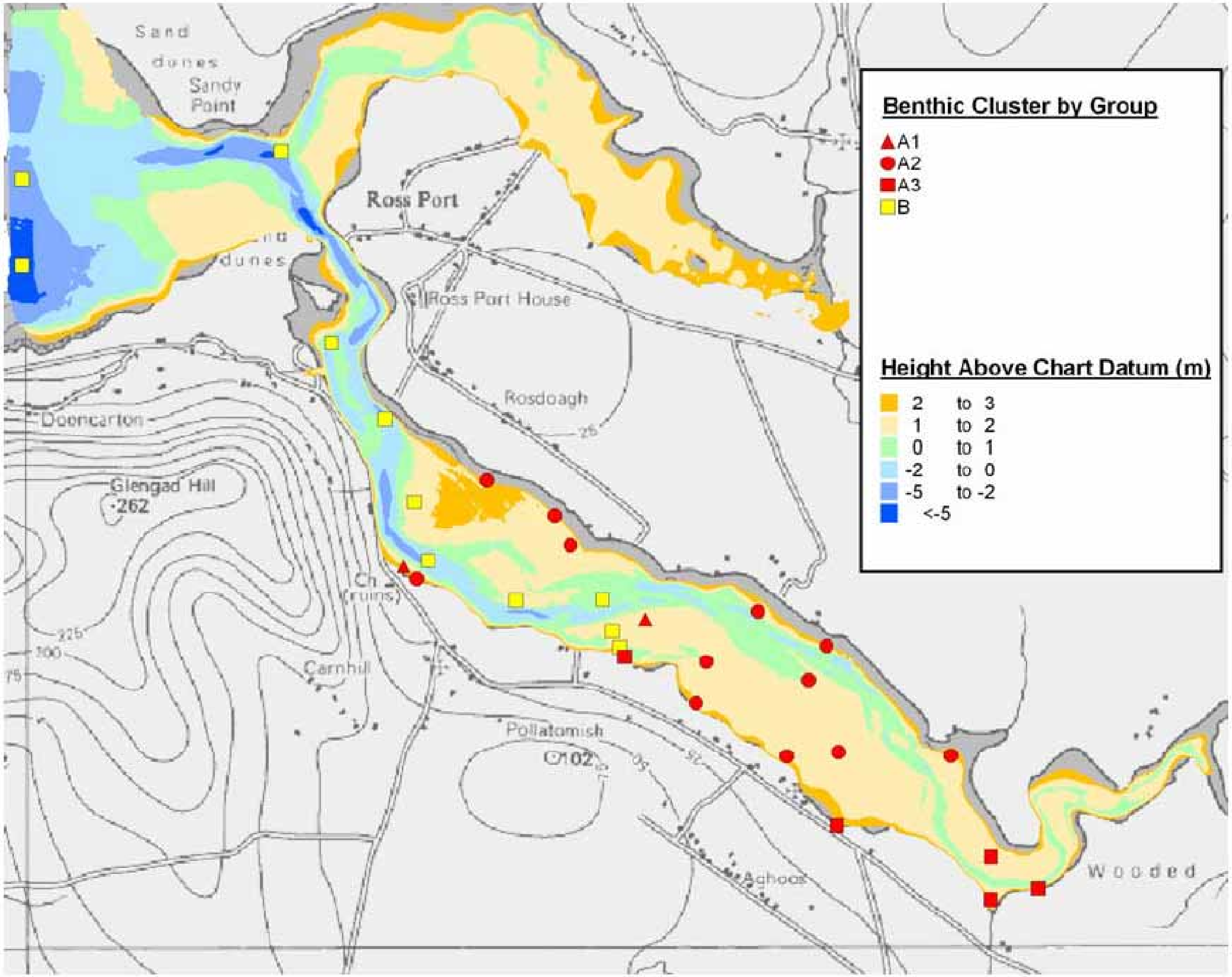
As the macrofauna constitutes an important food source to higher predators, both resident and transient, within Sruwaddacon Bay, an assessment of the macro–invertebrate biomass in the surface sediments over 1mm (considered to be the minimum size to be selected for predation) was measured quantitatively on all analysed samples using an ash-free dry weight conversion (outlined in RSK 2007, Wilson 2007_2 and Wilson 2010_1). For the earlier studies, the total biomass recorded throughout the bay was low at all sites, with values ranging from 0.003g/m^2, within the upstream channel, to 11.86g/m^2 recorded at the top of the bank in a downstream section of the bay. This can be compared to 0.15 to 11.5g/m^2 recorded in 2010 for a similar depth and minimum body size. Unlike abundance, the biomass of the bay was dominated by molluscs, and in particular the edible cockle (*Cerastodema edule*) contributing over 90% of the biomass at selected sites in 2007 and 85% in 2010. Molluscs accounted for around 75% and 48% for all sites combined in 2007 and 2010, respectively. The dominant polychaete taxa, contributed to only 19% of the biomass overall in 2007, with all stations recording less than 0.5g/m^2. This was partially due to the small size of macro-invertebrate recorded during the study and the general absence of the larger polychaete species, such as the burrowing lugworm (*Arenicola marina),* or the mobile ragworm (*Hediste diversicolor),* which can burrow down into deeper sediments and may live beneath the effective level of sampling thereby evading capture. In 2010, the proportion of biomass constituted by polychaetes had increased to 31% (2.13g/m^2), although the majority of this was due to very large numbers of *Tubificoides benedeni* in a few stations where lower tidal energies were encountered (Wilson 2010_1). In 2007, the existence of a very shallow layer of anoxic sediments recorded over most of the estuary would prevent any significant vertical migration by the ragworm (Wilson 2007_2). However, observations in 2010 suggested that the depth of this layer had universally increased slightly from that of the earlier study, also undertaken in the winter period (Wilson 2010_1). This may partially be due to the bioturbation by increased numbers of *Arenicola marina* recorded throughout the sands of the bay.

In 2007, significant populations of *Arenicola marina* were limited to clearly defined patches, in particular towards the upper shores and in areas where standing/surface water remained but generally avoiding gravels and upper-stream areas due to an intolerance to freshwater. The highest density of *Arenicola marina* was recorded at 40-45 individuals/m^2, recorded at a mid-tidal muddy sand and a relatively high organic content. However, by 2010, the number and coverage of *Arenicola* casts had increased significantly to cover most of the sands throughout the bay. The reason for this is uncertain but this fact highlights the natural variability in the macrofaunal population within the bay between survey years and through some seasons.

Epifauna on the Upper Shoreline

In addition to the biomass recorded within the sediments of the main bay and on the upper shore, the thin perimeter of mixed gravels found bordering the entire bay also supports a significant population of epifaunal species living amongst larger stones and within the fucoids (Wilson 2007_2 and Wilson 2010_1). Fauna in the upper sections of the bay were dominated by the gammarid crustaceans *Echinogammarus marinus* and *Gammarus zaddachi* although some molluscs, in particular *Littorina,* were a common genus particularly downstream where freshwater effects were less marked. In 2007, a calculation of the biomass showed a progressive increase from 0.33g/m^2 to 3.445g/m^2 (the south and north sides of the upper estuary) to 7.7g/m^2 recorded in the centre of the estuary (RSK 2007). This latter site recorded 11 species and over twice as many individuals (1360m^2) than found at the upper estuary during that year. Overall, epifaunal biomass was almost an order of magnitude greater than those recorded within the underlying soft sediments at similar locations. In 2010, the total biomass varied by a similar amount (from 0.56 to 7.57g/m^2) between stations, with the 12 species and 1048 individuals per m^2 recorded at the most abundant site, although far fewer molluscs were recorded on this occasion.



Geographical Locations of Clustered Communities

Figure 14.6

File Ref: MDR0470GrEIS012 RevA03
Date: May 2010

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Regional Habitat and Biotope

In addition to sediment sampling, a regional assessment of both the habitats and associated biotopes were mapped for the whole of Sruwaddacon Bay (RSK, 2007) using the methodology described by Wyn *et al.* (2006) (see Figure 14.7). Provisional classifications of habitats according to Connor *et al.* (2004) were made following field observations and later analysis of both sediment samples and macro-invertebrate communities. Further detail is provided in Appendix L.

The biological communities recorded within the estuary are clearly dominated by the physical processes occurring, principally:

1. the effect of tides; and
2. the input of freshwater from the Glenamoy River and numerous small tributaries dotted around the perimeter of the bay.

Sruwaddacon Bay is interesting in that all stages of the estuary, from small freshwater streams to fully marine conditions, are represented within a relatively small area. The high-energy nature of the large yet shallow bay has resulted in the sediments being dominated by moderately exposed sands with few areas of low-energy muddy communities, typical of most estuaries, confined to the upstream end of the bay and small inlets away from the main channel. No unusual or rare biotopes were recorded within the wet areas of Sruwaddacon Bay.

Habitat denominations within the upper inter-tidal areas around the estuary were relatively consistent, with few exceptions. Grass dominated (*Puccinelia* spp,) saltmarsh (EU Annex 1 habitat) was present around the majority of the upper inter-tidal zone of the estuary, typically as a fringe between terrestrial vegetation and marine habitats (dominated by algae). The saltmarsh is described further in Chapter 12. Tidal influences into this zone were often marked by a strandline of decaying fucoid algae, together with an associated community of talitrid amphipods. An exception to this foreshore, was the seaward end of the northern shore, where steep cliffs of bedrock mark the upper boundary with a zone affected by sea spray and encrusted by lichens (possibly *Caloplaca marina* and *Verrucaria* sp.)

Between the upper saltmarsh or cliff areas and the homogenous sands that make up the majority of the Bay's surface soils, a regular band of mixed sediments supported several discrete but regular communities, with the thickness of the band characterised by the upper tidal range and the gradient of the shore. Traversing down the shore, the upper saltmarsh or bedrock gave way to a succession of varying habitats. These start with the clean coarse gravels, associated crustaceans and upstream, where freshwater influences are greatest, the channel wrack (*Pelvetia canaliculata)*, marking the upper limit of the high water mark.

Below this a zone of often mixed spiral wrack (*Fucus spiralis*), bladder wrack (*F.vesiculosus*) and in areas near freshwater input, horned wrack (*F.ceranoides)* was attached to large cobbles and boulders. Regular downshore strips of the gutweed *Enteromorpha* sp. and occasionally sea lettuce *Ulva lactuca* were also common near freshwater inputs (numerous ditches and small gullies). Further down the shore, egg wrack (*Ascophyllum nodosum)* and the epiphytic *Polysiphonia lanosa* were dominant. Epifaunal species were common within the fucoids, and included winkles (*Littorina* sp.), amphipods, and occasional juvenile shore crab (*Carcinus maenas*). Further seaward (towards fully marine conditions), occasional limpets (*Patella vulgata*), mussels (*Mytilus edulis*), barnacles (*Semibalanus balanoides*) and, less frequently, anemones (*Actinia* sp.) occurred attached to boulders. Below this, sedimentary environments were recorded throughout the remainder of the estuary.

Soft sediments are difficult to delineate as they are prone to very gradual changes. Consequently, the separation of these areas was generally based on aerial photography, assisted by changes in analysed macrobenthos and particle size parameters. Due to an inability to survey all of the study area during extreme low water periods, some inter-tidal areas could only be characterised by aerial photographic records.

Sandy sediments dominate the bay. However, a small variation in habitat is recorded due to subtle changes in exposure from both channel currents and wave action. The most mobile sands were recorded in the seaward third of the bay which had granular, freely-draining medium sands and a relatively deep redox layer (up to 15-20cm). Well-developed bedforms (ripples and meg-ripples) indicated these areas to be subject to strong currents. Obvious fauna in these areas was sparse although higher numbers of lugworms (*Arenicola marina*) were recorded when compared to previous survey years. The majority of the remaining sands within the bay showed varying levels of rippling (some wave induced in the shallower areas), and the sand flats became less well drained south of Poll an tSómais (Pollatomish) Pier. Mixed sediments occurred at the margins of the bay, but showed varying levels of gravel and elevated fines. Some gravels in the channels of small freshwater streams showed reworking with fines winnowed away. These gave rise to fluvial deposits, inhabited by both *Enteromorpha* sp. alongside fucoids, reflecting the brackish conditions.

Large areas of anoxic muddy sediments, more typical of many low-energy estuaries, were limited to small sheltered embayment in the upper estuary. Here, there were shallow basins outside the main current flow and sheltered from wave action, which have become a depositional environment. The resulting sediments were soft and unconsolidated with a relatively shallow redox layer.

General Anthropogenic Influences on Sruwaddacon Bay Marine Habitat

The bay is regularly punctuated by small sources of freshwater inputs. Many of these emanate from small man made ditches to assist in drainage of neighbouring farm lands and cut over peat bog. These will introduce small quantities of farm related runoff from the catchment area into the marine system during periods of wet weather.

Items of debris are littered on the upper shore line predominantly along the northern shoreline of the bay. Although some of this material can be considered as general “flotsam and jetsam” which are blown onto the shoreline via the prevailing south-westerly winds, a large proportion of the debris relates to terrestrial based dumping. Particular items of note are derelict vehicles, domestic waste, collapsed buildings and general building related debris.

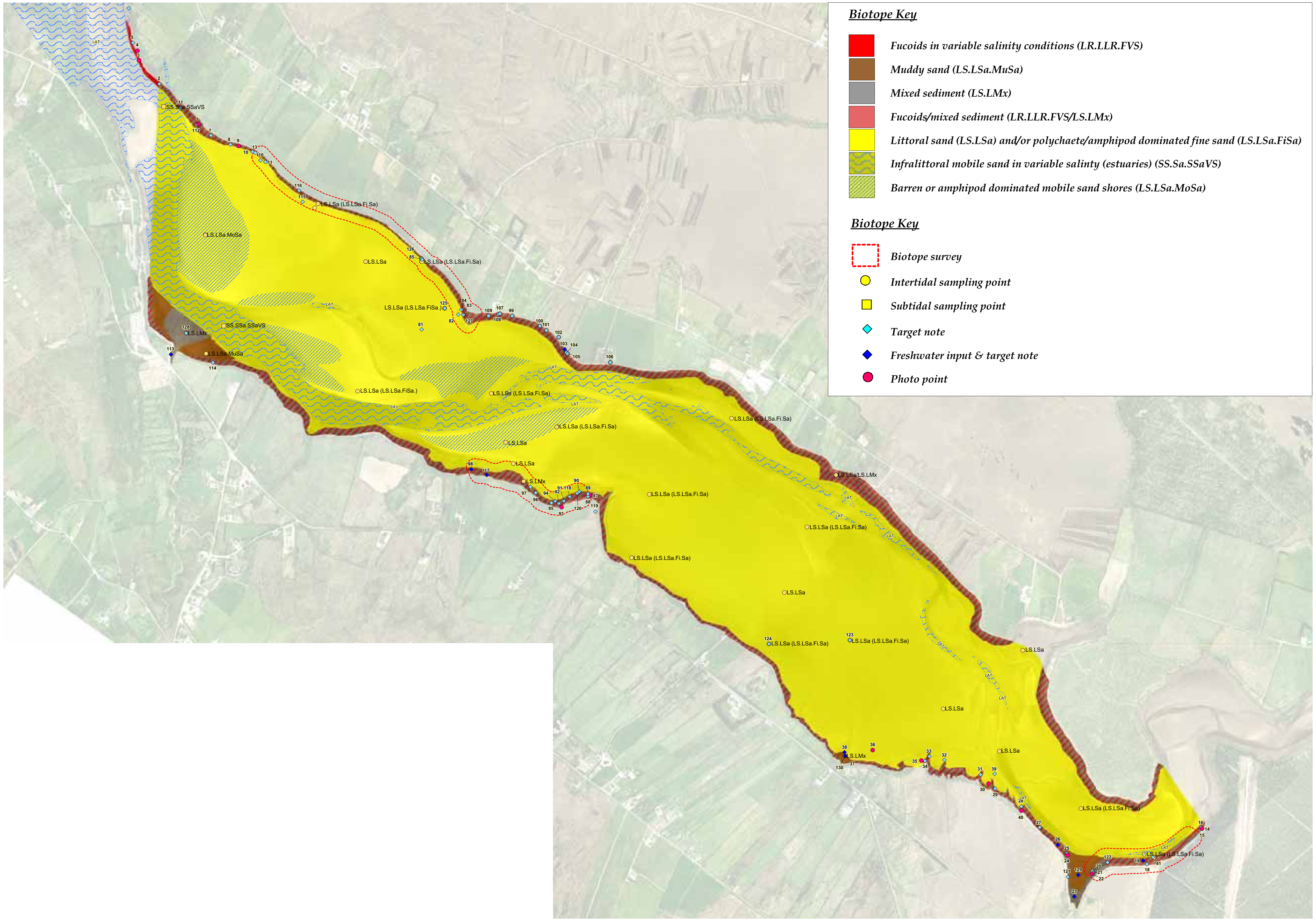
Other indicators of local anthropogenic disturbance are the grazing of livestock, fencing and the presence of vehicle tracks in the saltmarsh habitat (RSK, 2007). No bait collectors or recreational angling activity were observed during any of field studies, although locals were observed and are known to forage for shellfish (in particular for the mussel *Mytilus edulis* and the periwinkle *Littorina*) along the lower estuary, and the cockle *Cerastoderma edulis*) along the north-eastern shoreline of the bay. Several road/track access points lead onto the shoreline.

14.3.2 Proposed Pipeline Route

14.3.2.1 Geomorphology

The proposed pipeline route in Sruwaddacon Bay starts in the marine sector east of the landfall at Gleann an Ghad (Glengad) along the originally consented pipeline route (See Preamble). Consequently, this region of the bay has been subject to numerous survey activities, undertaken initially in 2000 and 2001, and revisited by Ecoserve in 2005, and again in 2007 as part of the current study to assess natural environmental changes at the site within the intervening years.

After the initial landfall, the proposed route passes into the natural narrowing of Sruwaddacon Bay. The western section is a shallow shelving sandy bay flanked to the south by weathered bed rocks and bank deposits and to the north by a reworked bank of both coarse and fine gravels. The bathymetric data (Figure 14.8) was unable to penetrate into the western bay due to its shallow nature. However, the main entrance of Sruwaddacon Bay was a classic channel feature with steep cut sides along the channel in the main flow, and a gently shelving inlet to the northwest. The proposed route starts at the top of the bay and follows the sandy part of the beach into a minor basin, approximately 1.1m above chart datum (CD), before following the alignment of the estuary and heading southeast across two shallow banks (ca. +0.8mCD) and a further channel (ca. -1mCD) at around 500m. Beyond this point, the seabed slowly rises until reaching the highest point on the main bank at +2.1mCD and 1000m. The route then tends to fall away slowly in steps but remaining above chart datum until the reaching the central channel at around -0.5mCD after 2100m. Another small bank at around +1.6mCD is encountered at 2300m, before passing over a relic channel feature at +0.9mCD at 2600m. The remainder of the route follows the main line of the upper estuary bank which remains at a consistent



Habitat and Biotope Map for the Sruwaddacon Estuary (RSK 2007)

Figure 14.7

File Ref: MDR0470GrEIS014 RevA03
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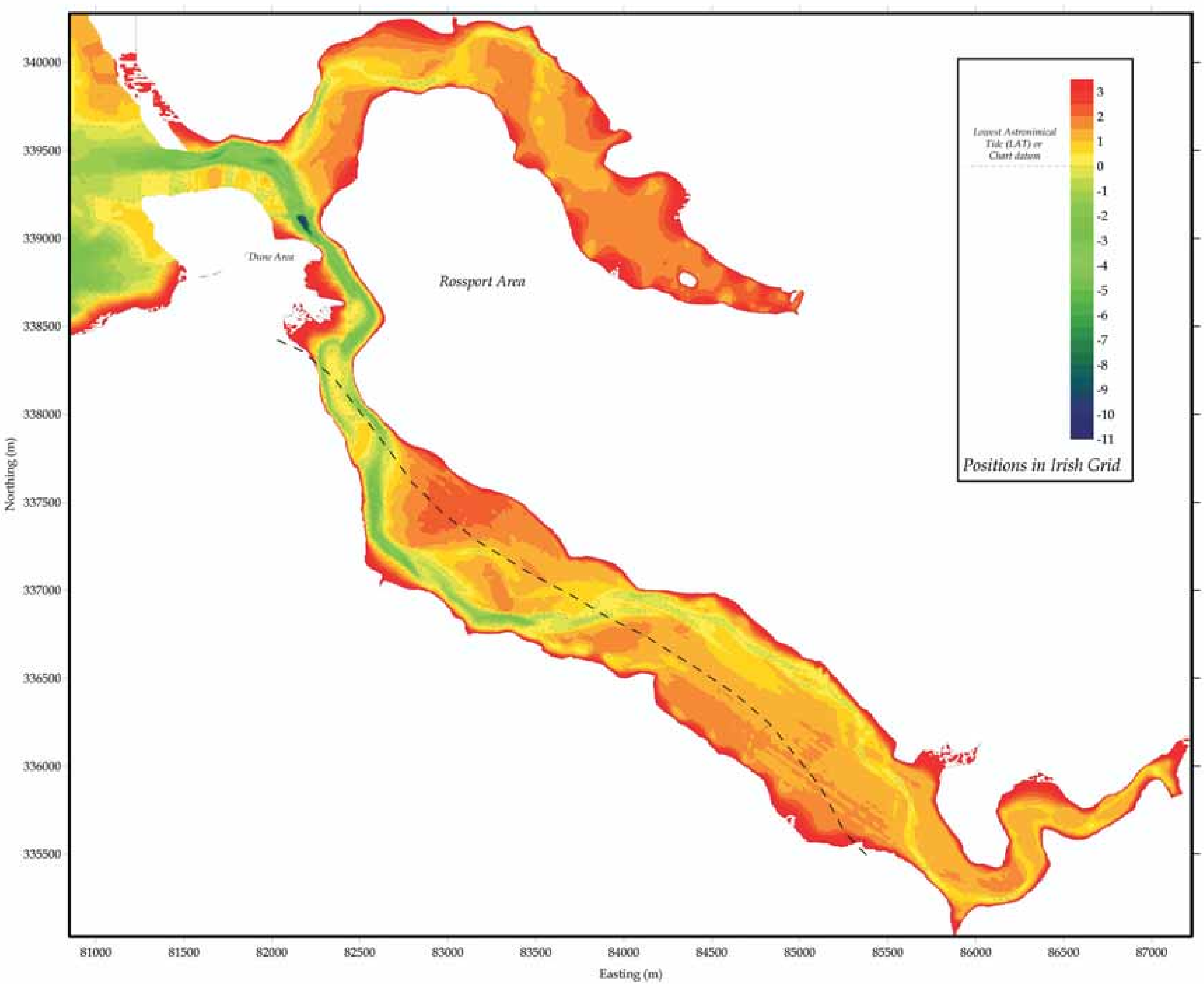
depth of around 1.5m above chart datum before encountering the rise of the bank and the edge of the upstream estuary after around 4200m.

Sonar data of the route indicated a mixed coarse sand and fine gravel passing into the initial channel. This quickly becomes a winnowed coarse rippled, sometime megarippled, sand through to the initial sand bank, before showing a slow transition to a finer sand along the remaining length of the route. No bedrock is expected, although small pockets of coarse gravels are expected along an isolated band on the lower foreshore on the upper estuary where the route leaves the estuary.

14.3.2.2 Benthic Environment

The western shore consisted of a fine muddy sandy bay between a raised cobble area to the north and a rocky shore to the south (Table 14.3), with a small stream running through the site. The extreme upper shore, dominated by grass and sea pinks (*Armeria maritime*) and amphipod burrows, were backed by a 0.5 m high peat 'cliff' to the west and a broad strand. In the north-west, the shore comprised muddy sand showing evidence of peppery furrow shells (*Scrobicularia plana)* and some *Ulva* spp. (*Enteromorpha* spp.). Below this was found the largest biotope in the area, characterised by *Arenicola* casts and the cockle (*Cerastoderma edule)* in muddy sand, becoming anoxic water-saturated muddy sand in the west with very few *Arenicola marina* casts and a small stream with an area of *Ulva* spp. (*Enteromorpha* spp.) covered rocks and muddy sands. In some areas an anoxic layer within millimeters of the surface was recorded down to the lower shore and the waters edge.

The reworked gravel bank to the east supported a green succulent and *Pelvetia canaliculata*, or the occasional area of fine sand with some *Ascophyllum nodosum* and *Fucus vesiculosus* attached to cobbles. A number of horizontal zonations were apparent within the coarser sediments with the fucoids *Pelvetia canaliculata*, *Ascophyllum nodosum*, *Fucus vesiculosus* and *Fucus serratus* dominant within the biotopes, along with a red filamentous algae.



Bathymetry of the Sruwaddacon

Figure 14.8

File Ref: MDR0470GrEIS021 RevA03
Date: May 2010

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Table 14.3: Summary of Habitat Zonation for the Lower Estuary (West Bank)

Shore	Habitat/Biotope	JNCC Code*
Upper	Talitrids on the upper shore and strand-line	LS.LSa.St.Tal
↓	*Hediste diversicolor*, *Macoma balthica* and *Scrobicularia plana* in littoral sandy mud	LS.LMu.MEst.HedMacSct
	Macoma balthica and *Arenicola marina* in littoral muddy sand	LS.LSa. MuSa.MacAre
Lower	*Fucus vesiculosus* on mid eulittoral variable salinity boulders and stable mixed substrata	LR.LLR.FVS.FserVS

* The Joint Nature Conservancy Council Phase 1 habitat survey methodology (JNCC, 1993).

The south of the bay was rocky backed by *Armeria maritima* and some peat, or high bank of rocky bedrock below farmland where the shoreline narrowed. Vertical zonation was apparent on the bedrock with lichen zones found below *Armeria maritime. Ascophyllum nodosum* and *Fucus spiralis* with patches of C*ladophora* spp. located on the upper shore, whilst *Fucus vesiculosus* and *Fucus serratus* were on the lower shore. Topshells (*Gibbula* spp.) winkles (*Littorina littorea*), limpets (*Patella vulgata*), barnacles, mussels (*Mytilus edulis*) and shore crabs *Carcinus maenas* were all recorded on rocks and amongst seaweed along this shore.

On the opposite eastern bank, the sheltered shore consisted of mixed cobbles and boulders with some sections of bedrock, backed by a steep rocky bank leading up to farmland (Table 14.4). *Armeria maritima* occurred above the upper shore, which was characterised by boulders and cobbles supporting the lichen *Verrucaria maura*. The cobbles below this supported a band of *Pelvetia canaliculata.* The mid-shore was dominated by *Ascophyllum nodosum* with *Gibbula* spp., *Patella lapillus*, *Littorina littorea*, *Carcinus maenas,* C*ladophora* spp. with barnacles and the anemones *Actinia equina* and *Actinia obtusa* were found on or around boulders. The lower shore was a zone of *Fucus vesiculosus* and attached epiphyte *Ceramium,* with patches of *Ulva* spp. (*Enteromorpha* spp.). Rocks in this zone supported barnacles and large patches of mussels (*Mytilus edulis*). Below this a zone *Fucus serratus,* along with *A. nodosum, Mastocarpus stellatus* and *F. vesiculosus* were found on mixed substrata with clumps of the mussel *Mytilus edulis* present on the rocks. Fauna included spirorbids on the fronds of *Fucus*, the limpet *Patella vulgata* and *Gibbula* sp, dog whelks (*Nucella* spp.) and a number of winkles including *Littorina obtusata* and *Littorina littorea*.

Table 14.4: Summary of Habitat Zonation for the Lower Estuary (East Bank)

Shore	Habitat/Biotope	JNCC Code
Upper	*Verrucaria maura* on littoral fringe rock	LR.FLR.Lic.Ver
↓	*Pelvetica canaliculata* on sheltered variable salinity littoral fringe rock	LR.LLR.FVS.PelVS
	Ascophyllum nodosum and *Fucus vesiculosus* on variable salinity mid-eulittoral rock	LR.LLR.FVS.AscVS
Lower	*Fucus vesiculosus* on mid eulittoral variable salinity boulders and stable mixed substrata	LR.LLR.FVS.FvesVS

The shoreline of upper part of Sruwaddacon Bay is backed by peat. The inter-tidal zone is similar in nature to the majority of the north coast areas (Table 14.5), with the marine area separated from the fully terrestrial environment by a low bank of earth and peat. The uppermost shoreline is characterised by a fringe of saltmarsh turf over thin soil and stones. Further down the shore there is a clear transition into a zone of cobbles and boulders. As with other areas along this part of the estuary, the littoral shoreline is marked by growth of the channel wrack *Pelvetia canaliculata* and *Enteromorpha* sp., characteristic of reduced salinity conditions (possibly as a result of freshwater seepage from the cliff and neighbouring farm land.

The boulders and large cobbles are characterised by an overgrowth of black lichen, possibly *Verrucaria maura*. Going seaward, macroalgae coverage becomes total with, firstly, a thin band of bladder wrack (*Fucus vesiculosus*), followed by a thicker band of egg wrack (*Ascophyllum nodosum*), attached to the cobbles and boulders. Fauna recorded within the fucoids comprised occasional epifauna, barnacle (*Semibalanus balanoides*), mussel (*Mytilus edulis*), and, less frequently, anemone (*Actinia equina*); mobile fauna included occasional limpet (*Patella vulgata*), frequent winkles (*Littorina* sp.), and frequent amphipods and shore crab (*Carcinus maenas*) under rocks. Beyond this band of fucoids over mixed sediment (e.g. cobbles, sand), the clear zonation of communities cease, and the soft sandy sediment of the majority of the Bay starts.

Table 14.5: Summary of Habitat Zonation for the Upper Estuary

Shore	Habitat/Biotope	JNCC Code
Upper	Saltmarsh	LS.LMp.Sm
↓	*Pelvetica canaliculata* on sheltered variable salinity littoral fringe rock	LR.LLR.FVS.PelVS
	Verrucaria maura on littoral fringe rock	LR.FLR.Lic.Ver
	Fucus vesiculosus on mid eulittoral variable salinity boulders and stable mixed substrata	LR.LLR.FVS.FvesVS
	Ascophyllum nodosum and *Fucus vesiculosus* on variable salinity mid-eulittoral rock	LR.LLR.FVS.AscVS
	Mixed Sediment	LS.Lmx
Lower	Polychaete/amphipod dominated fine sand shore	LS.LSa.FiSa

The lower shore was characterised by flat, stable sand, indicative of lower-energy conditions with a fine overgrowth of patchy filamentous green algae. Surface evidence of infauna was clear, with the occasional lugworm casts (*Arenicola marina*) and the large Maldanid polychaete (bamboo worm) also recorded.

The distribution of the dominant macrofauna varies with sediment type or proximity to the channels. Whilst samples within the upstream channel recorded very low numbers of individuals of freshwater tolerant crustacean *Bathyporeia elegans* and the rag worm *Hediste diversicolor,* the open sand flats are dominated by the small tube-dwelling polychaete *Pygospio elegans*. This was recorded at most sites with an abundance ranging from 133 to 2,130 individuals/m^2. Other top ranking species along the route are the annelids *Heterochaeta costata* and *Tubificoides sp*., the small mysid *Neomysis integer,* found generally on or close to the bank deposits and the gammarid *Corophium volutator*. Most other species were only represented by a few individuals at each site. A number of the species recorded, in particular the larger polychaetes, the mollusc *Hydrobia ulvae* and the crustaceans *Neomysis, Bathyporeia* and *Corophium* are all important food groups for birds feeding in the inter-tidal zone. However, the cumulative average of <100 individuals/m^2 recorded throughout area is considered low for this type of habitat, where waders are known to feed. For example the JNCC biotope for an estuarine mudflat with high numbers of ragworms (LS.LMu.MEst.HedMac) would typically record populations in excess of 1,000/m^2 for Hediste diversicolor alone (Conner, 2004). An additional study of the epifaunal macro-invertebrates within the coarser bank deposits (Wilson, 2007_2), indicated a small population of gammarid crustaceans living amongst the rocks, which would provide an additional food source for wading and foraging birds along this part of the upper shore equivalent to between 0.33 and 3.45g/m^2, although a significant proportion of these animals would be inaccessible to most birds due to the size of some of the stones.

Extensive surveys of the soft sediments (using cores, and quadrates) and hard substrates (via by quadrat counts) was undertaken in 2005 by Ecoserve, with additional sampling and walk-over surveys in 2007 (Table 14.6) and an additional site in 2010 (Wilson 2010_1).

Table 14.6: Sediment, Chemical and Biological Parameters along the Proposed Pipeline Route in Sruwaddacon Bay

Site	Easting	Northing	%Gravel	% coarse and very coarse sands	% medium to very fine sands	% Fines	Mean Size	TOC
ESL1	82150	338543	0	5.59	94.47	0	0.29	-
ESL2	82172	338450	0	6.53	93.50	0	0.3	-
ESL3	82241	338312	0	1.66	90.57	7.80	0.24	-
ESL5	82454	338296	0	4.60	95.36	0	0.3	-
SL7	82304	338375	0	64.13	35.86	0	0.61	1.70
R1	82238	338354	0	49.38	48.60	2.03	0.25	0.02
R3	82741	337468	0	73.23	26.77	0	0.32	<0.01
R5	83108	337312	0	47.84	48.20	3.96	0.24	0.04
R6	84035	336739	0	40.95	59.05	0	0.23	<0.01
R7	84196	336688	0	39.10	58.77	2.13	0.23	0.05
B9	84737	336406	0	41.78	56.18	2.05	0.23	0.22
R8	85036	336029	0	25.95	70.29	3.77	0.20	0.02
B6 East	85242	335604	0	20.79	55.25	23.96	0.11	0.89

Site	Easting	Northing	Sulphide	Al (mg/g)	Hg	As	Ba	Cd	Cr	Cu
L14	83322	337380	<20.0	1510	<0.0500	4.27	7.99	<0.100	4.79	<0.100
L17	83607	337211	<20.0	1140	<0.0500	4.3	5.34	<0.100	4.53	0.39
L22	84348	336538	41.2	2110	<0.0500	3.58	12	<0.100	5.62	0.51
L27	85074	336010	<20.0	2820	<0.0500	3.58	13.7	<0.100	6.69	0.83

Site	Easting	Northing	Fe	Pb	Li	Mn	Ni	Ag	Sn	Zn	TPH
L14	83322	337380	3900	1.8	4.06	<0.0500	1.73	<10.0	0.4	6.19	29000
L17	83607	337211	3020	2.12	2.09	<0.0500	1.35	<10.0	0.6	5.06	23800
L22	84348	336538	5830	1.84	4.13	<0.0500	2.37	<10.0	0.5	9.64	129000
L27	85074	336010	8810	2.13	4.68	5.45	3.21	<10.0	0.5	14	49900

Site	Easting	Northing	Species	Individuals (m^2)	Diversity	Simpsons
ESL1	82150	338543	11	5,611	1.985	0.68
ESL2	82172	338450	10	856	1.861	0.55
ESL3	82241	338312	16	1,144	2.507	0.70
ESL5	82454	338296	16	900	3.016	0.80
SL7	82304	338375	3	56	0.95	0.44
R1*	82238	338354	14	884	2.23	0.7088
R3*	82741	337468	10	476	1.965	0.6049
R5*	83108	337312	20	1028	3.454	0.8849
R6*	84035	336739	10	124	3.021	0.886
R7*	84196	336688	20	1112	2.759	0.7284
B9*	84737	336406	11	812	1.543	0.4979
R8*	85036	336029	15	800	2.921	0.8162
B6 East*	85242	335604	11	3428	0.7882	0.2072

* based on 0.5mm samples processed down to 20cm (Wilson 2010_1)

Inter-tidal sampling of the soft sediments in 2005, indicated low numbers of macrofauna, with low diversities polychaetes recorded in the upper shore, with the occasional mollusc (*Macoma balthica)* and crustacean (*Corophium volutator)* at mid and lower shores. Further sampling in 2007, and 2010 revealed a slightly different picture, with 27 species of fauna recorded at the western shore included eighteen species of polychaete worms, nine species of crustaceans and two species of molluscs. This fell to between 10 and 20 species recorded along the proposed route with the distribution of species related to the level of reworking and sediment mobility as this reduced slowly along the length of the proposed route towards the upper estuary. Of the dominant taxa, the annelids *Tubificoides benedeni*, *Pygospio elegans* and *Eteone flava/longa* dominated the sands, with large numbers of the crustacean *Bathyporeia pelagica* recorded within the mobile sediments, or *Corophium volutator* where the current energy was slightly lower. The mollusc *Cerastoderma edule* was also recorded at most sites, although for the most part, this species was represented by only one or two large individuals.

For the hard substrate, a quantitative assessment of the epifaunal coverage was carried out by Ecoserve at three levels on the eastern shoreline. This revealed 22 species or higher taxa present, dominated by barnacles (*Semibalanus balanoides),* at all levels, with the periwinkle (*Littorina obtusata)* and the tube polychaete (Spirorbidae indet) found in high densities in the mid shore and further periwinkles (*Littorina saxatilis* and *L.littorea*), mussels (*Mytilus edulis*), limpets (*Patella vulgate*) and the anemone (*Actinia equine)* on the lower shore.

For algaes, the upper shore was dominated by *Fucus spiralis, Pelvetia canaliculata* and *Verrucaria maura* in roughly equal measure, changing to almost completely *Ascophyllum nodosum* in the mid shore and light covering by *A.nososum* and *F. vesiculosus* for the lower shore.

14.3.3 Changes in the Marine Fauna in Sruwaddacon Bay

A number of similar surveys carried out at selected locations between 2001 and 2010 have highlighted natural changes that have occurred over time. On the western shore of the lower estuary a second stream was recorded in 2007 which introduced some new biotopes to the shoreline. The absence of this stream in the earlier survey may have reflected the extremely dry summer of 2005 when the earlier survey was conducted. Sediment analyses at selected locations have revealed some variations in the proportion of fines, whilst general observations of sandbanks and channels during survey operations within the estuary has revealed subtle changes in the depths of some channels and the shape of some banks surrounding the main channel (personal observations by P.Cowman and I.Wilson, 2010). Biological changes include a notable increase in the density and coverage by the polycheate *Arenicola marina* over most of the lower-energy sand banks along the length of the bay.

14.3.4 Inshore Fisheries and Fish Species

No commercial fisheries exist within Sruwaddacon Bay. Consequently, no catch logs can be related to this area. Furthermore the shallow water depth in the estuary means that access by fishing vessels (commercial or recreational) would be very difficult. The closest commercial fish related data was taken from the outer Broadhaven Bay by the Marine Institute, which was trawled many times over an eight year period between 1993 and 2000.

Information on fish species within Sruwaddacon Bay is limited. As part of the METRIC Program, the Central Fisheries Board (CFB) implemented a monitoring program for fish in transitional waters under the requirements of the Water Framework Directive (WFD). In addition to gathering and standardising existing archival datasets, new datasets were collected within thirteen estuaries surveyed in 2006, including Sruwaddacon Bay. The survey was carried out in October 2006, in conjunction with North Western Regional Fisheries Board (NWRFB) and again for Sruwaddacon in May 2008 (CFB, 2008) to review springtime fish use within the bay.

On both surveys, a total of three sampling methods were used (Appendix L). The majority of the survey was carried out using a beach seine net, which encompassed the majority of geographical area and habitat range within the estuary. In addition, fyke nets were placed in the middle and upper sections of the estuary, but were not suitable in the lower estuary due to exposure in 2006, but were obtained in 2008. Beam trawls were used in the lower estuary and mid-estuary during periods of high water.

In the initial 2006 survey, results from the seine nets recorded the lowest abundance of any estuary surveyed by the CFB in the period 2001-2005. The Sand goby (*Pomatoschistus minutes)* was recorded throughout the estuary, encountered at five of the six sites, whilst Sprats (*Sprattus sprattus*) were found associated with the *Fucus* area of the mid estuary. The highest abundances were recorded at the uppermost sites, as was the case with juvenile flounder (*Platichthys flesus;* 8-25cm), also shown in the fyke netting at all sites. This technique also revealed Bearded Rockling (*Ciliata mustela*) in the mid-estuary sites and trout (*Salmo trutta*) in the upper freshwater area. Species composition was similar to that of Tullaghan Bay close by and surveyed in the same week. Eels (*Anguilla anguilla*) were found in low abundance in the estuary.

Trawl sampling in Sruwaddacon Bay was characterised by a low Catch Per Unit Effort (CPUE) and the lowest diversity of any trawl samples taken during the METRIC project. Pipefish (*Entelurus aequoreus* and *Syngnathus rostellatus*) were present in low numbers in five of the six trawls and were associated with the large amount of weed found at these locations.

Hard substrate habitats within the lower and mid estuary revealed a low diversity and abundance within the fish communities, thought to be a natural feature of estuaries in the region (CFB 2006). Whilst many estuaries are generally considered to be a productive environment, this is not the case for Sruwaddacon Bay where relatively strong flowing currents continuously rework sediments maintaining a sparse macro-invertebrate community with a low biomass over the majority of the survey area. Fish assemblages within Sruwaddacon Bay and neighbouring Curraunboy Bay were similar to those recorded in nearby Tulachán (Tullaghan), which exhibited a similar habitat. The fast currents and a lack of depth at low water can provide difficult conditions for small fish to thrive (CFB 2006). Only species like the pipefish may be able to tolerate stronger currents by clinging onto the weed.

When looking at the seasonal changes in the fish usage within the Sruwaddacon, the timing of the autumn (2006) and spring (2008) sampling programmes were based on long-term studies of rivers (i.e. Thames estuary in the UK), which demonstrated the peak periods of use by fish species. The underlying differentiator between these two periods is considered to be related to temperature changes where falling marine temperatures encourage a range of marine-associated species into the estuarine waters (such as young stage gadoids, including cod, pollock and whiting) or the movement of many species into the marine waters following a rise in spring temperatures.

A comparison of fish populations recorded between the 2006 and 2008 surveys showed a greater number of species captured in both beach seine and fyke deployments during the later survey whilst the beam trawl gave similar results. Many of the additional species were represented by only a single individual, with a very low mean number recorded per sample (Table 14.7), with the only exception being the sandeel (*Ammodytes tobianus*). Taking into account a slight increase in sampling effort and the targeting of more varied habitats in the later study, results were shown to broadly mirror the earlier autumn pattern, where the sand goby (*Potamoschistus minutus*) was the only species strongly represented. Mean flounder numbers were lower in the spring survey for both beach seine and fyke nets.

The increase in fish species in the spring survey was probably due to sampling effort being dispersed onto a wider range of different substrata. Fykes were laid in the outer bay (not accessible in 2006 due to the weather) and over rocky areas, whilst beach seines were conducted in weedy areas. These last two environments tend to provide greater protection to small and juvenile fish species.

The total species numbers captured in Sruwaddacon in 2008 were slightly higher than those of east coast waters such as the Boyne, Liffey and Rogerstown at similar seasons, although there was no consistent trend when comparing spring and autumn species totals. However, whilst the Sruwaddacon datasets indicated an estuary with a relatively wide species richness in both spring and autumn samples, in line with other estuaries, it contains these species at generally low abundance levels.

Of the samples collected in the autumn of 2006 and spring of 2008, none of the species recorded were unusual or were listed as Annex II species under the Habitats Directive. This includes the anadromous species such as the lampreys, shad or salmonids. Whilst these data are separated by two years, they represent only a relatively short snap-shot of species using the estuary at these times. However, the data are expected to give a good representation of the fish species using the bay during these key seasons. Salmonids and other anadromous species along with their migrations are discussed in more detail in Chapter 13.

Table 14.7 Catch per unit effort for Non-target Fish Species Recorded in Sruwaddacon Bay and Curraunboy Bay in the Autumn 2006 and Spring 2008 (CFB 2006 & 2008).

Species	Common Name	Beach seine		Fyke nets		Beam trawl	
		08	06	08	06	08	06
Ammodytes tobianus	Lesser sand eel	42.8				0.1	0.17
Pollachius pollachius	Pollock	2.3		0.2	2.67		
Platichthys flesus	Flounder	1.8	4.17	1.2	5	0.3	
Gobiusculus flavescens	Two spotted goby	1.3				0.4	0.17
Pleuronectes platessa	Plaice	1.3	0.5			0.4	0.17
Pomatoschistus minutus	Sand goby	1.2	14			0.8	0.17
Atherina presbyter	Sand smelt	1.0	0.5				
Scophthalmus rhombus	Brill	0.8				0.1	
Unidentified	Gadoid juveniles	0.6				1.3	
Crenilabrus melops	Corkwing wrasse	0.4	0.17	0.45			0.33
Pomatoschistus microps	Common goby	0.2				0.1	
Syngnathus acus	Greater pipefish	0.2				0.6	
Anguilla anguilla	European eel	0.1		0.2	1.67		
Salmo trutta	Sea trout	0.1	0.17		0.33		
Labrus bergylta	Ballan wrasse	0.1		0.5			
Solea solea	Common sole	0.1					
Spinachia spinachia	15 spine stickleback	0.1					1.00
Gaidropsarus vulgaris	Three beard rockling			1			0.17
Ciliata mustela	Five beard rockling			0.7	4.33		
Taurulus bubalis	Long-spined sea scorpion			0.5			
Lipophrys pholis	Shanny			0.2			
Callionymus lyra	Dragonet					0.1	
Entelurus aequoreus	Snake pipefish					0.1	1.33
Raja clavata	Thornback ray					0.1	
Scyliorhinus canicula	Lesser spotted dogfish			0.3			
Psetta maxima	Turbot					0.2	
Myoxocephalus scorpius	Bull rout		0.5				0.17
Sprattus sprattus	Spratt		4.17				
Mugilidae	Mullet spp.		0.17				
Dicentrarchus labrax	Bass				0.33		0.33
Labrus bimaculatus	Cockoo wrasse						
Syngnathus rostellatus	Nilsonns Pipefish						0.33

14.3.5 Aquaculture/Shellfishery Activities

The previous EIS in 2001 (RSK, 2001) and 2009 (RPS, 2009) identified the limited development of aquacultural activities within the vicinity of Sruwaddacon Bay. There is currently only one licensed oyster culturing facility (*Ostrea edulis,* T10/81) within Sruwaddacon Bay (licence T10/81), which exists in the south side of Sruwaddacon Bay, close to Poll an tSómais (Pollatomish) pier. However, it is understood that very little culturing is carried out at the site and the licence is known to have remained unutilised for a number of years, up to October 2007, when operations recommenced. It is understood that the facility is not currently in production (personal observations I. Wilson, February 2010).

The facility is located approximately 500m away from the proposed pipeline route and it is anticipated that there will be no impact on the aquaculture activity if the licence were to be utilised again. Therefore there will be no economic impact on the facility.

Elsewhere, subsistence foraging by local residents occurs for the mussel (*Mytilus edulis*) and the periwinkle (*Littorina littorea*) at and around the coarse substrates at the mid to low-water mark on the eastern bank of Sruwaddacon Bay entrance, and for the cockle (*Cerastoderma edule*) on the main sand bank in the north part of the bay.

Shellfish fishermen, who routinely operate from the pier at An Baile Glas (Ballyglass), do not carry out any fishing for shellfish species within Sruwaddacon Bay due to inappropriate habitats and unsuitable access. The bulk of their catches, that of the lobster (*Homarus gammarus*) and the edible crab (*Cancer pagurus*) occurs in the outer areas of Broadhaven Bay, where the rocky coastlines provide a suitable habitat.

It is understood that Broadhaven Bay will be designated as shellfish waters within the meaning of the Shellfish Waters Directive (79/923/EEC). However at the time of writing it is not known if the designated boundaries will extend into Sruwaddacon Bay.

14.3.6 Marine Mammals and other Large Marine Species

Since the submission of the original EIS in 2001 (RSK 2001), a number of inshore monitoring surveys were commissioned north of the study area. In 2001 and 2002 marine mammal monitoring was carried out in Broadhaven Bay from cliff top and boat-based visual observations and photo-identification, between August, 2001 and October, 2002. This included some acoustic monitoring (O Cadhla *et al*., 2003). Following this, marine mammal monitoring in Broadhaven Bay, was undertaken in 2005 using both visual and acoustic survey methods. Visual monitoring (cliff-based only) was undertaken over 46 days between 12th June and 30th September, 2005, whilst acoustic monitoring took place over ninety-nine days between 24th June to 30th September 2005 (CMRC, 2006). In 2007, a geophysical survey of Sruwaddacon Bay area was undertaken between June 19th June to 1st August, 2007. This was supported by a dedicated and qualified Marine Mammal Observer (MMO), who was vessel based at all times (C. Collins, 2007). Further observations were carried out as part of the ongoing marine mammal monitoring surveys (CMRC, 2010) and during dredging operations along the proposed pipeline route in Broadhaven Bay between 8th July and 5th November, 2008 (OSC and Coppock 2008) . These surveys were to ensure compliance to the guidelines described in the “Code of Practice for the Protection of Marine Mammals during Acoustic Seafloor Surveys in Irish Waters” during survey and construction operations. In addition to these dedicated field survey observations, validated records of incidental sightings and strandings were acquired from the database maintained by the Irish Whale and Dolphin Group (www.iwdg.ie). Searches were performed for the period since the submission of the original EIS (October 2001). Table 14.8 presents a summary of records of marine mammals species, when identified to species within the Broadhaven Bay and the entrance to Sruwaddacon Bay survey site.

These site-specific surveys have allowed for a much more accurate assessment of the existing populations within the inshore area of Broadhaven Bay. Based on the above observations it can be concluded that Broadhaven Bay and its neighbouring waters are important for marine mammals, both cetaceans and pinnipeds, in terms of diversity and abundance. Photo-identification studies suggest a level of residency of bottlenose dolphins, with records of newborn and young calves of dolphins (common, bottlenose and white-sided) reported. This may reflect the area’s importance as a potential breeding ground or nursery area for some species. The most common species of cetacean recorded in Broadhaven Bay was the small and generally inconspicuous harbour porpoise (*Phocoena phocoena*), constituting over 26% of all cetaceans observed in the bay between August, 2001 and October, 2002 (O.Cadhla, 2003). All but one observation of this species was recorded during a period of high or ebbing tide. Despite numerous sightings within Broadhaven Bay, the relative abundance of this difficult to spot Annex II species may have been underestimated. Consequently, a further acoustic survey was undertaken using remote recording devices situated seaward of Sruwaddacon Bay and Curraunboy confluence. The vocalisation of harbour porpoises were recorded in all months of the study with the highest number of recordings made at the listening station situation closest to the Gleann an Ghad (Glengad) landfall location. Although no cetaceans were recorded within Sruwaddacon Bay or Curraunboy Bay, an occasional foray into these areas by this species cannot be ruled out. This species was not observed at sea in the late 2007 and 2008, but was occasionally sighted in Broadhaven Bay from the shore in 2005, 2008 and 2009. Excursions by larger whales or dolphins in Sruwaddacon Bay remain very unlikely.

Table 14.8 Species list of Marine Mammals recorded within the Broadhaven Bay Area

Common name	**Scientific name**	***Source: When observed***
Minke whale	*Balaenoptera acutorostrata*	1,2,6
Sei whale	*Balaenoptera borealis*).	6
Killer whale	*Orcinus orca*	2
Pilot whale	*Globicephala melas*	3,
Risso's dolphin	*Grampus griseus*	1,2,3,6
Bottlenose dolphin	*Tursiops truncates*	1,2,5,6
White-sided dolphin	*Lagenorhynchus acutus*	1
White-beaked dolphin	*Lagenorhynchus albirostris*	1
Common dolphin	*Delphinus delphis*	1,2,3,6
Harbour porpoise	*Phocoena phocoena*	1,2,3,6
Unidentified dolphin	*Tursiops truncates?*	5,6
Pinnipeds		
Common seal	*Phoca vitulina*	1,2,4,5,6
Grey seal	*Halichoerus grypus*	1,2,4,5,6
Unidentified seal	*Halichoerus grypus?*	1,5,6

Sources: (1) 2001-2002: O Cadhla et al., 2003; (2) 2005: (CMRC, 2006); (3) Summer 2007: Collins, 2007; (4) IWDC 2001-2007: IWDC database records and OSC and (5) Coppock, summer 2008 and *(6) 2005: (CMRC, 2010).*

Broadhaven Bay has a resident population of both common and grey seals regularly recorded in Boardhaven Bay from 2001 to 2010. Both common and grey seals have been observed in the entrance (O Cadhla *et al*, 2003) and the lower portion of the estuary, particularly during periods of high flows (C Collins, 2007). It is presumed that the seals visit the narrow fast flowing channel at the point of the confluence to feed, as the natural hydrodynamics of the channel would concentrate fish species into a relatively small area. During more recent visits to the estuary, a small family group of grey seals has been recorded within the mouth of the Sruwaddacon, as well at occasional sightings on banks within the bay and swimming within the upper part of the estuary in 2007 and 2010 ((I.Wilson/Ornithologist observations).

In addition to the significant numbers of cetaceans recorded within Broadhaven Bay, the apparent biological importance of the region is also supported by the occasional observation of basking sharks *(Cetorhinus maximus*), sun fish (*Mola mola*), and a single sighting of a sea turtle (species unknown), along with large numbers of seabirds. However, only the otter and seal has been recorded within Sruwaddacon Bay estuary itself (see Chapter 12 for further details on otters).

14.4 POTENTIAL IMPACTS

As outlined in Chapter 5 it is proposed to tunnel beneath Sruwaddacon Bay using a Tunnel Boring Machine (TBM).. This method avoids surface intervention in the sea-bed, unless an exceptional problem is encountered during tunnelling, which is considered to be extremely unlikely (see Chapter 5). Bentonite is used during the process to lubricate the TBM drilling head and to carry arisings back to the compound for processing. Its use is monitored throughout the process to avoid potential releases of bentonite into the marine environment.

Should an exceptional problem be encountered during the works and an intervention pit be required, then there is potential to cause impact to the immediate and adjacent habitats. This can be caused by noise, excavation activities, sediment scour, increased traffic, sediment suspension and potential emissions. These may affect habitat, the hydrodynamic regime, and the sediments or pollute both the sediments and waters. There may also be a requirement for a temporary jetty on the shore should an intervention pit be required.

Flora and fauna, water quality and sediment stability have the potential to be negatively impacted by the construction process. This includes releases into the marine system carried by surface runoff from the compounds or noise and vibration effects in the sediments caused by the tunnelling operation.

Loss/change of Sediment Habitat

The extremely unlikely event of the construction of the pipeline requiring a temporary surface intervention pit will impact the sediments and associated fauna at this location of the bay. Whilst the location of this pit could be anywhere along the length of the pipeline route, its subsequent impact will vary subject to its location and proximity to the main channel. The natural habitat varies slightly along the route from a low energy sand flat in the upper estuary, to a higher energy medium to coarse sand with some fine gravels in the lower estuary and the lower channel. Both ends of the route are bordered by a thin band of mixed sediments high up on the foreshore. In addition to the direct impact to the habitats at the site, secondary habitat change will also occur due to increased sediment scour and deposition caused to sediments surrounding the operations by temporary changes in the hydrodynamics within the vicinity of the operations. The overall impacts are expected to be slight and temporary.

The potential for a bentonite leakage, is extremely unlikely, although should this occur it is not expected to cause habitat loss, although there would be an imperceptible impact within a limited geographical range of the escape. This is expected to be only temporary.

Change in Water Quality and Sediment Load

Whilst the pumping of ground/pore waters may take place during the construction phase, no additional water supplies will be used. Therefore the salinity and temperatures are not likely to alter much from the range normally experienced in these areas.

The movement of seabed sediments during the construction of an intervention pit (in the extremely unlikely event that it should be required) will increase the turbidity of the surrounding waters over the short term. Any bentonite leakage would equally have a notable impact on sediment turbidity and suspended load. This increase in turbidity could result in increased siltation and the smothering of sediments and organisms accompanied by a reduction in the light available to the seabed for photosynthesis. High levels of suspended solids settling on the seabed can alter habitats resulting in a potential loss of feeding and spawning grounds. Mobile species (including sensitive species such as salmon and sea trout) may temporarily move away from unfavourable conditions. However sessile, benthic fauna may be smothered and lost. As the area to be developed in the littoral and sub-littoral environments is small, the impact will also be localised and imperceptible.

Impacts of increased turbidity are likely to be minimal in the overall context of the bay as there is already a relatively high degree of suspended solids and peat-staining in this area from riverine influx from the surrounding bog. Furthermore, as the majority of sediments reflect a medium to high energy environment, there are little or no sediment fines naturally present. Consequently, a discharge of coarser sediments (such as sands) will have a limited area of settlement during periods of increased sediments loads.

A release of bentonite may marginally increase the levels of some chemical components within the vicinity of the discharge. These may include some metals, although the components within the bentonite drilling fluid are naturally occurring and generally non-toxic to marine benthic fauna.

A small quantity of this suspended clay can escape into the water course and produce a plume effect within the water column and a smothering effect on benthic communities, in particular suspension feeders. In small quantities and areas of low tidal movement, the viscous high density clay will initially remain localised before becoming suspended and flushed out of the estuary over subsequent tidal cycles. Should a release be coincidental to a period of migrating salmonids where a short-term elevation in turbidity could have a detrimental effect on fish gills, the higher concentrations (>300mg/l) will be avoided by the adults during their passage, or in an extreme case, migration may be delayed for a tidal cycle. Dilution of bentonite to below this level, will occur rapidly from the point source. Marine fauna will be unaffected by the plume as the strong tidal flow will prevent any significant settlement of the clay into the reworked sediments of the bay. Consequently, this impact is expected to be negligible and temporary.

Noise Pollution

Little is known about the effects of noise and vibration on invertebrates; however impacts are likely to be minimal, given the low populations recorded within the vicinity, and the short term for the works. Noise impacts would also be likely on vertebrate fauna for the area. For the most part, this will be the population of fish species which live within close proximity of the proposed route or migrate up and down the estuary during the daily tidal cycles. The most sensitive biological receptors will be the seal population, known to patrol the lower part of the estuary on occasion. However, the proposed route is considered not to be very important for foraging, with the majority located beneath the shallow bank areas where water depths are limited. This very mobile species is expected to simply avoid the immediate area during noisier parts of the construction phase. Consequently, impacts are likely to be imperceptible and temporary.

The tunnel boring machine (TBM) operates by slowly rotating a cutter head that will produce a low level ground vibration through the sediments and water column above the route of the pipeline. Since sound moves differently through water than it does through air, it is also measured differently for the two media. Noise travelling through air is typically measured in decibels (dB) relative to a reference pressure of 20 micro-Pascals (μPa); however, as water is denser than air, sound travels much faster and further, so noise travelling through water is measured in dB relative to a much lower reference pressure of 1 μPa. Since our hearing responds logarithmically to received sound levels, the ratio to the reference is also expressed in logarithmic terms, in dB:

$$SPL\ (dB) = 20\log\frac{P}{P_0}$$

where SPL is the *Sound Pressure Level* and P_0 is the reference, 1μPa. Every 20dB thus represents a ten-fold increase in SPL.

These reference pressures are standards adopted among acoustic engineers. Since the reference pressures that apply to the two mediums are not the same, direct comparisons between measurements taken in air and water cannot be made.

The likely groundborne vibration arising from tunnelling was modelled for the proposed pipeline route, sediment type and expected geological profiles at selected points along the proposed profile (Taylor, 2010, see Appendix H3). The model shows that the main output frequencies occur at 16Hz, 20Hz, 31.5Hz, 40Hz and 63Hz. The vibration outside this frequency range is not of significant amplitude and the responses are generally below 10Pa (140dB re. 1 μPa).

The vibration model shows that the highest underwater noise output is at 31.5 Hz with a pressure level of around 100Pa (160dB re. 1 μPa) within a few metres of the TBM, decreasing to less than *ca.* 30Pa

(149.5dB re. 1 μPa) within a 30m distance from the TBM, and *ca.* 18Pa (145 dB re. 1 μPa) at a distance of 90m. At higher and lower frequencies the pressure level (dB re. 1 μPa) is generally lower and also declines with distance from the TBM.

Frequencies of 4, 25 and 63Hz also show moderate outputs of between 145dB re. μ1Pa and 150dB re. 1μPa (Figure 25, Taylor, 2010). Outside of these frequencies, the responses were generally below 10Pa (140dB re. 1 μPa).

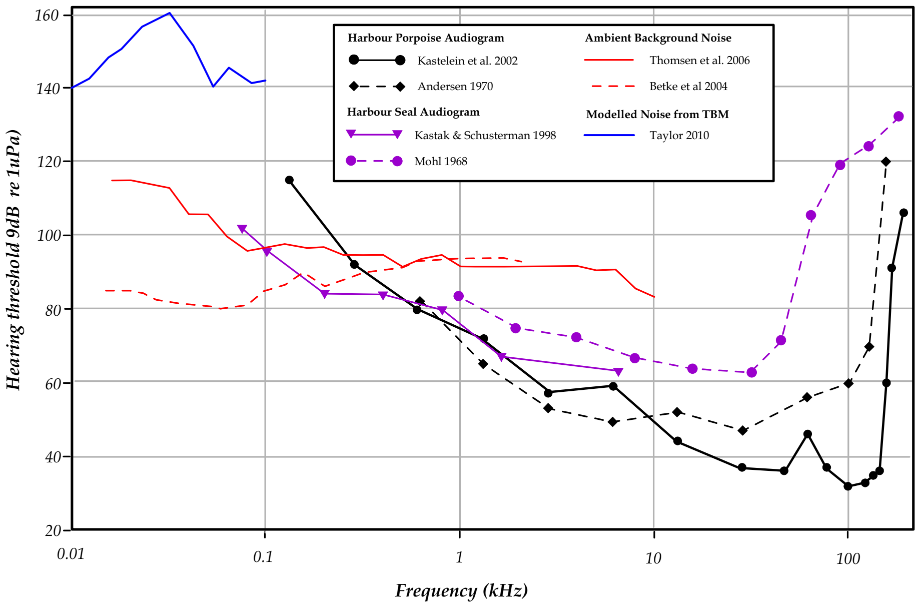
On average the sound output within the frequency range modelled (i.e. 1-100Hz) ranges from 160dB re 1μPa to 120dB re 1μPa within 10m of the TBM to about 140-120dB re 1μPa at 90m distance. These sound levels are the highest modelled. They represent the situation directly above the cutting face and propagating along the axis of the tunnel during high water; they show a clear decline with distance. A slightly faster decline in noise levels with distance from the source will occur at right angles to the path of the tunnel.

Owing to the tidal nature of the site, the proposed route of the TBM will pass beneath sediments exposed by the receding tide for significant periods of time. A review of the bathymetric profile in Sruwaddacon Bay (Chapter 14 Figure 14.2) shows that less than 2% of the route lies below lowest astronomical tide (LAT), whilst around 38% remains exposed when the tide is at mean sea level (MSL). Consequently, whilst the propagation of groundborne vibration will be occur through the seabed throughout construction, temporally this will only also impact the overlying waters in respect of underwater noise for a proportion of the time. These areas relate mainly to the channel areas represented by between 2 and 44% of the route during maximum and minimum low water periods, respectively. The excavation of the tunnel by the TBM will neither be static nor continuous with the tunnel expected to advance around 11m on average per day, and to be underway for less than a third of the total operational time per day. (See Chapter 5 of the EIS)

Background Noise levels

Ambient underwater noise levels depend upon a number of factors, including surface interaction between wind and waves, rainfall, marine animals and shipping. Early studies into ambient noise levels (Knudsen *et al*., 1948 and Wenz 1962) determined relationships between descriptors of physical and anthropogenic noise sources (e.g. ships; wind speed) and noise spectrum level in the deep open ocean. In shallow water (which includes the North Sea and the waters around Ireland), there is greater spatial and temporal variability in ambient noise level. Ambient noise levels would be expected to be higher in coastal locations due to the noise from breaking surf; the movement of shingle, sand, gravel and other sea/coast interactions; and from ships (near ports, harbours and shipping lanes) and smaller vessels. Thomsen *et al* (2006) published results on the measurements of ambient noise around wind farms in the North Sea, with results showing a 1/3rd-octave spectrum typically peaking at just below 115dB re 1μPa at around 20 to 30Hz but falling to below 95 dB re 1μPa above 250Hz (Figure 14.9). Other common ambient background noises are quite natural and relate to the clicking of communicating crustacea (1 to 100kHz), or are anthropogenic and relate to marine engines. These can vary from fast running outboard motors (152-156dB re 1μPa @ 630Hz to 6.3KHz) or slower running fishing type vessels (151dB re 1μPa @ 250Hz to 1KHz). Vessel noise is broadband, ranging from 10 Hz to 10 kHz or more, and source levels can vary by vessel type from 157 to 187dB re 1μPa for a variety of vessel types travelling at 10 knots (Kipple and Gabriele, 2004). Other ship borne devices, such as sonars and echo sounders, typically operate at 100 to 500KHz frequency in shallow water environments.

Figure 14.9 Summary of Modelled TBM Sound Pressure Levels compared to expected ambient background noise and the Audiograms of Harbour Porpoises and Harbour Seals



Noise Impacts to Marine Mammals

Based on extensive survey and monitoring programs in 2001-2, 2005, 2008 and 2009 (see Appendices in Offshore Supplementary Update Report, RSK, 2009) the only marine mammals apart from otters, known to use Sruwaddacon Bay are harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) To date there are no records of cetaceans occurring in Sruwaddacon Bay. The occasional presence of harbour porpoise (*Phocoena phocoena*) and larger odontocetes (e.g. dolphins) cannot be ruled out; however, while they are known to occur in Broadhaven Bay, it is unlikely that they would enter the shallower waters of Sruwaddacon Bay, unless pursuing prey species. Despite the unlikelihood of their presence, potential impacts on odontocetes have been assessed.

Impacts to marine mammals will vary with the sensitivity of the receptor species. The baleen whales (mysticetes), whose collective auditory range of 7 Hz to 22 kHz can be classed as low-frequency (Table 4.9; after Southall *et al.*, 2007) are not found in the waters of the Sruwaddacon, although they have been recorded further out in Broadhaven Bay (CMRC, 2010). While low-frequency noise propagates further than higher frequency noise in optimal conditions, it may be possible that mysticetes are impacted by the noise from tunnelling; however, the shallow and tidal nature of the site is not conducive to transmission of low frequency sound, and it is expected that this will be rapidly dissipated in the intertidal and nearshore environment. As such, baleen whales are not anticipated to be impacted by the operations. Of the toothed whales and dolphins (odontocetes), only the smaller species could be expected to occur within the estuary on rare occasions, whilst the seals (pinnipeds) are commonly recorded at the entrance of the Bay and can be occasionally seen to venture into the Sruwaddacon to forage or haul out. Table 4.9 summarises the typical auditory range for all of these species, although the sensitivity of these ranges may alter significantly with the frequency. Kastelein et al. (2002) showed that the harbour porpoise exhibited a very wide hearing range with relatively high hearing thresholds, although this was relatively poor (ca. 92-115dB re 1µPa) at the lower frequencies produced by the TBM. Hearing was notably more sensitive (i.e. lower thresholds) in the mid and higher frequency bands (60-80 dB between 1 to 8KHz, falling to only 32 to 46dB re 1µPa from 16 to140kHz, respectively. Consequently noise output from the TBM below 100Hz is unlikely to interfere with the sounds used for routine foraging and communication activity of the odontocetes encountered in the region.

The hearing sensitivity of harbour seals is marginally greater than that of the cetaceans for the lower frequencies with a central hearing range of around 8 to 16kHz, and potentially with some infrasonic perception (,Figure 14.9). The summary figure shows that the higher frequencies produced by the

TBM might just be detectable by the seal on the very limit of its auditory range when within close proximity to the drilling location, but this level is well below any threshold for damage for this species 218dB re.1µPa, Table 4.9). The majority of the TBM frequencies will be imperceptible to this group.

Table 4.9: Summary of Key Hearing Frequencies for Sensitive Receptor Species and Criteria for Injury (after Southall *et al.* 2007)

Species of marine mammal	Potential for occurrence in Sruwaddacon Bay	Approximate distance from nearest sighting to the estuary narrows at Rossport Pier	Estimated auditory bandwidth (hearing group*)	Criteria for injury*
Sei whale (*Balaenoptera borealis*)	Not expected	11 km	7 Hz to 22 kHz (Low-frequency cetaceans)	Sound Pressure 230 dB_{peak} re.1µPa (flat) Sound exposure 198 dB re.1µPa^2-s(M_{lf})
Minke whale (*Balaenoptera acutorostrata*)	Not expected	5 km		
Killer whale (*Orcinus orca*)	Not expected	8 km	150 Hz to 160 kHz Mid-frequency cetaceans	Sound Pressure 230 dB_{peak} re.1µPa (flat) Sound exposure 198 dB re.1µPa^2-s(M_{mf})
Risso's dolphin (*Grampus griseus*)	Not expected	4 km		
White-beaked dolphin *(Lagenorhynchus albirostris*)	No expected	13 km		
White-sided dolphin (*Lagenorhynchus acutus*)	Not expected	3 km		
Common dolphin (*Delphinus delphis*)	Not expected§	4 km		
Bottlenose dolphin (*Tursiops truncatus*)	Rare§	1.5 km		
Harbour porpoise (*Phocoena phocoena*)	Rare§	2.5 km	200 Hz to 180 kHz (High-frequency cetaceans)	Sound Pressure 230 dB_{peak} re.1µPa (flat) Sound exposure 198 dB re.1µPa^2-s(M_{hf})
Harbour seal (*Phoca vitulina*)	Rare to occasional	0 km	In water: 75 Hz to 75 kHz In air: 75 Hz to 30 kHz	(IN WATER) Sound Pressure 218 dB_{peak} re.1µPa (flat) Sound exposure 186 dB re.1µPa^2-s(M_{pw}) (IN AIR) Sound Pressure 149 dB_{peak} re.20µPa (flat) Sound exposure 144 dB re.20µPa^2-s(M_{pa})
Grey Seal (*Halichoerus grypus*)	Occasional	0 km		

**Data from Southall* et al.*, 2007, Table 2 and Table 3.*

§ For assessment purposes it is assumed that these species would occur rarely, if at all.

Overall, the majority of noise energy produced from the TBM operation in water is below 100 Hz; any vibration outside this range is unlikely to be of an amplitude high enough to affect marine mammals. The hearing sensitivity of the high and mid frequency cetaceans along with the pinnipeds falls rapidly below 100 Hz. Table 4.9 also lists example criteria contained within Southall *et al.* (2007) which have been adopted by the UK Joint Nature Conservation Committee (JNCC) as a suitable criteria to determine what constitutes an 'injury offence' in accordance with Article 12 of the Habitats Directive. The TBM noise output model shows that the expected maximum outputs fall well below these limits. Consequently, the overall impact of the TBM noise to marine mammals is expected to be imperceptible and temporary. No mitigation procedures are deemed necessary for this the level of impact.

Noise Impacts to Fish

The potential impacts to the migratory Annex II fish species (Salmon and Lamprey) from TBM operations are discussed in Chapter 13 of the EIS, whilst the impacts to the small population of resident marine fish are considered below. As noted above, approximately 2 to 44% of the tunnel route will pass beneath channel areas that will be flooded with water during low water spring and neap tides, respectively. The majority of resident marine fish species will be limited to these channel areas for most of the time, and only periodically move into shallow waters over the main banks to feed with the advancing tide.

The sensitivity of different fish species to noise and vibration is dependant upon whether the fish has a swim bladder or specialised auditory couplings within to the inner ear (e.g. herrings). These make them more sensitive to sound pressure waves. Species without specialised auditory coupling (e.g. cod) or fish with reduced or absent swim bladders (e.g. flounder, mackerels and rays) have lower sensitivities (Fay 1988). Auditory thresholds for all groups vary from below 80dB re 1µPa to over 100dB re 1µPa for these different groups in the frequency range 30Hz to 1kHz. In reality, for shallow field environments the broadband ambient background noise caused by wind induced waves in shallow waters acts to mask any sensitivity threshold to below around 100dB re 1µPa. Fish also have a "lateral line" system that runs lengthwise down each side of the body and over the head. The lateral line consists of pressure-sensitive cells that convert subtle changes in water pressure into neural pulses that allow fish to avoid collisions, participate in schooling behaviour, orient to water currents, elude predators, and detect prey. For most fish, the lateral line is only sensitive to low frequency (10 Hz to 30Hz) (Popper and Fay, 1993) and near-field pressure changes, limited to an area immediately surrounding the fish. It should be noted that the sensitivity, is at a level well below that which would detect the TBM operation.

Noise levels of 140 to 160dB re 1µPa arising from the tunnelling and transmitted to the water column would be perceptible to all fish species, but with a peak frequency of 31.5Hz, this would be at the very lower end of the audible range. The largest impact on marine fish is likely to be that affecting demersal species such as the flounder (*Platichthys flesus)* or the goby (*Pomatoschistus sp)* located on the seabed directly above the drilling location, although these have the lowest sensitivity to noise.

Behavioural response by fish to noise and vibration is related to the perceived loudness of the sound. Nedwell et al, (2003 & 2007), carried out an assessment of fish avoidance from noise and vibration produced during a construction project. He produced criteria for fish behavioural responses and concluded that this is based on the level of noise in dB above the hearing threshold of the fish (i.e. dBht). The range of responses listed in his 2007 report were as follows:

- 90 dBht (species) and above – Strong avoidance reaction by virtually all individuals;
- 50 - 90 dBht (species) - Stronger reaction by the majority of individuals, but habituation may limit effect
- 0 – 50 dBht (species) – Mild reaction in minority of individuals, probably not sustained.

Outputs from the vibration modelling show a worst case scenario for underwater noise occurring at high tide, along the axis of the tunnel and at a frequency of 31.5Hz. At 90m from the TBM, the modelled underwater noise level is 145 dB re 1µPa.

Assuming an average hearing threshold for fish species within Sruwaddacon Bay of 100dB re 1µPa (approximate lower threshold for Atlantic salmon), the Nedwell data above would suggest that, for the less sensitive species such as flounder and plaice, the likely effect of the tunnelling activities at this distance would result in a mild reaction in a minority of individuals (i.e. 45dBht). While for more sensitive species, represented by the Atlantic cod, with lower hearing thresholds, it is likely that the response of fish would be within the category of 'stronger reaction' but that the effect could be limited by habituation. Thus within 90m of the TBM, some marine species may avoid the area, while others are much less likely to be affected, with the possibility that affected species may habituate to the noise in any case.

It is important to note that, the duration of this impact will be small as this is limited by actual drilling time (ca. 1/3rd) and will only occur whilst the seabed is covered by water. Consequently, impacts to the marine fish species caused by noise and vibration are expected to be negligible and short term.

Noise Impacts on Benthos

Unlike noise impacts caused by the TBM to the surrounding air and waters, the impact to the sediment environment is based on the vibration produced by the slow rotation drill head (ca 6 revolutions per minute). Data derived from the model (Taylor 2010), predicted the highest vibration velocity as 0.16 mm/s (RMS) with a broadband frequency range of 1 to 100 Hz. This is equivalent to a peak particle velocity (ppv) of approximately 0.5 mm/s. This can be compared to the 14m Hamburgh Elbe tunnel, which recorded a ppv of 0.5mm/s between 20 and 100Hz at 50m through mixed sediments, or the 4m Boston MWWST tunnel, which recorded a ppv of 0.2mm/s between 20 to 80Hz in limestone. To place the unit into context, a ppv level of 0.5 mm/s may just be perceptible to humans in a residential environment but probably not detectable in water logged sediments where minor settlement may absorb some of the energy. Dissipation of the vibration velocities in the field will typically halve with each doubling of distance from the TBM location (i.e. 0.16 mm/s reduces to approximately 0.07 mm/s 40 m away and to 0.035 mm/s 80m away).

Little or no information is known on the effect of low level vibrations on the benthos. However, given the small vibration values modelled and the short term nature of the localised activity, impacts are expected to be limited to short term behavioural mechanisms. Vibrations may impact on the benthos in the following ways:

- Consolidation of sands. Sands deposited onto the seabed from suspension usually undergo an extended period of consolidation where particles continue to settle into interstitial spaces. The introduction of a short period of low frequency vibration may accelerate this process and cause some sediments to slump slightly leaving an area of water on the surface. This is only likely to effect areas where sediments have previously been disturbed due to other processes, such as continued erosion and deposition at the edges of the channel, and current related bedforms.

- Benthos migration. Unlike the terrestrial earth worm, which migrates to the surface during periods of vibration as a behavioural response to avoid drowning from rainfall, polychaetes and other macro-invertebrate species are likely to retract or migrate into the sediment in predator-avoidance behaviour. Groups such as the molluscs may simply retract surface siphons, whilst surface dwelling amphipods and some polychaetes may migrate vertically downwards. In the case of the latter, the depth to which the species can retreat will be limited by of the redox discontinuity layer (RDL), where free-oxygen remains available to the organism within the interstitial waters. This layer is typically around 2-5cm thick for most of the bay (Wilson 2010_1). The impact of vertical migration may be a minor reduction in avian predation by species with shorter beaks in the immediate area (ca. 50m) of the TBM location. As drilling is not continuous, the more mobile benthos will quickly return to normal behaviour immediately after drilling.

All impacts will be localised and temporary, as the continued movement of the TBM will ensure that any given area will not be impacted by more than 2 or 3 days at a time during periods when exposed by the tide.

Pollution and Waste

During the construction phase of the proposed development, pollutants and chemicals used could contaminate the area. Potential contamination of sediments and marine organisms from the accidental release of hydraulic, pipeline grout, lubricant and fuel oils associated with excavation equipment and machinery onsite, or drilling related leakage may occur. This can arise from accidental spillages to water, through poor operational management, the non-removal of spillages, poor storage, handling and transfer of oil and chemicals or poor handling or accidental release of bentonite fluids during drilling operations. Other sources of contamination are minor metal spoils from the cutting of sheet piling.

Should contamination occur, species and habitats could be seriously impacted. Future colonisation of the area could be inhibited. Bioaccumulation of certain substances could occur in the flora and fauna present. If suitable precautions are taken and best practice for the storage, handling and disposal of hazardous materials are followed, such impacts are largely avoided.

Concrete structures

There are no specific plans to use concrete structures for the proposed marine section of the pipeline route, although concrete structures may be used during the construction phase to provide supports or scour protection. Concrete is regularly used in the construction of piers, sea walls, mooring and slipways around the Irish coast and is typically formulated to seal quickly from the ingress of sea water and to prevent leaching of possible harmful admixtures such as heavy metals, gypsum etc. Where concrete coatings or mattressing are used in the pipeline construction in gravity moorings or for scour protection (usually in the form of a jacket or large flexible mattresses), these are typically supplied preformed and hardened before entering the marine environment. Consequently, they are expected to be benign to the surrounding environment and to have a negligible impact.

Fish Including Salmonids

The numbers and variety of fish recorded within Srwuwaddcon Bay are low, with most species limited to a relatively small area of the channel for extended periods of time during low water periods. The installation of an intervention pit if required could adversely impact fish population in the immediate vicinity of the works due to elevated noise or vibration to the surrounding waters. The overall impact of this is expected to be imperceptible and temporary.

There is currently only one licensed oyster culturing facility (*Ostrea edulis,* T10/81) within Sruwaddacon Bay (licence T10/81), which exists in the south side of Sruwaddacon Bay, close to Poll an tSómais (Pollatomish) pier. However, it is understood that very little culturing is carried out at the site and the licence is known to have remained unutilised for a number of years, up to October 2007, when operations recommenced. It is understood that the facility is not currently in production. However, even if this was not the case, the impact of the proposed development will be insignificant or nil.

Impacts on cSAC and cited Species in Sruwaddacon Bay

The construction area falls under two Annex I habitat designations, ie. '"estuaries" (Code 1130) and "sandflats not covered by seawater' (Code 1140; Natura, 2000), neither of which are qualifying habitats for the cSAC. Both of these are generally large scale features defined as a result of local geographical characteristics and the surrounding hydrodynamics. Even in the event that surface intervention pits are required, the construction of the pipeline through this area would have a very limited spatial impact on these qualities. Given the existing dynamic and highly variable nature of the environment, all impacts will be temporary post construction.

As the site is also part of a large pSPA for resident and over-wintering birds, the construction operations within Sruwaddacon Bay estuary, have the potential to disturb the bird population and a small surface area of their potential food source (invertebrates) either directly, through the very unlikely event of an intervention pit, or indirectly through vibration of sediments close to the TBM along the route. Birds are discussed further in Chapter 12.

'Do-Nothing' Scenario

In the absence of the development it is likely that the marine habitats and water quality along the proposed route would remain unchanged, although both environments are subject to short term variability and long term natural changes.

The 'Worst Case' Impact

In the event that mitigation measures fail it is possible that certain aspects of the construction activities associated with the tunnelling could have an adverse affect on the hydrodynamic flow within the estuary and cause the localised flow of the main channel to vary slightly. This will alter the erosional/deposition regimes within certain parts of the bay, along with the habitats they support. The hydrography of the bay may also alter. Given the natural variability and dynamic nature of the estuary, this impact would be short to medium term, with slight to moderate significance of neutral to negative quality.

In the unlikely event of an accidental bentonite release during surface construction (if necessary), the receiving environment would show a slight impact over a short term on sediments around the periphery of the bay. This is likely to have only an imperceptible impact on water quality for a very short term.

14.5 MITIGATION MEASURES

Mitigation measures have been developed to prevent, control and minimise potential impacts from the proposed upper and lower estuary. The key mitigation measures for the pipeline route will be as follows:

- Use of a segment-lined tunnel (i.e. trenchless operation) to further avoid and/or minimise surface interaction on the Bay;
- The area of habitat disturbance will be kept to a minimum during construction, and will be limited to the high water area at the head of the Leenamore inlet in the absence of surface interaction along the route. This area will be reinstated to its original condition by replacing excavated material and preserving the surface sediment type. Epifauna & flora attached to large stones will be preserved by relocating to a similar height on the shore for the duration of the construction works. These will then be reinstated on completion of the construction. Impacts will be slight to moderate, localised and temporary;
- The construction period will be undertaken over as short a time period as possible;
- To minimise the interruption of adult salmonid migration and that of other anadromous fish in the estuary, the flow within the main channel will be maintained to allow the passage of fish during construction;
- The surface sediments of the proposed route through the Sruwaddacon Bay will be reinstated to their original condition if impacted;
- Any significant scour areas will be in-filled by back filling with the surrounding surface sediments to preserve the current hydrodynamic regime of the estuary; and
- All bentonite usage will be monitored though materials balance calculations, pressure monitoring in the lines and above ground visual assessment of the works;
- In the unlikely event that emergency surface intervention should be required, construction methods will be agreed in advance with the NWRFB and the NPWS to minimise disturbance to the migration of salmonids and resident and over-wintering birds. Potential noise impacts during the construction of an intervention pit construction would be monitored and guidelines followed to minimise the impact of construction to sensitive receptors (i.e.pinepeds and cetaceans).

Loss or Alteration of Habitats and Species Composition

During construction, any areas of seashore or seabed to be disturbed (i.e. upper Leenamore inlet) should be kept to a minimum i.e. within the temporary working area. As the upper estuary covers two thin bands of bank deposits, in the event that a temporary intervention pit will be required within one of these areas, the larger stones and associated fauna will be manually removed from the working area and placed on either side of the route at the same point up the shoreline to ensure the correct tidal exposure. The remaining surface sediments, as well as the superficial substrates over the remainder of the sand flats will be mechanically removed and placed to the side of the working area to preserve the invertebrate populations within. By preserving the marine life and sediments types, impacts to the marine habitats will be imperceptible and short term.

Increased Suspended Solids

Disturbance of inter-tidal and sub-tidal habitats will be minimised so as to reduce the creation of suspended solids within the marine and estuarine habitats. The working area will be bordered by sheet piling (or similar) which will surround the main excavation site minimising the escape of suspended sediments from the site. As most sediments within the bay contain very little fines, the retention of excavated spoil at the work locations for backfilling adjacent sections will also minimise the release of sediments within the main flow of the estuary where it will be dispersed.

The potential for an accidental release of bentonite will be minimised by closely monitoring its use during all works.

Noise and Vibration Pollution

The tunnel boring machine (TBM) will produce a low-level noise emissions in the sediments and overlying waters when at high water. Modelled data shows that both the level and frequency of both noise and vibration caused by the TBM will have negligible impact on the benthos, fish and marine mammals in the estuary.

Pollutants and Waste

Best practice for the storage, handling and disposal of hazardous materials will be followed to prevent chemical pollution. All fuels or chemicals kept on the construction site will be stored in protected containers and all refuelling and maintenance will be carried out in bunded containment areas. Refuelling and maintenance in areas draining directly to water habitats will be avoided where possible. Oil interceptors will also be installed in appropriate locations. Equipment will be regularly maintained and leaks repaired immediately. Accidental spillages will be contained and cleaned up immediately. Remediation measures will be carried out in the unlikely event of pollution of the marine environment.

14.6 RESIDUAL IMPACT

There will be no discernible residual impacts on the marine environment once constructed.

There is the potential to cause habitat disturbance due to noise, excavation activities, sediment scour, emissions and elevated sediment loads. However, allowing for the mitigation measures outlined above, the limited operational window envisaged for the construction period of an intervention (in the extremely unlikely event that it is required) and the dynamic nature of the environment, residual impacts within the bay are expected to be localised and imperceptible over a short term.

If surface intervention construction were to be required, a relatively localised area of impact would occur to the soft surface sediments due to scour and temporary changes in hydrodynamics. However, the existing population of surface macro-invertebrate fauna is generally for the majority of the proposed route subject to natural stresses and sediment dynamics. Furthermore, the sediments are expected to physically return to normal within a small number of tidal cycles, closely followed by a re-colonisation by the faunal population within a few months (through natural sediment dynamics) to a year (though spring reproductive cycle and settlement). Therefore, the residual impact will be imperceptible and short term.

There will be no residual impacts on transient or highly mobile species, such as fish (including migrating salmon), seals and possible cetaceans once the development is in operation.

14.6.1 Monitoring

Geomorphological Survey of Route Corridor

Any proposed intervention pit locations will be surveyed using a combination of acoustic (SBES or AGDS), video/sampling techniques to confirm the current geomorphology prior to the survey works, intermittently throughout the construction period and on completion of the works. The purpose of the survey is to identify the sediment and habitat types prior to operations, and to monitor the scale and reinstatement of the natural sediment dynamics following the works. These survey works will also assist in the reinstatement of the pre-operational conditions prior to the demobilisation of the marine equipment.

Cetacean/Marine Mammal Observers

Existing monitoring activities within Broadhaven Bay show that only seals occasionally pass into the proposed working area, although there is an expectation that Harbour porpoises may also enter the estuary on rare occasions. Operational monitoring for marine mammals and cetaceans will be carried out from the channel edge during the deployment of sheet piling for an intervention pit, should it be required. Field observers will record the excursion of any animal into the vicinity of the survey area (500m) during the deployment of the sheet piling prior to excavation activities. The deployment of the sheet piling (using a vibration technique) will be undertaken using a soft-start procedures should marine mammals be located within this observation area. The animal's identification and behaviour will be recorded throughout the period of these operations.

Ecological Habitats and Biota

Should surface intervention be necessary, pre-and post-project monitoring will be carried out at the impacted location to substantiate conclusions relating to the macrofaunal and habitat impacts outlined within this EIS. Benthic sampling will be carried out using variety of video, visual observations and sampling in both littoral and sub-littoral areas of the corridor. Spatially, the survey will be undertaken at a control site in a similar sediment type and hydrodynamic regime. Additional attention will be paid to extensive areas of scour.

Sampling and analysis will include full particle size analysis, benthic macrofauna, biomass and, on selected sites, sediment chemistry (including low level heavy and trace metals and hydrocarbons). Hard substrates will be qualitatively assessed for biological coverage and recolonisation. It is recommended that pre and post construction surveys are carried out with a further repeated monitoring survey undertaken one or two years after completion of the construction, should an intervention pit be required. Further ecological monitoring will be undertaken following an interpretation of the rate of recovery from the initial studies.

Bentonite Release

Environmental survey monitoring will be carried out in the unlikely event of a bentonite release. A water quality and benthic assessment will be carried out along the up and down stream route of the dispersion. Sampling and analysis will include water quality and turbidity, sediment particle size analysis, benthic macrofauna, and sediment chemistry relating to components within the fluid. Tissue sampling of shellfish within the bay may also be undertaken. Monitoring will take place immediately after an accidental release and repeated approximately one year later.

14.7 OCEANOGRAPHY AND HYDROGRAPHY

14.7.1 Introduction

This section describes the hydrography of Sruwaddacon Bay. This includes the neighbouring Curraunboy bay which falls within the hydrodynamic boundary of the estuary and affects the oceanographic regime within Sruwaddacon Bay which is a combination of the daily tidal cycles and riverine flow, through the system. Furthermore, a numerical hydrodynamic model is also described which predicts the changes to the currents likely to occur during potential construction alternatives for the proposed route and suggest mitigation measures to combat any adverse effects. The primary construction proposal is based upon a segment lined method i.e. trenchless method which will not impact the marine system within the bay. However, potential construction requirements dictate that temporary engineering works may be necessary along the proposed route to resolve potential blockages. This would then have the potential to impact on the marine system and be exposed to the ebb and flow of the tidal cycle on a daily basis. Any structures deployed within the bay will alter the current dynamics for the duration of the works.

14.7.2 Bathymetry

The hydrography of Sruwaddacon Bay and Curraunboy Bay was acquired during a geophysical survey (Osiris, 2007). Data was collected using a combination of vessel–mounted and land-based survey techniques. A limited access to the bay by vessel meant that large areas of relatively flat seabed have been interpolated from relatively few data points. However, a combined dataset and interpolation is estimated to be within a 20cm vertical accuracy.

The bathymetric data covered all areas within the bay except a north facing sand bank in the estuary mouth adjacent to the Curraunboy convergence, some shallow inlets within the main estuary and along the upper section of the Glenamoy river east of the proposed landfall and the confluence of the Glenamoy and Muingnabo Rivers. Consequently, the river channel at this location was digitised from detailed aerial photographs, along with the whole of the upper high water estuarine boundary (a height of 3.7m above chart datum was applied).

Figure 14.8 shows a full interpolation of Sruwaddacon Bay and Curraunboy hydrography. This indicates the dominated channel of flow which meanders the length of each bay. Within Sruwaddacon Bay, the channel separates and recombines at a number of points with the depth of the channel remaining shallow (<0.6m) for the majority of its course in the upper estuary during low water periods. The upper third of Sruwaddacon Bay channel dries, in part, above chart datum during extreme low water springs, although flow will remain within these areas due to a persistent riverine component. Areas close to or within the channel (particularly in the downstream area of the bay) indicate stronger currents with clearly defined rippled bedforms. These are particularly well developed on the outer edge of the main sand bank southeast of the mouth, where their form indicates a strong flooding tide influence.

A review of the historical admiralty chart data (which includes bathymetric soundings of Sruwaddacon Bay taken in 1852-3) and a more recent representation of the main channel given by the Ordnance Survey, show significant variability in the route of the main channel over time. This is not unexpected as the whole environment is based upon a dynamic relationship between the prevailing meteorological, tidal and river effects upon scouring, reworking and deposition of materials within the sand banks. Consequently, the natural course of the channel and the dimensions of certain banks are likely to vary continuously. Further anecdotal evidence of this ongoing process has been observed during a number of recent field surveys into the bay which have identified recent changes in the main channel and adjacent banks, particularly in the lower reaches of the estuary surrounding the main channel (P.Cowman/I.Wilson personnel observations 2010).

14.7.3 Oceanography

Oceanographic data was recovered during two surveys within Sruwaddacon Bay using a combination of tide recorders, profiling current meters and temperature sensors. Seabed mounted instruments were deployed at 4 points within the estuary between 24th July, 2007 and 8th August, 2007 (EGS

2007). An additional tide gauge was deployed at An Baile Glas (Ballyglass) Pier between the dates 14th June, 2007 and 8th August, 2007 (Osiris 2007). The flow of currents through the central part of the bay was further verified using drogue streamlining on a mid high water period in February of 2010 (Wilson 2010_2).

14.7.3.1 Tidal Data

An Baile Glas (Ballyglass) Pier (southern Broadhaven Bay) is classed as a secondary port by the United Kingdom Hydrographic Office (UKHO), and was the position for a tide recorder deployed within a seabed frame for a 55 day period. The final dataset was a combination of seven shorter observations deployed for the duration of the geophysical and oceanographic operations in Sruwaddacon Bay. The depth of the instrument deployment was levelled statistically using mean sea level and provided a reference for all other tide recorders within Sruwaddacon Bay, deployed for a simultaneous fourteen day period. These were recorded using four seabed mounted pressure sensors deployed between Sruwaddacon Bay/Curraunboy Bay confluence and the upper neck of the estuary.

A comparison of the five datasets, reduced to mean sea level, showed that there was a notable phase change (time delay) in the tidal cycle with penetration into estuary. The constriction in the channel at the mouth and the friction caused by the shallow seabed over the 9km separation between the ends of the estuary retards the high water over the length of the estuary by over 40 minutes. Conversely, the low water time is delayed by over two hours, as the returning flood is delayed in the constriction of the mouth. Furthermore, the tidal range within the estuary also falls from 3.7m at the bay mouth, to 2.9 m at the upper station, a difference of over 80cm. The tidal times and ranges at the confluence of the two bays, was similar to those recorded at An Baile Glas (Ballyglass) Pier (Appendix L).

14.7.3.2 Tidal Streams Data

Tidal currents were recorded using acoustic doppler current profilers (ADCPs) at 4 seabed mounted moorings deployed the length of Sruwaddacon Bay over a fourteen day period. These instruments were able to record current speed and direction for the whole of the water column. The data was depth-averaged to remove spikes prior to further processing (Note: this may result in the occasional peak event also being averaged out of the dataset if not recorded at other depths within the profile). The depth averaged data is summarised in Table 14.10 and represented into a scatter plot (Figure14.10).

Table 14.10: Summary Depth Averaged Current Meter Data for Sruwaddacon Bay.

Mooring	Depth Averaged Velocities (m/s)		Depth Averaged Directions (degrees)		Duration of Flow (hours)	
	Maximum	**Mean**	**Flood**	**Ebb**	**Flood**	**Ebb**
4	1.08†	0.40†	109	294	5.48	6.24
1	1.22	0.56	041	212	5.45	6.36
2	1.00	0.37	084	271	5.65	6.37
3	0.60	0.23	142	309	4.52	5.99

† *only half of the dataset was recovered due to sediment burial midway through the spring tide.*

Overall, mean depth averaged data recorded the strongest flows at Mooring 1 (lower estuary) at 1.22 m/sec (2.37 knots) during the spring tides. This decreased progressively upstream towards the river, falling to 0.6m/sec (1.17 knots) at Mooring 3 (upper estuary). The current speed fell slightly to 1.08m/sec (2.1 knots) downstream at the bay convergence (at Mooring 4) where the channel widens (although it should be noted that not all of the spring tidal current data were recorded here due to the instrument being partially buried midway through the observation period). The mean direction of each of the flood and ebb flows is also presented in Table 14.10, or can be seen in Figure 14.10, and follows the orientation of the main channel at each respective location.

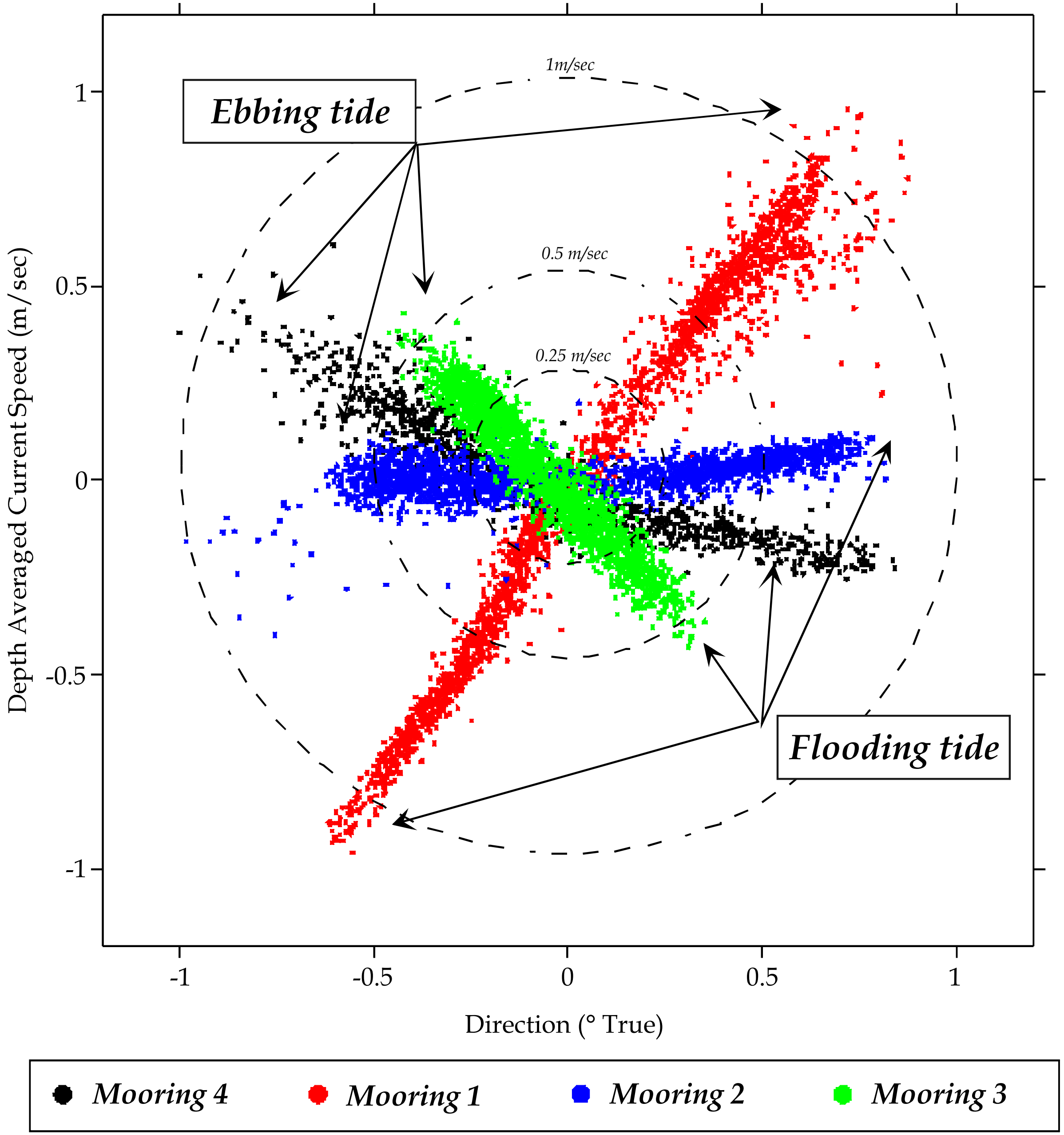
This pattern of current velocities highlights the constriction to the current flow skewing the sinusoidal shape of the tidal curve progressively upstream. This results in an uneven balance in both current velocities and duration. Table 14.10 shows the mean duration (in hours) for both flooding and ebbing tides. In all cases, the ebbing tide is extended showing a prolonged ebb flow of between 43 minutes in the centre of the estuary, to 88 minutes further upstream at the proposed upper estuary.

A review of peak flows from the raw data indicated that slightly stronger flows can occur, predominantly along the surface with the exception of the lower estuary (Mooring 1), where a peak flow of 1.52 m/sec (2.95 knots) was recorded at mid depth (3.1m) at the beginning of the ebbing tide.

14.7.3.3 Hydrodynamic Flow Model

To be able to model the circulation of the tidal flow throughout Sruwaddacon Bay, the hydrographic data was inputted into a finite-element mesh (HR Wallingford, 2007). This consisted of triangular elements with a flexible variation of the resolution throughout the model domain ranging from 20m (within the channels) to 100m (across the open sand flats). Hydrodynamic quantities (e.g. water levels, current magnitude and direction) were computed at each node. This model was then validated using observations recorded at the four moorings deployed within Sruwaddacon Bay, with the results showing a realistic representation of modelled hydrodynamics versus the recorded data for each of the mooring locations.

By running the model over a sequence for a typical spring cycle, the general flow behaviour along with the expected velocities was observed (HW+10 hours, Figure 14.11a and HW+5 hours, Figure 14.11b). Overall, the constriction to flow within Sruwaddacon Bay mouth retards the flooding tide. This results in a shorter, yet stronger flooding flow within the downstream area compared to longer but slower ebbing tide. This results in the productions of current related bedforms at the seaward end of the bay, which can be clearly observed in both hydrographic and aerial photographic data in this area. The hydrodynamic model indicates that the strongest tidal flows within the operational area would occur at the downstream estuary, with a maximum speed of approximately 2m/sec (3.9 knots; Figure 14.11a) during a flooding spring flow. A freshwater flow of 2.5m^3/sec was used in the production of this model, although average data records for the Glenamoy river suggest an average freshwater flow an order of magnitude below this (i.e. ca, 0.25m^3/sec).



Scatter Plot of Depth Averaged Current Speed and Direction

Figure 14.10

File Ref: MDR0470GrEIS022 RevA03
Date: May 2010

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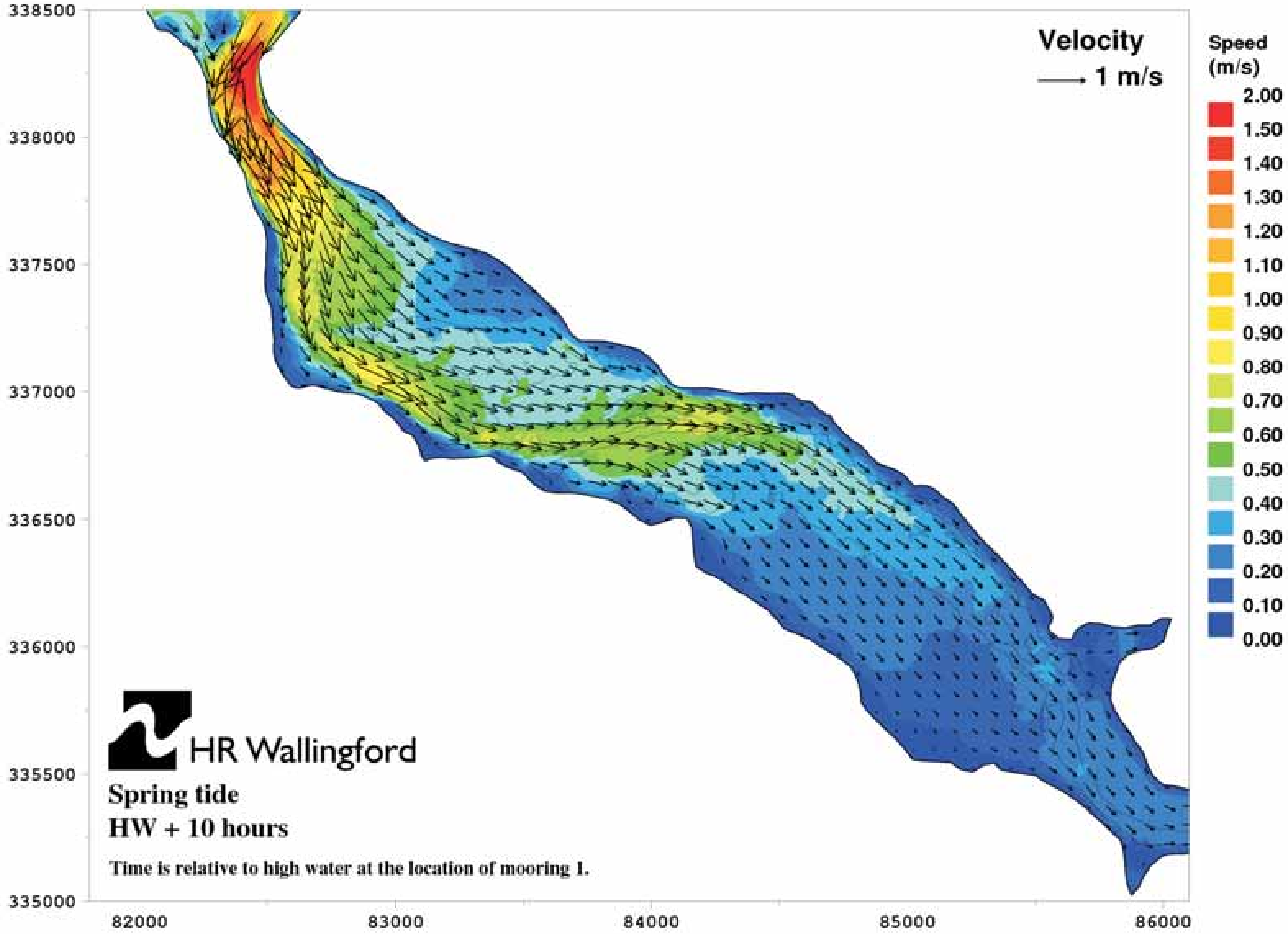

Modelled Peak Flows within Sruwaddacon Bay

Figure 14.11a

File Ref: MDR0470GrEIS023 RevA03
Date: May 2010

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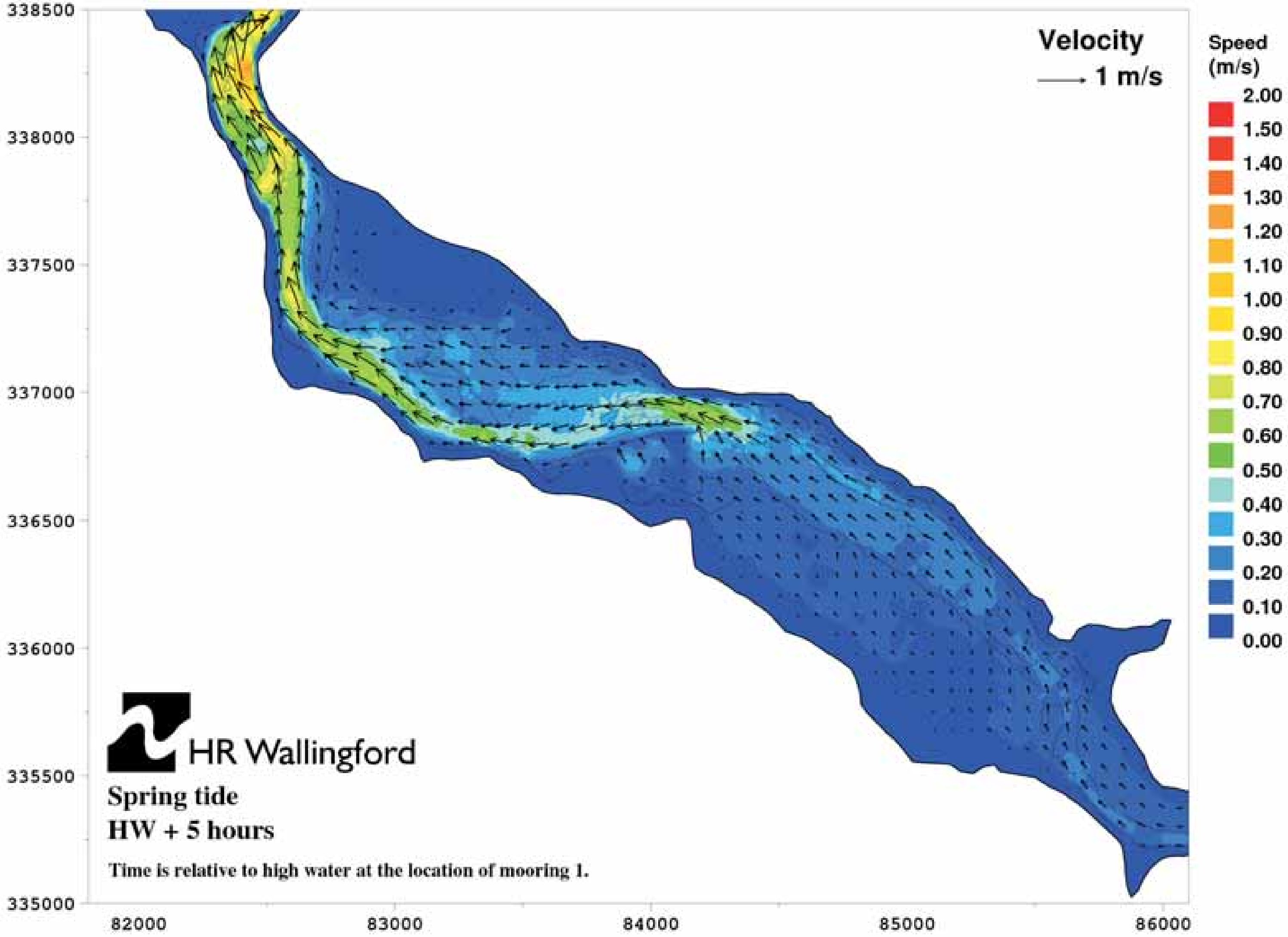

Modelled Peak Flows within Sruwaddacon Bay

Figure 14.11b

File Ref: MDR0470GrEIS023 RevA03
Date: May 2010

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14.7.3.4 Natural Changes in the Channel

Natural variations in the level of the seabed and the flow of the channel are occurring in the Sruwaddacon Estuary on a continuous basis. The sediment transport within a system comprises of both bedload transport and suspended load transport. Bedload transport occurs when the forces exerted by the flow of water on the sediment bed is sufficiently large to cause the sediment to be displaced by suspension into the water column or rolling along the seabed, or conversely, slow to allow suspended sediment to settle. The strength of the forces within the moving water mass depends on the velocity of flow and the roughness of the sea bed (increased by coarser sediments or sediment bed forms such as ripples and mega-ripples). The presence of wind driven waves can also increase these forces.

Sediment movement is controlled by oceanographic factors such as tidal streams, storms surges, waves, river discharges and wind-driven currents, which together act upon sedimentological factors such as particle size, seabed roughness, bedforms and suspended sediment load to determine way that sediment is transported. In the Sruwaddacon the flow of the semi diurnal tidal range over a 1.8 to 3.2m range is highly modified by the prevailing geology and bathymetry of the bay producing considerable friction to the movement of water along its length. This has been hydrodynamically modelled and subsequently verified with field measurements along the length of the bay. The latter showed a slow transformation of the tide from a sinusoidal curve near the open sea to a more triangular curve of reducing amplitude progressively into the bay. The tidal currents show flood tide asymmetry which will tend to transport materials into Sruwaddacon Bay compared with the weaker but longer ebbing tide. The tidal currents are considered to be the primary controlling factor for sediment transport and bed level changes in the estuary.

The semi-diurnal tide drives an exchange of water between Broadhaven Bay and Sruwaddacon Bay. The volume of water exchanged is a function of the bathymetric profile and the tidal range (approx. 6.9M m^3). Whilst the period of tidal exchange remain approximately the same, a higher spring tidal range produces a greater volume, this will generate faster current velocities and increase sediment mobility. The potential oceanographic contributors to channel erosion and bed level changes are as follows:

- Storm surges:
  Storm surges in Broadhaven Bay will lead to a modified water level in the sea which will modify the flow into and out of Sruwaddacon Bay. The influence of storm surge will be limited dependent upon on frequency and event magnitude. Impacts to the Sruwaddacon oceanography will be temporary before returning to the normal tidally dominated equilibrium.

- Waves:
  Sruwaddacon Bay is directly sheltered from Atlantic waves as a result of the narrow entrance. Locally generated wind waves will be small as a result of the size of the estuary and extensive drying tidal flats, reducing the length over which the wind can generate waves. Thus wave action is limited within the bay and not considered to be a primary controlling factor for bed level changes within the bay.

- Wind-driven currents:
  Wind-driven currents are small for reasons outlined above and are not a primary control factor for bed level changes within the bay.

- River discharge:
  The discharge from the Glenamoy River is highly variable but small compared to the volume of tidal flow in Sruwaddacon Bay (i.e. <1m^3/sec to mean 300 m^3/sec, respectively). Nevertheless, the river discharge reinforces the late ebb tidal flow in the shallow channel passing over the upper pipeline crossing and is of local important in maintaining the low tide channel in this area.

- Sea level rise:

  Sea-level is continuing to rise with respect to the land level, a process that is ongoing since the end of the last glacial period many thousands of years ago. Although predicted to rise in the future, the magnitude of this is low (typically predicted between 3.5 to 8mm per year) and not considered significant to the volume of water exchange and impact on bed level changes within the bay.

In conclusion tidal action is considered to be the dominant oceanographic control factor for bed level changes within Sruwaddacon Bay. The potential sedimentological contributors to channel erosion and bed level changes are as follows;

- Seabed sediment size and type

  The sediments in Sruwaddacon Bay are in dynamic equilibrium with the oceanography, established over thousands of years. The continuous transfer of tidal energy into the sediments results in the suspension and subsequent transportation of finer sediments (such as silts, clays and riverine organics) out of the bay. Consequently, the seabed in Sruwaddacon Bay is predominantly made up of granular marine sands with little or no finer sediments recorded in the main flow areas.

- Presence of harder/coarser ground

  The tidal flow is controlled by the constriction at the mouth of the bay, reducing the duration of flow but strengthening the currents, producing granular sediments, coarser than would normally be expected for an enclosed estuary. This constriction is bordered by bedrock and not liable to change.

- Presence of bed forms

  The dominant tidal action (predominantly flooding tide) reworks the seabed sediments and has resulted in the creation of bedforms such as ripples and mega-ripples in the sediment deposits.

- Existing suspended sediment load

  The river flow continuously introduces suspended sediments into the estuary. This is predominantly made up of organic matter, fines and peat staining from the surface runoff from the surrounding bog areas. Water quality sampling undertaken in 2007 showed the concentration of this material to be around (52mg/l). Sediment analysis within the central part of the estuary showed that all of this material remains in suspension until discharged into Broadhaven Bay.

In conclusion, the generally coarse, granular material is in a dynamic equilibrium with the dominant tidal action.

Observed Morphological Changes in Sruwaddacon Bay over Time

Sruwaddacon Bay has infilled with sediment as sea level has risen over thousands of years since the end of the last glacial period. Sruwaddacon Bay is a dynamic system and subject to small natural changes over long periods of time. Consequently, the routing of the main channel and inter-tidal banks may have altered over time. The bay can be subdivided into three segments along its length with respect to morphology. These are:

(1) The short outer segment which has strong tidal flow velocities and a well defined channel constrained by geology;

(2) the wide middle segment which has a well defined channel, moderate tidal flow velocities and large volumes of sediment stored between the banks of the bay; and

(3) the inner segment which has a shallow meandering channel with low tidal flow velocities and large volumes of sediment stored between the banks of the bay.

A change in the pattern of banks and channels is demonstrated through a comparison of historical data over the past 170 years (Figure 14.12). Data obtained by the Admiralty using a lead line in 1852-3, was compared with high resolution multi-beam echo sounder data acquired in 2007. Although the earlier dataset is based in qualitative observations of the flow and very limited spot depth locations, the main alignment of the tidal channel and key depths can be compared. This comparison shows that with the exception of a change in the channel position in the middle segment of the bay, the combination of banks and channels has remained broadly unaltered over this period. However, the recent bathymetric data has identified three areas where the channel pattern has already altered or may naturally alter over time in the future (Figure 14.12). This is supported by a first addition drawing from the Ordnance Survey dated 1839 which showed an earlier route for the channel.

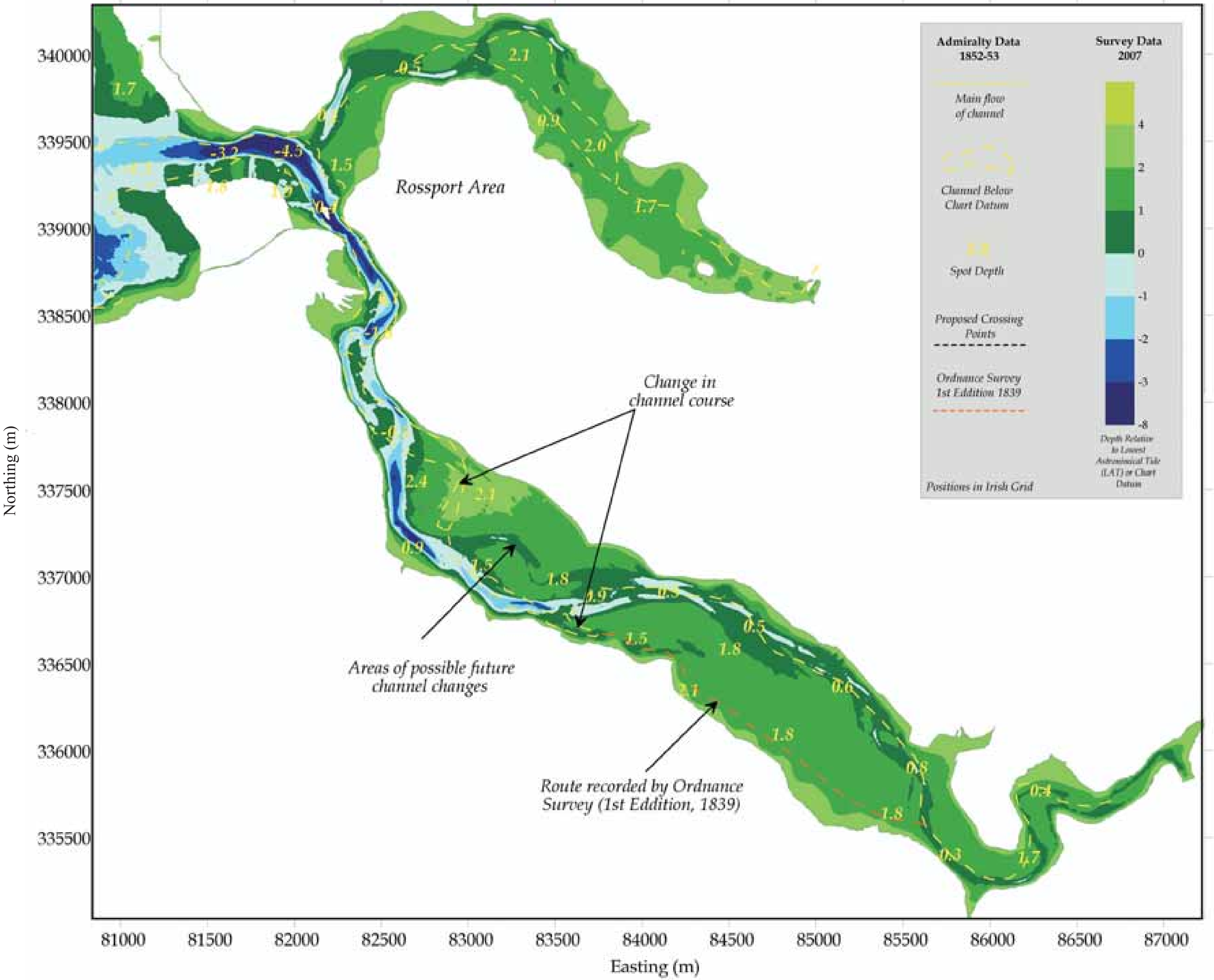
14.7.3.5 Water Quality Parameters

Water quality parameters were measured in Sruwaddacon Bay during both the ecological survey (RSK, 2007) and the oceanographic measurements (EGS, 2007). Data were acquired as a combination of spot readings for turbidity, total suspended solids and temperature, using an electronic data sonde and near seabed (20cm) self-recording measurements of temperature and salinity at the four mooring locations over a 14 day tidal cycle. In addition, meteorological data (including rainfall) were acquired from Met Éireann at Béal an Mhuirthead (Belmullet) to assess the impact this might have on the consistency of the above readings. However, whilst a number of short-period peaks in rainfall were identified, these peaks were below 6mm for July falling to below 3mm in August for the period of the oceanographic observations. Consequently salinity and suspended load readings will not have been adversely affected due to elevated river flows produced by heavy rainfall during the study period.

Temperature records for the Bay over the full tidal cycle showed that overall temperatures vary more during periods when the warmer riverine flows predominate. For the summer observation period, the high water times showed a consistent 14 - 16°C for all sites except the upstream Mooring 3 which was typically 1.5-2°C warmer, whilst low water periods showed considerable variability at 15 - 18.5°C, except mooring 3 which varied by a further 3°C.

Salinity records for the Bay over the full tidal cycle showed that Moorings 1, 2 and 4, within the mouth and lower estuary were dominated by seawater. High water salinities remained consistently around 33 ± 1psu (practical salinity units) during all states of the tide, whilst salinities progressively fell to between 10 and 20psu during neaps, or 20 to 30psu during spring tides between the mid estuary (mooring 2) and the bay confluence (mooring 4). Only the upstream locations (mooring 3) showed a notable fluctuation in salinity at both high and low water times, for both neap and spring cycles. For high water, the salinity varied from 10 to 33 psu (neaps to springs, respectively), whilst the low water becomes completely fresh (psu <0.1) during neaps, but reaches 10psu during the spring tides

Combined turbidity and suspended solid readings recorded during the ecological survey indicated that the two parameters could not be statistically correlated (high turbidity readings did not necessary relate to elevated sediment loads), presumably due to the variability in peat-staining from the river run-off. The highest recorded turbidity (24-27 NTU) was recorded in Sruwaddacon Bay within an hour of low water, indicating that suspended material of freshwater origin contributed significantly to the levels of turbidity at that time. The highest level of total suspended solids was also recorded at the same place and time. Lower turbidity levels (<2 NTU) were recorded during the flooding tide along the main channels or during the high water slacks when the clearer seawater influence is at its greatest. Generally, all total suspended solids records were similar ranging from 14 to 70 mg/l (RSK 2007, Ecoserve 2007). This is approximately 20 times higher than those recorded for the full marine conditions found in the outer Broadhaven Bay (near Iorras (Erris) Head, (Ecoserve, 2005), where the suspended sediment load is dispersed or carried out to deeper waters and slower currents where it is deposited on the seabed.



Changes in Seabed Bathymetry in Sruwaddacon Bay

Figure 14.12

File Ref: MDR0470GrEIS018 RevA03
Date: May 2010

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14.7.4 Potential Impact of Tunnelling beneath Sruwaddacon Bay

The construction along the proposed route may require some operations to be undertaken within the marine sections of the route along the length of the estuary from the narrow, fast flowing lower section to the wider, slower-flowing upper section of the estuary. In all cases, segment lined tunnelling beneath the Bay will not impact on the oceanography within the Bay. However, the potential impact of an emergency surface intervention pit on the Bay's tidal circulation during construction has been assessed, for completeness, as a worst-case scenario. The deployment of an intervention pit within the marine section will be based upon a sheet piling (or similar) operation for a relatively short length of time.

Any construction operations carried out within the bay have the potential to cause a physical impact by altering the flow regime around temporary structures and producing both scour and deposition effects which may lead to a loss or aggregation of surface sediments and an alteration to the existing sediment regime.

Long term observations of the Bay shows slow changes in the shape and route of the channel, which is expected to continue even in the event that the project does not impact within the bay.

14.7.5 Modelling of Oceanographic Impacts During Construction

By using the hydrodynamic model described in section 14.7.3, several temporary construction scenarios have been employed to assess variations in the flow regime for the duration of the construction at various locations. These data, were then used to assess the propensity of the altered flows to induce additional scour, or deposition beyond that normally experienced at any given locations. This assessment is conservative, as it does not take into account any scour mitigation methods.

The potential impact to localised hydrodynamics and sediment scour are highly variable dependant upon the exact location of a proposed intervention pit. As this is not known, the range of possible impacts have been reviewed based on two simulated scenarios placing an intervention pit within the central channel at both the lower and upper ends of the estuary as these constitute the range of conditions expected to be encountered along any part of the proposed route.

For the simulation, the intervention pits were represented as islands in the hydrodynamic model to prevent flow through them. Additionally, the existence of the adjacent pontoon was also represented as a solid in the shallow water depths, thus preventing flow to the seafloor. This assessment therefore treats the effects of the obstruction in a very conservative manner, as part of the flow may pass underneath the pontoon during mid to high water periods. The geometry and location of these contingency access pits are likely to be notably smaller than modelled here, but will be engineered following a technical evaluation of the obstruction if encountered.

The outputs of the hydrodynamic model, producing a hydrodynamic footprint, were combined with the available information on sediment type and distribution to assess the maximum impact on sediment mobility and the potential for scour. The grain size information relates to the sand fraction, whilst other coarser fractions may also be present in the margin for the bay. The lower estuary was assessed based on a combination of sediment parameters and observations taken during recent survey works (RSK, 2007. Ecoserve, 2007, Osiris, 2007 and Wilson 2010_1). Here, the channel was described as coarse sands and gravels, flanked by bank deposits of sands through to cobbles and boulders, particularly to the east. The upper estuary was characterised as a medium to fine sand across both the flats and within the channel, and flanked by bank deposits of sands through to cobbles and boulders.

14.7.5.1 Lower Estuary

Even though the likely necessity for an intervention pit for the tunnel is extremely low, a simulation of a single intervention pit was run in a central location of the lower estuary (area of peak flow close to the route; HR Wallingford, 2007_2) as a worst case scenario. This simulation was run over several spring tidal cycles and peak flows recorded for both flood and ebb tides (Figure 14.13). Control simulations were also used to extract the reference flow for each location to provide a summary hydrodynamic footprint for the full cycle.

The pit has been located in the centre of the main channel to represent a 'worst-case' scenario. The pit will form an obstruction to flow producing a shadow zone on either side of the pit, together with lateral zones of increased current velocity of around 0.3m/s. Location A, positioned on the north western bank of the channel, showed a greater increase in maximum ebb velocity from 1.5 to 1.8m/s with similar variation (ca. 0.3m/s) for the weaker flood flow. Location B showed the opposite, with small increase in the maximum ebb (ca. 0.1m/s), but a greater increase in the larger flood flow, from 1.4 to 1.8 m/s (Table 14.11).

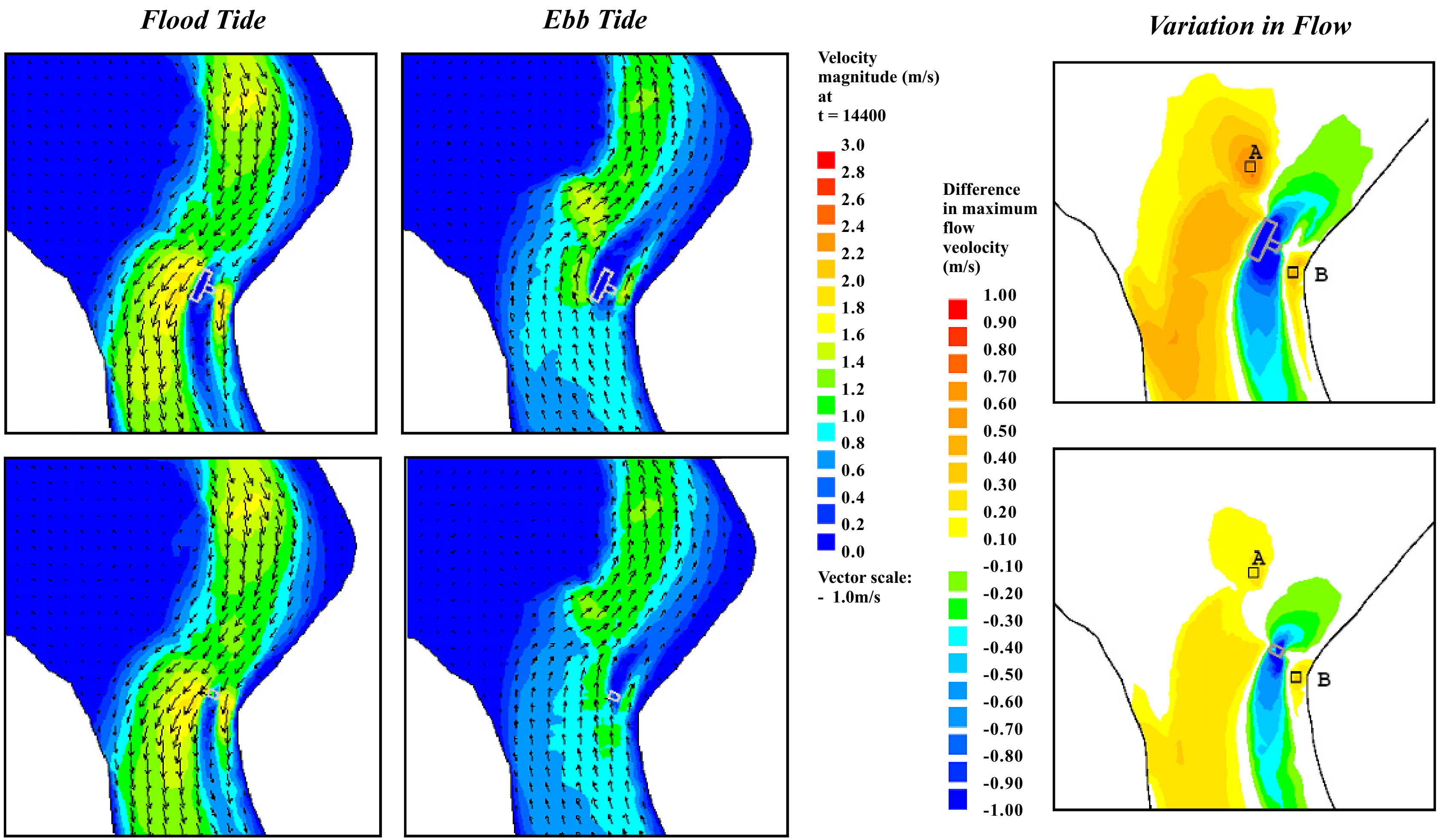
Channel sediments were predominantly mixed coarse sands and gravels, grading to bedrock at the eastern end. Finer surface sediments are expected to be mobile during the peak flows in the tidal cycle and local scour will occur. Assuming a representative diameter of 12m for the access pit and applying the scour estimation methods of May and Willoughby (1990), Escarameia and May (1997) and Breusers *et al.,* (1977), the maximum scour depths ranges from 3.4 to 7.9m at Location A and from 5.1 to 7.6m at Location B. Assuming that the intervention pit is in this location for 4 weeks, the scour may not have time to develop to its full depth during this period but a large amount of the potential scour can be expected. However, as the channel naturally deepens to around 4m seaward of the lower route, scour will further deepen this and extend the channel to the point of the pit (Figure 14.13). Assuming a cone-shaped scour hole with an angle of repose of the sediments under local flow conditions of 10°, the scoured area associated with this depth is around 5,700m^2, near Location A and 4,950m^2 near Location B. All calculation are conservative, based on a homogenous sediment size with depth and the absence of cyclic infill of scour on alternating tides.

Table 14.11: Summary of Simulated Flows and Predicted Scour at two ends of the Estuary.

Route Location	**Baseline max.ebb velocity**	**Scenario max. ebb velocity**	**Baseline max.flood velocity**	**Scenario max. flood velocity**	**Estimated scour depth**	**Scoured area associated with scour depth**
	m/s	**m/s**	**m/s**	**m/s**	**m**	**m^2**
Lower Estuary						
Pit, Location A	1.5	1.8	0.9	1.2	7.5	5,700
Pit, Location B	0.6	0.7	1.4	1.8	7.0	4,950
Upper Estuary						
Pit, Location A	0.2	0.3	0.3	0.6	3.5	900
Pit, Location B	0.2	0.6	0.4	0.7	5.0	1,600

14.7.5.2 Upper Estuary

A simulation of two separate scenarios relating to a smaller intervention pit within the main channel were run for the proposed upper estuary towards the mouth of the Glenamoy River (HR Wallingford, 2007_2). Each simulation was run over several spring tidal cycles and peak flows recorded for both flood and ebb tides (Figure 14.14). Control simulations were also used to extract the reference flow for each location to provide a summary hydrodynamic footprint for the full tidal cycle. A summary of the impacts are as follows:



Summary of Hydrodynamic Footprint for the Downstream Estuary

Figure 14.13

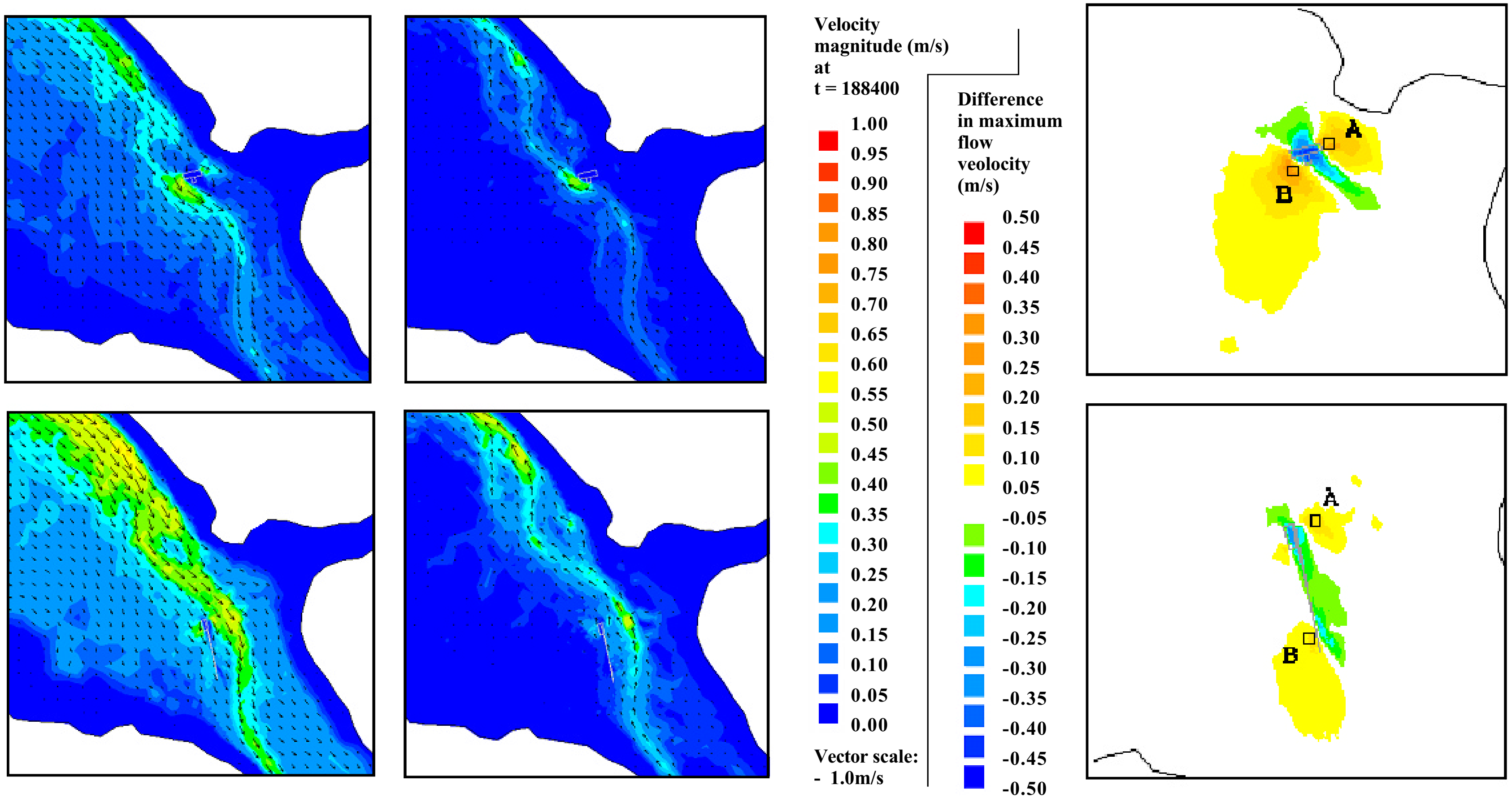
File Ref: MDR0470GrEIS024 RevA03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

Flood Tide *Ebb Tide* *Variation in Flow*



Summary of Hydrodynamic Footprint for the Upstream Estuary

Figure 14.14

File Ref: MDR0470GrEIS025 RevA03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

The intervention pit has been located in the centre of the main channel crossed by the upper estuary to represent a worst-case scenario, although in reality the proposed route follows a much shallower bank to the south and west were currents are expected to be more benign. Together with the adjacent pontoon, this pit will form an obstruction to the flow through the channel. A shadow zone can be seen on either side of the pit and pontoon, together with zones of increased maximum flow velocities (Location A and B). Assuming a discharge from the Glenamoy River of 2.5m^3/s, the maximum increase is approximately 0.35m/s for ebb tides whilst flood velocity changes up to 0.3m/s. The effects on the flow direction are generally less than 10 degrees. The effects of these flow obstructions on the modelled maximum water level excursion are less than 0.1m throughout the bay.

Owing to the medium to fine sandy nature of the sediments within this part of the bay, the finer surface sediments will be mobile during the high water peak of the tidal cycle and local scour, estimated to be around 3m in the areas indicated by yellow and orange based on Breusers et al. (1977), May and Willoughby (1990) and Escarameia and May (1997), assuming that the potential scour of up to 7.4m has insufficient time to develop during the maximum of four weeks required for the structure. Some deposition of fine material will also take place in the areas of green.

14.7.6 Predicted Impacts during Construction

There are no predicted oceanographic impacts to the estuary in the likely situation that an intervention pit will not be required for the construction. However, for a worst-case scenario model for an intervention pit necessary along any part of the route in exceptional circumstances, simulations were run and predictions of the hydrodynamic and resulting impacts to the seabed assessed. These are a central intervention pit at the lower estuary and two scenarios, including a ‘worst-case’ location for an intervention pit within the channel for the upper estuary. These predictions show that scouring and winnowing of sediments around temporary structures during construction can be significant, particular if located within the main channel flow for either of the upper and lower estuary. Whilst, the hydrodynamics of the region would be expected to revert to their natural course post construction, a significant alteration in the hydrography of the area caused by excessive scour may have a significant impact on the flow patterns within the estuary over a longer term.

Excessive scour of the seabed will remove and smother large areas of habitat within close proximity to the construction site.

‘Do-Nothing’ Scenario

In the absence of the development it is likely that the marine habitats and hydrodynamics along the proposed construction routes would remain unchanged, although the current regime is subject to short term variability and long tern natural changes.

The ‘Worst Case’ Impact

In the event that the project or mitigation measures fail it is possible that the surface construction activities could produce significant areas of scour at the point within the estuary where an intervention pit was required. This would result in a seabed hollow on completion of the operations which might fail to infill post construction and subsequently alter the hydrography and oceanography at this location. On the lower estuary, this could result in a lengthening of the existing deeper water channel, possibly altering the routing for the main channel. This in turn could result in erosion and deposition of the larger bank features surrounding the channel over time. Given the natural variability and dynamic nature of the estuary, this impact could be medium to long term, with slight to moderate significance of neutral to negative quality.

14.7.7 Mitigation during Construction

The key mitigation measures for the construction route in the event of an intervention pit will be as follows:

- the size of the pit will be reduced to a minimum to present as small an impact as necessary to the flow of the currents along the route;

- the shape of the pit will be designed to induce minimum impact to the flow of the currents along the route;
- a hydrodynamic simulation will be run prior to operations to assess the potential for impact by the operation;
- partial to full reinstatement of sediments around scour features will be carried out to reduce effects;
- following a further review of the construction designs, the use of scour protection (such as weighted matressing out to 10m) will be considered if necessary; and
- any significant scour areas will be in-filled by back filling with the surrounding surface sediments to preserve the current hydrodynamic regime of the estuary. Natural reinstatement of sediments within the scoured area are expected to occur through normal sediment movement processes during the stronger periods of tidal flow.

14.7.8 Residual Impacts

Assuming segment lined tunnelling is employed successfully without any complications (i.e. no intervention pits), there will be no residual environmental impact within the marine section of Sruwaddacon Bay. In the unlikely event that emergency surface intervention should be required during tunnelling, there remains a potential to cause some disturbance of the seabed predominantly due to altered sediment mobility around temporary structures causing scour and deposition. Allowing for mitigation and coupled with the fact that most of the scour will naturally refill with mobile re-deposited material post construction, the residual impacts are expected to be neutral to negative of imperceptible to slight amplitude and over the short term.

A minor deepening and lengthening of the deeper channel may remain within the lower estuary area if a pit was required in this area. As the seabed in this region is generally coarse and mobile, the impact of this change will be insignificant. Isolated areas of scour remaining will naturally infill with surrounding sediments as previously recorded during geotechnical operations in the bay in 2008 (Wilson, 2008).

14.7.10 Monitoring of Hydrography

Should emergency surface intervention be required, then the immediate hydrography of the seabed around the location of the pit will be surveyed using a small vessel and single beam echo sounder (SBES) both prior to and after the construction works. Aerial photography will be used to continue to monitor the regional flow of the main channel and surrounding banks within the bay twelve months after the completion of the construction works. Further monitoring will be carried out over a longer subsequent period based on these results.

15 SOILS, GEOLOGY, HYDROLOGY & HYDROGEOLOGY

This chapter examines the potential impact of the proposed development on soils, geology, hydrology and hydrogeology. No impacts to these issue areas are anticipated during the operational phase; however, the construction phase has the potential to result in impact. Consequently, impact assessments have been undertaken on the geology (including geotechnical characteristics) (see Section 15.1), hydrology (see Section 15.2) and hydrogeology (see Section 15.3) along the route, while a separate assessment of blanket bog hydrology has been undertaken on the peatlands traversed by the proposed route (see Section 15.4). Details on the potential impacts and associated mitigation measures are provided within each of these sections. Residual Impacts are outlined in Section 15.7.

These assessments were undertaken by:

- RPS (geotechnical, hydrology and hydrogeology aspects);
- Applied Ground Engineering Consultants (AGEC) (geological conditions within the Bay, peat stability, stone road in peat and ground movement risk); and
- Hydro-Environmental Services (peatland hydrology).

15.1 SOILS & GEOLOGY

Two separate assessments were undertaken to gain an understanding of the geological and geotechnical characteristics along the proposed route. RPS undertook an assessment on the geotechnical aspects in non-peat areas traversed by the route, while AGEC undertook an assessment on the peat areas traversed by the route and the geological conditions within the bay.

A desk study of available information including aerial photography, available background information including Geological Survey of Ireland (GSI) information and historical ground investigation data (as set out in Appendix M1-A and M1-B), was undertaken for the proposed route.

Walkover surveys were also carried out to assess the route, including a geomorphological walkover survey by AGEC of the peat areas (see Appendix M3). A number of ground investigations were also undertaken along the route in 2007, 2008, 2009 and 2010 (see Section 15.1.1). Various investigation techniques were used to determine stratification and soil types and gain samples for laboratory testing. These investigations involved both land and marine works and included shell and auger drilling, rotary coring, cone penetrometer testing (CPT) (used to collect information to classify soil type), televiewer surveying, geophysical surveying, peat depth probing and shear vane testing (used to estimate the undrained shear strength of the material).

Details on the ground investigations are summarised in Table 15.1 and Section 15.1.1. A detailed assessment of the geotechnical aspects of the proposed works in non peat areas is contained in Appendix M1. A report by AGEC on the assessment of peat stability along the route including a detailed analysis of the proposed ‘stone road’ method of construction in peat areas (see Chapter 5) is provided in Appendix M2.

15.1.1 Existing Environment

15.1.2 Route Description

The geology and soils of this route can be divided into distinct sections, of which blanket bog forms approximately one third. Each section of the pipeline route is described in Table 15.1 along with the approximate chainages (as shown in the route alignment sheets in Appendix A of this EIS) and the proposed construction methods for each section (as described in Chapter 5). The ground conditions anticipated along the route are summarised in the following sections with detailed assessments in Appendices M1, M2 and M3.

Table 15.1: Description of geology along route (showing approximate chainages) with details of Proposed Construction Methods (see Chapter 5).

Section	Approximate Chainage		Land type*	Description	Proposed Construction Method
	From	To			
Gleann an Ghad (Glengad)	83.40	83.88	Improved agricultural grassland	The proposed landfall valve installation location is at the west of this section. A small cliff face about 3m to 4m high is exposed at the western end fronted by a beach leading to the sea. Sand dunes are located to the north of the section. Ground conditions comprise generally shallow granular subsoil on psammite (metamorphosed sandstone) rock, which was encountered in boreholes between about 3.85m and 5m bgl. Psammite rock is exposed along the cliffs at the landfall site. Rock typically dips at 80^{o} to the south although close to the landfall there is a near perpendicular change in dip angle. The pipeline will be within a tunnel from the eastern Gleann an Ghad (Glengad) headland where a compound area with a reception pit will be constructed.	Spread technique
Tunnel	83.90	88.77	Wet grassland, marsh, estuary and intertidal, eroded/cutover blanket bog	This section of the pipeline passes beneath Sruwaddacon Bay and will be constructed using tunnelling methods (Segment Lining). Shallow granular and cohesive subsoils exist in the foreshore section. Geophysical and geotechnical surveying within Sruwaddacon Bay showed granular deposits consisting of mainly sands and gravels with occasional cobbles and small boulders to depths of about 25m overlying bedrock. The bedrock is exposed on the foreshore in the northern part of the bay.	Segment lined tunnel technique
South of Sruwaddac on Bay / na hEachú (Aghoos)	88.77	89.18	Modified cutover and eroding blanket bog- undesignated	The tunnel will be constructed from na hEachú (Aghoos) on the south eastern shore of Sruwaddacon Bay where a compound area associated stringing area and starting pit will be constructed.	'Stone Road' method
	89.18	89.36	Stream inlet and salt marsh/ improved agricultural grassland and wet grassland	This section comprises gently sloping peatland underlain by granular and cohesive subsoil to a depth of 8.2mbgl** in turn underlain by weak to moderately weathered schist bedrock to 16.4m bgl underlain by a strong slightly weathered psammite bedrock to depth as determined from a borehole in the area (IDL, 2009).	Spread technique
	89.36	89.55	Recovering Eroded blanket bog	Peat probing indicated peat depths of between about 1m and 4m. This section crosses peatland and a small valley associated with the Leenamore River, until it reaches a forested area at chainage 89.545.	'Stone Road' method
Forested Area	89.55	91.72	Coniferous forestry on blanket bog/ some trees recently felled	This section of the route runs south east crossing commercially forested land before changing direction where it crosses a road. It changes direction again to run south to south west falling towards a small valley and rising again to the Terminal site. Peat probing indicated peat depths of between about 2m and locally 5m. Trial pits indicated soft to very soft slightly to highly amorphous peat from 0m to 3.5mbgl. Slightly silty very gravelly sand was present at 3.5mbgl in one of the trial pits. Approximately 900m of stone road was constructed in this area (Ch. 90.73 to 91.69) during previous pipeline construction activities	'Stone Road' method

*Sections are generally based on land types as defined by habitat mapping (see Chapter 12).
**m bgl: metres below ground level

15.1.2.1 Bedrock Geology

According to the bedrock Geology of Mayo, Sheet No. 6[1], the proposed route is underlain by Dalradian Rocks, laid down over 600 million years ago. They were subject to massive compression and faulting over the first 200 million years, due to several periods of continental convergence. As a result, the Dalradian rocks consist of metamorphic and faulted sedimentary sandstones - quartzites, psammitic schists and pelitic schists with some marbles also present. The Dalradian rocks, having undergone a number of deformation events, are also characterised by extensive folding; therefore dips in the area are variable. The bedrock within the Sruwaddacon Bay area is shown in Figure 15.1.

From site walkovers psammitic rock exposures are evident along the foreshore particularly in the northern part of Sruwaddacon Bay. Rock exposures are also evident along the cliffs and wave cut platforms at the landfall site. Rock typically dips between 60^{o} and 80^{o} to the south along the beach close to the landing. Rock exposures of massive to moderately fractured psammite and weathered sandstone, highly fractured in places, occur closer to the mouth of the bay along the foreshore. Rock outcrops are less evident heading east and south into the bay.

The dip directions of rock joints within the exposures in the northern shoreline of the bay varied from those at the landfall location and are generally near vertical to steeply dipping to the southeast. There is notable variation in joint orientation which is considered due to localised folding. Rock joint spacing within the rock exposures in the bay is notably variable with spacing ranging from 5mm up to 500mm.

Ground investigations along the terrestrial section of the route (GES, 2007[2]) indicated psammite rock with bands of pelitic schist and pelite with rockhead between 1.4m and over 21.0m below ground level.

Ground investigations in Sruwaddacon Bay (IDL, 2008[3]) indicated psammite rock with bands of semi pelite, quartz muscovite schist, semi-pelitic schist and psammitic schist. Rockhead was encountered between 3.3m and 24.8m below seabed level. The recovered rock cores were generally highly fractured. Rock strength from Point Load and Unconfined Compressive Strength (UCS) testing varied from very weak to extremely strong. Cerchar abrasivity testing on samples from the bedrock indicated that the rock can be classified as very abrasive.

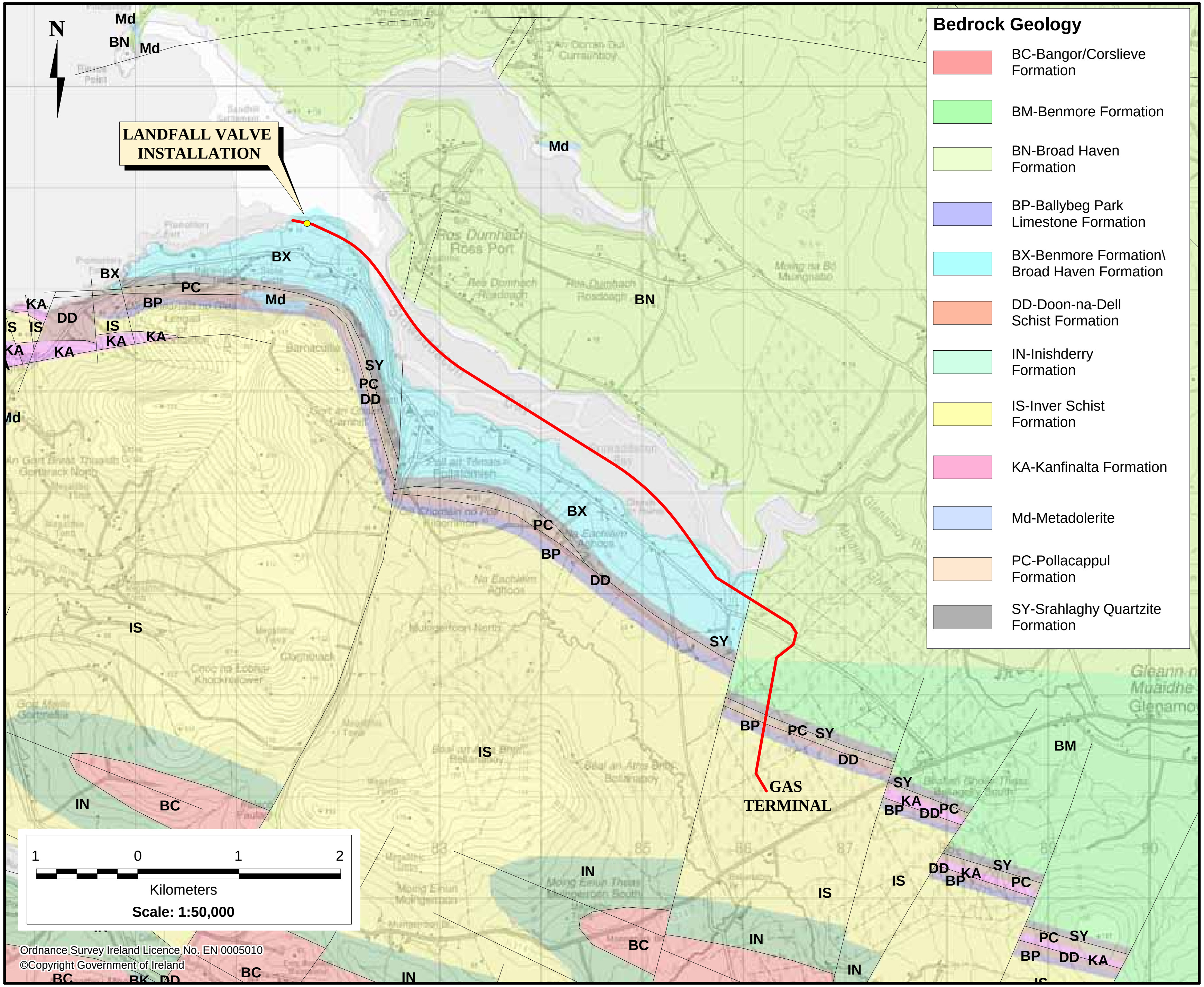
Geophysical surveying in Sruwaddacon Bay (Osiris, 2007[4]) indicated rockhead between about 1m and 25m below seabed level. The shallower rockhead was evident towards the edges of the bay with the deeper rockhead towards the bay centre. Several geophysical anomalies were recorded during the survey, which are likely to correspond to igneous dykes within the bedrock.

15.1.2.2 Soils/Subsoils

According to the GSI/Teagasc online subsoil map of Ireland (see Figure 15.2), the dominant subsoil in the area is peat. A small amount of soil derived from windblown sands is present, at the western edge of Sruwaddacon Bay and to the north of the bay, near the coast. Alluvial deposits comprising mixed granular material (sand to boulder sized particles) are present along river channels in the area.

At the landfall location at Gleann an Ghad (Glengad), site walkovers recorded topsoil underlain by aeolian sands and gravel over colluvium or weathered rock over weathered to fresh rock. Clayey sands were visible in the bay when the tide receded. On the foreshore cliffs, shallow peat underlain by sandy gravely clay was evident. Excavations undertaken at the landfall (close to the proposed location of the LVI) as part of the offshore pipeline works in late 2008, exposed sand and gravels with cobbles to a depth of between about 2.5m and 3.0m.

[1] Geological Survey of Ireland, 1992. Geology of North Mayo. Sheet 6
[2] Geotechnical and Environmental Services, 2007. Corrib Onshore Pipeline Onshore pipeline Route Selection Geotechnical Ground Investigation Factual Report (See Appendix M1)
[3] Irish Drilling Limited, 2008. Corrib Foreshore Pipeline Site Investigation Factual Report (See Appendix M1)
[4] Osiris Projects, 2007. Corrib Gas Pipeline Landfall Sruwaddacon Bay Geophysical Survey



LEGEND:

Proposed Pipeline Route

Fault Line

Bedrock Geology

Figure 15.1

File Ref: COR25MDR0470Mi2125A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

Peat is present along the section of the pipeline route south of Sruwaddacon Bay, at na hEachú (Aghoos), and extends to the terminal site. Probing south of Sruwaddacon Bay, east and west of the Leenamore River, indicated peat depths of up to about 5m. Generally the peat was firm underfoot in this area with locally very soft and wet areas in cutaway strips. The peat along the section of the route within the forestry to the Terminal was also generally firm underfoot. An existing stone road, which has been trafficked by construction plant from the Terminal site, was constructed along part of this section of the route during previous pipeline construction activities. It has remained stable since construction. The pipeline will be placed within this existing stone road. This section of stone road is detailed in Appendix M3.

Ground investigations carried out at Gleann an Ghad (Glengad) and Ros Dumhach (Rossport) (IDL, 2002 and GES, 2007) generally indicated topsoil overlying sand and gravel with some clay/silt bands. Overburden deposits varied in depth between about 1.4m and 10.1m. Investigations along the section of the route towards the Terminal east of the Leenamore River (GES 2007[5], AGEC 2004[6], IDL 2002[7]) indicated peat depths of between about 2m and 5m. Trial pits indicated soft to very soft, slightly to highly amorphous peat from 0mbgl to 3.5mbgl. Slightly silty, very gravelly sand was present at 3.5mbgl in one of the trial pits.

Ground investigations carried out in Sruwaddacon Bay (AGEC 2004[8], IDL 2008[9]), which comprised boreholes and some trial pits, indicated fluvial sediments of dominantly sands and gravels with some cobbles. These sediments, where encountered in boreholes, extend to a depth of about 25m below river/seabed level within the northern part of the bay. In the southern part of the bay, boreholes encountered occasional clay/silt layers and, at shallow depth between about 0.1m and 0.7m, some peat layers. The clay/silt layers become more prominent towards the southwest shoreline of the bay.

Geophysical investigation survey results for Sruwaddacon Bay (Osiris, 2007[10]) indicated fluvial sediments of dominantly granular material to a depth of about 25m below river/seabed level in the northern part of the bay and to a depth of about 10m below river/seabed level in the southern part of the bay. These sediments become shallower towards the margins of the bay. The sediments comprised a mixture of reworked medium to fine sand through the central part of the bay and mixed gravel sediments, derived from glacial tills and weathered bedrock, at the bay margins and in areas of stronger current flow. The mixed gravel sediments are incised by the Glenamoy and Muingnabo River channels, which enter the bay as one channel at its extreme southeast point.

15.1.2.3 Pipeline in Non-Peat Areas

It is proposed that the pipeline between the landfall at Gleann an Ghad (Glengad), (Ch. 83.38) and where the pipeline enters the proposed reception pit for the tunnel under Sruwaddacon Bay to the east (Ch. 83.91) will be installed using conventional pipelaying construction methods. This involves laying the pipeline in an open excavation approximately 2m deep but could be up to 5.5m deep approaching the landfall valve. Excavation may encounter the upper layer of bedrock due to the low elevation of the landfall valve.

Conventional pipe laying construction methods are described in Chapter 5 of this EIS.

15.1.2.4 Pipeline in Peatland

It is proposed that the pipeline where it emerges from the tunnel at na hEachú (Aghoos) (Ch. 88.77) to the Terminal site (Ch. 91.72) will be installed within a stone road constructed through the peatland found within this section of the route.

The stone road comprises the excavation and removal of peat along the line of the pipeline route and replacement with suitable stone fill to form a stable roadway through the peat. The peat will be

[5] Ibid, pg.15-5
[6] Applied Ground Engineering Consultants, Sept 2004. Final Report on Onshore Gas Pipeline – Glenamoy River Estuary Crossing – Site Investigation Factual Report
[7] Irish Drilling Limited, 2002. Bellanaboy Bridge Co. Mayo Factual Site Investigation
[8] Ibid, pg. 15-6
[9] Ibid, pg. 15-5
[10] Ibid, pg. 15-5

removed over a width of about 12m to form the stone road but reduced to 9m wide in a short section (190m) of recovering eroded bog (Ch. 89.35 to 89.54) east of the Leenamore River.

The peat thickness for the section typically ranges from about 2m to about 5m locally, except where a stream is crossed (Leenamore Inlet) where peat is absent. Based on site investigation data about 60% of the route within the peatland will be within peat depths ranging from 2 to 3m.

Where the route passes across the Leenamore River inlet there is some reclaimed agricultural land with some localised peat cuttings. To the southeast of the peat cuttings, the route passes into an area of open peatland that extends to an area of commercial forestry (Ch. 89.55).

The peat surface condition in the section outside of the commercial forestry varies from surface hummocks with some water-logging to reclaimed peatland. Close to where the peat has been cut, the peat is relatively drier.

Within the commercial forestry the pipeline route generally follows forest breaks that run through the forestry plantation. The peat surface condition within the commercial forestry varies from some local water-logging to well-drained peat. There is extensive man-made surface drainage within the forestry which comprises regularly spaced forestry drainage.

An assessment of peat stability along the route within the peatland including a detailed analysis of the proposed stone road method of construction in peat areas (see Chapter 5) is provided in Appendix M2. The stone road stability report demonstrates that the stone road can be safely constructed in the peatland.

The use of a stone road within peatland is, in many cases, the preferred construction method as it greatly reduces the risk of peat failure and also essentially eliminates subsequent settlement. The stone road construction method will provide a robust and stable platform for the safe construction and installation of the pipeline and will protect the pipeline from any possible peat movement or instability.

15.1.2.5 Tunnelling

It is proposed that the pipeline between Gleann an Ghad (Glengad) (Ch. 83.91) and na hEachú (Aghoos) (Ch. 88.77) is installed within a segment lined bored tunnel and which will be constructed using a Tunnel Boring Machine (TBM). Tunnelling by the Segment Lining method is described in Chapter 5.

The proposed tunnel will be approximately 4.9km long and have an outside diameter of 4.2m. Approximately 4.6km of the tunnel will be underneath Sruwaddacon Bay. The proposed tunnel alignment is mainly through sands and gravels as shown in Appendix M1-A (Drawings Dg0401 – Dg0404). The horizontal alignment of the tunnel may deviate by up to 8m on each side. The vertical alignment of the tunnel may vary between a minimum cover of 5.5m and a maximum depth of 10m below the indicated centreline.

The geophysical and geotechnical data that is now available provides sufficient basis for the selection of the proposed construction method (segment lined tunnelling). The size of the TBM required to construct the proposed tunnel and the inherent flexibility of these machines will ensure that all ground conditions likely to be encountered can be managed. Where potential difficulties arise, e.g. large boulders, igneous dykes etc, these will only result in delays in tunnelling progress.

No surface construction works are anticipated in Sruwaddacon Bay and it is understood that such requirement has only ever arisen on similar projects (but not with segment lined tunnels) due to exceptional site specific circumstances. Therefore it is considered that the probability of there being a requirement for surface intervention as a contingency measure is remote.

Notwithstanding the above, additional geotechnical site investigations will be carried out (subject to Foreshore Licence). Information gathered during these works will serve to verify existing data with respect to ground conditions and ranges of values for various parameters. Rockhead profile will be verified also. The full set of geotechnical data gathered will be made available to the tunnelling contractor. This will enable the tunnelling contractor to optimise the design of the tunnel and the TBM.

15.1.2.6 Tunnelling in Superficial Deposits

Ground conditions within the bay comprise dominantly fluvial sediments of varying thickness. Sediments range from coarse gravels to firm silts and occasional thin bands of peat. Most of the deposits are fluvial in origin. Glacial cohesive soils may also be present within the superficial deposits in the bay. Sediment thicknesses vary from about 2m near na hEachú (Aghoos) to up to 25m at the mouth of the bay near Gleann an Ghad (Glengad).

The existing ground investigation data within the bay indicates the possible presence of boulders within the sediment deposits. Detailed site investigation within the bay may provide more information on the size, distribution or strength of any boulders, if present.

The design of the tunnel boring machine (TBM) will take into account the nature of the fluvial sediments present in the bay area; that is fluvial sediments with mixed silt but dominantly coarse soil up to possible boulder size. The tunnel cutter head will be optimised for these fluvial soil conditions and other soil or rock conditions encountered along the line of the proposed tunnel.

15.1.2.7 Tunnelling in Rock

Geophysical surveying has been undertaken throughout Sruwaddacon Bay (Osiris, 2007[11]) to determine the depth of sediments and the rockhead profile. The geophysical rockhead profile along the central part of the bay shows the rockhead profile between typically about -25 to -10 m below OD. The current borehole ground investigation information comprises data from 14 boreholes (at previously proposed crossings) at the mouth of the bay and another at the southern end of the bay (AGEC 2004[12], IDL 2008[13]).

Faults in the rock are shown on the GSI 1:100,000 scale map of the bay area running north-south across the northern part of the bay, and the geophysical survey also identified possible faults through the bay. Walkover survey of the rock exposures in the northern part of the bay did not identify any significant shear or disturbed zone associated with faulting. Where faults are encountered in tunnel works within rock there is the possibility of localised fractured rock and increased water inflow. TBM design will take into account the possibility of encountering faults.

Several linear geophysical anomalies, possibly igneous dykes[14], were identified during the geophysical survey generally aligned across the bay. If these dykes are present they are likely to represent localised areas of igneous rock of the order of several metres wide. Igneous rock may be harder than the dominant rock within the bay area. As part of the detailed site investigation, boreholes will be carried out to determine the extent and presence of such dykes. Igneous dykes would not represent a risk where encountered in tunnel works, though where igneous rock is notably hard this may locally slow the rate of tunnelling. TBM cutter design will take account the possibility of locally encountering harder rock within igneous dykes.

Rock condition with respect to tunnelling has been assessed from the available borehole descriptions and test results from investigations carried out within the bay. Using the Rock Quality Designation (RQD) values and the rock descriptions, an assessment of the rock condition has been carried out using the Tunnel Quality Index system (Q system). Rock 'Q' values range from about 0.2 to 5, which would be as expected considering the fractured nature of the rock.

[11] Ibid, pg. 15-5
[12] Ibid, pg. 15-6
[13] Ibid, pg. 15-5
[14] An Igneous Dyke is a body of intrusive igneous rock that cuts across the structural fabric of the host bedrock

15.1.2.8 Tunnel Compound Areas

Aghoos Tunnelling Compound

The Aghoos tunnelling compound comprises the tunnel starting shaft / pit, the main tunnelling compound and an adjacent pipe stringing area. Ground conditions in the area are summarised in Table 15.1. The ground surface gently falls to the north at about 2 degrees. To the east of the compound the ground falls to the Leenamore River inlet, which is surrounded by agricultural fields used for grazing.

Construction of the Aghoos tunnelling compound and stringing area is described in Chapter 5. A detailed analysis of the proposed construction approach (stone road method) is contained in Appendix M2.

Where heavily loaded equipment or materials are required to be placed onto the compound, additional measures may be required to support the equipment or materials in order to provide adequate bearing capacity. These additional measures could comprise localised removal of peat to the underlying soil and replacement with granular fill or the use of piled support structures.

The tunnel start pit at Na hEachú (Aghoos) consists of an excavation approximately 10m deep x 9m wide by 20m long (including sealing body) with an access ramp approximately 75m long by 5.5m wide. Given the ground conditions, the excavation will be supported by temporary support such as sheet piles (and bracing where necessary) in soil and fill, or battered slopes where more competent ground or bedrock is encountered.

Glengad Reception Pit and Compound

Ground conditions in the area of the Glengad reception pit and compound are summarised in Table 15.1 and in Appendix M1. The ground surface in the area falls gently to the north.

The tunnel reception pit at Gleann an Ghad (Glengad) consists of an excavation approximately 10m deep x 7.5m wide by 28m long (including sealing body) with access ramp. Given the ground conditions, the excavation will be supported by temporary support such as sheet piles in soil or battered slopes where more competent ground or bedrock is encountered.

15.1.2.9 Topography

At Gleann an Ghad (Glengad) headland the topography of the proposed route comprises gently sloping ground with an elevation range from 0 to 10m above sea level.

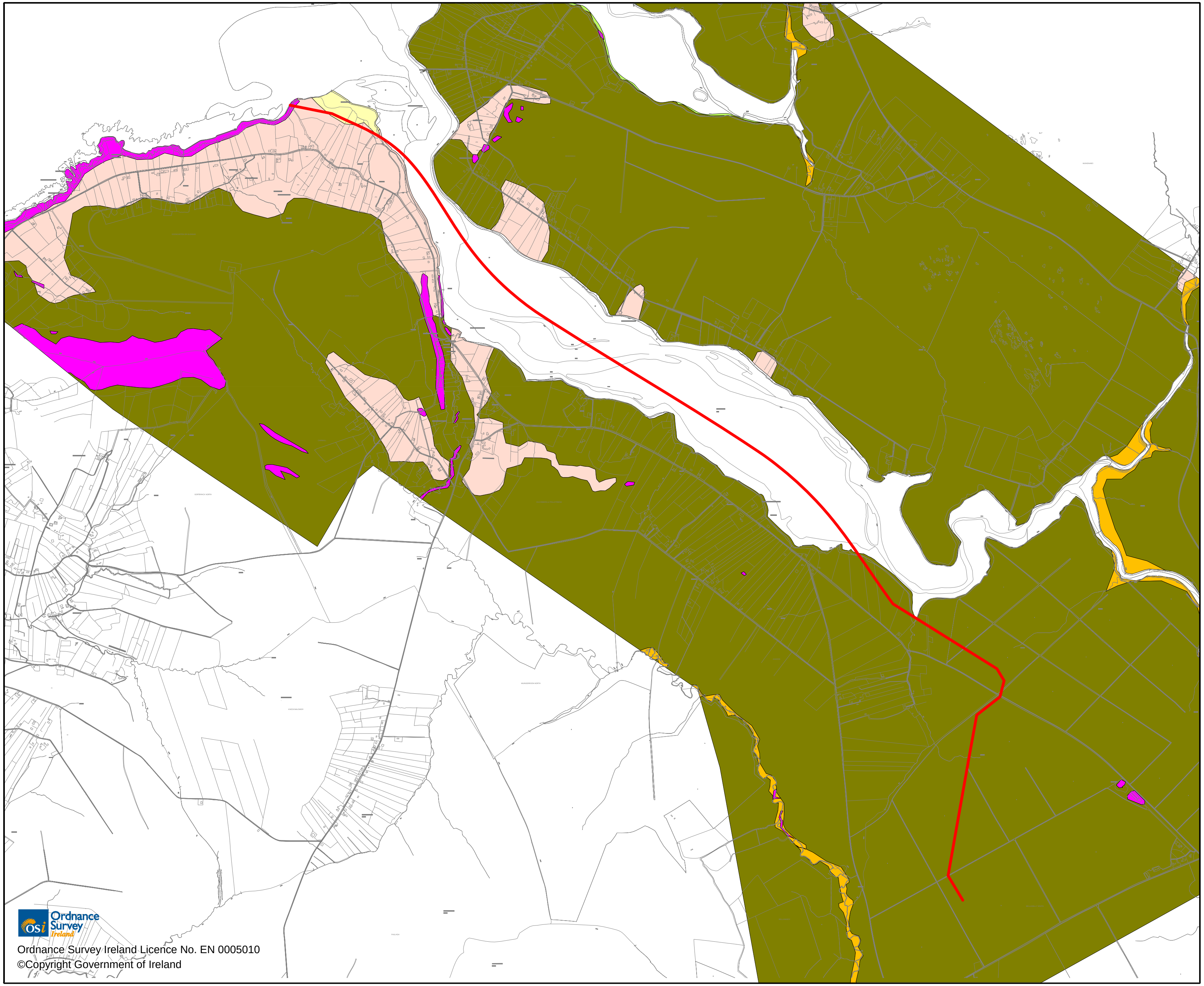
South of Sruwaddacon Bay at na hEachú (Aghoos) the elevation generally increases, reaching a maximum of approximately 38m above sea level close to the Terminal site at Béal an Átha Buí (Bellanaboy). The slope gradients along the route generally vary between less than 2^o and 4^o for most of the route with relatively steeper slopes close to river crossings at the Leenamore River inlet (Ch. 89.25) and at a tributary of the Leenamore River (Ch. 90.66).

15.1.2.10 Groundwater

Groundwater strikes were recorded during drilling of boreholes along the route between about 1.1m and 3.8m below ground level in the inorganic soils and between 0m and 0.4m below ground level in the peat areas south of Sruwaddacon bay at na hEachú (Aghoos).

Groundwater has been monitored in borehole piezometers since their installation in 2007 by GES.

See Section 15.3 for details on hydrogeology.



LEGEND:

SUBSOILS

- Alluvium
- Blanket Peat
- Estuarine/Marine Deposits
- Rock
- Till Derived from Metamorphic Rocks
- Water
- Wind Blown Sand

Proposed Pipeline Route

Subsoils Geology

Figure 15.2

File Ref: COR25MDR0470Mi2131A03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

15.1.2.11 Landslides

In establishing the proposed route of the pipeline and the construction method employed in peat a number of key landslide events were examined, namely the 2003 Dún Cheartáin (Dooncarton) landslide event and the 2003 Derrybrien peat slide.

The adoption of a stone road construction method for installing the pipeline eliminates the risk of placement of load onto the peat surface where weaker peat may be present.

The construction methodology in peat for the Corrib Onshore Pipeline is the stone road method within which the pipeline will be installed (see Chapter 5). The stone road will be constructed on competent ground and will be inherently stable as detailed in the assessment of the stone road construction method (Appendix M2). A Geotechnical Risk Register (Appendix M4) has been compiled which includes construction in peat areas and appropriate mitigation measures determined to minimise geotechnical risk (See Section 15.1.3).

15.1.3 Geotechnical Summary

The installation of the proposed pipeline, services and outfall pipeline will use several different construction methods as set out in Chapter 5 and indicated in Table 15.1 above. From the geotechnical assessments carried out it was determined that around one third of the proposed route will be within peat areas. Assessment of the route through peat areas shows that the proposed stone road construction method provides a stable platform for the installation of the pipe (see Appendix M2).

Bedrock will only be encountered during construction of the landfall valve at Gleann an Ghad (Glengad) and in the construction of the proposed pipeline tunnel under Sruwaddacon Bay, where part of the tunnel will pass through bedrock.

Where the pipeline is constructed in inorganic soils it will be founded within medium dense to dense sand or gravel. These deposits have adequate strength to support the pipeline loads. A detailed geotechnical assessment of the sections of the route in inorganic soils and within Sruwaddacon Bay is included in Appendix M1. The assessment of factual data and analyses carried out demonstrates that the pipeline can be constructed in the proposed environment.

Geophysical surveying has already been undertaken throughout Sruwaddacon Bay (Osiris, 2007[15]) to determine the profile of the interface boundary between the superficial sediments and bedrock. Geotechnical site investigations were also carried out in Sruwaddacon Bay in 2008. The ground conditions through Sruwaddacon Bay consist of:

(1) Varying depths (up to approximately 25m) of fluvial and glacial sediments, mainly consisting of sand and gravel, with possible boulders present near the base of the sediments.

(2) Bedrock consists of weak to very strong psammitic and pelitic schists of Dalradian age, which has been significantly folded. Geophysical surveys indicate the possible presence in the bedrock of igneous dykes at various locations within the bay.

Within Sruwaddacon Bay, the pipeline will be installed within a segment lined tunnel. The proposed tunnel will be approximately 4.9km long and have an outside diameter of 4.2m. Approximately 4.6km of the tunnel will be underneath Sruwaddacon Bay. The proposed tunnel alignment is mainly through sands and gravels as shown in Appendix M1-A (Drawings Dg0401 – Dg0404). The horizontal alignment of the tunnel may deviate by up to 8m on each side. The vertical alignment of the tunnel may vary between a minimum cover of 5.5m and a maximum depth of 10m below the indicated centreline. Previous survey work will be further supplemented by borehole investigation within the bay, which will allow the appointed tunnelling contractor to optimise the design of the tunnel.

In peat areas, due to the inherent weak strength of peat, it is proposed to construct a stone road within which to lay the pipeline and also to act as a working platform for construction plant. This stone road method provides long term stability and protection of the pipeline.

[15] Ibid, pg. 15-5

A detailed assessment of peat stability and the stone road stability in peat is included in Appendix M2. The stone road stability report demonstrates that the stone road can be constructed in the proposed peat environment. The stone road will provide a robust and stable platform for the safe construction and operation of the pipeline.

15.1.4 Potential Impacts & Mitigation Measures

15.1.4.1 Geotechnical Risk Register

A Geotechnical Risk Register is provided in Appendix M4. The register has been compiled to show the degree of uncertainty associated with various elements of the proposed pipeline construction on a qualitative scale derived from Clayton (2001)[16]. This register has been compiled to address geotechnical hazards and risk control measures during the design and construction stages of the project. These findings have been used to identify the potential impacts/risks of the hazard, to identify the design and construction controls to be implemented in order to minimise geotechnical risk (i.e. mitigation measures), and to identify residual impacts and appropriate remedial measures.

The register will be used actively throughout the detailed design and construction and will be updated to reflect additional data and experience as it is gained.

15.1.4.2 Potential Leak from Water Outfall Pipe

In the unlikely event that the water outfall pipe leaks, water will be released into the pipeline backfill material. Due to the limited flow within the outfall pipe any effect will be very local and will have no adverse effect on the stability of any part of the pipeline system or surrounding land.

A review of potential stability risk arising from leakage of the water outfall pipe where it is installed within the stone road in peat areas is provided in Appendix M2.

15.1.4.3 Geotechnical Monitoring of the Pipeline

Construction Monitoring

All site works will be monitored thoroughly during the construction period. Site staff will be made fully aware of the ground conditions expected along the route of the pipeline. A dedicated geotechnical engineer will be employed to oversee construction monitoring with respect to ground movements.

Ground survey markers will be installed at regular intervals along the length of the stone road in peat to monitor movement during stone road construction and following installation of the pipe. In areas of deeper peat inclinometers will be installed in peat adjacent to the stone road to monitor any possible lateral movement of the peat. Groundwater levels will be monitored from drive-in piezometers installed in deeper peat areas in advance of stone road construction, see Appendix M2 for details. Visual sighting lines as a minimum will be installed adjacent to the working areas within peatland and monitored for any excess movements. If necessary, remediation measures will be implemented and the movement/ground conditions/groundwater levels monitored until they stabilise again.

An observational method of monitoring will be adopted by all personnel, where any unexpected changes in ground conditions, groundwater levels and/or ground movement is noted and the appropriate construction management personnel made aware of said changes.

The above measures are included in the geotechnical Risk Register (see Appendix M4)

[16] Clayton, C.R.I., (2001). Managing Geotechnical Risk. Thomas Telford, London.

Post Construction Monitoring

Post construction visual inspections will be carried out regularly along the pipeline route to identify any indications of movement. At selected locations and where possible, ground survey markers installed within the stone road during construction will be extended above the finished peat restoration level to enable long term monitoring of movement (see also Appendix M4)

15.2 HYDROLOGY

A report on the assessment of the potential impact of the proposed onshore pipeline on the existing hydrological regime is provided in Appendix M5. The assessment was undertaken by RPS. The following section describes the existing environment from a hydrological perspective and outlines the potential impacts and mitigation measures. A separate assessment has been undertaken of the peatland hydrology of the blanket bog traversed by the proposed route and this is described in Section 15.4 and Appendix M6.

15.2.1 Existing Environment

15.2.1.1 River Catchments & Flooding

The proposed pipeline route lies mainly within the Sruwaddacon Bay catchment area. The two largest rivers draining into Sruwaddacon Bay are the Glenamoy River and the Muingnabo River. The Sruwaddacon Bay catchment forms part of National Hydrometric Area – 33 and falls within the Western River Basin District (WRBD). Figure 15.3 shows the extent of the associated river catchment areas draining into Sruwaddacon Bay along with a layout of the proposed pipeline route. A short section of the route within the Terminal is not shown within any catchment as it is understood to be facilitated by the surface water drainage in the Terminal site, which discharges to the Carrowmore Lake Catchment.

The Glenamoy River rises in a mountain located at Gleann an Ghad (Glenagh), Co. Mayo (land elevation 304mOD Malin Head), approximately 20km northeast of its confluence with Sruwaddacon Bay. The Glenamoy River has an approximate catchment area of 87km^2 upstream of this confluence. The Muingnabo River rises in high ground at Gleann an Ghad (Glenagh) (at land elevation of 265mOD Malin Head) approximately 15km upstream of its confluence with Sruwaddacon Bay. This river has an approximate catchment area of 40km^2 upstream of the confluence. Both river catchments are steeply sloped towards Sruwaddacon Bay with an approximate main channel slope of 1 in 85. The soil types within both of the catchment areas vary between the FSR (The UK Flood Studies Report, NERC 1975) soil types 3 and 5, suggesting moderate to very low winter rain acceptance potential.

In addition to the two main river catchments mentioned above, a number of smaller local river/stream catchments and some lands surrounding Sruwaddacon Bay drain directly into the Bay.

The Glenamoy and Muingnabo rivers generally flood every winter after heavy prolonged rainfall. These catchments have experienced a number of high floods in the past. The worst flooding in this catchment occurred in 1984 (21st September), 1989 (27th October) and in 2003 (19th September). Much of the low lying flood plains of the river catchments flooded during these flood events. However, the Office of Public Works (OPW) flood hazard map (see Appendix M5) does not show any areas prone to flooding in the vicinity of the proposed pipeline route.

15.2.1.2 Rainfall

Observed long term average annual rainfall at Bangor, Gleann na Muaidhe (Glenamoy), Ros Dumhach (Rossport) and Béal and Mhuirthead (Bellmulet) are 1352mm, 1416mm, 1339mm and 1173mm, respectively (source Met Éireann). The estimated 100 year return period hourly rainfall at Béal and Mhuirthead (Bellmulet) is 34mm, while the maximum observed hourly rainfall at Poll an tSómais (Pollatomish) is approximately 40mm, recorded in September 2003.

The west of Ireland experienced notably high rainfall in November 2009, along with other many parts of Ireland. The most extreme rainfall occurred over the period from 16th to 18th November 2009. The observed daily total rainfall on 16th November 2009 at Béal and Mhuirthead (Bellmulet) was 23.20mm. The estimated return periods of the November 2009 rainfall totals for the 4, 8 and 16-day periods at

Béal and Mhuirthead (Bellmulet) are 2, 3 and 5 years respectively (source Met Éireann- Climatological Note No. 12, February 2010).

15.2.1.3 Drainage

The lands along the proposed pipeline route drain directly into Sruwaddacon Bay as overland flows and also via the above-mentioned main rivers, their associated tributaries and other land drains located within the Sruwaddacon Bay catchment area. These drainage systems form part of the regional OPW arterial drainage network.

15.2.1.4 Water Quality

Water quality records for the watercourses in the vicinity of the proposed pipeline route were sourced from the Environmental Protection Agency (EPA). An assessment carried out by the EPA on these water quality records showed that the Glenamoy River at Gleann na Muaidhe (Glenamoy) (located approximately 5km upstream of the confluence with Sruwaddacon Bay) has "good" water quality status (Biotic Index of Q4) (source - *Water Quality in Ireland 2001-2003, EPA 2005)*. Bathing water quality in Gleann an Ghad (Glengad) in the vicinity of the proposed Landfall Valve Installation has been assessed as "*good"* and complies with EU Guide Values under the EU Bathing Water Directive. Risk assessments carried out by the WRBD have identified both the Glenamoy and Muingnabo Rivers in the immediate upstream vicinity of the confluences with Sruwaddacon Bay as "*1b- probably at significant risk of not achieving good status"* under the Water Framework Directive (2000/60/EC) by 2015, while Sruwaddacon Bay (which is classified as a transitional water) has been assessed as "*probably at risk of not achieving good status by 2015*".

15.2.1.5 Recreational & Amenity Value

The recreational and amenity value of the waters in the study area are discussed in detail in Chapter 6 of this EIS.

15.2.2 Potential Impacts

The potential impacts on various hydrological aspects, such as flooding, drainage and water quality, associated with construction of the proposed pipeline have been examined and appropriate mitigation measures have been proposed in accordance with the "*Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (Draft)*" (NRA 2007). These potential impacts are discussed in detail in the following sections.

15.2.2.1 During Construction

Flooding

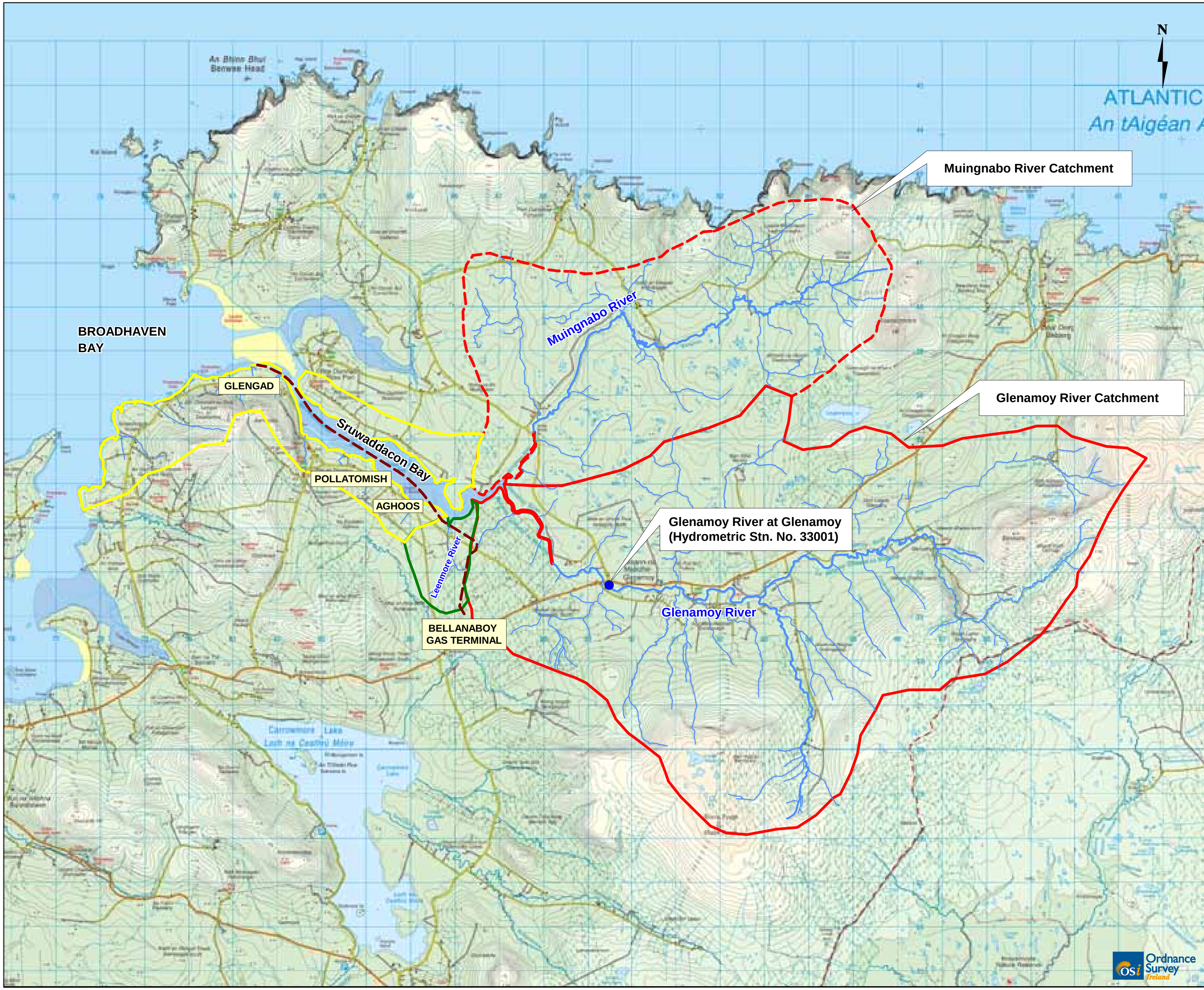
During the construction phase of the works, there is the potential for temporary, localised flooding of lands to occur in the vicinity of the proposed river/stream crossings. The causes of flooding could be due to:

- Obstruction to surface water flow paths caused by the pipeline alignment and the stone road construction works;

- Obstruction to flow paths to the natural drainage system and river channels at the location where open-cut technique will be used for laying pipe in the river bed (at Leenamore River crossing); and

- Blockage of surface water flow paths by collapse of unstable river/stream/trench banks, specifically in the peatland areas.

Prolonged extreme rainfall event and joint occurrences of an extreme rainfall event in the catchments and a high tidal event in Sruwaddacon Bay.



Legend

- Proposed Pipeline Route
- Muingnabo River Catchment
- Glenamoy River Catchment
- Leenmore River Catchment
- Additional Catchment Areas
- River Station
- River

Client

Corrib natural gas

Project

Corrib Onshore Pipeline

Title

River Catchments

Figure 15.3

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Approved by: C. Cahill	
Scale: 1:80,000 @ A3	**Drawing No.** Mi2194 / **Rev.** A03
Date: May 2010	

Notes
1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. Ordnance Survey Ireland Licence EN 0005010 ©Copyright Government of Ireland.

Drainage

The existing land drainage system in the vicinity of the proposed pipeline route, which forms part of the regional OPW arterial drainage network, could be affected during the construction period of the project. Impacts on the existing drainage system could include:

- Change in the pattern of runoff, with some existing drains and ditches receiving significantly more or less flow than they receive currently;

- Rainfall on elevated areas washing peat and silt into the surrounding watercourses. Localised erosion and scouring could occur, while reduced flow may result in stagnation in some drains and ditches;

- Obstruction to upland flow paths causing localised water logging in the upstream vicinity of the pipeline route; and

- Slight changes in the existing surface and subsurface drainage flow paths along the blanket bog areas during the construction phase of the project. (The potential impact of the stone road construction on the peatland hydrology is covered in Appendix M6).

Water Quality

There is potential for the water quality and fisheries of Sruwaddacon Bay and its tributaries to be affected by construction of the proposed pipeline. Impacts could arise from the following sources:

- Mobilisation of sediments and harmful substances during the construction phase, due to exposed soil and peat/soil movement/storage, particularly from construction of the stone road in the peat bog areas, which may block local streams and drains and could be flushed into the adjacent surface watercourses during heavy rainfall events;

- Accidental spills of harmful substances, such as petrol or oil and liquid cement, during delivery and storage or by leakage from construction machinery; and

- Increased pollutant and nutrient input due to an increase in surface runoff and removal of existing vegetation.

The above potential adverse impacts may affect aquatic habitats by: reducing light penetration, thus affecting primary production; displacement of aquatic invertebrates, which act as a fish food source; and smothering of spawning substrates. Disturbance of the peat could also result in increased oxidation and the release of a greatly increased level of humic acids.

Amenity Values

Impacts on the recreational and amenity value of the waters in the study area are discussed in detail in Chapter 6 of this EIS.

15.2.2.2 During Operation

There will be no impacts on hydrology as a result of operation of the proposed pipeline. In addition, during operation the proposed pipeline will not be impacted by the existing hydrological character of the area along the route for the following reasons:

- The pipeline will be buried with a minimum depth of cover of 1.6m beneath all watercourses traversed by the proposed route. Therefore, it will not be at risk from potential interferences from watercourses, e.g. erosion of stream/river bed, which might expose the pipeline. Furthermore, in the unlikely event of the pipeline at stream/river crossings being exposed, it is covered with impact protection in the form of a concrete slab to further safeguard the pipeline;

- The pipeline will be buried in the ground with a minimum depth of cover of 1.2m (see Chapter 5 of this EIS). At such depths it is not likely to be at risk from groundwater. However, even if it were to become surrounded in water for a period of time, the pipeline has been designed to withstand potential corrosion risks as it is protected by a 3-layer polypropylene coating. The pipeline has also been designed to ensure that it will not float.

- In areas of peatland, it is proposed to construct the pipeline within a stone road. Therefore, the hydrology of the peatlands will not impact on the pipeline during operation as it will be maintained within a stable platform and therefore will not be at risk from alterations in the surrounding drainage regime, i.e. flooding. The potential operational impact of the stone road on hydrology in the area of blanket bog traversed by the route has been addressed in Section 15.4 and Appendix M6.

15.2.3 Mitigation Measures

15.2.3.1 Flooding and Drainage

During Construction

The following mitigation measures will be implemented to manage flooding and storm water drainage during the construction phase of the project.

- Surface water runoff from the lands and green areas up-gradient of the working area will be conveyed via existing drainage channels where they occur along the route. These channels will be piped under (or in the case of compounds, around) the working area through a series of pipes to connect to existing outfalls and drains. Where drainage channels do not occur, a shallow interceptor ditch or barrier will intercept overland flows and discharge to the outfalls without any further attenuation and/or treatment as this runoff will be from undisturbed areas;

- Storm runoff will be conveyed via a swale or vee drain located on the down slope of the working area. Flow will be intercepted and a number of attenuation features (silt traps or check dams) will be located intermittently along the swale to encourage the sedimentation of any potential silt. At the outfall the discharge will be passed through a graded stone chamber encased in geotextile fabric as a final silt control mechanism;

- Where significant runoff from the stone road and compound locations is anticipated, sedimentation management is required. The sedimentation management system will be sized for a 10 year 24 hour storm event (CIRIA Report 142, 1994; CIRIA Report 532, 2001; CIRIA C648, 2006 & CIRIA Report B14, 1993);

- Any temporary ditches down slope from the construction works shall be designed to drain to a sediment pond. For the construction works, a return period of 10 years is appropriate (CIRIA 648, 2006); and

- Stockpiles will be kept at a minimum reasonable distance (minimum 50m) from any stream crossing, particularly from the Leenamore river crossing, to prevent any blockage to flood water flow paths from occurring during high rainfall events. Given the steep nature of the catchment slope, a flash flood in the Leenamore River could occur. Thus, adequate flood diversion works will must be designed and put in place for this. Pumping of floodwater may be also be considered as necessary.

Further details of the stormwater management measures proposed during the construction phase of the works have been provided in Appendix M5.

During Operation

Minimal to no impact on the existing flooding and drainage regime is expected during the operation phase of the project. Therefore, no remedial or reductive measures are considered necessary.

15.2.3.2 Water Quality

During Construction

The following measures are proposed for protecting water quality and aquatic habitats during the construction phase:

- A series of ditches and drains will be installed during the construction phase, to collect runoff. Temporary and permanent ditches will be used. Localised pumping may also be required;

- Fuels, oils, greases and hydraulic liquids will be stored within enclosed concrete/bunded areas and as far as possible from drainage ditches, surface water drains and watercourses. These bunds will be designed in accordance with the EPA Guidance Note on Storage and Transfer of Materials for Scheduled Activities (requirement for 110% storage volume for all tanks storing petroleum products). For the construction phase appropriately sized hydrocarbon interceptors will also be placed at outfall locations along the surface water drainage system;

- Runoff from construction areas will be will be collected and managed so that no direct discharges to watercourses occur;

- Stockpile areas for sands, gravels, excavated mineral soil and peat will be kept well away from any watercourses;

- Runoff will only be routed to the watercourse via suitably designed and sited sedimentation ponds, swales and channels,

- Sedimentation ponds will be inspected daily and maintained regularly,

- Watercourse banks will be left intact where possible. If they have to be disturbed, all practicable measures will be taken to prevent soils from entering the watercourse,

- A pollution prevention plan will be implemented at commencement of the construction phase;

- Weekly, and where necessary, daily inspections and maintenance of the above measures will be carried out to ensure that they are maintained in a satisfactory condition, and discharges will be monitored prior to discharge; and,

- Strict control of erosion, sediment generation and other pollutants associated with the construction process will be implemented including silt barriers and ditches downslope from construction works to intercept waters with high sediment loads and accidental leakages/ spillages of harmful substances.

Further details of the stormwater management measures proposed along the pipeline route during the construction phase of the works have been provided in Appendix M5.

During Operation

The risk to surface water quality during the operational phase of the works is expected to be minimal.

15.2.3.3 Water Quantity and Water Abstraction

The proposed pipeline (both during construction and operation) will not pose any risk to either the quantity or quality of existing sources of raw water that are currently being used for the regional water supply system. No remedial or reductive measures are proposed.

15.3 HYDROGEOLOGY

An assessment of the potential impacts of the proposed pipeline development on hydrogeology was carried out by RPS. The assessment addresses the groundwater in the bedrock along sections of the route in non-peat areas. An assessment of peatland hydrology is provided in Section 15.4.

15.3.1 Existing Environment

The Geological Survey of Ireland (GSI) classifies the groundwater in the underlying bedrock as a Poor aquifer, which is generally unproductive except for localised zones. Bedrock groundwater flow occurs predominantly through a limited and poorly connected network of fractures, fissures and joints. Shallow groundwater encountered within the peatland area is discussed in detail in Section 15.4. Shallow zones of higher permeability may exist within the upper levels of the fractured/weathered rock and along fault zones. These zones may provide locally important supplies of water but in general, the lack of connection between the limited fissures/fractures results in poor aquifer storage and flow paths that may only extend a few hundred metres.

Regional groundwater flow in the bedrock is expected to follow the regional topography of the area.

Geotechnical survey information (IDL, 2008) and geophysical survey information (Osiris, 2007) from Sruwaddacon Bay show rock head between 1.4 and 21.0m bgl. The superficial deposits under Sruwaddacon Bay comprised predominantly sands and gravels with some cobbles and boulders. The deepest depths to bedrock were recorded near the centre of the mouth of Sruwaddacon Bay. Rock exposures of massive to moderately fractured psammite and weathered sandstone, highly fractured in places, were recorded at the mouth of the Bay along the foreshore and at the LVI site. Rock outcrops were less evident heading east and south into the Bay. Bedrock information for the area from the GSI, including previously identified fault lines, is presented in Figure 15.1.

The geophysical survey of Sruwaddacon Bay (see geophysical cross sections in Appendix M1-A) also identified geophysical anomalies underlying the Bay. These anomalies are likely to correspond to igneous dykes within the bedrock, which in general restrict the flow of groundwater within bedrock.

Groundwater levels were recorded in monitoring wells along the northern shoreline of Sruwaddacon Bay and to the south of the Glenamoy River Estuary using a number of automated data loggers between December 2007 and October 2008. The highest recorded water levels in these boreholes ranged between 2.7 and 16.8m OD. Groundwater variations in a number of wells, impacted by tidal water, varied up to 2.5m in magnitude.

15.3.2 Potential Impacts

15.3.2.1 During Construction

Groundwater levels were measured at the proposed LVI site at Gleann an Ghad (Glengad) in December 2007 and January 2008 (representing periods of elevated rainfall and associated elevated groundwater levels). The highest water levels recorded during this period were 5.73m OD (Malin Head) at the proposed LVI site and 10.09m OD (Malin Head) up gradient of this location. There is potential for ground water levels to reach the floor level of the LVI during extreme conditions (inclement weather, high ground water levels and tides).

Bentonite is used for lubrication, cooling of the drill shield, removal of cuttings and stabilisation of the cut. The use of bentonite will be managed at a bentonite-handling unit, which will be located within the site compound, close to the start pit. This facility will circulate and recycle bentonite throughout the tunnelling process via dedicated hoses in the sleeving pipe to and from the TBM and includes areas for settlement and filtration. Tunnelling is likely to progress through both alluvial deposits and bedrock along the pipeline route. In the unlikely event of bentonite loss, bentonite is unlikely to migrate beyond the immediate vicinity of the tunnel bore based on the likely low permeability of the alluvial deposits, the composition of the bentonite slurry and the hydrostatic pressure of overlying water bodies. As such, impacts to groundwater in the unlikely event of bentonite loss would be imperceptible. If major water-bearing fractures are encountered, migration of bentonite may occur in these areas resulting in slight to moderate impacts on groundwater. However, based on encountered and surveyed geological conditions (i.e. sediment-laden fracture zones and geophysical anomalies which appear to be dykes) as well as information from the GSI, the likelihood of encountering major water-bearing fractures is deemed to be low.

Localised and temporary dewatering works will be required at the starting pit at na hEachú (Aghoos) and the reception pit at Gleann an Ghad (Glengad). Dewatering works in these areas may temporarily alter groundwater flow conditions in these areas; however, impacts are not likely to significantly impact on the groundwater flow regime of the area as a whole. In addition, silt laden groundwater discharge may impact on surface water quality.

Accidental spillages of fuels, lubricants and hydraulic fluids from construction refuelling facilities, chemical and waste storage or handling areas pose a significant risk to groundwater should inadequate prevention measures be installed.

15.3.2.2 During Operation

No impacts to groundwater are anticipated during the operation stage of the proposed pipeline.

15.3.3 Mitigation Measures

15.3.3.1 Construction Stage

The mitigation measures listed below will be implemented to address potential impacts to groundwater during the construction stage.

- It is proposed that effective water management be implemented during construction to avoid contamination of groundwater. It is also recommended that an Emergency Response Plan to deal with accidental spillages be contained in within the Environmental Management Plan (see Chapter 18 of this EIS).

- Detailed site investigation works along the pipeline route will be carried out to confirm the conditions along the route and identify, if any, major-water bearing fractures.

- Continual monitoring of bentonite volumes during the tunnelling works will be undertaken throughout to ensure maximum reuse at all times and to prevent the release of bentonite into the subsoils. In addition, visual monitoring of potential evidence of bentonite migration into the Bay shall be undertaken throughout the works.

- Treatment of discharge from dewatering operations shall be undertaken and is discussed in Section 15.4.4.

- Waste fuels and materials will be stored in designated areas that are isolated from surface water drains or open waters. Skips will be closed or covered to prevent materials being blown or washed away and to reduce the likelihood of contaminated water leakage. Hazardous wastes such as waste oil, chemicals and preservatives, will be stored in sealed containers and kept separate from other waste materials while awaiting collection by a registered waste carrier. Fuelling, lubrication and storage areas and site offices will not be located within 15m of surface water features and shall take place in a designated area of the compound. Fuel interceptor tanks will be installed on the site to treat any runoff.

- All waste containers (including all ancillary equipment such as vent pipes and refuelling hoses) will be stored within a secondary containment system (e.g. a bund for static tanks or a drip tray for mobile stores and drums). The bunds will be capable of storing 110% of the tank capacity. Where more than one tank is stored, the bund must be capable of holding 110% of the largest tank or 25% of the aggregate capacity (whichever is greater). Drip trays used for drum storage must be capable of holding at least 25% of the drum capacity. Where more than one drum is stored the drip tray must be capable of holding 25% of the aggregate capacity of the drums stored. Drainage of bunded areas shall be diverted for collection and safe disposal off site by an appropriately licensed contractor.

- Refuelling of construction vehicles and addition of hydraulic oils or lubricants to vehicles will be undertaken at a designated area of site.

- All water from the tunnelling compound at na hEachú (Aghoos) is collected via a closed drainage system and will be past through a petrol interceptor and settlement tanks / ponds.

15.3.3.2 Operational Stage

A perforated drainage pipe network will intercept both groundwater and surface water and divert elevated groundwater from the LVI site to a concealed outfall in the cliff face (refer to Chapter 4 for details). As such, only imperceptible impacts on local groundwater levels and groundwater flow in the area would be expected during the operational stage of the proposed project. Therefore, no remedial or reductive measures are proposed.

15.4 PEATLAND HYDROLOGY

15.4.1 Introduction

A peatland hydrological impact assessment has been undertaken for the peatland areas traversed by the revised pipeline route. This assessment, which was undertaken by Hydro-Environmental Services (HES), describes the physical processes (hydrological and hydrochemical) that support and control peatland environments and evaluates direct and indirect impacts on these processes in the peatland area traversed by the proposed pipeline. The methodology used in the peatland hydrology impact assessment is presented in a report in Appendix M6 of the EIS.

15.4.2 Existing Environment

This section relates only to the interval of the pipeline route which traverses peatland habitats. Due to revision of the pipeline route under Sruwaddacon Bay, the first peatland habitat encountered along the revised pipeline route from the landfall at Broadhaven Bay occurs at na hEachú (Aghoos) (Ch. 88.622).

From na hEachú (Aghoos) to the Terminal the revised pipeline route traverses various habitat types that are underlain by peat.

The following sections provide the regional context for the study area with regards to surface water hydrology and peat hydrology as well as the local characteristics of blanket peat. Further detail on climate in the region along with the subsoil geology, bedrock geology and bedrock hydrogeology is provided in Appendix M6.

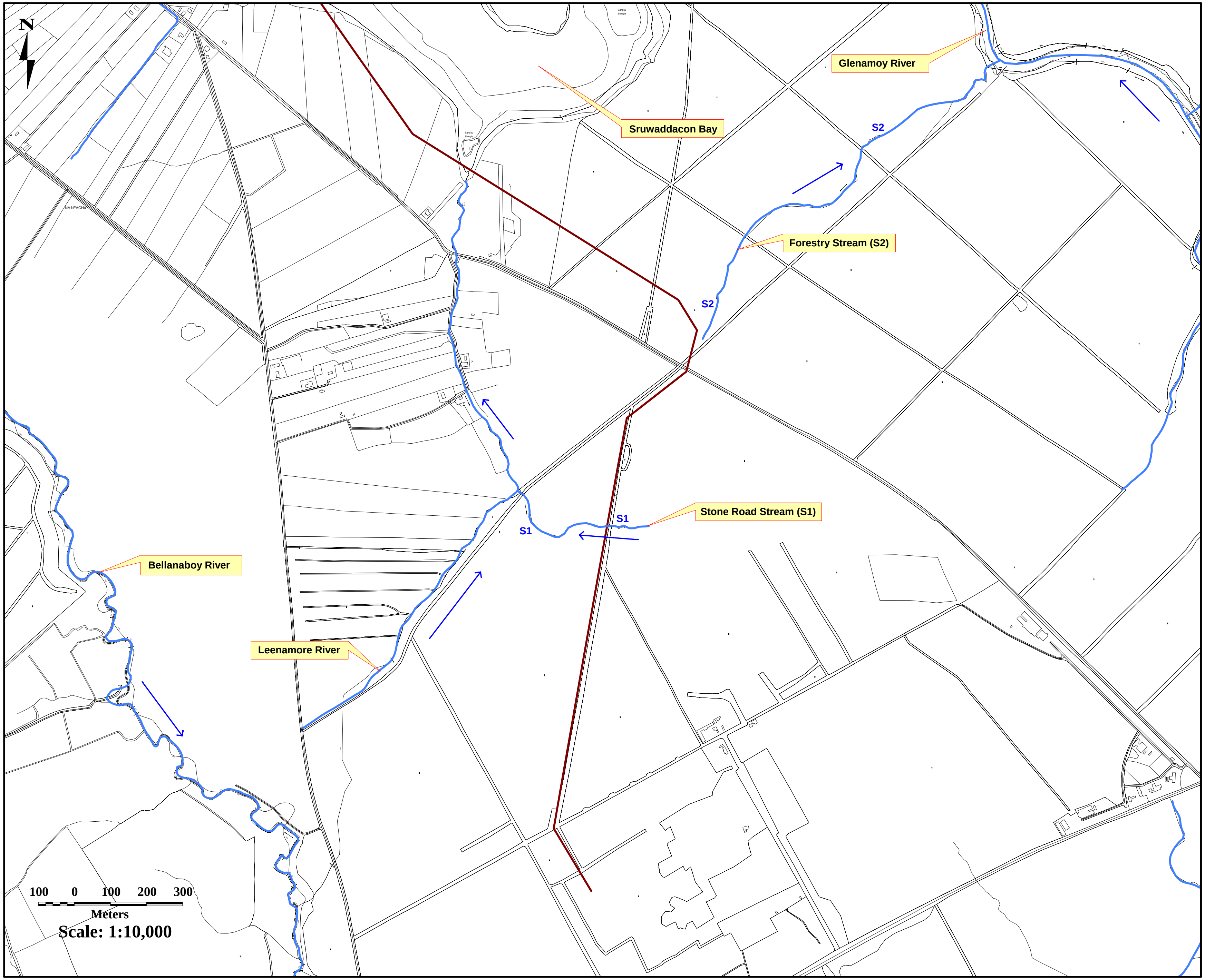
15.4.2.1 Surface water hydrology

Regional surface water hydrology is described in Section 15.2. Local streams and rivers along the pipeline route between na hEachú (Aghoos) and the Terminal are shown on Figure 15.4. The following sub-catchments drain towards these rivers and streams.

The Leenamore River sub-catchment is very small, comprising approximately 2.4km^2. It rises to the north west of the Terminal Site and flows northwards to discharge into Sruwaddacon Bay. A small tributary to the Leenamore River (S1 on Figure 15.4, and referred to as the ‘stone road stream’) drains forestry to the north of the Terminal Site and this stream crosses the pipeline route at Ch.90.66. The natural hydrology of this catchment has been significantly altered by drainage for forestry and peat extraction.

Another small tributary (S2 on Figure 15.4, and referred to as the ‘forestry stream’) of the Glenamoy River rises north of the proposed pipeline route in coniferous forestry north of the L1202. This stream flows north east and discharges to the Glenamoy River.

At the southern end of the pipeline route, at the Terminal, approximately 200m of the route drains south into the Bellanaboy River via the terminal surface water system, draining eventually into Carrowmore Lake. The total catchment area of the site draining towards the Bellanaboy River is 0.05km^2 (approximately 5 ha).

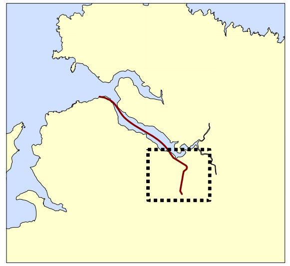


LEGEND:

Proposed Pipeline Route (2010)

River / Stream

Stream/River Flow Direction



Local Hydrology Bellagelly

Figure 15.4

File Ref: COR25MDR0470Mi2496A01
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

15.4.2.2 Peat hydrology

The original extent of post glacial peatland (Fens, Raised Bogs, Atlantic Blanket Bog and Mountain Blanket Bog) cover in Ireland was estimated by Hammond (1979) as being 11,456km^2. Of this area 3,292km^2 was classified as Atlantic Blanket bogs. Peatland comprises 1,938 km^2 of the land area of Co. Mayo (5,586 km^2). These peats comprise mountain and lowland blanket bogs, raised bogs and cutover raised and blanket bogs (Teagasc/EPA, 2004). A portion of these peatland types has been planted with coniferous plantation forestry. In the environs of the proposed pipeline, the Glenamoy Bog Complex cSAC of 127 km^2 is designated predominantly for the priority Annex 1 habitat of lowland blanket bog and also includes the marine and coastal margin of Sruwaddacon Bay. The area of the cSAC supporting lowland blanket bog is located north of Sruwaddacon Bay on the northern side of the Glenamoy River. There is no hydrological connection between the area of the proposed pipeline route and this Annex 1 habitat.

Blanket bog develops in areas where the ratio of precipitation to evaporation is typically greater than 2:1 (i.e. there is excess precipitation over evapotranspiration), with rainfall spread throughout the year, cool summer temperatures and low evapotranspiration rates (Doyle, G.J. and O'Criodain, C., 2003) as well as where a low permeability layer exists to retain the rainfall and cause water logging. This can consist of low permeability bedrock and / or the presence of a clay soil or subsoil layer.

Peat water flow directions are strongly controlled by topographic gradient, including the micro-topography of the underlying substrate. Localised flow gradients in the peat will occur in response to sub-surface micro-topography, and also as a result of drainage and ditches resulting from peat cutting and forestry. Within the peat profile, peat water gradients are generally vertically downwards, resulting in downward flow of water through the peat. Upward gradients can also occur, but are generally localised and occur as a result of local changes in peat type or morphology.

15.4.2.3 Local Characteristics of Blanket Peat

15.4.2.3.1 Hydrological and Hydrochemical monitoring at 'control' sites

This section provides a summary of the results of hydrological and hydrochemical monitoring that was completed as part of the peat hydrology impact assessment, and also provides a summary outline of the baseline assessment of peatland hydrology along the pipeline route. Detailed descriptions of baseline hydrological and hydrochemical characteristics of the route as well as the methodology used to determine these are provided in Appendix M6.

Baseline hydrological and hydrochemical monitoring was completed at 3 no. 'control' sites at Aghoos Bog, Bellagelly and Bellanaboy Terminal during 2008[17]/2009 (refer to Figure 1 of Appendix M6 for locations). This monitoring was completed by QMEC (QMEC, 2010) and included:

- Water level monitoring – weekly (January to April 2009) and monthly thereafter;
- Field hydrochemistry – bimonthly (February, April, June, August, October, and December 2009); and
- Analytical hydrochemistry – biannual (6th/7th May and 15th/16th/17th December 2009).

Baseline water level monitoring

The peat at the site is generally saturated, with phreatic[18] water levels at or close to ground level for much of the year.

Temporal trends in peat water levels throughout the 2009 monitoring period indicate that water levels were highest during January to February and October to December. Notable increases in water levels occurred in August and in May 2009. These increases coincide with high monthly total rainfall values.

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[17] Some initial hydrological monitoring (water levels only) began in December 2008.

[18] The water surface in an unconfined aquifer or confining bed at which the pore water pressure is atmospheric.

The lowest levels for the period were recorded in July 2009, which was preceded by a dry month of June.

The annual groundwater levels indicate that phreatic water levels are sensitive to seasonal fluctuations, with below average rainfall in June and July resulting in dry phreatic tubes. Phreatic water levels at Aghoos Bog and Béal an Ghoile (Bellagelly) show less seasonal fluctuation than those at Bellanaboy Terminal, and also indicate slightly higher water levels (closer to ground level) with more frequent waterlogging above ground level. Larger seasonal ranges were recorded at the Bellanaboy Terminal transects. The maximum range at the Bellanaboy Terminal transects could not be recorded in all of the phreatic tubes as the screens were too short.

There is a predominant pattern of downward vertical gradients within the peat profile across the three hydrological 'control' monitoring sites throughout the 2009 monitoring period. Some local variations occur in the shallower peat profile following rainfall and these are related to recharge and possible peat water flow within localised higher permeability zones (due to changes in peat stratigraphy or structure).

The seasonal range of phreatic and piezometric water levels is small (<0.5m), and this is indicative of a relatively static low permeability wetland environment. The dominant process is surface water runoff, with limited water flow or recharge occurring within the peat profile. Deeper levels of peat show slower response to rainfall events and indicate minimal water movement below 0.5m.

By way of comparison, seasonal water level monitoring in local bedrock indicates a range of 1-1.5m (poor aquifer), while a limestone (regionally important) aquifer may have seasonal fluctuation in water levels of up to 10m.

The main peat mass (the catotelm) and immediately underlying subsoils are of relatively low permeability and this impedes water movement. Vertical leakage from the base of the stone road will be minimal if a layer of basal peat is left in-situ and the underlying mineral soil remains undisturbed.

Baseline field hydrochemistry monitoring

The average EC (electrical conductivity) and pH values at the Bellanaboy Terminal, Béal an Ghoile (Bellagelly) and na hEachú (Aghoos) monitoring locations remained relatively stable throughout the 2009 monitoring period. In general, the average EC values in the peat water at the 3 no. 'control' monitoring sites increase with depth and demonstrate a slow downward seepage of rainwater.

The average pH recorded during 2009 was slightly acidic (5.47 pH units), comprising an average of pH 5.74 in the peat/subsoil interface groundwater, an average of pH 5.58 in the deep peat installations (P2-P4) and an average of pH 5.35 in the phreatic tubes.

The peat has higher EC and pH values than would be expected for inland blanket peat. This is a consequence of mineral enrichment from sea spray and wind blown sediments during and post peat formation. This gives a characteristic hydrochemical profile for blanket peat in coastal areas.

Comparison of the up-gradient and down-gradient hydrochemistry of the existing stone road (within the Bellanaboy Bridge Gas Terminal site) indicates that the stone road does not have any discernable impact on the hydrochemistry of the surrounding peat.

Baseline analytical hydrochemistry analysis

The analytical data for peat water samples indicates a predominant sodium-chloride (Na-Cl) signature with varying proportions of calcium and bicarbonate ions. The variation in the water types reflects the combination of the acidic peat environment and the proximity of the coastline, which can alter the chemical signature through the contribution of sea spray and wind blown sediments.

The majority of peatland water samples have elevated concentrations of ammoniacal nitrogen, which is typical for peat groundwater, due to the decomposition of organic material.

Elevated concentrations of orthophosphate in the peat water were recorded at piezometers at na hEachú (Aghoos), Béal an Ghoile (Bellagelly) and the Bellanaboy Terminal site. This is most likely due to the use of rock phosphate fertilizer in the adjacent forestry plantations.

A comparison of the hydrochemical data up-gradient and down-gradient of the existing stone road (within the Bellanaboy Bridge Gas Terminal site) indicates that the stone road has not had any discernable impact on the hydrochemistry of the surrounding peat.

15.4.2.3.2 Summary of peat permeability testing

Permeability tests in peat have been completed at the 'control' hydrological monitoring sites by QMEC. K-tests were completed at all the piezometers listed in Table 2.1 of Appendix M6. A summary of the results obtained are presented in Table 15.2.

Table 15.2. Summary of QMEC k-test results. (Source: QMEC, 2009)

Location	Shallow Peat/Phreatic	Mid/Deep Peat	Deep Peat/Subsoils
	Permeability range (m/s)	Permeability range (m/s)	Permeability range (m/s)
Aghoos	$2.1 \times 10^{-8} – 1.7 \times 10^{-11}$	$1.7 \times 10^{-8} – 4.3 \times 10^{-10}$	$1.2 \times 10^{-7} – 8.0 \times 10^{-11}$
Bellanaboy Terminal	$7.8 \times 10^{-5} – 4.4 \times 10^{-10}$	$1.3 \times 10^{-7} – 9.5 \times 10^{-10}$	$2.7 \times 10^{-10} – 1.6 \times 10^{-11}$
Bellagelly	3.6×10^{-6}	$2.7 \times 10^{-8} – 7.6 \times 10^{-10}$	$2.2 \times 10^{-10} – 9.4 \times 10^{-11}$

15.4.3 Potential Impacts

The potential impacts from all proposed aspects of the infrastructure development (e.g. access road, pipeline trench, site compounds, movement of plant, drainage, and excavated materials re-location) have been examined in the context of peatland hydrology. Table 15.3 summarises the potential impacts of the development on the peatlands traversed by the pipeline route. Section 15.4.4 summarises the proposed mitigation measures for identified significant impacts. Other mitigation measures for moderate or slight impacts are detailed in Section 6.2.1 of Appendix M6. Details on the impact classification system used in peatland impact assessment are provided in Section 1 of Appendix M6 of this EIS.

Table 15.3 Summary of Potential Peatland Hydrological Impacts

Impact Description	Type of Potential Impact	Hydrological or Hydrochemical	Direct or Indirect	Receptor	Magnitude of Potential (unmitigated) Impact
Excavation: Dewatering / Diversion	Change in water flow and magnitude (dewatering, diversion).	Hydrological	Direct	Recovering Blanket Bog	Significant
				Cutover Bog and forestry plantation	Slight
				Aghoos Compound	Imperceptible
Water Quality: Dewatering discharges	Increased silt content runoff to habitats and watercourses.	Hydrochemical	Direct	Recovering Blanket Bog	Slight
				Cutover Bog and forestry plantation	Moderate
			Direct and Indirect	Downstream water courses or surface water receptors	Significant
Excavation: Vertical leakage	Vertical hydraulic leakage of water through base of stone road.	Hydrological	Indirect	Recovering Blanket Bog	Significant
				Cutover Bog and forestry plantation	Moderate
Placement of stone road	Disturbance of natural hydrology. Stone road acting as barrier or conduit for water flow. Increase in runoff rates during construction.	Hydrological	Direct	Recovering Blanket Bog	Slight
				Cutover Bog and forestry plantation	Imperceptible
Placement of stone road	Introduction of foreign chemistry construction material to disturbed or recovering blanket bog (e.g. imported stone).	Hydrochemical	Indirect	Recovering Blanket Bog	Significant
				Cutover Bog and forestry plantation	Moderate
				Downstream water courses or surface water receptors	Significant
Storage of peat scraw or turves for reinstatement excavation works	Runoff entrainment of peat suspended solids resulting in sediment outwash onto peatland habitats, or to downstream receiving waters.	Hydrochemical	Direct and Indirect	Peatland habitats	Slight
					Slight
				Downstream water courses or surface water receptors	Significant
Fuel Storage / Usage on Site	Accidental spillage of contaminants leading to localised pollution of peat water or downstream surface water.	Hydrochemical	Direct	Peatland habitats	Significant
			Direct & Indirect	Downstream water courses or surface water receptors	

15.4.4 Mitigation Measures

The following mitigation measures are proposed to prevent significant hydrological impacts:

- Stone road construction method will be used whilst retaining a minimum of 0.5m of peat below the excavation invert. Leaving a minimum of 0.5m of peat in-situ above the mineral subsoil will avoid exposure or disturbance of the sub-peat mineral soils.

- The proposed stone road construction includes transverse peat plugs, and a basal peat layer, which will control vertical and longitudinal drainage.

- Leakage into the underlying sub-soil/bedrock, in excess of natural leakage rates, will be minimised to baseline conditions by retaining a minimum of 0.5m of low permeability peat at the base of all excavations in peat.

- Low permeability peat plugs will be inserted along the length of the stone road construction to retard longitudinal flow, thus forming virtually isolated cells in the road and preventing the road becoming a longitudinal preferential pathway for drainage. Plugs shall be placed at such intervals so as to negate the possibility of upward seepage of water from the stone road core at the down-gradient end of any cell.

- The stone road shall be reinstated with either turves or a peat layer of up to approximately 600mm. The re-instatement of peat turves and/or peat layer will prevent rapid recharge of rainwater into the stone road stone/peat core.

- Where turving is proposed, transverse (perpendicular to the line of the stone road) slightly elevated and contoured turve ridges coincident with peat plugs shall be placed to divert surface water flow gathering along the reinstated stone road onto downstream peatland habitat (i.e. preventing the reinstated stone road acting as a channel for surface water, reducing surface water flow velocities and removing the potential for erosion). These shall be integrated with the patchwork array of peat turves across the alignment of the stone road. These details are presented on Figure 16 of Appendix M6.

- Similar transverse slightly elevated turve ridges will be placed at minimum 50m intervals along sections of the stone road that will be reinstated with peat. They will have the same dual function of deflecting surface water runoff laterally and preventing longitudinal erosion along the reinstated stone road.

- Where turving is proposed the turves will be placed on a regulation layer of peat, and shall be placed using a patchwork array. Any remaining gaps shall be hand packed with peat to prevent inter-turve flow of surface water.

- The resulting retention of water in the individual cells will result in high peat water levels, as naturally occurs, and prevent changes to hydraulic gradients and resultant flow direction in the peat, i.e. to mimic the natural hydrology. Regeneration or retention of habitat on the re-instated peat will be facilitated by these conditions.

- Where natural drainage gullies or local significant micro-relief runoff pathways for surface water are encountered during stone road construction these shall be marked (by stakes and marker boards) and this pathway for surface water flow shall be restored as part of the reinstatement works.

The following mitigation measures are proposed to prevent significant hydrochemical impacts:

- Discharge from dewatering will not be discharged directly to any watercourse.

- Discharge will be routed into the ‘dirty’ water collection system and treated in a system which shall include in–line settlement and storage elements, such as including check dams, straw bale filters, settlement ponds, storage ponds and other suitable filtration facilities if required. At higher risk areas such as Aghoos Compound appropriate storage, settlement and treatment shall be designed for a 1 in 20 year return period rainfall event before being discharged to Sruwaddacon Bay.

- Silt fences, straw bales and biodegradable geogrids will be used to control surface water runoff and erosion from temporary stockpiles and storage areas for peat scraw and turves.

- The stone road in the area of recovering eroded blanket bog (PB5/PB3, see Appendix M6) at Aghoos Bog (ch.89.350 to 89.540) shall be composed of suitable locally sourced materials.

- The stone road in the area of habitats PB5/PB4 (see Appendix M6) and in forestry plantation will include cuttings from tunnelling (under Sruwaddacon Bay) as these areas are less sensitive from a hydrochemical and ecological perspective. The stone road shall be encapsulated by peat along the margins (in-situ peat) and by peat plugs longitudinally. The fill will also be covered during reinstatement with a layer of peat so the stone road fill will be isolated from surface vegetation or surface water flows. The reinstatement cover of peat shall prevent erosion of the fill material during high runoff events.

- Retention of a minimum of 0.5m of peat substrate in all excavations shall protect the groundwater aquifer from potential hydrocarbon contamination via any exposed excavations.

- Specific hydrocarbon storage and re-fuelling areas shall be designated at the site compounds. Refuelling shall only be completed in a controlled manner at the site compounds.

- Fuel storage areas shall be bunded appropriately for the volume of fuel stored and have suitable storm drainage and oil interceptor mechanisms. Spill kits and absorbent pads shall be available on site for cleaning up minor spills.

- The site compound surface water drainage system shall have an oil interceptor in advance of any proposed discharge point.

- An emergency response plan for the construction phase to deal with accidental spillages shall be contained within Environmental Management Plan.

- Temporary stockpiling of peat turves for re-instatement on the stone road shall only occur on the site up-gradient of the stone road excavation.

- Drainage from up-gradient of the stone road shall be intercepted on the up-gradient side of the stone road by an interceptor drain. This prevents up-gradient surface water run-off from crossing the excavation and becoming contaminated with suspended sediment. Collected clean water shall be discharged to Sruwaddacon Bay via stilling ponds with appropriate attenuation.

- Run-off from across the stone road excavation shall be intercepted on the down gradient side of the road. It shall be directed through the site 'dirty' water collection system, which shall include in-line settlement and storage elements, i.e. check dams and settlement ponds. This will be routed via stilling ponds with appropriate storage and settlement before being discharged to Sruwaddacon Bay.

- Aghoos Compound will have a site specific drainage system (See Section 6 of Appendix M6 and Appendix M7) which develops as the compound construction proceeds.

- The Aghoos Compound drainage system comprises an interceptor ditch system for the small volumes of clean up-gradient runoff and a 'dirty' water collection and treatment system for site drainage. This will be routed to an oversized swale and settlement pond with appropriate storage and settlement designed for a 1 in 20 year return period rainfall event before being discharged to Sruwaddacon Bay. Discharge will be automated and controlled by water quality sonde.

15.5 "WORST CASE" SCENARIO

In the event that a pollution incident occurs, it could have a significant negative impact on habitats, including peatland habitats, surface waters and underlying groundwater.

In the event that the mitigation measures for peatland areas (as outlined above) failed to work, the worst-case scenario would be a slight dewatering impact on adjacent peat within 10-15m of the edge of the stone road and a moderate change in vertical gradients.

Another worst-case scenario impact would be the absence of runoff control and drainage during the construction phase, resulting in accelerated runoff and potential erosion of the surface vegetation (i.e. gullying), and also an increase in sediment discharge to Sruwaddacon Bay.

15.6 "DO NOTHING" SCENARIO

It is likely that areas of undesignated blanket bog would continue to be subject to damage from localised peat extraction (manual and mechanised), sheep and cattle grazing and afforestation. There is little pressure on land for development in the area apart from one-off housing. There are no expected large-scale changes in the area. Thus, it would be expected that the area would undergo changes in a 'do-nothing' scenario.

15.7 RESIDUAL IMPACT

Soils & Geology (including Geotechnical Assessment)

The Geotechnical Risk Register (see Appendix M4), which was compiled to address geotechnical hazards and risk control measures during the design and construction stages of the project, includes a description of the residual impacts (or potential risk) once mitigation measures have been implemented.

Hydrology

Following implementation of the proposed mitigation measures, minimal to no residual impacts on the existing hydrological/drainage regime are expected as a result of construction and operation of the proposed project.

Hydrogeology

There will be no residual impact on hydrogeology during the operation of the proposed development, except at the LVI, where there is potential for groundwater to reach the floor level of the LVI during extreme conditions (inclement weather, high ground water levels and tides).

Peatland hydrology

Based on experience from peatland hydrology studies in blanket bogs and in particular the experience from the BGE Pipeline at Glencullin Upper, Co. Mayo, the peatland hydrological impact assessment predicted that the proposed development would have a short-term and slight negative impact on the hydrology of peatland areas along the route with some slight and very localised, changes to water levels and hydraulic gradients. However, in terms of residual impact on peatland hydrology the proposed development will have an imperceptible impact on the non-designated Annex 1 habitats present, which in this case is recovering blanket bog.

16 ARCHAEOLOGY, ARCHITECTURAL & CULTURAL HERITAGE

16.1 INTRODUCTION

Margaret Gowen and Co. Ltd undertook an archaeological, architectural and cultural heritage assessment of the proposed onshore pipeline. In addition, an assessment of underwater archaeology was undertaken by Archaeological Diving Company Ltd (ADCO).

Sections 16.1 to 16.5 provide details on the archaeological, architectural and cultural heritage assessment while Section 16.6 addresses the underwater archaeological assessment. Section 16.7 discusses the residual impacts. Reports on both assessments are contained within Appendix N (Archaeological, Architectural and Cultural Heritage) and Appendix O (Underwater Archaeology).

The following sections describe the methodology used in the assessment and the existing environment from an archaeological, architectural and cultural heritage perspective. It also examines the potential impacts of the proposed development and recommends mitigation measures to ameliorate these impacts on features of archaeological potential, architectural heritage or cultural heritage.

16.2 METHODOLOGY

The methodology used involved a desktop assessment, field inspection, an examination of aerial photography, test excavation and consultation, as described in Sections 16.2.1 to 16.2.3, to identify features of interest within 50m of either side of the centreline of the proposed route, i.e. a 100m assessment corridor.

A review of the construction layout plan was also undertaken to identify associated temporary works and the potential to impact on features of archaeological, architectural and cultural heritage potential.

16.2.1 Field Inspection

A field inspection was undertaken by archaeologists in August 2007, January 2008, June 2008, July 2008, January 2009 and February 2010 to assess present topography and land use. It also sought to identify potential low-visibility archaeological features and upstanding features of architectural or cultural heritage interest. Although the width of the proposed temporary working area is 40m, the assessment was generally carried out over a 100m corridor and beyond in areas of proposed ancillary works, e.g. LVI and site compounds.

16.2.2 Desk-top Assessment

A desk study of the proposed route was undertaken which examined the following sources:

- RMP files (Record of Monuments and Places);
- Topographical files (recorded stray finds, held in the National Museum of Ireland);
- Mayo County Council (consulted for schedules of buildings and items of architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest that are listed for protection in the study area);
- Documentary sources (additional published and unpublished documentary and literary references consulted are listed in Appendix N); and
- Cartographic sources (various editions of Ordnance Survey mapping) and historic mapping (William Bald’s map ‘Maritime County of Mayo’).

The methodology utilised for this desktop assessment included:

- An examination of aerial photographs (2004, 2006 and 2008); and
- A review of previous cultural heritage reports.
- Consultation with various parties. Those consulted included:
  - Department of Environment, Heritage and Local Government (DoEHLG): National Monuments Section, Underwater Archaeology Unit;
  - Noel Dunne, author of ‘Pre-bog Archaeology: The Glenamoy-Barnatra Peninsula Co. Mayo’. Unpublished MA, 1985, UCD;
  - Dr. Graeme Warren, lecturer in the School of Archaeology, UCD and director of an archaeological field survey and excavation project based in Béal Deirg (Belderrig), Co. Mayo;
  - Greta Byrne, Manager of Céide Fields Visitor Centre, Co. Mayo;
  - Local landowners;
  - Dr. Seamus Caulfield, formerly of the School of Archaeology at UCD, the renowned and now retired expert on the prehistoric landscape at Céide; and
  - Dr. Niall Brady, underwater Archaeologist, Director of ADCO Ltd. and Rex Bangerter, underwater archaeologist conducting the underwater archaeological survey for the project.

16.2.3 Test Excavation

Following desk based research and a detailed field inspection; the National Monuments Section of the DoEHLG requested that a potential archaeological site, a mound (ID A3) be investigated through test excavation. The proposed development works at Na hEachú (Aghoos) had been deliberately located to avoid this feature. However, the use of test-excavation was applied to provide greater certainty and definition of the suggested archaeological potential of this site.

16.2.4 Assessment Criteria

Impacts on archaeological, architectural and cultural heritage are generally categorised as being a direct impact, an indirect impact or as having no predicted impact as described in Table 16.1.

Table 16.1: Type of Impact

Category of Impact	Description
Direct	Occurs when an item of archaeological, architectural or cultural heritage is removed in part, or totally, due to the proposed works. A direct impact can also occur when the pipeline is crossing an environment or area considered to be of archaeological potential.
Indirect	May be caused due to the close proximity of the proposed development to an archaeological, architectural or cultural heritage feature. Mitigation strategies and knowledge of detail design can often ameliorate any adverse indirect impact.
No predicted	Occurs when the proposed route option does not adversely or positively affect an archaeological, architectural or cultural site.

The impacts of the proposed route on the archaeological, architectural or cultural heritage are first assessed in terms of their quality i.e. positive, negative and neutral as described in Table 16.2.

Table 16.2: Impact Quality

Quality	Description
Negative	A change that will detract from or permanently remove an archaeological, architectural or cultural heritage monument, structure or feature from the landscape.
Neutral	A change that does not affect the archaeological, architectural or cultural heritage environment.
Positive	A change that improves or enhances the setting of an archaeological, architectural or cultural monument, site or feature.

A significance rating for these impacts is then given i.e. slight, moderate, significant or profound as described in Table 16.3.

Table 16.3: Impact Significance

Significance	Description
Profound	Applies where mitigation would be unlikely to remove adverse effects. Reserved for adverse, negative effects only. These effects arise where an archaeological, architectural or cultural site is completely and irreversibly destroyed by a proposed development.
Significant	An impact, which, by its magnitude, duration or intensity alters an important aspect of the environment. An impact like this would be where the part of a site/structure would be permanently impacted upon leading to a loss of character, integrity and data about the archaeological, architectural or cultural feature/site
Potentially Significant	An impact on a potential feature or area of archaeological, architectural or cultural heritage potential that could be significant without mitigation measures taking place. This impact relates to items of archaeological potential, possible sub-surface remains, recorded archaeology, possible archaeological sites and areas of archaeological potential as well as features of architectural heritage merit and sites of cultural heritage interest.
Moderate	A moderate impact arises where a change to the site is proposed which though noticeable, is not such that the archaeological integrity of the site is compromised and which is reversible. This arises where an archaeological, architectural or cultural heritage feature can be incorporated into a modern day development without damage and that all procedures used to facilitate this are reversible.
Slight	An impact which causes changes in the character of the environment which are not significant or profound and do not directly impact or affect an archaeological, architectural or cultural heritage feature or monument.
Imperceptible	Impact capable of measurement but without noticeable consequences.

16.3 RECEIVING ENVIRONMENT

The following section describes the existing environment along the route of the proposed onshore pipeline from an archaeological, architectural and cultural heritage perspective.

16.3.1 Archaeological Heritage

The following is a description of the areas of archaeological potential within the 100m assessment corridor (see Figures 16.1 and 16.2). Further information is included in an inventory format listed below.

16.3.1.1 Greenfield

The proposed route passes through a greenfield environment at the landfall at Gleann an Ghad (Glengad) until it reaches Sruwaddacon Bay. Considerable reorganisation of western Ireland's field pattern occurred in the nineteenth and early twentieth centuries. New farms were arranged in parallel strips or 'ladder farms', running down the slopes with the farmsteads arranged in lines along new roads (Aalen & Whelan 1997). The fields comprise unimproved, self-improved and improved pastoral mixed sized fields. As such it is important to note that, even if the landscape does not retain surface traces of archaeological remains, it does not mean that it is devoid of archaeological value.

To date archaeological test-excavation at the landfall site has revealed no features or finds. In June 2002, archaeological monitoring of topsoil-stripping was carried out in the Gleann an Ghad (Glengad) area. Soil was stripped from an area of 0.25ha along the route of an access road and approximately from an area 500 – 600m sq along the pipeline route itself across the Gleann an Ghad (Glengad) headland. Nothing of any archaeological significance was noted during any of the topsoil stripping. Monitoring of inshore dredging operations in Broadhaven Bay was also undertaken. Geotechnical test trenches excavated in the intertidal zone were also monitored. Nothing of an archaeological nature was observed or recovered during the monitoring programmes.

Further to this in May and June 2005, monitoring of the excavation of three geo-technical test pits located within the pipeline wayleave on the eastern shore of Gleann an Ghad (Glengad) Headland (Plate 2). All three pits were excavated to a depth of 3m using a tracked mechanical excavator. The pits were excavated through natural sand with some gravel and occasional shell fragments noted in the upper levels to a depth of 0.35m. In order for the tracked excavator to reach the location of the three pits, two 5m long sections of field boundaries were removed. The field boundaries consisted of banks of mixed sand and peat. Nothing of any archaeological significance was noted (Delaney, 2005).

Also at Gleann an Ghad (Glengad) a roughly linear 15m long bank was test excavated in order to assess its archaeological potential (Excavation Licence Number 05E0411). This feature is located in a naturally marshy field which has been partially drained. A field drain is situated at the southern edge of the field and is oriented east-west. The neighbouring field to the north has been completely drained and is improved pasture land. The linear bank is 15m long and runs from north-north-west to south-south-east. It has a maximum height of 0.5m and is 2.75m wide. The ground to the south-west of the linear mound is noticeably flat and even. Stones were noted protruding through the grass which covers the linear bank.

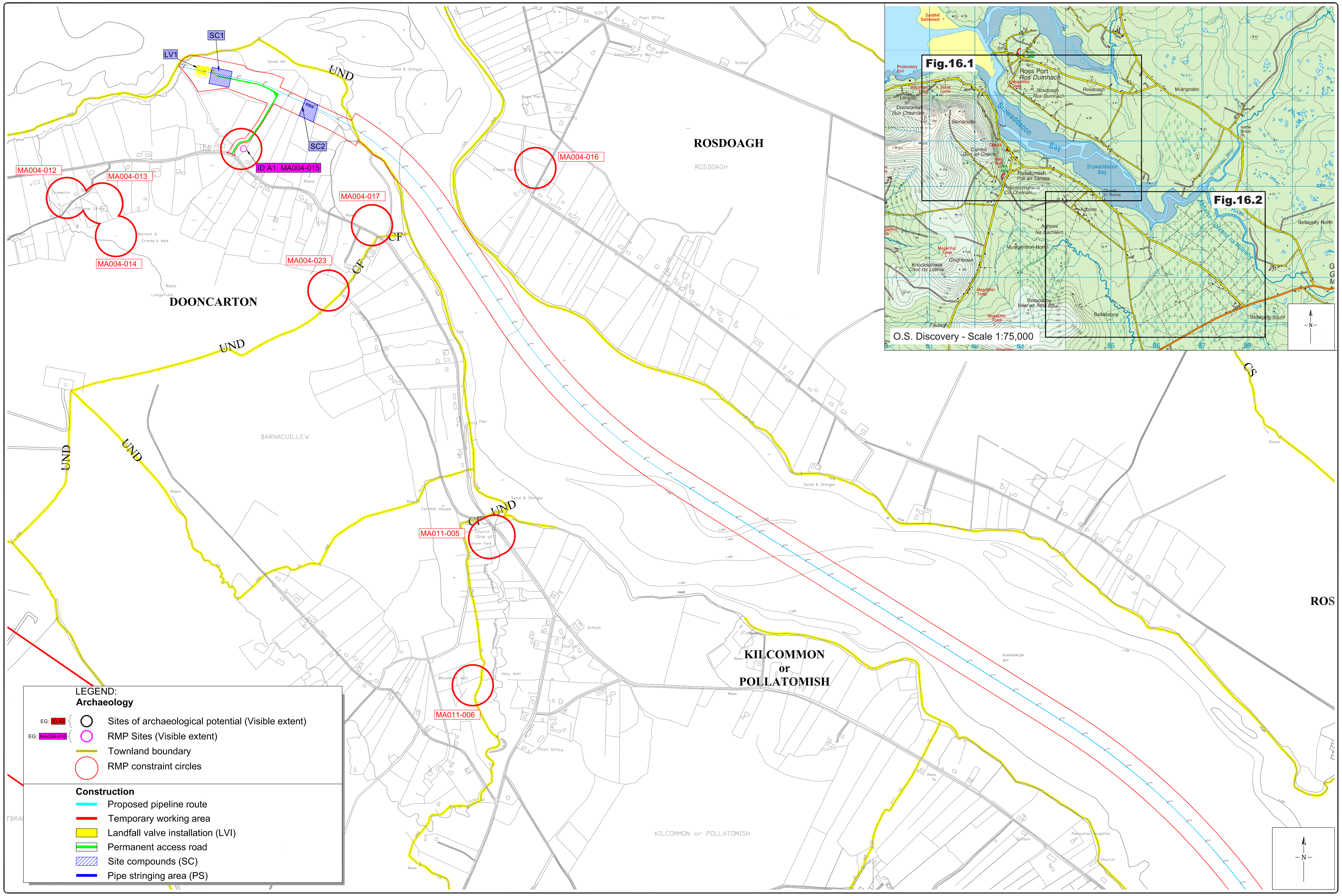
A tracked excavator fitted with a toothless grading bucket was employed to excavate two sections across the linear feature. The bank was composed of irregular loosely packed limestone rocks mixed throughout with sandy clay. The underlying natural was light brown/yellow sandy clay. The feature was thought to be the result of field clearance and modern drain excavations along the western field boundary. It was not archaeologically significant (Delaney, 2005).

An enclosure site (MA004-015, ID A1, and Plate 16.1) is recorded in Gleann an Ghad (Glengad). It is located c. 10m to the east of the permanent access route to the LVI.

Enclosures can date to a variety of periods. Often identified from early OS maps or through aerial photography, they are referred to as ‘enclosures’ in the Archaeological Survey of Ireland (ASI) unless a more precise classification can be established. The site at Gleann an Ghad (Glengad) is depicted on the first edition Ordnance Survey (1838-39) as a circular feature, resembling a ringfort. It now presents as a mounded area and is approximately 16.5m in diameter at its base and 2.2m in height (ASI, 1995). The site is encircled by traces of an in filled fosse[1]. From the east, south and west, portions of the mound have been removed as a consequence of the construction of a modern field boundaries and the fosse has been incorporated into the field boundary. The north-eastern half of the site has been largely quarried away, probably for use in the modern field boundaries described above. It is known locally as a ‘kileen’ (*cillíní*), which are also called ‘caldraghs’ (*ceallúrach*), or a children’s burial ground.

Archaeological monitoring took place in this area during the construction of the access route for the landfall works in Gleann an Ghad (Glengad). During this time no archaeological features or finds were revealed (Frazer, 2002).

[1] A surrounding ditch



Record of Monuments and Places (RMP) Site Location and Sites of Archaeological Potential

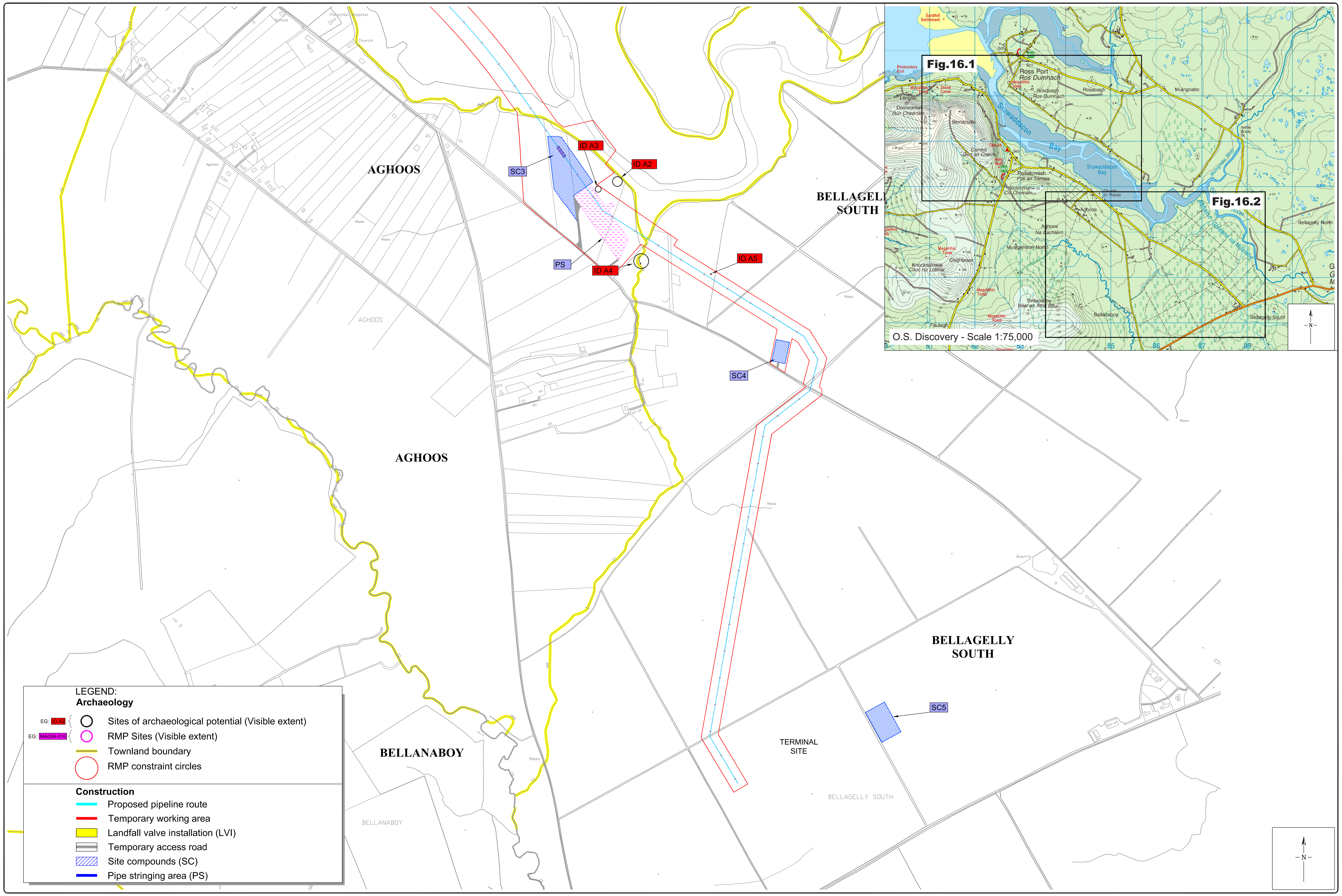
Figure 16.1

File Ref: MDR0470GrEIS103 RevA03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS



Record of Monuments and Places (RMP) Site Location and Sites of Archaeological Potential

Figure 16.2

File Ref: MDR0470GrEIS104 RevA03
Date: May 2010

CORRIB ONSHORE PIPELINE

Corrib natural gas

RPS

16.3.1.2 Coastal/Estuarine/Riverine

Coastal, estuarine and riverine environments, especially in the west of Ireland, have been shown through research and fieldwork to have significant archaeological potential. Archaeological evidence has shown that these areas have acted as focal points for both settlement and ritual activity through all periods of human settlement. The Mesolithic period (c.8,000-4,000 BC), which records human activity in Ireland after the end of the last ice age, does not appear to be represented among the known archaeological records for the immediate area. Mesolithic people did not build permanent stone monuments, and the sites dated to the Mesolithic are usually connected with habitation or food production activity. However, the hunting and fishing economy of this period means that many Mesolithic sites are coastal and estuarine, and there is significant possibility that work in coastal, estuarine and riverine areas, such as Sruwaddacon Bay, may reveal Mesolithic material.

There is a prehistoric settlement site (MA004-007) at the mouth of the estuary of Sruwaddacon Bay (Curraun Boy). While this site is over 900m from the proposed route it provides a good example of the type of coastal settlement which may be found in the surrounding area providing that environmental and physical conditions are suitable. Sand hills are also noted to the east of the landfall site, these are limited in extent and it is unknown whether the environmental conditions existing at this location would have attracted settlement. To date, no archaeological features or sites have been identified at Gleann an Ghad (Glengad) by archaeological monitoring or investigation.

Particular areas of potential archaeology relating to coastal, estuarine, and riverine environments within the assessment corridor are detailed in the underwater archaeology section 16.6 and include:

- The landfall at Geann an Ghad (Glengad);
- The tunnel from Aghoos to Glengad;
- The coastal region of Na hEachú (Aghoos) townland to the southeast of Sruwaddacon Bay; and
- The crossing of the Leenamore River.

16.3.1.3 Blanket Bog

The Céide Fields are a pre-bog field system in north Mayo located approximately 23km northeast of the proposed route. The Céide site encloses an area 12km² and consists of two large conjoined coaxial prehistoric field systems preserved intact under a mantle of deep blanket bog in excess of 4m deep in places. Within these field systems, there is evidence for settlement in the form of enclosures, hut sites and megalithic tombs. Research has revealed that they are amongst the oldest known preserved field systems in the world at over five and a half millennia old (Neolithic). Blanket bog has the ability to mask these types of field systems and the Céide Fields, Rathlacken, Béal Deirg (Belderg) and Glenamoy – Barnatra peninsula were only detected by using a method known as probing.

The presence of these pre-bog field systems in the northern part of the country and on the western seaboard is much more extensive than originally thought, with systems being revealed in Co. Donegal, in the northern part of the Inishowen peninsula, the Iveragh peninsula in Co. Kerry, and in the vicinity of Clifden in Co. Galway.

Pre-bog field systems of this nature also occur west in the Glenamoy-Barnatra peninsula. These field systems were detected and recorded by Dunne (1985) at Gleann an Ghad (Glengad) (MA004-021 and MA011-023), Graghil (MA011-024), Gortbrack North (MA011-025), Gort Meille (Gortmellia) (MA011-026), Cnoc Na Lobhar (Knocknalower) (MA011-027), Fálach (Faulagh) and Muingerroon South (MA011-028) (Dunne 1985).

The nearest recorded field system (MA004-021) is 1.8km from the proposed pipeline route. Dunne suggests that megalithic tombs reflect areas where field boundaries once existed, as is the case on Glenamoy –Barnatra Peninsula. An analysis of the overall survey results of his study revealed that the pre-bog field systems have a very high correlation, spatially, with the other prehistoric monument types within the peninsula (Dunne 1985, 57).

To date, no archaeological deposits, finds or features have been revealed as a result of an archaeological field inspection, engineering investigations or probing in the Na hEachú (Aghoos) area where blanket and eroding bogland extends from the shore of Sruwaddacon Bay to the townland boundary of Béal an Ghoile Theas (Bellagelly South) (Ch 88.650-89.260). A peat probe survey has established that the depths of bog vary from 3.6m to 0.2m.

Archaeological test excavation of a mound (ID A3) (approximately 11m in diameter and 1m high) identified during field inspection at na hEachú (Aghoos) took place in April 2010). Excavation confirmed that the mound was formed as a result of natural processes (displaced peat covering a pine stump) and is not archaeological in nature with no archaeological material revealed.

Evidence for prehistoric forest cover in the low lying townland of na hEachú (Aghoos) is demonstrated by the remains of tree stumps, predominantly of pine, preserved either in the lower layers of the bog or under it. These remains of scrubby pine were studied by Prof. M. Downes (Maynooth) and he achieved a C14 determination of 2,348BC from one pine stump (Dunne 1985). Two further pine samples were dated from this townland, one was taken from 0.65m above the mineral soil and dated to 4,340 ± 60BP, the other from 0.75m above the mineral soil, dated to 3,950± 60BP (Caulfield, O'Donnell & Mitchell 1998). Because these pines grew on peat and were preserved by it, the C14 dates of the pines are central to providing a date for the initiation of blanket bog. These dates place the growth of the pine trees in the Late Neolithic-Early Bronze Age Period placing the growth of bog to the Neolithic period and earlier. It follows that the initiation of the bog, given the depth of cover, must have been relatively early in this area, possibly earlier than Neolithic settlement; leaving this area devoid of archaeology dating to this period. The results of the test excavation would confirm this theory.

At Béal an Áha Buí (Bellanaboy), which is located to the south of the proposed onshore pipeline, an exposed section of blanket bog along the river bank was examined in the 1970's. Two superimposed layers of pine stumps, one at the based of the peat, the other 0.2m higher, were radiocarbon dated to 7,110±75BP (Håkansson 1974), and 4340±65BP, respectively suggesting that the rate of growth was extremely slow and that the bog was already there throughout the Neolithic period. Around 4,000 years ago, a great expansion of pine on bog surfaces took place in western and central Ireland. Pine also flourished on raised bogs in the midlands between 4,000 and 3,500 years ago.

16.3.1.4 Inventory of Sites and Areas of Archaeological Potential Within and Adjacent to the 100m Assessment Corridor

The following inventory is categorised on the basis of:

- Recorded archaeological monuments; and
- Specific features of archaeological potential.

The inventory considers features and areas of archaeological potential within and adjacent to the 100m assessment corridor, i.e. 50m on either side of the proposed pipeline and areas immediately adjacent. It also considers associated works (and one permanent access road), as described in Chapter 5.

The inventory (Table 16.4 and 16.5) should be read in conjunction with Figure 16.1 and 16.2. Further details are provided in Appendix N.

Table 16.4: Inventory of RMP Sites.

Unique ID	ID A1
Legal Status	Recorded Monument
Ref No.	RMP MA004-015 (see Plate 1 in Appendix N)
Townland	Gleann an Ghad (Glengad)
Site type	Enclosure site
NGR	GPS coordinate 816800, 338390
Description	Circular earthen mound (diam. at base 16.5m; max. H 2.2m) encircled by traces of an infilled fosse. From E-S-W, portions of the mound have been removed as a consequence of the construction of a modern field boundaries and the fosse has been incorporated into the field boundary. The NE half of the site has been largely quarried away, probably for use in the modern field boundaries described here.
Sources	RMP Archive and historic mapping
Approximate distance from access road to LVI	10m to east.
Approximate distance from the proposed pipeline route	235m to the southwest.

Table 16.5: Inventory of Specific Features of Archaeological Potential

Unique ID	ID A2
Legal Status	None, specific site of archaeological potential
Townland	Na hEachú (Aghoos)
Site type	Large Mound
NGR	GPS coordinate 857779.44, 335252.11
Description	This site was identified during a field inspection and is located in an area of uneven, eroding bogland south of and immediately adjacent to Sruwaddacon Bay. The site appears as a circular mound. It is c. 12m north-south and c. 13m east-west. There is also a flat projection (c. 11m long north-south) attached to the north of the mound. The site is positioned at a strategic point overlooking Sruwaddacon Bay where it narrows forming the Muingnabo and Glenamoy Rivers. It is also located beside the inlet for the Leenamore Stream. While the location is unsheltered, this mound and ID A3 are both visible in the landscape and can be viewed from the roadside at Na hEachú (Aghoos). While this feature occupies a prominent position in the landscape, given the test excavation findings of the other mound (ID A3) and the dating evidence of the pine stumps it is considered likely to be natural in origin.
Sources	Field inspection
Approximate distance from the proposed pipeline route **Approximate distance from working area**	106m to the north The working area is located approximately 31m northwest and 51m southwest of the mound

Unique ID	ID A3
Legal Status	None,
Townland	Na hEachú (Aghoos)
Site type	Mound – not archaeological
NGR	GPS coordinate 85712.91, 335233.37
Description	Located in an area of uneven and eroding bogland south of and adjacent to Sruwaddacon Bay. This site was identified during a field inspection of the area. The site appears as a circular mound c. 11m in diameter (Plate 27 in Appendix N). A rectangular feature abuts the mound to the northeast which measures c. 3.5m long and c. 2m wide. This site was archaeologically test excavated and was found to be formed by natural processes. It is not an archaeological monument or feature.
Sources	Field inspection
Approximate distance from the proposed pipeline route **Approximate distance from working area**	21m from the edge of the mound to the pipeline. 3m from the edge of the mound to the fence line of the working area.

Unique ID	ID A4
Legal Status	None, specific site of archaeological potential
Townland	Béal an Ghoille Theas (Bellagelly South)
Site type	Commemorative mass site and stone wall/enclosure
NGR	GPS coordinate 85876, 334964
Description	This site is situated in close proximity to a small stream called *Leenamore*, which forms the townland boundary between Béal and Ghoile Theas (Bellagelly South) and na hEachú (Aghoos). It is located on low ground, cut into a west facing slope. It is naturally protected from the elements and has good views out to Sruwaddacon Bay. William Bald's map (surveyed 1809-1817 and published 1830) shows a chapel in much the same location as this site. The site consists of stone foundations in a rectangular form (c. 11m north-south x c. 5m east-west). There are two possible entrances on the western side. The stone foundations of the site are overgrown by earthen banks and the stone that is exposed is very worn. Locals say the site was used as a church in penal times and that it was never roofed (*pers comm*. local landowners). There is still a local tradition of practicing mass at this location every Easter Sunday. Noone states that 'by the mid 1820's the chapel at Leenamore had fallen' (1991, 142). He also states that the sacrament of confirmation was celebrated there in the 1820's (1991, 142). The 1st edition six-inch Ordnance Survey mapping depicts two structures roughly in this location each enclosed by a ditch or wall. Approximately 1.5m from the southwest corner of the foundations (ID A4) is the southern extent of a curving stone wall/enclosing feature. This feature (c. 0.5 - 0.7m high) follows the bend of the *Leenamore* stream from the south-eastern extent of ID A4. Further along this feature, to the north, the stone wall bends away from the river. Noone says this feature protected the 'chapel' (ID A4) in times of floods.
Sources	Field inspection, local knowledge, Noone 1991, 141-142, cartographic (Bald 1809-1817, 1st edition O.S map 1838)
Approximate distance from the proposed pipeline route	82m to the south
Approximate distance from working area	52m

Unique ID	ID A5
Legal Status	None, specific site of archaeological potential
Townland	Béal an Ghoille Theas (Bellagelly South)
Site type	Mound
NGR	GPS coordinate 86128.41, 334921.64
Description	This feature presents as a roughly oblong, linear anomaly which is located within bogland parallel to the forestry plantation. The feature is approximately 11m east-west and while the northern extent is clearly defined the southern extent blends into the rising level of the bog. Therefore, the feature while visible when approaching from the northwest appears as a natural ridge when viewed from the south. Telegraph poles have also been placed parallel to the forestry boundary and it is possible that this feature was created as a result of the disturbance caused by the various development activities. The northern extent of the feature is defined by a drop in the bog as the field becomes steeper towards Sruwaddacon Bay. There are good views to the north and northwest over Sruwaddacon Bay. While noted, it is considered likely that this feature is part of a natural ridge and not archaeological in nature.
Sources	Field inspection
Approximate distance from the proposed pipeline route	This feature is located 13m to the north of the proposed pipeline.

16.3.2 Architectural and Cultural Heritage

16.3.2.1 Architectural Heritage

The Mayo County Development Plan (2008-2014) was consulted to identify the presence of any protected structures or features of architectural heritage merit in close proximity to the proposed scheme. No upstanding historic structures, items of architectural heritage significance or their surrounds, curtilage or attendant grounds will be affected by the construction of the proposed pipeline or associated works.

16.3.2.2 Cultural Heritage Features including Field Systems and Townlands

A commemorative mass site (ID A4), which is a site of cultural heritage interest, is located immediately east of the Leenamore stream. This stream forms the townland boundary between Béal an Ghoile Theas (Bellagelly South) and na hEachú (Aghoos). The site is located on low ground, cut into a west-facing slope. It is naturally sheltered and protected from the elements (Plate 4 & 5). The location also affords good views to Sruwaddacon Bay. William Bald's map (surveyed 1809-1817 and published 1830) shows a chapel in much the same location as this site along the Leenamore stream, which is referred to on the map as '*Muingnanoone*', the stream of the lamb. The site consists of stone foundations in a rectangular form (c. 11m north-south c. 5m east-west). There are two possible entrances on the western side. The stone foundations of the site are overgrown by earthen banks and the stone that is exposed is much worn. Locals say the site was used as a church in penal times and that it was never roofed (*pers comm*. local landowners). There is still a local tradition of practising mass at this location every Easter Sunday. Noone, states that 'by the mid 1820's the chapel at Leenamore had fallen' (1991, 142). He also records that according to a local of the na hEachú (Aghoos) area; Mass was celebrated at Leenamore during penal times at a place known as *'Pollan an Aifrinn'* which possibly is a reference to the topography of the valley (the mass hollow). The first edition six-inch Ordnance Survey mapping depicts two structures roughly in this location each enclosed by a ditch or wall.

Approximately 1.5m from the southwest corner of the foundations (ID A4) is the southern extent of a curving stone wall/enclosing feature (Plate 5). This feature, c. 0.5 - 0.7m high, follows the bend of the *Leenamore* stream from the south-eastern extent of the church site. Further along this feature, to the north, the stone wall bends away from the river. Noone says this feature protected the 'chapel' (ID A4) in times of floods.

The fields traversed by the proposed route could be described as stripped fields. This type of field pattern was created in the nineteenth and early twentieth centuries by the Congested Districts Board, a government body established to improve conditions in disadvantaged areas. The fields comprise unimproved, self-improved and improved pastoral mixed size fields. The maintenance and replacement of field boundaries is important as it leads to the restoration of a traditional landscape.

Townlands are a unique feature in the Irish landscape, and their origins are undoubtedly of great antiquity, most certainly pre-Norman. They existed well before the establishment of parishes or counties. Townlands can take the form of natural boundaries such as Sruwaddacon Bay, rivers, or route ways, as well as artificially constructed earthen banks and ditch divisions. They are predominantly formed by well-built boundaries that demarcate the townland and are usually distinguishable from standard field division boundaries. There are 62,000 townlands in Ireland, grouped into civil parishes, then counties and finally provinces. The proposed route passes through three townlands, Gleann an Ghad (Glengad), na hEachú (Aghoos) and Béal and Ghoile Theas (Bellagelly South)

Townland names are an invaluable source of information on topography, land ownership and land use within the landscape. They also provide information on the history, the archaeological monuments and folklore of an area. A place name may refer to a long forgotten site, and may indicate the possibility that the remains of certain sites may still survive below the ground surface. The Ordnance Survey surveyors wrote down townland names in the 1830s and 1840s, when the entire country was mapped for the first time. Most of the townland names in the study area have Irish origins (which is unsurprising given that this is a Gaeltacht area), and have been anglicised through time. A description of each of the townland names along the proposed route is provided in Appendix N.

16.4 POTENTIAL IMPACTS

16.4.1 Recorded Archaeological Sites, Sites of Archaeological Potential and Areas of Archaeological Potential

The proposed pipeline route avoids all recorded archaeological monuments. A recorded enclosure (RPM MA004-015) (ID A1) is located adjacent to an existing access road in Gleann an Ghad (Glengad) that is scheduled to be upgraded as part of the proposed project (plate 16.1). However, all previous work conducted in this area was archaeologically monitored and did not reveal any finds or features of an archaeological nature. The enclosure is located 10m from the nearest (eastern) edge of the existing road. The monument has been fenced off for protection and any further work in the area will take place on the opposite side of the road to the enclosure and will be monitored by a licensed archaeologist. This is to ensure that no impact occurs to the recorded monument.

One specific site of archaeological potential (ID A5) has been identified within the working area (see Table 16.4 above). As such, this site is considered to be indirectly impacted by the proposed development. This site has been described as a mound. Archaeological work carried out in bogland environments has proven that features noted on the surface of the bog do not necessarily equate with a buried archaeological site. Mounds may simply reflect a rise in mineral soil, a rock or tree stump which lies beneath the peat. This was the case at na hEachú (Aghoos), where a mound (ID A3) was identified during field inspection of the working area in Na hEachú (Aghoos) townland. The DoEHLG required this mound to be subjected to test excavation the findings demonstrated that the mound represented displaced peat surrounding a substantial buried tree stump. As the feature was proven to be natural in origin and not archaeological in nature, there will be no impact on ID A3.

In Béal an Ghoile (Bellagelly), an oblong irregular mounded area (ID A5) was identified approximately 13m north-east of the proposed pipeline route within the working area. The location of this feature has been noted and while it is likely to be part of a natural ridge, it can be avoided.

Areas of archaeological potential, identified as greenfield/coastal Gleann an Ghad (Glengad) and blanket bog Na hEachú (Aghoos) and Béal an Ghoile Theas (Bellagelly South) (see Figures 16.1 and 16.2) will also be impacted by the extended construction working area. In these areas there is a possibility that previously undiscovered features or sites of archaeological and cultural heritage could be revealed. This will be mitigated by the archaeological monitoring of all earthmoving work. Estuarine and riverine areas of archaeological potential are dealt with in the underwater archaeological assessment in Section 16.6.

Table 16.6 summarises the types of potential impacts on identified sites and areas of archaeological potential, which are described in more detail in Appendix N.

Plate 16.1: Enclosure site ID A1 facing northwest

Table 16.6: Summary potential impact assessment on archaeological, architectural and cultural heritage.

Ref. No	Townland	Site Type	Type of development causing impact	Type of Potential Impact	Distance (approximate)	Impact Level
ID A1	Gleann an Ghad (Glengad)	Enclosure site MA004-015	Access road to the LVI	Indirect impact	10m from access road to LVI	No predicted impact
ID A2	Na hEachú (Aghoos)	Mound	None	No predicted impact	Located outside the working area and 106m from the proposed pipeline route	No impact
ID A3	Na hEachú (Aghoos)	Mound - non archaeological	Working area	No predicted impact	Located immediately outside the working area and 21m from the proposed pipeline route	No impact –
ID A4	Béal an Ghoille Theas (Bellagelly South)	Commemorative mass site and stone wall/enclosure	Fencing associated with project	No predicted impact on the feature but indirect, short term impact on the setting of the site	Located 52m to the south of the working area and 82m south of the proposed pipeline route	Indirect, short term impact on the setting of the site
ID A5	Béal an Ghoille Theas (Bellagelly South)	Mound	Proposed route	Indirect impact	Within temporary working area & 13m from pipeline	This site is likely to be part of a larger natural ridge and can be avoided. No impact

16.4.2 Plantation Forests

Approximately 2.1km of the proposed route travels through forested areas. A proposed compound (SC4) is situated within an area cleared of forest. Much of these forested areas have gone through the entire forestry cycle of thinning, felling and harvesting. This type of concentrated disturbance considerably reduces the possibility of archaeology surviving intact below the surface of the bog and marginal land. Monitoring the removal of peat from the Terminal site did not produce any archaeological features or finds, given the dating evidence obtained at Bellanaboy Bridge (Håkansson 1974) (Appendix N), and from the results of archaeological monitoring it appears that the bog and pine stumps predate the Neolithic period resulting in no archaeological activity through out the area.

16.4.3 Groundwater

As part of the proposed development, measures will be taken to deal with the seepage of groundwater in areas such as low-lying floodplain areas adjacent to rivers / streams or blanket bog. As trenches for the pipeline may act as conduits for groundwater flow when backfilled, they can sometimes promote the drainage of bog areas. This can reduce the consolidation of the peat and dry out the layers, affecting archaeological sites and features of organic content that prefer waterlogged conditions (See Chapter 15). Peat plugs will be used within the stone road to maintain the hydrology of the area and prevent the stone road acting as a preferential drainage channel within the bog. A similar approach will be used to maintain hydrology in the tunnelling compound at Na hEachú (Aghoos).

16.4.4 Architectural and Cultural Heritage

There are no protected structures or structures of architectural heritage merit located along any part of the proposed pipeline route or within any area proposed for ancillary development. Therefore, there is no anticipated impact to features of architectural heritage merit.

The commemorative mass site (ID A4) has been avoided by the proposed pipeline development. However, during the construction period fencing will be erected around the working area which will have an indirect, short term impact on the setting of this site.

In Gleann an Ghad (Glengad) the proposed route traverses fields that are organised as stripped field systems. The boundaries of these field systems will be directly impacted. However, this impact will be localised to the extent of the proposed temporary working area (where it will be necessary to remove field boundaries). All boundaries will be reinstated following completion of the construction works therefore, the predicted impact will be temporary in nature.

16.4.5 ‘Do Nothing’ Scenario

In the event of such a scenario, in general any previously unrecorded subsurface archaeological features not yet discovered would remain intact and undisturbed. In the event of a ‘do nothing’ scenario, features of a cultural heritage nature would remain intact and undisturbed.

16.4.6 ‘Worst Case’ Scenario

In the ‘worst case’ scenario the proposed pipeline development could disturb previously unrecorded features of archaeological merit or that archaeological material could be destroyed, without preservation by record taking place. Similarly, in the ‘worst case’ scenario, the proposed development could disturb and potentially remove previously unrecorded features of cultural heritage merit without the appropriate recording taking place.

16.5 MITIGATION

All recorded archaeological features (ID A1), sites of archaeological potential (ID A2 and A5) and of cultural heritage interest (ID A4) have been avoided by the proposed scheme. The following mitigation measures have been prepared and agreed with the National Monuments Section of the DoEHLG.

16.5.1 Archaeological Heritage- Construction Stage

16.3.1.5 Monitoring

An archaeological program of inspection will enhance and build upon the historic information gathered to date and provide a further understanding and appreciation of the historic landscape and its evolution along the proposed route. Having discussed the proposed pipeline development and the matter of archaeological mitigation with the National Monuments Section of the DoEHLG, it is recommended by that authority that archaeological monitoring by a licensed archaeologist be undertaken during the earthmoving works of the construction stage. This will ensure that any potential archaeological feature or discovery of an isolated stray find is identified, recorded and fully resolved under licence to the statutory authorities.

16.3.1.6 Mitigation Assessment Table

Table 16.7 outlines the mitigation measures specific to each site/area of archaeological potential identified in Section 16.3

Table 16.7: Archaeological Mitigation Strategy

ID Number	Type of site	Location in relation to proposed development (approximate)	Mitigation strategy
ID A1	RMP (MA 004-015) - Enclosure	Access road to LVI	This recorded archaeological site will be avoided. ID A1 has been fenced off previously and this protective measure will be subject to review by the licensed archaeologist on site and the DoEHLG to ensure that no inadvertent damage occurs to the monument. Archaeological monitoring will take place throughout the preconstruction stage.
ID A2	Mound – potential archaeological site	Located 106m from the pipeline	This feature is located outside the working area associated with pipeline and will be avoided
ID A3	Naturally occurring mound	21m north of the proposed pipeline	Archaeological test excavation has demonstrated that this site is **not archaeological** in nature and therefore requires no further mitigation.
ID A4	Commemorative mass site and stone wall enclosure	82m from the proposed pipeline and 52m to the south of the working area	This site and area will be avoided. Appropriate signage in relation to the historic nature and cultural heritage significance of the site is suggested for fencing in proximity to this feature.
ID A5	Mound-potential archaeological feature	13m north of the proposed pipeline	This anomaly is part of a long natural ridge and given the early initiation of bog formation and disturbance in the area and the results of test excavation in the neighbouring townland of na hEachú (Aghoos), considered to be of limited archaeological potential. Archaeological monitoring will take place throughout the pre-construction stage. The feature will be avoided during the construction process.
All works			Archaeological monitoring will be undertaken. Environmental analysis of organic archaeological remains will occur where it is considered necessary.

16.5.2 Architectural & Cultural Heritage

No structure or building will be removed as a result of the development of this project and no protected structure or structure of an architectural heritage merit will be subject to a direct impact. Therefore, no mitigation measures are necessary.

It is not anticipated that any proposed maintenance works to the already existing road network will impact on features of a cultural or architectural heritage merit. If improvement measures are deemed necessary they will be subject to review by the appropriate statutory authority. As a result, it is anticipated that there will be no direct impact by the proposed development on any items of architectural heritage merit (for example bridges, stone boundary walls, gateways) which are at a remove from the route of the onshore pipeline and the proposed works at Gleann an Ghad (Glengad), na hEachú (Aghoos) and Béal and Ghoile Theas (Bellagelly South).

It is recommended that fencing surrounding the compounds and working area at Gleann an Ghad (Glengad) and na hEachú (Aghoos) display information in relation to archaeology and the cultural heritage of the area. This is particularly relevant to the pedestrian access route at the commemorative mass site (ID A4), where signage could be developed to reflect the historic nature of the area and provide a more aesthetically pleasing backdrop to the setting of the site during the construction period.

Where necessary, field boundaries will be appropriately reinstated during the post construction stage of the proposed development. All townland boundaries along the proposed route are formed by watercourses. An underwater archaeological survey of these watercourses was undertaken and results of this survey are outlined in Section 16.6.

16.6 UNDERWATER ARCHAEOLOGY ASSESSMENT

The pipeline route traverses two watercourse areas of archaeological interest. These include:

- Sruwaddacon Bay from Na hEachú (Aghoos) to Dún Ceartáin/Gleann an Ghad (Dooncarton/Glengad); and
- Estuarine crossing known locally as the Leenamore River.

These crossings were considered in the underwater archaeological assessment. The detailed report containing this assessment is included in Appendix O.

It is proposed to construct the pipeline beneath Sruwaddacon Bay using a tunnelling technique known as segment lined tunnelling. This method is designed to minimise surface disturbance during construction. However, if a problem is encountered during the works an intervention pit may be required to overcome the problem (see Chapter 5).

It is proposed to cross the Leenamore River using an open-cut method.

16.6.1 Methodology – Underwater Archaeology

The methodology for the underwater archaeological assessment involved a desktop assessment, archaeological interpretation of acquired marine geophysical data and geotechnical site investigations conducted in the lower and upper areas of Sruwaddacon Bay and a field inspection.

16.6.1.1 Desktop Assessment

A desktop assessment of cartographic and archival information was conducted in advance of the on-site assessment. This included examination of:

- Ordnance Survey mapping for the area since the First Edition six-inch series in 1839;
- Topographical files in the National Museum of Ireland; and
- RMP files (Record of Monuments and Places) in the Department of the Environment, Heritage and Local Government, with specific attention to the Inventory of Historic Shipwrecks.

The legislation, standards and guidelines that were considered and consulted for the purposes of this evaluation are outlined in Appendix O.

16.6.1.2 Archaeological Interpretation of Geophysical/ Geotechnical Data

Review and interpretation was undertaken of the marine geophysical and geotechnical data previously acquired for Sruwaddacon Bay.

16.6.1.3 Field Inspection

The following field surveys were conducted:

- The inter-tidal survey was undertaken in September 2007 and April 2010 under licences granted by the DoEHLG; and

- The underwater assessment and diver-truthing of the side-scan sonar anomalies was carried out in October 2007 under licences granted by the DoEHLG.

The survey included both the underwater and the inter-tidal survey areas. Detailed descriptions were made of topography, bottom composition, and a photographic record of the existing environment was made. Further details of the field surveys can be found in Appendix O.

16.6.1.4 Assessment Criteria

The assessment criteria used in the underwater archaeological assessment are those outlined in Section 16.2.2.1.

16.6.2 Existing Environment

16.6.2.1 Cartographic Information

The earliest detailed accurate map of Sruwaddacon Bay, which is appropriate to this assessment, is provided in the Ordnance Survey First Edition six-inch map series dated to 1839. The maps show the estuarine nature of the Bay with large tidal mudflats and sandbars. In contrast with present-day Bay topography, the river channels appear to be somewhat wider, and there was a second channel running along the southern shore of the Bay below a large mudflat expanse. Today that southern channel has almost disappeared and waters flowing from the Gleann na Muaidhe (Glenamoy) and Moing na Bó (Muingabo) rivers are directed northwards along the only main channel through the Bay at low water.

Since 1839, the Bay has changed, both in terms of the infilling of the southern channel, and the more extensive development of the ferry crossing point at the north end of the Bay. Little else has changed and the tongue-like sandbars remain similar to the way they were in the 1830s.

16.6.2.1.1 Shipwreck Sites

The Shipwreck Inventory in the DoEHLG's archive is a list of recorded instances of wrecking since 1750. This is not a record of where the wreckage lays, since the historic records generally only deal with the vessel before it sunk. More detailed information can be obtained from other sources, such as fishermen's records of snag points and diver records of sites located underwater. These are included in the Shipwreck Inventory wherever possible most entries lack this final level of data. Finally, while the Shipwreck Inventory provides a record of wrecking incidents since 1750, it does not claim to be a comprehensive record for earlier events, therefore the medieval and prehistoric periods are not represented in this archive.

Broadhaven Bay in general was also included when searching the Shipwreck Inventory for wrecks in Sruwaddacon Bay. The results suggest that recorded wreckings on this coastline are relatively few, however, this might have more to do with the under-populated landscape, as there would have been fewer people regularly observing shipping movements than on more densely populated stretches of coastline. If this was true for the more active coastline, the relative absence of settlements on Sruwaddacon Bay even up to 1839 might explain the lack of wreckings reported in the Bay.

16.6.2.2 Field Inspection

Geophysical Inspection

A series of geophysical anomalies were identified and those within the Bay were diver-truthed as part of the underwater/inter-tidal assessment and the foreshore and sandbank walk-over. None of the anomalies are deemed to retain archaeological significance.

Systematic visual inspection of the foreshore/inter-tidal and sub-tidal seabed areas surrounding the proposed pipeline route did not reveal any material or features of archaeological significance. While it is possible to conclude that the known archaeological potential of the area assessed is low, the possibility nevertheless remains that subsurface deposits retain archaeological material. The mobile nature of the estuarine silts and the palaeo-channel on the south side of the Bay in particular would be an ideal holding area for such material.

Geotechnical Investigation

The geotechnical logs and data report on a series of rotary and percussive boreholes taken within Sruwaddacon Bay identified a buried peat level in four locations (see Appendix O for summary data of borehole logs). The peat is located in a single thin band in each of the four boreholes but at various depths of between 5.8m and 10.7m below current seabed level. In one instance hazelnut shell fragments were identified. The hazelnut shells have been set aside for further analysis. No archaeological artefacts were identified in the samples recovered.

The most appropriate mitigation strategy will be to maintain a monitoring programme during tunnelling operations in this area, with special attention to the locations of the four boreholes.

16.6.3 Potential Impacts

The tunnelling operation requires the excavation of a starting pit at na hEachú (Aghoos) and a reception pit at Gleann an Ghad (Glengad). These works represent potentially significant impact on the existing environment, from an archaeological perspective. The main tunnelling work will be conducted at a minimum depth of 5.5m below surface and represent an imperceptible impact on the known archaeological environment.

In the unlikely event that an intervention pit in the Bay is required, this would represent a potentially significant impact on the existing environment, from an archaeological perspective. Surface intervention would require a shaft to be excavated from the seabed surface to the obstruction located at the TBM head. This intervention pit would require sheet pilling prior to excavation of the seabed material. In addition, the use of an intervention pit may result in a secondary impact to the foreshore at na hEachú (Aghoos); with a shore access point required to mobilise and embark the excavation machinery. A temporary access point has been designated for this purpose. It is located across a section of foreshore, adjacent to the Aghoos tunnelling compound.

An open trench construction method will be used to construct the pipeline at a small inlet located at the south-eastern corner of Sruwaddacon Bay, called the Leenamore River inlet.

16.6.3.1 ‘Do Nothing’ Scenario

In the event of a ‘do nothing’ scenario, foreshore/inter-tidal/underwater deposits, features, or structures of archaeological significance would remain intact and undisturbed by the proposed development.

16.6.3.2 ‘Worst Case’ Scenario

In the event of a ‘worst case’ scenario, the proposed development would disturb previously unrecorded deposits, features, or structures of archaeological significance within the foreshore, inter-tidal, or underwater zone; resulting in the destruction of these deposits/features/structures without preservation by record taking place.

16.6.4 Mitigation Measures

16.6.4.1 Pre-construction Measures

No further underwater archaeological mitigation measures will be necessary in advance of construction works commencing.

16.6.4.2 Construction Phase Measures

It is recommended that archaeological monitoring licensed by the DoEHLG be conducted during all seabed and inter-tidal/foreshore disturbances associated with the construction of the proposed onshore pipeline.

An archaeologist experienced in maritime archaeology will be retained for the duration of the relevant works.

Monitoring of the tunnel arisings is recommended. A programme of monitoring is to be carried out for all tunnelling works. This programme will be reviewed once the works are underway.

In the event of archaeologically significant features or material being uncovered during the construction phase, any machine work should cease in the immediate area to allow the archaeologist to inspect any such material.

If the presence of archaeologically significant material is established, full archaeological recording of such material is recommended. If it is not possible for the construction works to avoid the material, full excavation is recommended.

16.7 RESIDUAL IMPACTS

There will be no residual impacts on archaeological, architectural or cultural heritage as it is anticipated that any issues associated with features and sites of archaeological, architectural or cultural significance will be resolved in the pre-construction or construction stage of the proposed pipeline development.

17 INDIRECT, CUMULATIVE IMPACTS AND IMPACT INTERACTIONS

The purpose of this chapter is to assess the indirect (or secondary) and cumulative impacts of the proposed Corrib Onshore Pipeline development. Although the indirect impacts as they relate to particular issues (e.g. terrestrial ecology, air and noise) have generally been discussed within Sections B – D of the EIS, these are consolidated in this chapter. In addition, while Sections B – D establish the full extent of the direct impacts associated with the proposed development, this section provides a discussion on the inter-relationship of these impacts during the construction phase of the proposed development. The assessment has indicated that there will not be a significant environmental impact during the operational stage.

Section 17.1 below describes separately indirect (secondary) impacts of the proposed development and the impact inter-relationships are discussed in Section 17.2. Some overlap exists in the discussion between these impacts. Cumulative impacts relate to the proposed Corrib Gas Field development as a whole including the proposed Onshore Gas Pipeline and are discussed in Section 17.3.

The assessment of these impacts has been undertaken with regard to EPA documents 'Guidelines on the Information to be contained in Environmental Impact Statements 2002' and 'Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)' 2003. It has also been prepared with consideration to the EU 'Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions', prepared for the European Commission (1999).

17.1 INDIRECT (OR SECONDARY) IMPACTS

The EPA Guidelines for EIS describe indirect impacts as:

'impacts which are caused by the interaction of effects, or by associated or off-site developments'.

In the case of this development, indirect impacts are those which are considered to be caused by consequential associated development, i.e. not directly part of the project, but associated with the project, e.g. aggregate extraction. In addition to associated developments, some mitigation measures can also cause indirect impacts, e.g. the requirement for offsite surplus peat disposal as a result of using stone road construction to minimise environmental impacts in peatlands. These are described in Section 17.1.4.

17.1.1 Road Maintenance

The public road network will provide access to the temporary working area of the pipeline during the construction phase. The main route for hauling materials to the site will be via the R313, L1204, R314 and the L1202. As such this route has been upgraded during the last few years in connection with the Corrib Development, and will be maintained to a high standard in order to accommodate the level of construction traffic expected to occur as part of this project. This maintenance will have a limited indirect impact on the local communities along the local road network due to temporary and localised disturbance, with an overall positive indirect impact from maintenance of the road.

17.1.2 Aggregate Extraction

It is estimated that approximately 120,000m^3 of stone will be required for the construction of the proposed development. Raw materials required during construction will be sourced from local suppliers. Where suitable, this may include the use of stone from local quarries and reuse of excavated materials in construction to minimise traffic impact. The extraction of this material will have a minor indirect negative impact on locally available natural resources (see Chapter 11). However, where possible, stone sourced on site from tunnelling works will be reused for temporary haul roads, construction of the stone road and compound construction. The sourcing and purchasing of materials will have a positive local economic impact.

17.1.3 Economic

In addition to the direct employment opportunities for construction of the onshore pipeline, indirect employment opportunities are expected to be created during the construction phase through increased demand for a range of goods and services, including construction materials and rental or guesthouse/hotel/B&B accommodation. This will have temporary socio-economic benefits for local residents, retailers and other commercial operators, e.g. accommodation services and transport companies, including increased workforce participation and income levels.

17.1.4 Indirect Impacts Resulting from Mitigation Measures

Table 17.1 summarises the main mitigation measures, which will result in a consequent indirect impact and associated secondary mitigation measures. These indirect impacts have been considered in Sections B-D of Volume 1 of this EIS and Volume 3 of the EIS, which describes the proposed peat deposition site at An Srath Mór (Srahmore) and the proposed operations to dispose of up to 75,000m^3 of surplus peat from the construction of the onshore pipeline.

Table 17.1: Indirect Impacts resulting from Mitigation Measures.

Potential Direct Impact	Mitigation Measure	Indirect Impact	Mitigation Measure
Impact on marine environment	Segment lined tunnel under Sruwaddacon Bay.	Avoidance of potential impacts to the estuary. Positive impact.	n/a
		Requirement for temporary working areas at both ends of the tunnel	Tunnel from one side only, minimises impact at Gleann an Ghad (Glengad) and Poll an tSómais (Pollatomish) Careful siting of tunnelling compound to minimise impacts on human, natural environments and cultural heritage. Mitigation in design of lighting, noise attenuation, traffic management.
		Increased material transport such as tunnel lining, bentonite etc.	Reuse materials on site as much as possible Bentonite recycling
		Disposal of excavated materials – tunnel arisings and surplus stone after site reinstatement.	Reuse of tunnel arisings and stone, where possible. Appropriate disposal of remaining waste to authorised facilities.
		Disposal of water recovered from drilling fluid / tunnel arisings	Appropriate treatment of wastewater.
		Use of bentonite.	Careful monitoring and management of use and disposal of bentonite.
Impact on sensitive bog habitat (190m section east of Leenamore inlet)	Reduce impact on the bog by installing stone road.	Increased materials requirement.	Source local material to reduce traffic impacts and resultant emissions. Re-use stone from excavated materials where possible.
	Turving of peat	Compaction of peat on which turves are stored	Turves stored in a single layer.
	Avoid storage of excavated peat on top of surface of sensitive bog.	Offsite storage (within pipeline temporary working area) and disposal of surplus peat to An Srath Mór (Srahmore).	Appropriate disposal of excess peat to a permitted site (Srahmore). Traffic management plan
	Install inert plugs to prevent creation of preferential flow path, subsequent damage and drying out of the bog.	Preservation of any potential archaeological features preserved within the area of the bog around the stone road. Positive indirect impact.	n/a
Impact on local community	Construction of tunnel from one side only	Reduce impact on more densely populated communities situated along L1202 haul route. Positive Impact. Increase in Aghoos compound duration due to tunnelling from one direction only	Design of lighting at compounds, site access and pipe stringing areas to minimise disturbance. Installation of temporary 3m barrier (fence) designed to attenuate construction noise and reduce lighting and visual impact. Enclosing certain plant in sealed containers in compound to provide further noise attenuation.
Visual Impact associated with LVI	LVI compound will be dished to minimise visual impact	Excavation of soils and bedrock requires rock breaking and transport of excavated materials	Noise attenuation during construction to minimise disturbance Traffic Management Plan

17.2 IMPACT INTER- RELATIONSHIPS

The EIA Directive requires that the 'inter-relationships' and 'interactions' between specified environmental effects be considered. While almost all environmental aspects are inter-related to some degree only the significant interactions were taken into consideration in this assessment. For example, noise can interact with a number of environmental aspects. Noise issues primarily feature under the heading of 'Human Environment' and most of the standards and guidelines on noise relate exclusively to human beings. However, noise can also impact on terrestrial fauna such as birds and material assets in the form of commercial livestock and so it must be taken into account as part of the ecological and agricultural assessments.

Interactions have been clearly identified in the early stages of the project and where the potential exists for interaction between environmental impacts, the EIS specialists have taken the interactions into account when making their assessments. Where there is interaction between two disciplines, the impact of lesser relevance to one discipline has referred to the impact in the other discipline. This ensures that the main aspects of the proposed development are considered overall as well as separately.

Summary details on the main direct impacts that result in interactions between environmental effects are provided in Table 17.2 for the construction phase of the proposed development.

Table 17.2: Summary of Potential Interactions resulting from the Construction Phase of the proposed Corrib Onshore Pipeline Development.

Environmental Topic	Potential Impact	Inter-relationship	Potential Impact	Refer to Chapter / Section
Human Environment				
Traffic (Chapter 7)	Increase in traffic on local roads	Community	Reduced recreational amenity & residential quality	Chapter 6
		Terrestrial Ecology	Disturbance to wildlife	Chapter 12
Air Quality and Climate (Chapter 8)	Increase in dust/air emissions	Community	Reduced recreational amenity & residential quality	Chapter 8
		Ecology	Disturbance to wildlife	Section C
Noise and Vibration (Chapter 9)	Increase in noise	Community	Reduced recreational amenity & residential quality	Chapter 9
		Ecology	Disturbance to wildlife	Section C
		Material Assets	Disturbance to livestock	Chapter 11
Landscape and Visual Impact (Chapter 10)	Change in landscape character	Community	Reduced recreational amenity & residential quality	Chapter 10
		Ecology	Disturbance to wildlife	Section C
Natural Environment				
Terrestrial Ecology (Chapter 12)	Loss of habitat/species	Community	Reduced recreational amenity	Chapter 6
		Freshwater Ecology	Loss of habitat/species	Chapter 13
Soils and Geology (Chapter 15)	Contamination of soils / groundwater	Ecology	Loss of habitat/species	Chapter 15
		Groundwater / surface water	Reduced recreational amenity	Chapter 15
	Impact on drainage	Archaeology	Increased deterioration to adjacent potential archaeological features	Chapter 16
		Material Assets	Reduced farm productivity due to disturbed field drainage systems Loss of growing season, grazing and on permanent wayleave	Chapter 11
Cultural Heritage				
Archaeology (Chapter 16)	Disturbance of potential archaeological finds	Community	Impact on cultural heritage	Chapter 16

Table 17.2 shows that the inter-relationships identified during the construction phase of the project are mainly between each of the environmental aspects / impacts with ecology and community. However, as suitable mitigation measures will eliminate/reduce the possibility of these temporary effects during the construction phase, the above interactions will be avoided or significantly reduced.

17.2.1 Interaction of Construction Schedule and the Environment

It is expected that the overall construction phase will be carried out over twenty six months. Therefore, it will inevitably coincide with periods of environmental sensitivity including migrating salmonids in the March to May and July and August period, over-wintering birds in the October to March (inclusive) and nesting birds between March and August (inclusive). Construction will take place throughout the year, however the potential for impact due to interaction between construction activities and seasonal sensitivities are minimised through strict mitigation, as follows:

- Phasing of land based construction activities to avoid peat transport during winter.

- Use of a tunnel which will avoid surface disturbance, during construction of the pipeline route through Sruwaddacon Bay.

- Use of specialised fencing in site compounds to attenuate construction noise and reduce potential lighting impacts.

- Sound proofing will be used on plant producing high noise, such as generators and pumps, to reduce the levels of noise generated on site.

- Use of appropriately designed lighting at the tunnelling compound to minimise lighting spill, and impact on sensitive receptors.

- Implementation of detailed surface water management system at tunnelling compounds and LVI, including on site treatment facilities.

- Turving the relevant area of salt marsh prior to the excavation of the pipeline trench at the Leenamore river crossing.

- Pre-construction ecological surveys as identified in Section C.

- Watercourse crossings to be discussed and agreed with NWRFB prior to commencement of construction.

Environmental sensitivities have been outlined in the discussions of each environmental element in previous chapters of this EIS. A Natura Impact Statement, in respect of the potential for the proposed development to impact on the Natura 2000 site,, is provided in Appendix P. Table 17.3 presents a summary of the key sensitivities that will coincide with construction activities.

Table 17.3: Potential Interaction of Key Environmental Sensitivities.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Construction Activities												
Migrating salmonids (see Chapter 13, 14)												
Over-wintering Birds (see Chapter 12)												
Nesting Birds (see Chapter 12)												

17.3 CUMULATIVE IMPACTS

A cumulative impact can be considered as an impact on the environment that results from incremental changes to environmental parameters when added to changes brought about by other past, present or reasonably foreseeable actions (European Commission, 1999). Cumulative impacts can result from individually minor but collectively significant actions taking place over the same period of time or/and within the same geographical area. Cumulative impacts therefore can cover all aspects of the environment.

While a single activity may itself result in a minor impact, it may, when combined with other impacts (minor or insignificant) in the same geographical area, and occurring at the same time, result in a cumulative impact that is collectively significant. This impact is known as a synergistic cumulative impact.

To address the cumulative impacts for the proposed development, an understanding and knowledge of historical, existing, and reasonably foreseeable future activities are essential. It was assumed that current day-to-day activities within the area would continue into the future. These activities include agriculture, forest management (felling in rotation) and other primary activities, residential development and generally moderate commercial activity. On examination of current activities and land-uses and the continuation of these activities it was deemed that they would not contribute significantly to compound an impact so were not considered further in this cumulative impact assessment.

In identifying proposals and projects for consideration in estimating cumulative impacts, only projects with a reasonable certainty of being executed within the next 15-20 years can be considered. The Corrib Gas Field Development is not currently designed to cater for future tie-ins from other gas field developments and any such tie-ins would require a design review of the project and a review of the statutory approvals process. In this regard, when considering cumulative impacts in the future, those developments which are currently in the planning process are considered reasonably foreseeable actions.

At the time of writing this EIS, no other committed developments, which would contribute to cumulative impacts, are planned in the local and wider area. However, it is worth noting that, though not yet committed, ESBI Ocean Energy Strategy are planning to develop 150MW of ocean energy by 2020 and have made an application for three foreshore exploration licences from the Department of Environment, Heritage and Local Government to undertake wave measurements and a sea-bed survey in the Achill / Blacksod area. Applications are being made for exploration licences to enable ESBI to deploy wave measurement buoys for a minimum period of 12 months in order to assess the wave climate at each site. ESBI will also undertake hydrographic surveys at each site to assess the sea-bed conditions. These works will take place over a 12 to 24 months period upon receipt of foreshore exploration licences commencing in 2010.

The following elements, which have the potential to contribute to cumulative impacts, were addressed as part of the cumulative impact assessment for the proposed development:

1. Corrib Gas Project, which consists of the following elements in addition to the proposed Onshore Gas Pipeline considered in this EIS:

    a. Offshore gas field development including seabed installations and offshore pipeline (works completed in Summer 2009).

    b. Offshore umbilical (to be installed in mid 2011).

    c. Bellanaboy Bridge Gas Terminal (Construction ongoing; likely to be complete Q4 2010. Finalisation of landscaping, water treatment and reinstatement will be completed after completion of onshore pipeline construction.

    d. Srahmore Peat Deposition Site (Deposition from Terminal completed in 2007)

   e. An Srahmore Peat Deposition Site (Deposition from onshore pipeline) (see Volume 3 of the EIS)

2. Bord Gáis Éireann Mayo to Galway pipeline (Constructed 2005 – 2006 and final tie-in to Bellanaboy Bridge Gas Terminal 2009)

In all cases, the residual impacts arising from each proposal have been identified and assessed for their cumulative impacts at a national (see Section 17.3.1) and regional scale (see Section 17.3.2). The potential cumulative impact of the works associated with the construction of onshore pipeline and the pre-commissioning of the offshore pipeline have been considered separately in Section 17.3.3 below.

Site investigation works undertaken in Sruwaddacon Bay associated with works for the Corrib Onshore Pipeline will take place prior to the construction of the onshore pipeline, and will not have a cumulative impact with the construction of the onshore pipeline.

17.3.1 National

The impacts of the Corrib Gas Field Development have been considered in the context of effects on the national economy and compliance with national policy.

The Goodbody Report[1] (2007) identifies that the Corrib Natural Gas Field Development will contribute over €3bn to Ireland's GDP over its lifespan, supplying up to 60% of the country's natural gas needs at peak production. The gas field is estimated to yield approximately one trillion cubic feet of natural gas over an operating life of fifteen to twenty years.

The Corrib Gas Project supports Ireland's proposed national strategic fuel switch from solid fuel and oil to natural gas and renewables and so contributes to Ireland's target to limit national greenhouse gas emissions while ensuring security of energy supply (see Preamble). A fuel switch from oil and coal gas will also result in lower NO_x and SO_x emission levels nationally.

The Corrib Gas Field Development will make a significant contribution to Ireland's national energy supply by moderating Ireland's dependence on imported energy. It will also provide stable and economic energy supplies, enhancing the sustainability of existing industry in the Border Midlands and Western Region.

As well as providing natural gas for homes in the region, the Corrib Gas Field Development will contribute to making the North West a more attractive investment destination. Potential investors will be attracted by the availability of natural gas as a reliable source of energy. In addition, the availability of natural gas may lead to electricity generation in the area, which could improve the reliability of electricity supplies. As well as being a benefit for the residents of the area, this is in line with the national need to promote balanced regional development.

17.3.2 Local & Regional

At a local and regional level, impacts of the Corrib Gas Project and the Bord Gáis Éireann Mayo to Galway Pipeline have been considered. Cumulatively there are positive local and regional economic impacts anticipated from these developments as a result of direct employment in construction, indirect employment in supporting services during construction and longer term community gain arising from developments.

As the majority of the elements are below ground and will have limited emissions in the operational phase, no long-term cumulative impacts are anticipated for air or noise. Visually, the LVI and the Terminal will be the only long term visible elements and cumulatively these elements are expected to result in a moderate impact for surrounding sensitive receptors. There will also be land-use restrictions

[1] Economic Assessment of the Corrib Gas Project, Goodbody Economic Consultants, November 2007

on forestry and development restrictions on the permanent wayleave. Ecology has some of the greatest potential for cumulative impacts through disturbance, fragmentation and loss.

Consequently the cumulative impact assessment has focused on impacts arising from construction activities. However, it should be noted that the majority of impacts during the construction phase will be short term, will be transient in nature and will in general only impact on environmental resources on a local basis.

From a local perspective construction activities associated with the Corrib Gas Field Development have been ongoing since 2004 including:

- construction of the Gas Terminal and associated peat removal since 2004;
- preparation of the landfall for the offshore pipeline in 2005; and
- Laying of the offshore pipeline completed in 2009 and associated landfall works at Gleann an Ghad (Glengad)

It is anticipated that works for the construction of the onshore pipeline, including associated peat disposal will begin in 2011 and will continue to 2013. These construction activities will result in additional traffic, noise, dust and visual disturbance in the immediate area of the works. The continuous nature of construction works associated with these elements of the Corrib Gas Field Development has the potential to result in significant cumulative impact on those living in immediate area of the works and those living on the haul route to an Srath Mór (Srahmore). However, these potential impacts will be mitigated as outlined in Sections B – D of the EIS. Potential cumulative impacts on the local community and on the local environment will be therefore be minimised.

For the purposes of this cumulative impact assessment, the accumulation of temporary construction impacts of all elements (regardless of whether works are completed or about to be completed) are considered with the accumulation of temporary construction impacts within the planned construction phase of the proposed Corrib Onshore Pipeline development (approximately 26 months) commencing in early 2011 (see Figure 17.1). It is anticipated that works associated with the installation of the offshore umbilical and the construction of the onshore pipeline will overlap for a period during this time, although work will be suspended briefly on LVI construction during the pull-in of the offshore umbilical. Any cumulative impacts resulting from increased traffic, noise, dust and visual disturbances associated with this activity will be minimal and only last for approximately three months.

An overview of the impacts arising from each of the distinct elements of the development on the human, natural environment and cultural heritage are provided below in sections 17.3.3 – 17.3.5 and Table 17.4, together with an assessment of the cumulative impact.

A separate assessment of the cumulative emissions of greenhouse gas emissions arising from the construction and operation of the Corrib Gas Field Development is provided in Section 17.3.6.

17.3.3 Pre-Commissioning of Offshore Pipeline

It is planned to begin the pre-commissioning of the Offshore Pipeline at Gleann an Ghad (Glengad) during the summer of 2012. The pre-commissioning of the Offshore Pipeline will involve marine based activities which are best carried out during clement weather conditions.

The Offshore Pipeline is currently filled with seawater containing corrosion inhibitor. Pre-commissioning of the Offshore Pipeline will involve the following steps (subject to receipt of all necessary permits and approvals of the Corrib Project).

- Tie-in of Offshore Pipeline to completed LVI;
- Connection of a temporary PIG trap to the offshore end of the Offshore Pipeline on the sea bed;

- Connection of a temporary PIG trap to the Offshore Pipeline at the LVI (downstream of the in-line ball valve);

- Water in the Offshore Pipeline will be expelled (into the sea) using a PIG propelled by nitrogen gas. This will be launched from the temporary PIG trap downstream of the LVI;

- Nitrogen gas will be generated at the landfall site using specialised plant and compressors. This will be pumped into the offshore pipeline via the temporary pig trap; and

- When the pig reaches the temporary pig trap on the sea bed, the offshore pipeline will be completely filled with nitrogen gas. Nitrogen gas within the Offshore Pipeline will be used later in the commissioning of the onshore pipeline.

The pre-commissioning works will involve the use of a nitrogen generation plant and compressors, which will be located at the landfall site for a period of approximately 2 weeks. A 3m high noise attenuation fence will be installed around the site for the duration of the pre-commissioning works. The construction activities associated with the offshore pipeline pre-commissioning will be temporary in nature, and will involve setup of the site in which the generators will be contained, and small numbers of traffic to transport the plant to the site.

Noise from the plant could result in a significant increase in noise levels in the Gleann an Ghad (Glengad) area The compressors will be enclosed to reduce noise from source.. However, potential noise from nitrogen compressors and associated compressors means that this activity would need to restricted If further noise attenuation measures can be identified and proven to reduce noise levels to an acceptable target, it is proposed to carry out this work on a 24-hr basis. Should further noise attenuation not be available, this activity will be curtailed, and not carried out during the period 22:00 – 07:00.

This activity will last for a short period only and impacts are predicted to be temporary and moderate. It is anticipated that there will be only minimal construction works occurring in Gleann an Ghad (Glengad) at this time, therefore only a negligible cumulative impact in anticipated during this time.

The nitrogen plant will require the use of mobile diesel generator units, which will generate emissions of combustion gases. The predicted cumulative impact to air quality of the operation of the generators during the construction of the Corrib Onshore Pipeline on the nearest residential dwellings will be a slight adverse impact of a temporary nature. The levels will remain at all times well below the limits for the protection of human health. The nearest residential receptors affected are those approximately 200m south of the compound. Based on the EPA air quality index, the air quality in this area will remain in the range of “good” to “very good” with the generators in operation. The potential for cumulative impact of generator emissions from this plant on the cSAC is considered negligible.

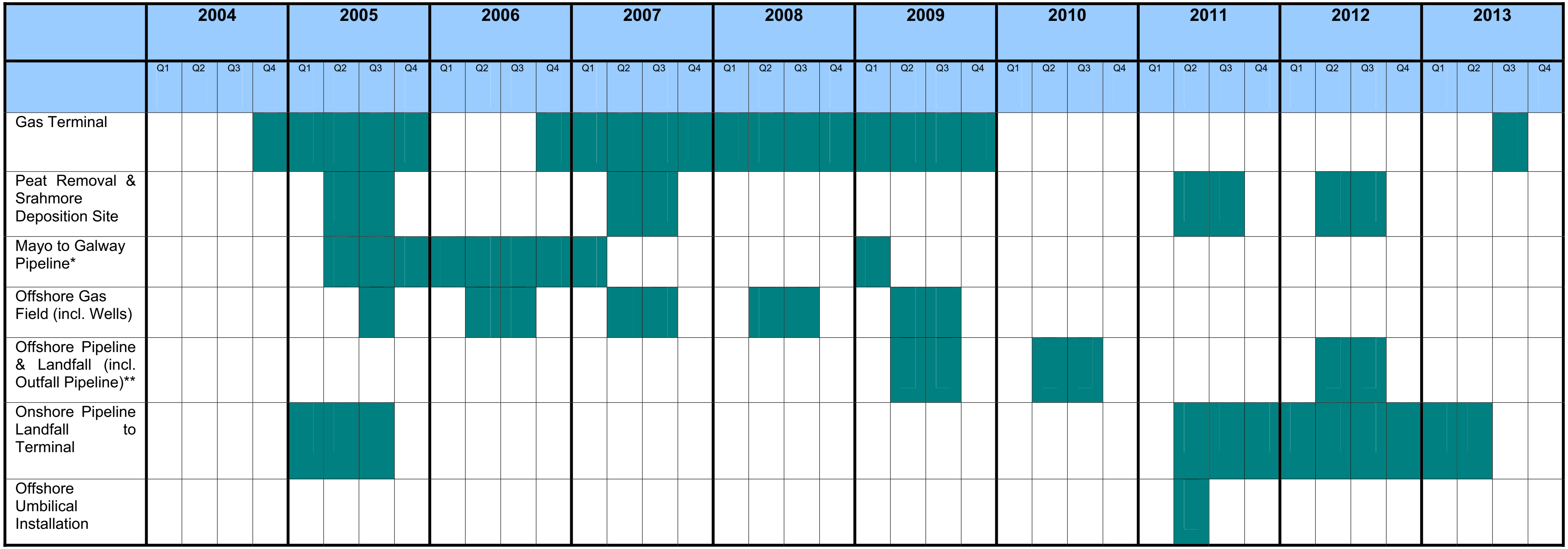


Figure 17-1: Corrib Project Construction Progress to date and Proposed Construction Programme (**indicative only and subject to timely regulatory approval**)

Note: Figure 17.1 provides indicative periods during which activities may occur.
*Pipe tie-in (Mayo – Galway pipeline) to Corrib pipeline in Q1 2009.
**This includes offshore pipeline pre-commissioning in Q2 and Q3 in 2012 (for approximately 2 weeks) and offshore rock placement in Q2 and Q3 in 2010.

17.3.4 Human Environment

17.3.4.1 Local Employment

Bellanaboy Bridge Gas Terminal

Up to 1,000 people have been employed during construction of the Gas Terminal providing a positive impact on the local economy during the construction period with enhanced opportunities for local service providers.

Peat Removal and Srahmore Peat Deposition Site

An estimated 50-55 people were required for the peat Srahmore Peat Deposition Site in 2005 / 2007. These included existing / returning temporary employees.

Mayo to Galway Gas Pipeline

Approximately 500 people were employed during construction and reinstatement of the Mayo to Galway Pipeline. In addition, short-term benefits to local communities in terms of increased income in shops, pubs, cafes/restaurants and accommodation and indirect employment were predicted as a result of pipeline construction activities.

Offshore Development

Construction of the Offshore Seabed Installation involved a workforce of approximately 200 to 300 people over the construction period. However, this was mainly an international specialist workforce with limited local benefits. Construction of the landfall and the subsequent laying of the offshore pipeline in 2009 involved a workforce of approximately 300 to 400 with a positive impact on the local economy, with enhanced opportunities for local service providers. These included increased trade in local shops, pubs, restaurants, and service providers. There were also opportunities for supply of equipment, catering, transport and delivery of goods. There will also be tangible economic benefits to Killybegs from the offshore components of the project.

Onshore Corrib Gas Pipeline

Construction of the Onshore Pipeline is predicted to result in a significant and positive impact on the local economy from major employment opportunities and construction of the pipeline. During construction it is estimated that 120 to 140 personnel will be employed on the onshore pipeline project. The onshore pipeline is predicted to have an overall positive economic impact on the existing community.

Peat removal from the Onshore Pipeline will also provide direct and indirect job creation during the peat deposition activity.

Cumulative Impact

As detailed in the Goodbody Report, construction of the Development will result in significant benefits for the local economy. It is estimated that the local Mayo economy will directly benefit by approximately €181m as a result of the Corrib Development. In excess of 800 jobs will be created during the construction phase including direct, indirect and induced employment. This will result in a positive cumulative impact during construction.

17.3.4.2 Tourism and Recreation

Bellanaboy Bridge Gas Terminal

The EIS for the Gas Terminal predicted a negligible negative short term impacts on visitors to the area during the construction period. Whilst Bed & Breakfast and self catering type accommodation would benefit from increased trade, visitors to the local area who pass the Terminal site would notice site activity, increased traffic movements and construction activity.

Peat Removal and Srahmore Peat Deposition Site

Most major tourist attractions in the area are sufficiently remote from the Srahmore Peat Deposition Site to be unaffected by the peat deposition activity.

Mayo to Galway Gas Pipeline

The Mayo to Galway Pipeline was completed in 2006. Negligible short term impacts existed on visitors to the area during the construction period.

Offshore Development

The Offshore Seabed Installation is thought to have resulted in imperceptible impacts on tourism and recreation. The offshore pipeline was laid in the summer of 2009. Attractions were sufficiently remote from the offshore activities and therefore associated visitors were unaffected during construction.

Onshore Corrib Gas Pipeline

The development will have a slight to moderate temporary negative impact upon visiting communities of the local and wider vicinity of the proposed route during the construction phase.

Cumulative Impact

None of the construction activities associated with the elements of Corrib Gas Field Development are expected to impact significantly on tourism and recreation. As all elements will not occur simultaneously, cumulative impacts will be limited to the umbilical lay and onshore pipeline construction where some overlap is expected. Where cumulative impacts do occur they will be temporary in nature and are not expected to be significant.

17.3.4.3 Traffic

Bellanaboy Bridge Gas Terminal

The local road network, including the upgraded haul road L1204, adequately catered for traffic volumes generated during the construction phase of the Bellanaboy Bridge Gas Terminal.

Peat Removal and Srahmore Peat Deposition Site

In terms of the movement of peat from the Terminal to the Srahmore Peat Deposition Site, the traffic assessment concluded that the local road network could adequately cater for traffic volumes generated by the construction of the project. The main traffic impact was predicted to result from damage to the road pavement due to heavy construction traffic. This was mitigated through extensive upgrading of local roads.

The Traffic Impact Assessment and Traffic Management Plan provided in Chapter 7 and Appendix E & F has taken account of the cumulative impact of all traffic associated with the movement of peat to An Srath Mór (Srahmore) from the construction of the Onshore Pipeline.

Mayo to Galway Gas Pipeline

The Mayo to Galway Pipeline was predicted to result in moderate adverse short-term impacts on local traffic along the proposed pipeline route as a result of construction traffic associated with the delivery of pipe, equipment, fencing, hardcore, sand padding and supplies to construction areas and, and the subsequent removal of temporary facilities upon completion.

Offshore Development

The existing road network has adequately catered for the volumes of traffic generated during construction associated with the landfall for the offshore development. Traffic associated with the installation of the offshore umbilical will be minimal.

Onshore Corrib Gas Pipeline

In terms of the Onshore Pipeline, the traffic impact assessment has predicted that the road network surrounding the development is capable of facilitating the construction activities. There will however be a moderate impact on the local road network surrounding the development during the construction stage but this will be temporary in nature. Maintenance works will result in a local positive impact for local road users. Adverse traffics impacts during construction can be satisfactorily mitigated and the overall residual traffic impact will be imperceptible.

Cumulative Impact

Construction traffic associated with all elements of the Corrib Field Development project has, and will continue to result in increased traffic volumes and may cause intermittent noise, vibration, dust and delays to other road users for the duration of the construction. However, for future works only traffic associated with the installation of the offshore umbilical and construction of the onshore pipeline will occur simultaneously. Although there may be some overlap in 2011, which will lead to a cumulative traffic impact on the local road network, the impact will be slight. This will be further reduced through the implementation of a Traffic Management Plan (see Appendix F) and the maintenance of local road network.

17.3.4.4 Air Quality

Bellanaboy Bridge Gas Terminal

Construction of the Gas Terminal has resulted in emissions of dust, and emissions from traffic and machinery; however construction activities are not predicted to result in significant negative air quality impacts.

Peat Removal and Srahmore Peat Deposition Site

During peat deposition from the Terminal, the Srahmore Peat Deposition Site was predicted to result in a minor localised impact on air quality through dust generated during positioning of peat at the depository, and exhaust fumes from haulage on onsite vehicles and equipment. Similar impacts will arise from peat deposited from the onshore pipeline.

Mayo to Galway Gas Pipeline

The Mayo to Galway Pipeline was predicted to result in a minor localised impact on air quality through exhaust fumes from machinery used during construction.

Offshore Development

The Offshore Seabed Installation was not predicted to have a significant impact on air quality in view of the short duration or periodic nature of most of the activities associated with the offshore works. In general, there were no resident sensitive receptors offshore and impacts were negligible. Given the location of the offshore development, no cumulative impact with onshore pipeline construction is expected.

Onshore Corrib Gas Pipeline

The Onshore Pipeline will result in emissions of dust (during dry weather only) from construction and emissions from construction traffic. However this is not predicted to result in significant air quality impacts. The local impacts to air quality along the proposed haul routes as a result of construction traffic are considered to be temporary slight negative.

Cumulative Impact

Construction activities associated with all elements of developments will result in temporary impacts on local air quality. In terms of cumulative impacts it is anticipated that only works associated with installation of the offshore umbilical and construction of the Onshore Gas Pipeline will occur simultaneously. Where cumulative impacts do occur they will be slight and temporary in nature. Peat deposition will not result in an increased cumulative impact on air quality as An Srath Mór (Srahmore) is located sufficiently far away from the other elements of the Corrib development.

17.3.4.5 Noise and Vibration

Bellanaboy Bridge Gas Terminal

The construction of the Gas Terminal was predicted to give rise to increased noise and vibration levels. However, as the site is remote, compliance with normal construction noise and vibration controls has been achieved. Any particularly noisy operations are planned in advance in order to ensure that appropriate community liaison can be put in place.

Peat Removal and Srahmore Peat Deposition Site

Peat deposition from the Terminal to the Srahmore Peat Deposition Site was predicted to result in minor short-term impacts on noise generated by the transfer of material to the site and movement within the site during construction. Similar impacts will arise from peat deposited from the Onshore Pipeline.

Mayo to Galway Gas Pipeline

The Mayo to Galway Pipeline was predicted to result in minor temporary short-term impacts on noise during construction as a result of rock breaking and excavation.

Offshore Development

The Offshore Seabed Installation (offshore component) resulted in negligible noise impacts on noise. At 65km offshore, the drilling rig and vessel activities have been too far from human sensitive receptors to be of concern. The Offshore Pipeline Installation (nearshore component) has not resulted in significant impacts on noise. Vessels normally worked at night, with minimal disturbance to local residents. Pulling in of the pipeline to the landfall resulted in a slight increase in normal daytime noise levels and a significant increase in noise levels in the evening and at night when the area would normally be quiet. This activity lasted for a short period only and therefore impacts were temporary. Dredging in Broadhaven Bay in 2009 involved re-excavation of the previously infilled trench. This activity did not generate noise at levels that had more than a negligible and temporary impact on the receiving environment. It is anticipated that the offshore umbilical will be installed in 2011. Some rock placement will also occur in 2010.

Onshore Corrib Gas Pipeline

The Onshore Pipeline is predicted to result in a significant, although short term negative noise and vibration impacts during construction as a result of construction traffic and general construction activities.

There will be noise associated with 24 hour works required at the tunnelling compound in na hEachú (Aghoos). There will also be noise and vibration from the tunnelling, but this is considered to have an imperceptible impact on the human and ecological aspects.

Cumulative Impact

During construction there will be increased noise and vibration from construction works and traffic associated with each of the elements of the project. In terms of cumulative impacts only works associated with the installation of the offshore umbilical, pre-commissioning of the offshore pipeline and construction of the onshore pipeline could give rise to cumulative noise impacts.

As increased traffic associated with the installation of the offshore umbilical (though considered to be minimal) and construction of the onshore pipeline may occur simultaneously, there may be potential for cumulative noise impacts along the local road network. However, these impacts which will be slight and temporary in nature, will be limited to normal working hours and will be further managed through the implementation of a Traffic Management Plan (see Appendix F).

17.3.4.6 Visual Impact

Bellanaboy Bridge Gas Terminal

The Gas Terminal is predicted to result in minor temporary visual disturbance as a result of construction activities including the presence of large plant and cranes.

Peat Removal and Srahmore Peat Deposition Site

During construction, short term adverse visual impacts are associated with peat transfer traffic to the Srahmore Peat Deposition Site.

Mayo to Galway Gas Pipeline

The Mayo to Galway Pipeline resulted in minor short-term visual impacts during construction as a result of site facilities and working widths.

Offshore Development

The Offshore Seabed Installation (nearshore component) resulted in short term adverse visual impacts on highly scenic views at Gleann an Ghad (Glengad) as a result of temporary activity within the nearshore areas of Broadhaven Bay including the mooring of the large pipelay vessel, workboats, etc. Similarly, short term adverse visual impacts resulted from construction activity in the vicinity of the landfall including the beach. Any visual impacts associated with the installation of the offshore umbilical be temporary in nature.

Onshore Corrib Gas Pipeline

The Corrib Onshore Pipeline is predicted to result in substantial negative temporary / short term visual impacts as a result of construction activities. This is because the viewer sensitivity is high for the protected views designated along the scenic routes in the area. Visually, the LVI will be the only long term visible element which will result in a moderate impact for surrounding sensitive receptors.

Cumulative Impact

Visually, the LVI and the Terminal will be the only long term visible elements and cumulatively these elements are expected to result in a moderate impact for surrounding sensitive receptors. Construction activities associated with all elements of the project will result in localised temporary / short term moderate visual impacts. There will be no increased cumulative visual impact resulting from installation of the offshore umbilical, or from the peat deposition at An Srath Mór (Srahmore) as it is located sufficiently far away from the other elements of the Corrib Gas Field development.

17.3.5 Natural Environment

17.3.5.1 Terrestrial Ecology

Bellanaboy Bridge Gas Terminal

The Gas Terminal was predicted to result in short-term negligible or minor impacts on terrestrial flora and fauna during construction as a result of vegetation clearance and disturbance to habitats of low ecological interest.

The Terminal site covers an area of approximately 160 hectares but only habitats under the terminal footprint, access roads and some small drainage channels are permanently lost (13ha). Habitats affected include grassland, immature conifer plantation and small pockets of scrubland.

Peat Removal and Srahmore Peat Deposition Site

The Srahmore Peat Deposition Site was predicted to result in a number of temporary impacts on terrestrial flora and fauna during construction as a result of disturbance, including temporary loss of habitat.

Approximately 450,000m^3 of peat excavated from the Terminal site was deposited in a cutover peatland at An Srath Mór (Srahmore). Up to 75,000m^3 of peat will be deposited at An Srath Mór (Srahmore) as a result of construction of the Onshore Pipeline. Deposition of the peat takes place within an area of approximately 63 ha.

This site is one from which peat has been harvested for a local power station and is saucer shaped with an extensive drainage infrastructure that was installed for industrial peat extraction. On completion, the site has been allowed to recolonise with natural species. This promotes the re-establishment of peat-forming conditions and re-instates a peatland ecosystem in place of the original Atlantic blanket bog complex. The vegetation succession will lead to a more varied habitat which will contribute to local biodiversity and complement the ecological significance of the adjacent rehabilitated cutover areas. Over time the habitats will blend with the existing fringe habitats that currently border the development site. The long term prospect is therefore considered to be positive, with permanent beneficial impacts on the development site. The residual impacts overall are considered to be significantly positive given that they should result in habitat rehabilitation and increased local biodiversity.

Mayo to Galway Gas Pipeline

The Mayo to Galway Pipeline was predicted to result in temporary short-term impacts on terrestrial flora and fauna during construction as a result of disturbance. Short term impacts on fauna were limited to the working area, with works timed to minimise disturbance. Potential impacts on flora were minimised through route selection and appropriate construction and re-instatement techniques.

There were six Block Valve Installations (BVIs) along the 150km Galway to Mayo pipeline route, the site areas of which are estimated to be approximately 35m x 35m, except for BV4 (see Table 17.4) which incorporates a pigging station and requires an area of approximately 50m x 50m. This required the permanent loss of the following habitats at each Block Valve Installation (BVI):

Table 17.4 Habitats at Block Valve Installations

Station	Habitat Type
BVI 1	Mixed cutover bog and conifer
BVI 2	Cutover rushy grassland
BVI 3	Improved grassland and hedgerow / scrub
BVI 4	Improved agricultural land
BVI 5	Agricultural land
BVI 6	Agricultural land / stone wall

In addition to permanent habitat loss due to the six BVIs, approximately 13km of the Galway to Mayo Pipeline traversed conifer plantations, which were required to be felled. As the pipeline working width was 40m this meant that there was a permanent removal of approximately 52ha of conifer trees. Conifer felling should be seen in the context of local forest management which has seen extensive (ongoing) clearfelling of large areas of mature conifer plantation in recent years. The felling of trees for this pipeline should be viewed as an extension of the forest management in the area, as the mature conifers would be due for felling in rotation.

Offshore Development

The work required to install the offshore pipeline was relatively minor, and the route through the cliff at the landfall was re-instated fully following construction. No long term impacts on any species are predicted.

Seabed disturbance from the installation of the field facilities resulted in permanent habitat loss of benthic faunal communities and crustaceans over a footprint of $392m^2$ of the seabed (combined footprint for the gathering manifold and pipeline end manifold).

Installation of the pipeline on the seabed resulted in a permanent loss of benthic habitat. The total seabed area actually taken up by the offshore pipeline is approximately 4.28ha. Increased turbidity during construction and smothering of organisms underneath the pipeline will result in permanent but minor habitat change. Within Broadhaven Bay, the pipeline was trenched for approximately 13km from the landfall site and therefore no permanent habitat loss occurred. The offshore umbilical will be trenched along a similar route, with no permanent habitat loss anticipated. It is estimated that approximately 2 ha of the seabed will be taken up by the placement of rock on the offshore pipeline. This will occur in 2010.

Onshore Corrib Gas Pipeline

The impact of the proposed Onshore Pipeline on terrestrial ecology in the area is considered neutral or slight negative in the long-term as a result of disturbance during construction. No long-term significant impacts on species of conservation interest present on site, such as otters, badgers, bats and frogs are expected.

Permanent loss of habitat of the onshore pipeline occurs at the LVI, along the access road to the LVI and the tree felling of conifers. This represents approximately 3.5ha. Again, the felling of trees for this pipeline should be viewed as an extension of the forest management in the area, as the mature conifers would be due for felling in rotation.

Cumulative Impact

Construction activities associated with all elements of the Project would result in temporary slight negative impacts on terrestrial ecology. However, these impacts will not be additive in terms of temporary loss (i.e. in combination they do not result in a greater impact) on ecological resources such as cSAC or natural habitats.

Peat deposition at An Srath Mór (Srahmore) will result in habitat rehabilitation and increased local biodiversity, resulting in a positive impact on terrestrial ecology, which will add to the overall cumulative impact.

Approximately 76 ha of permanent habitat loss will be associated with the various elements of the Corrib Gas Field Development. The impacts from the loss outlined will not be additive (i.e. in combination they do not result in a greater cumulative impact) on ecological resources such as SAC or natural habitats. In addition it should be noted that the peat deposition site at An Srath Mór (Srahmore) can be seen as a positive habitat change and is therefore not included in the above figure.

17.3.5.2 Freshwater Ecology

Bellanaboy Bridge Gas Terminal

The Gas Terminal was predicted to result in temporary short-term negligible or minor impacts on freshwater aquatic ecology during construction, as pollution control measures, including run-off control has been successfully implemented.

Peat Removal and Srahmore Peat Deposition Site

The Srahmore Peat Deposition Site was predicted to result in negligible impacts on freshwater aquatic ecology with the implementation of appropriate mitigation measures to control discharges.

Mayo to Galway Gas Pipeline

Discharge of hydrostatic test water into the freshwater aquatic environment as a result of the construction of the Mayo to Galway Pipeline was predicted to result in negligible impacts on aquatic ecology.

Offshore Development

There were no predicted impacts to the aquatic (freshwater) ecology from the construction of the offshore pipeline (and its associated umbilical).

Onshore Corrib Gas Pipeline

At watercourse crossings work will be carried out in isolation of stream flow to avoid disturbance and to prevent water escaping onto the temporary working area. Robust surface water management systems, including on site treatment facilities, will be put in place during construction. Residual impacts on freshwater ecology, including salmonids, post construction are predicted to be slight to negligible.

Cumulative Impact

Construction activities associated with all elements of the development will result in imperceptible or slight temporary impacts on freshwater ecology. Cumulative impacts however will be limited as impacts on aquatic ecology will generally be local to individual elements of the overall development.

17.3.5.3 Marine Ecology

Bellanaboy Bridge Gas Terminal

There are no predicted impacts to the marine ecology associated with the construction phase of the Terminal.

Peat Removal and Srahmore Peat Deposition Site

There are no predicted impacts to the marine ecology associated with the peat removal and the An Srahmore Peat Deposition site.

Mayo to Galway Gas Pipeline

There are no predicted impacts to the marine ecology associated with the Mayo to Galway Gas pipeline.

Offshore Development

The installation of the umbilical will cause some temporary localised disturbance to the seabed sediments, but it is expected that recovery and recolonisation by benthic communities will occur fairly rapidly. Where rock armour or concrete mattressing is laid on the seabed the existing seabed habitats will be permanently lost, however the new introduced hard substrates may attract new species to the area. Overall, the predicted impact to benthic communities is considered negligible, with the exception of the rock-placement works in Broadhaven Bay, which is considered minor, due to the extent of the rock placed area. Projected noise levels associated with the rock-placement operations are not anticipated to have significant impacts. It is considered likely that marine mammals within 200m of operations would demonstrate an avoidance response. Controls to limit any impacts to marine mammals from the generation of noise during remaining near-shore construction will be implemented, and the construction techniques that will be used do not generate high noise levels. Any effect is likely to be transient and restricted to a behavioural response (avoidance).

Onshore Corrib Gas Pipeline

In the unlikely event that emergency surface intervention should be required during tunnelling there would be a potential to cause some disturbance of the seabed predominantly due to altered sediment mobility around temporary structures causing scour and deposition. Allowing for mitigation and coupled with the fact that most of the scour will naturally refill with mobile re-deposited material post construction, the residual impacts are expected to be neutral to negative or imperceptible to slight.

Cumulative Impact

The Offshore Seabed Installation and offshore pipeline (including rock placement) are predicted to impact on marine ecology. In the unlikely event that temporary surface intervention is required during tunnelling underneath Sruwaddacon Bay, the cumulative impacts are predicted to be imperceptible in the short term.

17.3.5.4 Soils and Geology

Bellanaboy Bridge Gas Terminal

Construction of the Gas Terminal resulted in the excavation of approximately 450,000m^3 of local peat and excavation of both weathered and unweathered bedrock. However, there was no predicted negative impact on the geology of the area.

Peat Removal and Srahmore Peat Deposition Site

The Srahmore Peat Deposition Site was predicted to have no adverse impacts on soils and geology with the implementation of mitigation measures including appropriate timing of works.

Mayo to Galway Gas Pipeline

The Mayo to Galway Pipeline was predicted to have a number of potential impacts on soils and geology during construction associated with the crossing of peat areas, the crossing of flood plain areas, the crossing of low-lying sand and gravel areas, areas underlaid by karstified limestone, and areas of shallow hard rock. Mitigation measures were identified to minimise such impacts on soils and geology including minimising the length of crossings in these areas.

Offshore Development

The Offshore Seabed Installation (offshore component) was predicted to have only a minor adverse geological impact, as it is not an area that is known to be especially important in geological terms. The drilling of wells will locally impact the solid geology in the removal of a core of rock during the drilling operation. Locally adjacent to the well site there was some local impact on the seabed geology, in that cuttings arising from the well drilling operation could be expected to settle nearby. Installation of the pipeline and umbilical will disturb the seabed and shallow sub-seabed geology temporarily during the construction phase. The umbilical will be buried and the seabed is expected to return to its present morphology within a matter of weeks after construction. Rock placement and any concrete mattressing introduced for seabed sediment scour protection will permanently impact seabed geology by smothering.

Onshore Corrib Gas Pipeline

In the short-term, there will be a slight impact due to the localised loss and/or compaction of peaty soils during construction. A stone road will remain permanently in place for the section of the pipeline route in peatland. A 4.9km grouted tunnel will also be in place. The LVI will be placed within a dished area in Gleann an Ghad (Glengad), which will be excavated. Once construction has been completed and after the full implementation of the mitigation measures there will be an imperceptible impact on soils and geology.

Cumulative Impact

A number of the individual elements of the project have the potential to result in localised impacts on geology and soils. Any cumulative impacts would not be synergistic, i.e. the combination of these impacts will not result in a more significant impact on soils and geology. Therefore the cumulative impact is considered to be slight.

17.3.5.5 Hydrology and Hydrogeology

Bellanaboy Bridge Gas Terminal

Construction of the Gas Terminal will result in localised minor adverse impacts on hydrology. The most noticeable feature would be the possible decrease in baseflow to the watercourse immediately downstream of the Gas Terminal. However it is anticipated that this impact would be negligible by the time this watercourse reaches the Bellanaboy River.

Peat Removal and Srahmore Peat Deposition Site

With the implementation of appropriate mitigation measures to treat and control discharges, the Srahmore Peat Deposition Site results in negligible impacts on watercourses adjacent to the site.

Mayo to Galway Gas Pipeline

The Mayo to Galway Pipeline was predicted to result in negligible adverse impacts as a result of changes to drainage during construction.

Offshore Development

The Offshore Seabed Installation was predicted to result in minor or negligible impacts to the aqueous environment as releases to the environment, if any, would be both small in quantity and of very low toxicity.

Onshore Corrib Gas Pipeline

In the short-term, there will be a slight impact due to the localised loss and/or compaction of peaty soils during construction. There will be a localised impact in the areas where the stone road is constructed. Once construction has been completed and after the full implementation of the mitigation measures there will be an imperceptible impact to the original drainage pattern.

Cumulative Impact

A number of the individual elements of the Project have the potential to result in localised impacts on hydrology and hydrogeology. However, each element is committed to stringent pollution prevention measures that are considered sufficient to address any impacts. Therefore the cumulative impact is considered to be imperceptible.

In terms of impact on habitats arising from the effects of the development on hydrology, no elements of the Corrib Gas Field Development will result in cumulative impacts on the cSAC or on the natural habitats traversed by the proposed Corrib Onshore Pipeline as each of the elements lie within a different catchment.

17.3.6 Cultural Heritage

17.3.6.1 Archaeology

Bellanaboy Bridge Gas Terminal

No impacts on known archaeological sites were predicted as a result of the construction of the Gas Terminal. During earthworks no archaeological features were discovered.

Peat Removal and Srahmore Peat Deposition Site

No archaeological features were discovered.

Mayo to Galway Gas Pipeline

No impacts on known archaeological sites were predicted as a result of the Mayo to Galway Pipeline. Possible minor/moderate impacts on unknown sites were identified.

Offshore Development

No impacts on known archaeological sites were predicted as a result of the Offshore Seabed Installation. Possible discovery of unknown archaeological material was identified but none were found.

Onshore Corrib Gas Pipeline

The proposed Onshore Pipeline route avoids all recorded archaeological monuments and specific sites of archaeological potential. As a result none of these known or potential archaeological sites will be directly impacted. However, one recorded archaeological site lies adjacent to the temporary working area and four other sites of archaeological potential remain within the temporary working area or lie adjacent to it. As such, these sites are considered to be indirectly impacted by the proposed development. The potential exists to reveal previously unknown and buried archaeological sites in the future as part of an archaeological testing strategy.

Cumulative Impact

As there is potential for unknown archaeological material to be discovered, archaeological monitoring has been, and will be, undertaken during construction for all elements to ensure the recognition and recording of any such remains.

As all vegetation clearance and excavation has taken place for all elements of the proposed development except the Onshore Pipeline and no impact on archaeology occurred, no cumulative impacts are expected.

17.3.7 Assessment of Total Greenhouse Gases

An assessment of the cumulative emissions of greenhouse gas emissions arising from the construction and operation of the Corrib Gas Field Development is provided below. This cumulative assessment includes the carbon losses arising from peat disturbance for the Corrib Gas Field Development, details of which are provided in Chapter 8 Appendix G.

Bellanaboy Bridge Gas Terminal

The total greenhouse gas emissions associated with the construction of the Gas Terminal were 43,340 tCO_2eq, of which 6,369 tCO_2eq was due to peat removal to the Srahmore Peat Deposition Site.

Mayo to Galway Gas Pipeline

The total estimated greenhouse gas emissions are presented in Table 17.5 below. Details relating to the construction of the Mayo to Galway Pipeline were limited in the EIS and where data was not available, scaled up construction details from the Corrib Onshore Pipeline have been included.

Table 17.5 Total GHG Emissions of the Mayo to Galway Pipeline

Item	Estimated GHG Emissions (tCO_2eq)
Construction Materials	37,764
Metals (pipeline Steel)	86,474
Plant Emissions	1,056
Peat Removal	29,670
Material Transport	3786
Personnel Transport	269
Total GHG Emissions	**159,019**

Offshore Development

The total greenhouse gas emissions for the offshore element of the project have been calculated to be 164,499 tCO_2eq.

Corrib Onshore Gas Pipeline

The total estimated greenhouse gas emissions for the onshore element of the project have been calculated to be 30,590 tCO_2eq, 4,059 tCO_2eq of which are the carbon losses from peat.

Cumulative Impact

Table 17.6 below provides an estimate of the total greenhouse gas emissions associated with the construction and operation of the Corrib Gas Field development.

Table 17.6 Summary of Total Estimated Greenhouse Gas Emissions associated with the Corrib Gas Field Development

Project	Construction Emissions (tCO_2eq)	Operational Emissions (tCO_2eq)	Total Emissions (tCO_2eq)
Offshore Pipeline & Well Installation	164,499	-	164,499
Onshore Gas Pipeline	30,590	-	30,590
Bellanaboy Bridge Gas Terminal	43,340	691,725	735,065
BGE Mayo to Galway Pipeline	159,019	-	159,019
Total	**397,448**	**691,725**	**1,089,173**

Note: 1. Assumes 15 years of Terminal Operations and 46,115 tonnes per year (Chapter 14 Terminal EIS)

From the above figures, the estimated total greenhouse gas emissions including those from carbon losses from the construction phase of the Corrib Onshore Gas Pipeline represent 7.7% of the total estimated greenhouse gas emissions associated with the construction of the Corrib Gas Field Development. The estimated contribution from carbon loss due to peat removal of 4,059 tCO_2eq from the construction of the Corrib Onshore Pipeline represents approximately 1% of the total Greenhouse Gas Emissions associated with the construction of all elements of the Corrib Gas Field Development.

17.4 CONCLUSIONS

Table 17.7 summarises the potential cumulative impact for each environmental topic discussed in Sections 17.3.3-17.3.5

Table 17.7: Summary of Potential Cumulative Impacts during the Construction Phase

Environmental Topic	Significance	Duration
Local Employment	Positive	Temporary
Tourism and Recreation	Imperceptible	Temporary
Traffic	Imperceptible	Short term*
Air Quality	Slight	Short term*
Noise	Slight	Short term*
Visual	Moderate	Temporary / short term
Terrestrial Ecology	Slight to Moderate	Short Term
Freshwater Ecology	Imperceptible	Short Term
Marine Ecology**	Imperceptible	Short Term
Soils and Geology	Slight	Short Term
Hydrology and Hydrogeology	Imperceptible	Temporary
Cultural Heritage	None	n/a
Carbon Loss	Slight	Permanent

* Short term cumulative impact, but activities will only coincide for short periods
* Emergency surface intervention (not expected to be required).

The above assessment of cumulative impacts on the environment indicates that the overlap in the installation of the offshore umbilical and the construction of the Onshore Pipeline has the potential to result in cumulative impacts on the local community as a result of increased traffic, noise, dust and visual disturbances. However, these impacts, all of which will be temporary or short term in nature will be minimised with the implementation of mitigation measures. In addition, the period of overlap between the construction of onshore pipeline and installation of the umbilical will be minimal (three months). There is also potential for noise and air quality cumulative impacts from the pre-commissioning of the offshore pipeline in 2012, but this will be for a very short duration (approximately 2 weeks).

There will be a positive cumulative impact on local employment. The other elements of the Corrib Field Development have either been completed (Mayo to Galway Pipeline) or in the case of the laying of the offshore umbilical in 2011 will not result in significant cumulative impacts on the local community due to the geographic location of the works.

In terms of cumulative impacts on the natural environment, potential impacts on the freshwater and marine environments will arise during construction. However, as these environments are transient in nature and capable of recovering in the short term no cumulative impacts are predicted to arise. Although the terrestrial environment will take longer to reinstate, the combined impacts of each element of development will not result in a more significant cumulative impact. This is due to the geographic locations of each element of the works, i.e. the combined post-construction impacts on the Mayo to Galway pipeline and the Corrib Onshore Pipeline do not give rise to a more significant synergistic impact.

It is expected that approximately 76 hectares of permanent habitat loss will be associated with the various elements of the Corrib Gas Field Development. However, the impacts from the loss outlined will not be additive (i.e. in combination they do not result in a greater cumulative impact) on ecological resources such as cSAC or natural habitats. Furthermore, it should be noted that since peat deposition was completed at An Srath Mór (Srahmore) from construction of the Terminal, the site has revegetated, providing additional habitat and reducing the potential for sediment run-off and thus having a positive impact on ecology. Areas subject to peat deposition from construction of the onshore pipeline, will also be allowed to revegetate, thus increasing the positive impact.

The above assessment of cumulative impacts concludes that impacts arising from the operation of each element of the Corrib Gas Field Development will not give rise to cumulative impacts on the human and natural environment. This is because the Terminal is the only element which requires operational activities with the potential for impact. Although the combined impacts during the installation of the offshore umbilical, pre-commissioning of the offshore pipeline and the construction of the onshore pipeline and peat deposition will give rise to the potential for cumulative impacts, these will be short term in nature.

18 SUMMARY OF IMPACTS AND MITIGATION MEASURES

18.1 INTRODUCTION

This chapter provides a summary of the assessment of potential impacts and impact mitigation in Table 18.2 for the construction and the operation phases of the proposed development, extracted from Chapters 6 – 16. A description is provided of the potential impacts and the predicted residual impact (the impact remaining after mitigation) upon the human environment, natural environment, and on cultural heritage. In addition, a summary is provided of the proposed mitigation and monitoring measures that will, when implemented, reduce the potential impacts. SEPIL are committed to implementing these measures, and achieving a level of environmental management and performance consistent with national and international standards and legislation.

It is important to note that certain specialists based their assessment of impacts on different significance criteria, e.g., Chapters 12 and 13 and therefore for a complete understanding of potential impacts, reference should be made to the relevant chapters.

Generally, the assessments of impact duration have considered the EPA criteria as outlined in Table 18.1 below:

Table 18.1: EPA Classification Criteria for Duration of Impacts.

Temporary	Impact lasting for one year or less.
Short-term	Impact lasting one to seven years.
Medium-term	Impact lasting seven to fifteen years.
Long –term	Impact lasting fifteen to sixty years.
Permanent	Impact lasting over sixty years.

Table 18.2 Summary of Potential Impacts and Mitigation Measures.

SOURCE AND SCALE OF POTENTIAL IMPACT	MITIGATION, PREVENTATIVE AND MANAGEMENT MEASURES	RESIDUAL IMPACT[1]	CHAPTER
OPERATIONAL PHASE			
- Long-term restriction of development within wayleave (generally 14m wide but 20m wide in peatlands) (localised)	- Compensation - Careful Reinstatement	Minor	**Chapter 6**
- Long-term visible impact of Landfall Valve Installation (LVI).	- Design of LVI in excavated lower terrain position dished - Careful Reinstatement	Moderate	**Chapter 10**
- Loss of 20mx22m of grassland habitat	- Natural regeneration of grassland areas on the slopes - Careful Reinstatement & Monitoring	Slight –moderate (long term)	**Chapter 12**
CONSTRUCTION PHASE			
HUMAN ENVIRONMENT			
Construction Traffic			
- Short-term, localised disturbance from increased traffic - Short-tern, localised increased vehicular emissions - Short-term, localised increase in dust	- Traffic Management Plan - Dust Management Measures - Ongoing Community Liaison - Environmental Management Plan - Tunnelling from one side - No nighttime haulage (except for abnormal loads) - Speed restrictions near Pollatmish school	None	**Chapters 6 to 9**
- Short-term, localised increase in noise	- Noise Monitoring - Traffic Management Plan - Ongoing Community Liaison - Environmental Management Plan		
- Short term, localised / global (for GHG) Impact on Climate	- Traffic Management Plan	Imperceptible	**Chapter 8**
- Short-term, localised increased traffic on local road network - Short-term, localised impact on local roads	- Traffic Management Plan - Ongoing Community Liaison - Reuse of tunnel arisings - Reuse of bentonite - Reuse of water	Imperceptible	**Chapter 7**

All Construction Activities			
- Temporary, localised structural issues resulting from increased vibration (piling and rock breaking, traffic)	- Pre-construction monitoring and structural survey	None	**Chapter 9**
- Short-term, localised change in landscape character - Increased Visual Impact	- Lighting system designed to minimise visual impact - Appropriate use of colour for structures and surfaces in tunnelling compound in Aghoos - Careful Reinstatement and Monitoring	None	**Chapter10**
- Short-term, localised decrease in development potential	- Compensation	None	**Chapters 6, 11**
- Short-term, localised disturbance to landowners/occupiers - Localised removal of land from production (e.g., forestry)	- Ongoing Landowner Liaison - Environmental Management Plan - Compensation	Minor – Grazing Moderate –Forestry	**Chapter 11**
- Short-term, localised intermittent disruption to accesses, water supplies, etc	- Ongoing Landowner Liaison - Ongoing Community Liaison - Rainwater harvesting on site in Aghoos tunnelling compound - Reuse of water and tunnelling drilling fluid where possible - Environmental Management Plan	None	
- Short-term, localised disruption due to noise.	- Noise attenuation barriers around tunnelling compounds - Sound-proofing of plant such as generators and pumps - Noise Monitoring - Ongoing Community Liaison - Environmental Management Plan	None	**Chapter 9**
- Short-term, localised and regional creation of employment opportunities	n/a	None	**Chapter 6**
- Generation of surplus material from excavation and demobilisation	- Reuse of material from excavation of tunnel, excavation of LVI site and demobilisation of compounds where possible	None	**Chapter 11**

NATURAL ENVIRONMENT			
Stream Crossings & Leenamore River Crossing			
- Temporary, localised release of Suspended Solids/Contaminants - Temporary, localised disruption to Freshwater habitat/ invertebrates/ spawning beds	- Use of appropriate Construction Methods (flume pipe, pumping, temporary bridging structures across certain watercourses to allow movement of construction vehicles, sedimentation control, retain streambed substrate) - Monitoring and appropriate treatment of water discharged from the works and hydrostatic test water - Construction carried out in accordance with EMP (including refuelling, drip trays, spill containment / recovery measures, etc.) - Liaison and consultation with NPWS and NWRFB - Hazardous Substance Management (EMP)	Minor- Negligible (Temporary)	**Chapter 13**
- Temporary, localised disturbance to otters	- Monitoring dense vegetation during clearance - Exclusion Zones/Screening[3] - Evacuation of holts[3] - Ramps in trenches - Environmental Management Plan - Liaison and consultation with NPWS	Moderate (short term) Neutral (long term)	**Chapter 12**
- Temporary, localised destruction / loss of habitat (saltmarsh) (Leenamore River Crossing)	- Liaison and consultation with NPWS - Specialist Construction Techniques (Turving of saltmarsh) - Environmental Management Plan - Careful Reinstatement & Monitoring	Slight-moderate (short term) Neutral /Imperceptible (long term)	**Chapter 12**
Tunnelling			
- Temporary, localised impact to fauna from noise and vibration from tunnelling process	- Monitoring of fish and birds during tunnelling works	None	**Chapter 9** **Chapter 12** **Chapter 13** **Chapter 14**
- Temporary to short-term, localised disturbance to birds in the vicinity of the Aghoos and Glengad tunnelling compounds	- Non-transparent screening and noise attenuation barriers around tunnelling compounds - Sound-proofing of plant such as generators and pumps - Noise monitoring - Downward lighting at perimeter of Aghoos compound - Green lighting to be used at top of crane in Aghoos to avoid bird collision - Environmental Management Plan	Slight/ Imperceptible (short term) Neutral (long term)	**Chapter 12**

- Temporary, localised release of suspended solids / contaminants to Sruwaddacon Bay from Aghoos compound construction	- Implementation of robust surface water management system during peat excavation, compound construction and reinstatement and during construction of tunnel - Environmental Management Plan	None	**Chapter 13**
Tunnelling (Emergency Surface Intervention[2])			
- Temporary, localised disruption to smolt/salmonids & other fish	- Liaise and consult with NPWS and NWRFB - Monitor movement of smolt - Stop works to allow smolt to pass - NWRFB supervision of works - Retention of excavated material for reinstatement - Spill Contingency Measures - Environmental Management Plan - Careful Reinstatement & Monitoring	Imperceptible (short term)	**Chapter 13**
- Temporary, localised loss/change of sediment habitat			**Chapter 14**
- Temporary, localised change in water quality and sediment load			
- Temporary, localised increased Noise pollution (marine fauna excl. avi-fauna)			
- Temporary, localised disturbance of bird population		Imperceptible to Neutral (short term) Long term (neutral)	**Chapter 12**
- Temporary, localised loss/deterioration of habitat		Neutral	**Chapter 14**
- Temporary, localised scour and deposition effects	- Use of scour protection - Appropriate sizing and shape of pit - Reinstatement of sediment scour around features	Slight - imperceptible	
- Temporary, localised disturbance to otters	As outlined in stream crossings.	Neutral (long term)	**Chapter 12**
- Temporary, localised destruction / loss of habitat (saltmarsh)	As outlined in Leenamore River crossing.	Slight-moderate (short term) Neutral/Imperceptible (long term)	

Construction in Blanket Bog			
- Temporary, localised potential weakening of peat structure/stability - Temporary, localised disturbance of natural hydrology - Temporary, localised consolidation of peat - Temporary, localised destruction/loss of habitat	- Specialised Construction Techniques (Turving) - Restriction of storage of peat on bog - Use of low permeability material to prevent impact on peat hydrology (e.g. peat plugs) - Surface Water Management Measures - Careful Reinstatement & Monitoring - Spill Contingency Measures - Hazardous Substance Management Measures - Environmental Management Plan - Reuse of vegetated surface layer of peat in areas of eroded bog	Slight to moderate (medium term) Neutral / Imperceptible (long term)	**Chapter 12**
Construction of LVI and Glengad Tunnelling Compound			
- Temporary, localised disturbance to faunal species which forage in the agricultural grassland	- Protective Fencing around exclusion zone - Vegetation clearance measures - Badger gates, where appropriate - Environmental Management Plan - Landowner liaison - Careful Reinstatement & Monitoring	Slight/ Moderate (short-term) Imperceptible - slight (long-term)	**Chapter 12**
- Temporary, localised destruction / loss of habitat (improved agri. Grassland,)		Slight (short-term) Neutral (long term)	
- Temporary, localised disturbance to sand martin colony		Slight negative (short-term) Neutral (long-term) Neutral	
General Construction Activities			
- Temporary, localised destruction / temporary loss of habitat (Sod (earthen) banks, scrub (gorse & willow), conifer)	- Protective Fencing and reinstatement - Vegetation Clearance Measures - Environmental Management Plan - Careful Reinstatement & Monitoring	Slight (short-term) Neutral (long-term)	
- Temporary, localised disturbance to badgers[3] Irish Hare, Stoat, and Pine marten, small mammals, frogs/lizards		Slight (short-term) Neutral (long-term)	
- Temporary disturbance or displacement of bird species in temporary working area			

CULTURAL HERITAGE			
Topsoil stripping & Excavation & Trafficking within Temporary Working Areas			
- Temporary, localised disturbance of Archaeological Sites - Temporary, localised disturbance of field systems and townland boundaries	- Pre-construction testing and analysis (under licence from DoEHLG) - Archaeological monitoring during topsoil stripping, peat excavation, and monitoring of tunnel arisings (under licence from DoEHLG) - Fencing of potential archaeological sites and temporary construction sites - Environnmental Management Plan	None	**Chapter 16**

Note 1: Residual impacts are post construction unless otherwise stated.
Note 2: Emergency Surface Intervention assessed for completeness, not expected to be required
Note 3: If active setts/holts are located within the temporary working area.

Following an extensive study of the potential impacts of the proposed development summarised in Table 18.2, it can be concluded that the onshore pipeline will not have a significant long-term negative impact on the human, natural environments and on cultural heritage. The majority of impacts will occur during the construction phase of the development. Therefore, these impacts are considered to be transient and of a temporary to short-term nature. Measures that will be used in the mitigation of any adverse impacts have been identified.

The preparation of this Environmental Impact Statement represents one stage of the Environmental Management process for the development. This process will continue throughout the duration of the project, during the detailed design, construction, commissioning and operation phases of the project. The assessments and surveys carried out to date are detailed in this EIS. Further surveys will be undertaken prior to, during and after construction to ensure and demonstrate that all potential environmental impacts are considered and adequately addressed. An outline of the requirements for these is further detailed in the relevant EIS chapters. Detailed specifications for the surveys will be developed and agreed with the relevant regulatory authorities.

Consultation will continue during the pre-construction and construction (including reinstatement) phases, with all relevant bodies, to ensure that construction and reinstatement methods are carried out in the most satisfactory manner.

18.2 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Preventative and management measures will be applied throughout the construction phase to ensure that all environmental effects associated with the proposed development are minimised, mitigated or avoided as outlined in the table 18.2 above. Various tools will be implemented to ensure sound environmental management. These include the preparation of an EMP.

The EMP will be used as an environmental management tool to ensure compliance with all relevant environmental regulations and standards and to minimise the potential impacts associated with the development. This EIS will form the basis for many of the environmental procedures that will be fully developed within the EMP.

The EMP will be drawn up in accordance with the schedule of commitments presented in Chapter 18 of this EIS. It will detail measures to minimise actual and potential impacts associated with the construction phase, describing or referencing the procedures and equipment proposed to prevent, monitor and manage possible effects. The EMP will serve as a compliance document recording the progress of commitments and their conformity with the requirements set by the relevant authorities and the expectations of the public.

The EMP will include:

- Measures to provide environmental protection, conservation and, where appropriate, enhancement whilst ensuring the viability of the project;
- Detailed Method Statements;
- Monitoring programmes and management practices to be undertaken during the execution phases of the project;
- Arrangements for effective liaison with regulatory authorities and other interested parties on environmental matters regarding mitigation;
- Arrangements to ensure that the conditions imposed by the EMP are enforced;
- Contingency measures.

Typical topics to be covered by the EMP are listed below:

- Vegetation clearing
- Audits and review
- Environmental Liaison and Consultation
- Pollution Control
- Waste Management
- Traffic Management
- Hazardous Substance management
- Environmental Supervision & Training (all personnel)
- Environmental Health and Safety (EHS) performance
- Spill Contingency
- Dust Management
- Noise Management
- Reinstatement Management/Monitoring
- Disease Prevention
- Community Liaison
- Surface Water Management
- Landowner Liaison

Method statements will be developed to demonstrate how potential impacts during construction will be managed. The EMP will also establish monitoring protocols for ecology, archaeology, water, dust, noise and sediment control. The monitoring programmes will be outlined in detail within the EMP and will include the timing and frequency of monitoring and policies for evaluating and amending the monitoring programme.

Once detailed design information is available, the EMP will be finalised. Upon the commencement of construction, the EMP will be reviewed according to a regular timeframe and updated, if necessary. These updates will be made in consultation with relevant regulatory authorities.

The EMP will provide systems for the effective environmental management of the construction process covering important items such as waste management and pollution control. Environmental auditing will be carried out to ensure compliance with the EMP.

Environmental liaison and consultation with statutory bodies, local authorities and non-statutory organisations, where required, will continue throughout the construction of the onshore pipeline system.

SEPIL is committed to achieving a level of environmental management and performance consistent with national and international standards and in compliance with all relevant statutory obligations. It will seek to incorporate the most environmentally sound technology and procedures into the design of the project in order to ensure optimal management of all activities.

18.2.1 Roles, Responsibilities and Reporting

A full time Environmental Officer will supervise the works from an environmental perspective. This will include monitoring the implementation and compliance with the EMP and approved construction method statements, and ensuring that the EMP is effective and up to date through regular reviews.

The Environmental Officer will have the power to stop any works not following agreed method statements or the environmental procedures set out in the EMP. The Environmental Officer will also ensure that all construction personnel receive appropriate induction training, including pollution awareness and control prior to commencing work. The Environmental Officer will co-ordinate and be the site focal point for communication with the relevant statutory bodies e.g. NPWS and NWRFB. The construction works will also be monitored by a dedicated Project Ecologist and Project Archaeologist.

Environmental liaison and consultation with statutory bodies, local authorities and non-statutory organisations (where required) will continue throughout the construction of the onshore pipeline system.

18.2.2 Environmental Labelling and Signage

Notices and appropriate warning signs will be erected on the site to inform staff of the precautions and measures required when working close to designated conservation sites, protected species or other relevant environmental constraints or sensitivities.

GLOSSARY OF TERMS

Below is a glossary of terms used in this report. The definitions herein are not to be taken as comprehensive, but solely as an aid to the non-technical reader.

Actuator	A device used to open and close a valve automatically.
Agricultural Liaison Officer (ALO)	Agricultural Liaison Officer appointed by the Developer to liaise with landowners.
Alluvial/Alluvium	Loose, weathered and/or eroded rock material that has formed in particles. Commonly of sands and gravels, transported and deposited by a river.
Alluvial Floodplain	Area composed of detrital material, bordering a stream or river, over which water spreads in time of flood.
Ambient Noise	Totally encompassing sound in a given situation at a given time usually composed of a sound from many sources near and far.
Ameliorate	Take measures to reduce a negative impact/effect.
Ancillary Works	Works additional to, but associated with the main project, similar to accommodation works. For example, the contractor's compound and material storage area.
Anticline	A ridge or fold in rock, in which the strata (layers) slope downwards, from a peak.
Auger	A tool for boring holes.
Aquifer	A stratum (layer) of rock which, is permeable or has voids within it, that allows water to be stored or tranmitted within it.
Anadromous	Fish that return from oceans to fresh water to spawn (eg salmon).
Anoxic	The absence of oxygen.
Bar / Barg	A unit of pressure. Bar (pressure). Barg (gauge pressure). 1 Barg = Pressure measured above atmospheric pressure. Atmospheric pressure varies but is approximately 1Bar.
Baseline Studies	Work done to collect and interpret information on the condition/trends of the existing environment.
Bathymetry	The measurement of the depth of the ocean floor from the water surface.
Bedrock	The solid rock lying beneath superficial material such as gravel, soil and vegetation.
Bedding	Layers within sedimentary rocks characterised by differences in composition, colour, texture or structure.
Benthic	Describes flora and fauna that live on or in the seabed or lake bottom. Benthic epifauna live upon the seafloor or upon bottom objects and benthic infauna live within the surface sediments.
Benthos	Organisms that live on or in the seabed.
Bentonite	Fine inert clay (natural product) widely used in an aqueous suspension in tunnelling construction projects.
Bioclastic	This is used as a term to describe a biochemical sedimentary rock made up of broken fragments of organic skeletal materials i.e. shells.
Biodiversity	The number, variety and variability of living organisms in a particular habitat.
Biotope	Combination of the physical habitat and its recurring community of animals and plants.
Biomass	Amount of living material, expressed herein as ash-free dry weight (after subtraction of inorganic remains after ashing).

Bioturbation	Disturbance of sediments by benthic organisms (e.g. burrowing, deposit feeding).
Blanket Bog	Peatland that formed between 10,000 and 4,000 years ago due to high levels of rainfall. Blanket bogs are distinct from raised bogs (which formed around topographical features such as former lakes / depressions where surface water collects). Blanket bogs cover areas of landscape like a blanket – hence their name.
Block Valve Stations	Valve installations spaced along a pipeline to allow isolation of sections when maintenance / operation dictates.
Bog Mats	Timber planking made into large and manageable flat sections (typically 5m long and 1m wide). Bog mats can be laid on top of the bog to form a temporary road way for construction vehicles.
Boulder Clay (Till)	Generally non-stratified material deposited directly by glacial ice. It is very poorly sorted with a wide range of grain sizes from clay to boulders.
Bronze Age	c. 2300 BC- 500BC.
Butt Weld	An end-to-end weld of two lengths of pipe.
Carboniferous	The geological period of the Palaeozoic Newer Era (345to 280 Ma).
Calcareous	Substance containing calcium carbonate.
Chart Datum (CD)	The water level used to record data on a chart.
Christmas Tree Assembly	The assembly of fittings or valves on the top of the gas well, which controls the production rate from the well.
Clarification	A process in which suspended material is removed from wastewater. This may be accomplished by sedimentation, with or without chemicals, or filtration.
Closed in tubing head pressure (CITHP)	Pressure in the gas well once all the 'Christmas Tree' assembly have been closed and no gas flows.
Cofferdam	A watertight enclosure pumped dry to permit work below the water level.
Commissioning	The rendering fully operational of a project or process.
Competent Authority	This is being taken to refer to any agency or body statutorily charged with making a decision or other determination in respect of an application for a proposed development.
Compulsory Acquisition Order (CAO)	A means whereby authorised bodies can acquire a parcel of land, subject to a public enquiry if objections are lodged. This legislative instrument is provided for under Gas Act. The powers to grant a Compulsory Acquisition Order have been transferred to An Bord Pleanála.
Condensate	Hydrocarbons which are in the gaseous state under reservoir conditions and which become liquid when the pressure and/or temperature is reduced.
Corine	This is a classification of land-use based on satellite imagery.
Cover (Construction)	The distance from the top (crown) of the 'as constructed' pipeline to the existing ground level.
Crustacea	Phylum of mostly aquatic arthropod invertebrates (e.g. crabs, lobsters, amphipods, shrimps, isopods).
Culvert	Structure or drain for the diversion of a stream or river.
Cuttings	Rock chippings cut out from the formation by the drill bit, and brought to the surface with the mud. Used by geologists, while drilling a well, to obtain formation data.
Decibel (dB)	The unit of sound pressure level, calculated as a logarithm of the intensity of sound, normally relative to an established reference level.
Decibel A (dB)A	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sound of different frequency (pitch) in a similar way to the human ear.
Demersal	Found at or near the bottom of the sea or lake (typically of fish).

Development Plan	Development Plans are prepared by each Local Authority every 5 years and outline the Council's general policy for the development of the County.
Design Factor	Safety margin for design described in pipeline codes of practice.
Devonian	A time interval of the Palaeozoic Newer era during which rocks of the Devonian system were formed (395 to 345 Ma).
Digestion	The process of decomposing organic matter by bacteria or by chemical action or heat.
Dissolved Oxygen	A measure of the concentration of oxygen in a liquid, such as water or wastewater, usually expressed in mg/l or per cent saturation.
Diversity	Variety of taxa; represented herein by both species richness (simple count of number of species) and Shannon-Wiener Diversity Index (H') - a widely used measure of diversity, providing an integrated index incorporating abundance.
Drumlin	An elongated elliptical hill consisting of unconsolidated material, which is, formed under ice sheets or very broad valley glaciers.
Ecosystem	A community of living things and the environment in which they live.
Ecotoxicological Assessment Criteria (EAC)	Formulated by OSPAR. An EAC range is given for specific contaminants, above which harm to the marine environment is likely to occur.
Enclosure (Archaeology)	Any monument consisting of an enclosing feature such as a bank or a ditch, usually earthen, such as barrows or ringforts. In this report, enclosures are circular or oval unless otherwise stated.
End bevels	Preparation to pipe ends to facilitate pipe welding. The end bevelling of pipes allows the innermost part of the pipe wall to be reached by the welder thus enabling a perfect butt weld to be made.
Environmental Impact Assessment (EIA)	The process of examining the environmental effects of development - from consideration of environmental aspects at design stage, through to preparation of an Environmental Impact Statement (EIS), evaluation of the EIS by a competent authority and the subsequent decision as to whether the development should be permitted to proceed, also encompassing public response to that decision.
Environmental Impact Statement (EIS)	A statement of the effects, if any, which the proposed development, if carried out, would have on the environment.
Epifauna	The animal life which lives on the bed of a body of water or other submerged surface etc., or attached to submerged objects or to aquatic animals or plants.
Epiphytic	A plant which naturally grows upon another plant but does not derive any nourishment from it.
Esker	A low winding ridge of pebbles and finer sediment on glaciated lowland. An esker marks the course of a sub-glacial stream flowing as melt water increases in volume towards the margin of a lowland ice body. As the stream flows it deposits sediment along its course, and this is left behind as a landscape feature after the end of the glacial period.
Estuarine	Of an area where a river empties into an ocean; of a bay, influenced by the ocean tides, which has resulted in a mixture of salt water and fresh water.
Evapotranspiration	Combined water loss through evaporation and transpiration by plants.
Excavatability	Related to the ease with which the trench can be dug.
Fauna	A collective term for the animals of a region.
Field System (Archaeology)	Pattern of fields, now no longer in use, usually visible as low earthworks, often associated with medieval or earlier settlements.
Fill	Material used for raising the level of the ground.
Fissure Flow	The movement of water by means of extensive clefts, cracks, breaks or fractures in a rock formation.
Fin Fish	A term used to separate true fish from shellfish, crayfish, jellyfish, etc.

Fines	Fine particle fractions i.e. grains of sand or silts.
Flora	A collective term for the plants of a region.
Flume Pipe	Pipe used temporarily during construction to maintain the flow of water in a drain or stream over an area that has been excavated. The flume pipe is removed during reinstatement.
Foreshore	Any land covered and uncovered by the flow and ebb of the tide at mean spring tides. The area between mean low water and mean high water. Foreshore is defined under the Foreshore Act as meaning: “the bed and shore, below the line of high water of ordinary or medium tides, of the sea and of every tidal river and tidal estuary and of every channel, creek and bay of the sea or of any such river or estuary”.
Formation Water	Salt water underlying gas (and oil if any) in the formation.
Fossiliferous	This is used as a generic term to describe rocks or strata containing or bearing fossils.
Gabion	A wire mesh cage, usually rectangular, filled with rock and used to protect channel banks and other sloping areas from erosion.
Gas Field	A geographical area under which an oil or gas reservoir lies.
Gas Production Well	A borehole, lined with steel, that is drilled from the sea bed into the reservoir and through which gas is brought to the seabed surface.
Gas Venting	Release of high-pressure gas to atmosphere.
Gas Wellhead	This is where the gas well comes to the surface of the earth’s crust. This can be under water, when gas field is out at sea. The Christmas Tree Assembly is located on top of the wellhead.
Geomembrane	A product used in layers along with the geosynthetic clay liner as part of the disposal facility cover system.
Geomorphology	The scientific discipline concerned with surface features of the Earth, including landforms and forms under the ocean.
Geophysical	A section of earth science that employs the principles and methods of physics (e.g. seismic (sound), resistivity (electrical resistance) or other) to search for natural resources within the earth’s crust, or to obtain information about subsurface structure for various civil engineering works.
Geotechnical	A section of Earth Sciences that involves extracting samples of material from the ground and the examination and analysis of same with the objective of informing engineering design.
Geotextile	A product used as a soil reinforcement agent and as a filter medium. It is made of synthetic fibres manufactured in a woven or loose nonwoven manner to form a blanket-like product. Also know as Geogrid. Geo-Jute is similar to geotextile but is made from plant fibres.
Geogrid	Strong but flexible material formed into a lattice or matrix and used in construction to provide lateral strength to layers of other material. Geogrids may be used in layers and in conjuctuion with geotextiles to form stable surfaces upon soft ground.
Glaciation	A period of cold climate during which time ice sheets and glaciers are the dominant forces of denudation.
Glacier	A body of ice occupying a valley and originating in an icefield.
Glacial Till	A mixture of clay, silt, sand, gravel and boulders ranging widely in size and shape deposited by a glacier.
Grilse	A two-year old adult salmon returning upstream. These fish are predominantly male; males are also referred to as “jacks”.
Groundwater	Water stored in the soil and rock both above and below the water table.
Habitat	The dwelling place of a species or community, providing a particular set of environmental conditions (e.g. forest floor).
HAZID	Hazard identification.
HAZOP	Hazard and operability study.

Hertz (Hz)	Unit of frequency (pitch) of a sound.
HIPPS	High integrity pressure protection system
HGV / HCV	Heavy Goods Vehicle / Heavy Commercial Vehicle.
Holiday Test	Inspection of external pipe coating during the installation procedure for defects to pipeline coating.
Hydrate	A solid ice-like material formed from gas and water at specific temperatures and pressures.
Hydrocarbon	A compound containing only the elements hydrogen and carbon. May exist as a solid, a liquid or a gas.
Hydrography	The representation of the location and characteristics of water bodies.
Hydromorphology	The physical characteristics of the shape, the boundaries and the content of a water body.
Hydrostatically	Relating to the study of the mechanical properties and behaviour of fluids not in motion.
Hydrotest (Hydrostatic test)	Non-destructive test used to prove the integrity of a pipeline. The hydrostatic test involves filling the pipeline with water and compressing this to a specified test pressure for a specified duration.
Hydraulic head	The height above a datum plane (such as sea level) of the column of water that can be supported by the hydraulic pressure at a given point in a ground water system. Fluids flow down a hydraulic gradient, from points of higher to lower hydraulic head.
Infauna	Fauna that lives within sediment.
Integrated Pollution Control	A system of licensing which covers all emissions to air, water and land, including noise and is intended to minimise the impact on the environment by taking account of pollution that may be transferred from one environmental medium to another.
Interbedded	A term used to describe strata being positioned between or alternated with other layers of dissimilar character.
Intervention Pit	A pit that would be constructed in the very unlikely event that surface works are required to deal with a problem that cannot be dealt with from within the tunnel.
Interstitial	Relating to being between things, especially between things that are normally closely spaced.
Invertebrates	An animal, such as an insect or a mollusc, that lacks a backbone or spinal column.
$L(A)_{10}$	The noise level that is equaled or exceeded for 10% of the measurement period.
$L(A)_{90}$	The noise level that is equaled or exceeded for 90% of the measurement period.
L_{eq}	The equivalent continuous sound level (Leq) that is the notional steady noise level which, over a given period, would deliver the same amount of sound energy as the actual fluctuating level
L_{Aeq}	The A-weighted equivalent continuous steady sound pressure level and effectively represents an average value.
Landfall	The point on the coastline where an offshore pipeline comes ashore.
Littoral	The zone of the seashore between the high and low tide mark.
LWM	Low water mark.
Machair	The Scottish Gaelic word 'Machair' or 'machar' refers to a fertile low-lying coastal plain.
Macroinvertebrate	An animal without a backbone large enough to be seen without a microscope
Macrofauna	Animals large enough to be seen with the naked eye; animals larger than 500 µm (0.5mm).

Mammal	A warm-blooded animal with hair that breathes air, has internal fertilization and nurses its live-borne young.
Master valve (wellhead)	One of the valves of the Christmas Tree Assembly which is located at the wellhead.
Maximum Allowable Operation Pressure (MAOP)	The maximum pressure at which a pipeline is allowed to operate.
Megafauna	The largest size category of animals in a community, of 44 kg (100 lbs.) mature body weight or more.
Microfauna	The smallest animals in a community, invisible to the naked eye.
Micro-tunnelling	See Trenchless Construction.
Migratory	Used of animals that move seasonally: migratory birds and fish.
Mitigation Measures	Mitigation measures are ways to avoid or lessen the negative impact/effects of a project on the environment.
Molluscs	Large group (phylum) of mostly aquatic invertebrates including mussels, snails, octopuses, etc.; soft bodied, often with a hard shell.
Mud Flat	A muddy, low-lying strip of ground usually submerged, more or less completely, by the rise of the tide.
Natura 2000	Identified as sites of Community importance under the Habitats Directive (candidate Special Areas of Conservation (cSACs) or classified as proposed Special Protection Areas (pSPAs) under the Birds Directive 79/409/EEC.
Natural Gas	Gas, occurring naturally, sometimes occurring in association with crude oil.
Natural Heritage Areas	Natural Heritage Areas (NHAs) are protected under the Wildlife (Amendment) Act of 2000. Some sites have been fully designated while others are still awaiting designation and are referred to as proposed NHAs (pNHAs).
Nitrogen Oxides (NO_x)	Nitrogen oxides usually include the two pollutants nitrogen monoxide and nitrogen dioxide produced by high temperature combustion and some natural processes. Nitrogen dioxide is the most important form which can contribute to adverse health effects, ozone formation and acid deposition.
Non-technical summary	This document provides an overview of the project for the planning authorities, statutory authorities and members of the public. It should cover all relevant impacts and emphasise the most important issues.
Open Cut Crossing	A method of pipeline crossing whereby an open trench is excavated.
OSPAR	OSPAR Commission/Convention for the Protection of the Marine Environment of the North-East Atlantic.
Outcrop	An area where rock is exposed at the surface.
Overburden	Material that exists above the rock/soil interface.
Pelagic	Refers to fish and animals that live in the open sea, away from the sea bottom.
Phreatic	The zone beneath the water-table, where the pores are full of groundwater.
Physiographic	Referring to the character and distribution of landforms.
Piezometer	An instrument used to measure the level of the water table.
Pile	Length of metal, concrete or timber driven into the ground as a support for a structure or to keep an excavation open. Steel sheet-piles are made from formed lengths of steel that can interlock and be used to construct extensive lengths of support, or to enclose an area for excavation. Concrete piles are typically driven vertically to frim ground to provide a stable support for a new structure.
Plankton	A diverse group of minute animals (zooplankton) and plants (phytoplankton) that freely drift in the water.
Pipeline Spread	The working width required to lay the pipeline within a defined temporary working area. Also referred to as Working Width/Strip.

Pollution	The direct or indirect alteration of the physical, chemical, thermal, biological or radioactive properties of any part of the environment in such a way as to create a hazard or potential hazard to the health, safety or welfare of living species.
Prescribed Bodies	Bodies that have been prescribed by regulations made by a Minister or other Statutory legislation. In this instance, certain prescribed bodies have been identified under the various governing legislation which must be consulted on the application and EIS, and given the opportunity to make comment thereon.
Prescribed Period	The specified period in which any person, prescribed body, or other party, can make a submission in relation to the application and EIS.
Protected Views	The protected views are identified as “Highly Scenic or Scenic Views” in the County Development Plan.
Q Rating	A quality rating for watercourses ranging from Q1 to Q5, the higher the rating the better the quality of the water.
Ramsar Site	An area designated under the internationally agreed Convention on Wetlands of International Importance, especially as waterfowl sites.
Rating level L_{ArTr}	The specific noise level plus any adjustment for the characteristic features of the noise.
Reception Pit	Pit / shaft excavated on land to receive the TBM as a tunnel is completed. The reception pit will form a second access to the tunnel which may be used during the installation of services.
Receptor	Any element in the environment which is subject to impacts.
Residual Noise	The ambient noise remaining at a given position in a given situation when the specific noise source is suppressed to a degree such that it does not contribute to the ambient noise.
Ring fort	Early Christian defended secular settlement consisting of a bank and external ditch defining a circular area that contained the dwelling structures of the occupants; also fairy fort, rath lios, or cashel (the latter constructed of stone as opposed to earth).
Ribbon-Like Development	Generally unplanned and non-systematic housing development.
Risk Assessment	An analytical study of the probabilities and magnitude of harm to human health or the environment associated with a physical or chemical agent, activity or occurrence.
Ripability	A measure of the ease of removing/excavating rock using a ripping tool mounted on construction plant.
Riparian	Of, on, or relating to the banks of a natural course of water.
ROW	Right of way (in the context of a temporary and/or permanent wayleave).
Run-off	Surface water flowing under the force of gravity.
Salmonids	Members of the fish family ‘Salmonidae’, including salmon, trout and chars.
Salt marsh	Strands of vegetation that occur in marine and brackish water conditions on a range of substrata that are wet, waterlogged or periodically submerged by the sea.
Sausage machine	A type of equipment used to harvest peat.
Scenic Route	Scenic routes indicate public roads from which views and prospects of areas of natural beauty and interest can be enjoyed. Sightseeing visitors are more likely to be concentrated along these routes.
Screening	The process of assessing the requirement of a project to be subject to Environmental Impact Assessment based on project type and scale and on the significance or environmental sensitivity of the receiving environment.
Scoping	The process of identifying the significant issues, which should be addressed by a particular Environmental Impact Statement.
Seashore	The area of the beach between the high and low water marks (see also Foreshore).

Segment Lined Tunnel	A tunnelling technique using concrete segments to support the tunnel that has been excavated. These segments are assembled to form complete rings and when connected, act as the tunnel lining.
Sewage	Liquid wastes from communities conveyed in a sewerage system. Sewage may be a mixture of domestic sewage effluents from residential areas and industrial liquid waste.
Side-scan sonar	Tool used for mapping the seabed for a wide variety of purposes to create efficiently an image of large areas of the sea floor.
Slurry	Water or a liquid containing a high concentration of suspended solids.
Smolt	Smolts are juvenile salmon or seatrout, usually around two years old, which have altered physiologically while still in freshwater to allow them to migrate into saline waters.
Sonar	A system for navigation and detection of objects underwater using sound through echo location.
Special Areas of Conservation	Special Areas of Conservation (SAC) are protected under the European Union (EU) Habitats Directive (92/43/EEC), as implemented in Ireland by the European Communities (Natural Habitats) Regulations, 1997. Where an area is proposed for this status it is described as being a candidate SAC (cSAC).
Special Protection Area	Special Protection Areas (SPAs) are protected under the EU Habitats Directive, which complements EU Directive 79/409/EEC, The Directive on the Conservation of Wild Birds ('The Birds Directive'), under which the SPAs were initially established.
Stakeholder	Refers to any individual or organisation who has an interest in a project. Examples of stakeholders include: landowners, members of the public, statutory bodies and non-government organisations.
Starting Pit	Pit / shaft excavated on land into which the TBM will be placed to begin the tunnelling process. The starting pit will form the access to the tunnel (tunnel portal) during the tunnelling process.
Statutory Body	Government department or public / state company. For example An Bord Pleanála and the National Parks and Wildlife Service are statutory bodies.
Stratigraphy	The branch of geology concerned with all characteristics and attributes of rocks as they are in strata, and the interpretation of strata in terms of derivation and geological background.
Sub-littoral	The marine zone extending from low tide to a depth of about 200m.
Subsoil	Soil lying immediately under the topsoil.
Supernatant	Liquid removed from a tank once the solids have settled.
Suspended Solids	Any particulate matter, which is suspended in water.
Sustainable Development	Defined by the Bruntland Commission (1987) as "development that meets the needs of the present without compromising the ability of the future generations to meet their own needs."
Temporary Working Area	The area along the pipeline which is temporarily used by the developer to facilitate construction. The temporary working area is larger than the permanent wayleave. Also referred to as (working/pipeline) spread.
Terminal	The plant where the produced gas will be separated from any associated liquids to meet the transmission specifications of the national gas grid.
Threshold	The magnitude of a project which, if exceeded, will trigger the requirement for an Environmental Impact Assessment to be carried out.
Topsoil	The uppermost layer of unconsolidated material on the earth's surface.
Topography	The physical features or configuration of a land surface.
Topographical Surveys	Mapping of land surface shape.

Total Final Consumption (TFC)	The Total Primary Energy Requirement less the energy consumed during the generation of power i.e. power stations. TFC includes energy consumed in the transport, tertiary, residential, agricultural and industrial sectors.
Tone	A noise with a narrow frequency composition.
Trenchless Construction	A method of pipeline construction that avoids surface excavation (open cut approach). Trenchless construction or tunnelling involves progressive sub-surface excavation within rock or soil layers and is typically used to install linear services beneath features such as rivers. Examples of trenchless construction methods include segment lined tunnelling and micro-tunnelling.
Tunnel Boring Machine (TBM)	Machine designed to excavate / bore a tunnel. A TBM comprises a rotary cutting head fitted with excavated and / or rock breaking tools. Material is excavated as the TBM pushes itself (or is pushed) forward hydraulically. TBMs can be designed for a wide range of ground conditions including rock.
Turves	Sections of vegetated surface layer of peat that are removed intact and placed to one side during construction
Umbilical	A ‘bundle’ of electrical and hydraulic control lines and chemical transportation lines used to control and monitor the subsea facilities from the Gas Terminal and supply methanol and other chemicals to the manifold and wellheads. The bundle is encased in a protective sheath.
Upstream Pipeline	Gas infrastructure from well head to (and including) as processing terminal. Processed gas will be admitted into the downstream gas network.
Vertebrates	Animals with backbones.
Wing Valve (wellhead)	One of the valves of the Christmas Tree Assembly which is located at the wellhead.
Wayleave	*Permanent Wayleave* The defined strip of land along the pipeline to which the developer needs access during the entire life of a pipeline for safe operation and maintenance purposes. Excavation or building within the permanent wayleave is not permitted. Deeds of Easement are agreed with relevant landowners to record this permanent wayleave.

ABBREVIATIONS

µg/l	Micro-grams per litre
$µg/m^3$	Micro-grams per metre cubed
µm	Micrometres
AADT	Annual Average Daily Traffic
AGI	Above Ground Installation
AMSL	Above Mean Sea Level
AOD	Above Ordnance Datum
ASL	Above Sea Level
BAT	Best Available Techniques
BGE	Bord Gáis Éireann
BH	Borehole
BOD	Biochemical Oxygen Demand (a measure of the pollution level in water)
BP	Before Present
BPEO	Best Practicable Environmental Option
BWI	BirdWatch Ireland
bgl	Below Ground Level
Cd	Cadmium
CH_4	Methane
CFB	Central Fisheries Board
CITHP	Closed in Tubing Head Pressure
CLO	Community Liaison Officer
CO	Carbon Monoxide
CO_2	Carbon Dioxide.
COD	Chemical Oxygen Demand
cSAC	Candidate Special Area of Conservation
CSO	Central Statistics Office
DED	District Electoral Divisions
dB	Decibels (units for the measurement of a parameter (frequently sound pressure level) relative to a defined reference level for that parameter). The established reference levels for sound are 20micropascals (in air) and 1micropascal (in water).
DO	Dissolved oxygen
DEHLG	Department of the Environment, Heritage and Local Government
EAC	Ecotoxicological Assessment Criteria
EH-LC	Mayo County Development Plan 2003-2009: Environment and Heritage – Landscape Character
EH-VP	Mayo County Development Plan 2003-2009: Environment and Heritage – Views and Propspects
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
ESB	Electricity Supply Board
ESRI	Economic and Social Research Institute
EQS	Environmental Quality Standard

FPO	Floral Protection Order
GIS	Geographical Information System
GSI	Geological Survey of Ireland
GWP	Global Warming Potential
ha	Hectare = 10,000 square metres or 2.47 acres
HDD	Horizontal Directional Drilling
Hg	Mercury
HP	High Pressure
HWM	High water mark
Hz	Hertz
IPPC	Integrated Pollution Prevention and Control
IS 328	Irish Standard for Gas Transmission Pipelines and Pipeline Installations.
kV	Kilovolts
kt	Kilotonne
LVI	Landfall Valve Installation.
LWL	Low Water Level
m	Metres
mbgl	Metres Below Ground Level
MDPE	Medium Density Poly Ethylene
Mg/l	Milligrams per litre
mg/m^2	Milligrams per metre square
mg/m^3	Milligrams per metre cubed
MHWSL	Mean High Water Spring Level
mm	Millimetres
mmscfd	Million standard* cubic feet per day. (*measured at standard temperature and pressure)
MSv/y	Millisievert per year
NaOH	Sodium Hydroxide
NAQS	National Air Quality Standards
NDP	National Development Plan
NGR	National Grid Reference
NGO's	Non-Governmental Organisations
NHA	Natural Heritage Area
NMI	National Museum of Ireland
NMVOC	Non-Methane Volatile Organic Compound
NO_x	Nitrogen Oxides
NO_2	Nitrogen Dioxide
N_2O	Nitrous Oxide
NO	Nitrogen Monoxide, also known as Nitric Oxide
NSS	National Spatial Strategy
NPWS	National Parks and Wildlife Service (of the Department of the Environment, Heritage & Local Government)
NWRFB	North Western Regional Fisheries Board
OD	Ordnance Datum
OPW	Office of Public Works
OS	Ordnance Survey
OSI	Ordinance Survey Ireland

pH	A Measure of the Strength of an Acid or a Base
PIC	Perimeter Interceptor Channel
PIG	Pipeline Integrity Gauge
PM_{10}	Particulate Matter (fine airborne particles) less than 10 micrometers in diameter
ppm	Parts per million
PSCS	Project Supervisor for the Construction Stage
PSDP	Project Supervisor for the Design Process
PSV	Pressure Safety Valve (relief valve)
PWT	Pond Water Tank
QRA	Quantified or Quantitative Risk Assessment
RMPs	(Archaeological) Record of Monuments and Places
SAC	Special Area of Conservation
SEPIL	Shell Ireland Limited
SIA	Strategic Infrastructure Act
SMRs	(Archaeological) Sites, Monuments and Records
SO_2	Sulphur Dioxide
SOx	Oxides of Sulphur.
SPA	Special Protection Area
SLM	Specific Landscape Mitigation
SWP	Storm Water Pond
TBM	Tunnel Boring Machine
VOC	Volatile Organic Compounds
WHO	World Health Organisation
ZVI	Zone of Visual Influence