AQUATIC & MARINE ENVIRONMENT

1 INTRODUCTION

1.1 My name is Ian Wilson and I am a Director and the principal scientist of Benthic Solutions Limited, an independent marine environmental consultancy. I also operate as an associate to RPS Energy (UK).

1.2 Assisted by Ger Morgan of Aquatic Services Unit, I have been responsible for the marine environmental impact assessment for the onshore pipeline undertaken in and around the Sruwaddacon Bay estuary and this is the subject of my assessment.

2 QUALIFICATIONS AND EXPERIENCE

2.1 I have a combined Batchelor of Science degree in marine biology and oceanography from the University of Southampton and my work experience covers the fields of marine environmental chemistry, biology, oceanography, geology and shallow geophysics. I have been working in these technical disciplines for the past twenty years both in Ireland and internationally. This experience includes the assessment of seabed environmental conditions for numerous projects including pipeline and cable route selection surveys. My experience in marine surveys includes the acquisition of multi-disciplinary survey data and its interpretation, both as individual datasets or the collective relationships between the multiple disciplines recorded during any marine environmental assessment.

2.2 I have extensive experience on environmental surveys for proposed marine infrastructure projects and large field developments. These include pipeline and cable route selection surveys for the Oil & Gas Industry and Renewables (e.g. offshore wind farms) and the utility companies (i.e. electricity, gas, telecommunications and water), throughout the UK and worldwide. This includes projects working in environmentally sensitive areas such as Special Areas of Conservation (SACs) or in close proximity to protected habitats (designated under the EU Habitats Directive).

2.3 I was the founder member of Gardline Environmental Limited (the largest marine environmental survey company in Europe) and its principal scientist for 16 years. During this time I pioneered many different survey and interpretation techniques now routinely used in habitat mapping and marine environmental assessments in the offshore industries. I now provide consultancy support to all of the major environmental consultancies and am responsible for the specifications on the majority of all offshore environmental baseline studies carried out for the Oil & Gas industry around the British Isles. I am also a committee member to the Society of Underwater Technology Offshore Site Investigation Group.

3 KNOWLEDGE OF THE SITE

3.1 Since 1996, I have carried out numerous studies on the marine sediments in the Corrib Field, including the initial assessment of the proposed pipeline route between the Field and Broadhaven Bay. I was commissioned by RPS in 2007 to manage the marine environmental surveys for the route selection and produce the marine environmental impact assessment for the Corrib Onshore Pipeline EIS. My duties included the provision of a scope of work for a baseline environmental assessment at several alternative landfall options and throughout the Sruwaddacon Bay area. This included assistance to the specialist field contractors in the interpretation and reporting, given the multi-faceted nature of the data acquired in the marine sector. Consequently, I have made regular visits to the survey area and have carried out a number of assessments along the proposed marine route corridor, both individually and in association with the survey contractors who carried out the assessments.

4 SCOPE OF EVIDENCE

4.1 My statement will:

- Summarise the existing environmental conditions within Sruwaddacon Bay.
- Summarise the key potential impacts that may occur from construction of the three proposed marine pipeline crossings (which are at the lower and upper Sruwaddacon and the Leenamore river), as outlined in the Corrib Onshore Pipeline EIS (Chapter 13 & 14).

- Identify potential impacts on migratory Annex II species in Sruwaddacon Bay (Chapter 13). These have been examined separately by Ger Morgan of Aquatic Services Unit. He has 25 years of experience in environmental consultancy specialising in aquatic ecological surveys and environmental impact assessment.
- Provide a summary of mitigation measures proposed to minimise impacts and any residual impacts that may remain.

5 ASSESSMENT APPROACH

5.1 The area of the marine assessment is everything below the high water mark (Slide 1). An assessment of the marine environment was undertaken following an extensive review of existing information acquired for the original consented route.

5.2 Further detailed assessments of the Sruwaddacon Bay estuary were completed following a large number of specialist surveys. These are summarised as follows:

- A geomorphological assessment of the Sruwaddacon Bay (section 14.3.1.1. of the EIS). This looked at the surface and shallow geology of the sediments, along with the seabed bathymetry and features created by currents and debris.
- An assessment of the ecological habitats recorded across the whole Sruwaddacon Bay area (section 14.3.1.2. of the EIS). This looked at surface sediments and associated biological communities and was recorded via visual observations, sampling and photography.
- Localised ecological assessments of the previously surveyed lower crossing and the proposed upper crossing location (section 14.3.2 to 14.3.4. and Chapter 13 of the EIS).
- Oceanographic measurement were taken along the length of the Sruwaddacon and referenced to the tides recorded at Ballyglass pier (section 14.7 of the EIS). These data were then used in the production of the hydrodynamic model. This is a mathematical simulation of water circulating within the Bay over a full tidal cycle.
- An assessment of the natural recovery of sediments on penetration scars and minor scour around the legs of a jack-up rig following geotechnical operations

in the Bay in 2008. Scour is an erosion process caused by water flowing around a hard object.

- Numerous continued observations for seals (pinnepeds), whales or dolphins (cetaceans) during other survey operations in Broadhaven Bay as well as within the Sruwaddacon itself (i.e. during the geophysics and geotechnical studies; section 14.3.7 in the EIS). The full version of the "Broadhaven 2008 Marine Mammal Monitoring Report" (Appendix 7-11 of the 2009 Environmental Management Plan) was not available as of the time of the publication of the EIS. These data confirm the continued importance of cetaceans in the outer Broadhaven Bay, but no records were recovered within the Sruwaddacon estuary.
- Fisheries assessments of the Sruwaddacon Bay by the Central Fisheries Board in association with the North Western Regional Fisheries Board in 2006 & 2008 (section 14.2.5; Appendix L3 and L7 of the EIS). These surveys were timed to record peak fish usage within the bay during autumn and spring periods. An additional assessment of the smolt run was carried out by NWRFB in the spring of 2009.

5.3 Outside of the marine boundary, detailed assessments of four freshwater crossing points were undertaken to assess macro-invertebrates, water quality and fish habitats.

6 A SUMMARY OF THE EXISTING ENVIRONMENT

6.1 Sruwaddacon Bay is an enclosed tidally swept estuary ranging from fully freshwater to almost fully marine conditions. The length of the bay is dominated by marine sands (these are the lighter areas on slide 2), with progressively finer sands in the upper reaches and in enclosed inlets (slide 3) where water movement is slower. Some coarser sediments are recorded in the fast flowing mouth (marked as grey in slide 4) and along the upper perimeter of the entire bay (marked as brown in slide 4) marking an exposure of underlying glacial till and weathered bedrocks underpinning all of the bay (Section 14.3 EIS).

6.2 The main extent of the bay is very shallow and exposed during low water periods (slide 5). A small channel meanders along its length and generally varies in depth between 60cm and around 4m below low water, although some shallow areas are recorded which are dominated by freshwater flow at extreme low water periods (section 14.7 of the EIS). Old admiralty data shows that the route of the main channel has altered only slightly over the past 150 years.

6.3 A hydrodynamic model of the Bay shows that the tidal flow is significant in the lower section of the estuary, particularly close to the main channel during the flooding tide. This has a maximum flow of around 2.5 to 3knots at the mouth, close to the lower crossing (slide 6; Appendix L5 EIS). Due to the constriction of the flow in this area, the tides within the bay itself show an asymmetrical cycle with the ebb running for 43 to 88min longer than that of the reciprocal flood.

6.4 The strong tidal flows have influenced the sediments around the channel along most of the bay. This, combined with the significant periods of exposure and influence from the freshwater, has created a difficult habitat for the marine invertebrates. Consequently the biological abundance and diversity throughout the estuary is generally low. For the most part, mean faunal numbers were below 837ind/m^2 in the main sand areas, falling to below 222ind/m^2 within the channel (section 14.3.1.2. EIS). This can be compared to 2,850 ind/m^2 recorded off Belmullet, Inner Broadhaven Bay.

6.5 Considered an important food source for the bird population, the invertebrates were not only recorded in low abundance but were also small in size, recording a very small biomass throughout the estuary. For biomass, the largest animal recorded within the sediments was the edible cockle (*Cerastoderma edule*) contributing about 75% of the total biomass recorded. The biomass of the large deep-dwelling lugworm (*Arenicola marina*) could not be fully estimated although distribution of this species was assessed using surface counts, and not thought to be significant at either of the proposed crossing corridors. Furthermore, the deep nature of this species precludes it as a viable food source for most wading birds (i.e. Golden Plover, Godwit etc).

6.6 In addition to the invertebrate-poor sands of the main estuary, the bay is fringed by a layer of mixed sediments high up on the water line (slide 7; Appendix L1 and L2 EIS). Here the rocks are covered with fucoid algae and support a moderate population of small gammarid crustacea and some molluscs with a biomass approximately an order of magnitude larger than that of the surrounding softer sediments. This is thought to be an important foraging area for resident and over-wintering birds.

6.7 The natural physico-chemical properties of the sediments were assessed along the length of the estuary (Section 14.3.1.2. and Appendix L of the EIS). These results reconciled the hydrodynamic observations within the bay with high energy sands throughout the central part, grading to mixed sands, silts and coarser sediments high up on the foreshore and within a couple of small inlets. For the most part, the levels of various parameters, such as organic matter, heavy and trace metals, sulphides and hydrocarbons reflected these sediment changes. Marginally higher concentrations were recorded in the upper reaches of the estuary where riverine and depositional trends dominated.

6.8 Whilst there are numerous records of cetaceans in Broadhaven Bay none have been recorded entering Sruwaddacon Bay during any of the studies carried out for this area. An occasional visit by the small harbour porpoise (*Phocoena phocoena*) cannot, however, be fully ruled out. Whilst Broadhaven Bay has a resident population of common and grey seals (*Phoca vitulina* and *Halichoerus grypus*), only a few seal sighting have been recorded within Sruwaddacon limited to the fast flowing entrance (north of the proposed lower crossing). Occasional excursions into the upper reaches of the bay are, however, expected (section 14.3.7 of the EIS). No seal haul-out locations exist within the bay.

6.9 With the exception of a small oyster culturing licence which is established in the central part of Sruwaddacon, close to Pollathomaish (licence T10/81 and thought not to be currently operating), no commercial fisheries exists within the shallow waters of the Bay. An assessment of this estuary by the Central Fisheries Board in 2006 and again in 2008 indicated a small resident fish population (Appendix L3 and L7 of the EIS). The earlier study using seine nets, quoted the "lowest abundance of any estuary surveyed by the CFB in the period 2001-2005", whilst "trawls were characterised by a low Catch Per Unit Effort and the lowest diversity of any trawl samples taken under the METRIC(1) project". A slightly higher species diversity was recorded in the later survey, partly due to increased sampling effort, although the CFB also quoted that "the low mean numbers of individuals captured for all methods, points to a low level of abundance of fish in this estuary". This poor fish population is thought to be associated with the sparse sediment invertebrate population and the dominance of freshwater in the upper reaches during low water periods. Normally, estuaries are considered to be highly productive environments due to the changeable conditions, extensive area of shallow soft sediments, high turbidity and continuous organic flux from the riverine input. Sruwaddacon Bay is thought to differ from this due to the unusual hydrodynamics which produces a strong flooding non-depositional regime along most of the estuary.

(1) METRIC is an EPA funded national programme to compile a baseline on fish species composition and abundance carried out by the Central Fisheries Board in conjunction with the seven Regional Fisheries Boards (undertaken between 2000 – 2006). The study was based on fish investigations to develop protocols and metrics for implementing the Water Framework Directive in Irish Coastal and Transitional Waters.

6.10 Details of the freshwater and migratory fish species are given in Chapter 13 of the EIS. Of the Annex II species protected under the EU Habitats Directive only the Atlantic salmon (*Salmo salar*) has been confirmed within the Sruwaddacon and Glenamoy river system, although the non-migratory Brook Lamprey (*Lampetra planeri*) has been recorded within the wider study area. Movement of Salmon through the estuary occurs predominantly over two periods relating to the migration of the adult salmon upstream between June and September and the smolts(2) (for both salmon and seatrout) which run seaward between March and May. A survey to identify the exact timing of the spring smolt migration for the Glenamoy river was carried out by the NWRFB in 2009. This showed a peak smolt migration in mid-April. Given the shallow nature of the bay, the main holding area for fish at low water is thought to be limited to the deeper parts of the channel roughly between Rossport Pier and seaward of Pollathomaish Pier.

(2) 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.

6.11 Anthropogenic, or man-made influences on the estuary are small scale but numerous. The perimeter of the estuary is regularly punctuated by small streams and man-made ditches facilitating runoff from local farm lands. These are expected to carry low level organics and contaminants which are deposited into the sediments in areas where current flow is low (i.e. upper reaches of the estuary, embayments and the upper foreshore). Other impacts are from ubiquitous "flotsam and jetsam" recorded on the strandline and small areas of terrestrial-based dumping. This includes derelict vehicles, domestic waste, collapsed buildings and general building related debris.

7 THE PROPOSED MARINE CROSSINGS IN SRUWADDACON BAY

7.1 The proposed pipeline route passes through three sections of estuary which may impact on the habitats in these locations. The first is the lower crossing between approximate chainage 83.91 and 84.51, a span of approximately 600m (slide 8). The route runs perpendicular to the main channel via a shallow shelving sandy bay on the western shore into a weathered psammitic bedrock on the eastern shore. The route further passes through the Sruwaddacon at the upper crossing via a 900m span between approximate chainage 88.59 and 89.55 (slide 9). With the exception of a band of mixed sediment high up on both shorelines, the majority of this route passes through marine sands becoming silty sands towards the edges of the bay. Finally, the route bends towards the east and intersects the southern tip of a small embayment at the Leenamore river mouth between approximate chainage 90.70 and 91.10 (slide 10). This is the upper limit of the foreshore in this inlet.

8 QUALIFYING HABITATS UNDER THE EU HABITATS DIRECTIVE

8.1 All marine sections fall within the Glenamoy Bog Complex candidate SAC (site code 500), the Blacksod Bay/Broadhaven proposed Special Protection Area relating to wild-fowl and over-wintering birds (pSPA; site code 4037) and the Blacksod and Broadhaven Ramsar site (site code 844). All marine routes pass through estuarine, inter-tidal sand flats and salt marsh habitats, all EU Annex I listed (code 1130, 1140 and 1330 Natura 2000), although none are listed as qualifying habitats for this SAC. The only qualifying marine species listed within the cSAC is Atlantic Salmon (*Salmo salar;* Annex II).

9 PROPOSED CONSTRUCTION METHOD

9.1 The construction method proposed for both main crossings involves micro-tunnelling. This generally avoids surface intervention on the sea-bed and has previously been discussed in the statement on the proposed construction methods (also section 5.5.2 of the EIS). The methodology involves the boring of a single horizontal shaft approximately 1.8m in diameter with the Tunnel Boring Machine (TBM) revolving at a very slow speed of 2-3 rpm and lubricated with a low volume low pressure bentonite slurry. This will produce little or no noise in the marine environment. The pipeline will typically have an overburden of approximately twice the pipes diameter below the sands within the bay.

9.2 In the unlikely event that difficulties do occur during the tunnelling, then an intervention pit may be required at a particular location within the estuary. During this phase, a temporary jetty will need to be constructed in the upper part of the estuary. These operations have a potential to cause impact to the immediate and adjacent habitats caused by noise, excavation activities, increased traffic, sediment suspension and potential emissions.

9.3 The short crossing of the Leenamore River estuary will be constructed using an open cut technique, as described in the statement on construction methods.

10 POTENTIAL IMPACTS IN THE MARINE ENVIRONMENT

10.1 The following potential impacts were assessed:

- Potential minor release of the clay based drilling fluid (bentonite[(3)]);
- Temporary localised loss of surface habitat along the open cut section in the crossing of the Leenamore river;

[(3)] Bentonite is a non-toxic naturally occurring expandable montmorillonite clay, which due its water retention properties, is used to lubricate and remove cuttings from the head of the boring machine.

10.2 In the unlikely event that an intervention pit will be required then the following potential impacts were assessed:

- Temporary noise during sheet piling disrupting fish and larger mammals (seals and otters), and feeding birds on the sand-flats;
- Temporary increase in suspended sediment load from excavation activities and pumping of waters effecting the migration of salmon;
- Temporary localised disruption of feeding birds and wildlife;
- Potential spills from increased vessel traffic;
- Potential disturbance/loss of the very localised habitat around the marine jetty in the upper estuary;
- Potential temporary obstruction to the flow in the main channel for migratory fish (i.e. salmonids);
- Scour of the surrounding sediments caused by increased currents around external structures of the intervention pit, temporary jetty and localised propeller wash from support vessels;
- Alteration to inter-tidal habitat from a change in the channel course;

10.3 The significance of the last three items (i.e. the obstruction to flow, scour and alteration to the channels course) will vary greatly with location of the intervention pit and proximity to the main flow of the channel. Using the hydrodynamic model, various intervention pit scenarios were simulated and the maximum impact from scour calculated (section 14.7.6 of the EIS). The report tabulates two scenarios for scour in each of the lower and upper crossings. Both have been located in the strongest part of the current flow to provide a “worst-case” scenario:

(1) The first is modelled for the fast-flowing deeper waters of the lower crossing using a single 11 x 12m intervention pit. This is marginally larger than that currently being proposed for the construction.

(2) The second is based on the shallower slower-flowing waters of the upper crossing and so consequently has an additional 50 x 14m (maximum dimensions) supply pontoon moored along side the pit during the operations. This will dry during periods of low water.

10.4 The estimates of the scour footprints were as follows (there approximate areas are illustration in slide 11):

- lower crossing: between 4,950 and 5,700m^2 and a depth up to 7.5m and;
- upper crossing: between 900 and 1,600m^2 and a depth up to 5m.

In both cases, these figures are very conservative calculations and in the absence of mitigation procedures. The impacts of this scour will be as follows:

(1) A redistribution of surface sediments immediately surrounding the structure. As existing sediments are generally sands, this material will be re-deposited immediately outside the scour footprint within the channel. The larger footprint estimates are associated with sites in the main flow and generally below the low water mark. Consequently, this places it outside the foraging area for wading birds within the SPA as the sediments are sub-littoral (i.e. submerged below water).

(2) A very localised increase in suspended sediments in close proximity to the structure.

In most cases, the scour is expected to be temporary and will naturally infill very quickly on removal of the pit. This process has already been observed on the footprints and scour produced by a small jack-up rig used during geotechnical investigations in the bay in the summer of 2008 (slide 9). Here, pits created by rig legs a metre across and up to 3.5m deep with associated minor scour up to 80cm deep, showed complete infill during natural tidal processes. Nevertheless, further mitigation may be required to fully reinstate sediment for deeper areas of scour.

11 MITIGATION MEASURES

Mitigation measures to reduce potential impacts during the construction of the crossings have been outlined in the EIS (section 14.5) and are summarised as follows:

11.1 All bentonite usage will be monitored though materials balance calculations. The pumping of bentonite will immediately cease if there is a loss of material into the formation. This will prevent the clay from reaching the seabed. In the extremely unlikely event of bentonite reaching the surface, the quantities involved will be small due to the precautionary measure outlined above. This material will be visible as a dispersion plume as it mixes within the normal tidal flow. It is likely to remain in suspension until it is flushed out of the estuary over subsequent tidal cycles. If this is coincidental to migrating salmonids, then higher concentrations will be avoided during their passage, or in an extreme case, migration may be delayed for a tidal cycle. Impacts here will be negative, imperceptible and temporary. Marine fauna will be unaffected by the plume as the strong tidal flow will prevent any significant settlement of the clay whilst in the bay. Consequently, this impact is expected to be negligible and temporary.

11.2 The surface sediments at the Leenamore crossing 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.

Mitigation measures to reduce potential impacts in the event that an intervention pit is required have been outlined in the EIS (section 14.5) and are summarised as follows:

11.3 The area of habitat disturbance will be kept to a minimum during construction;

11.4 Any construction works carried out in the marine sector will be supervised by a marine environmental scientist. This will include an assessment of the hydrodynamic regime, the monitoring of scour effects and the reinstatement of the seabed, in the event that an intervention pit and jetty are required.

11.5 If an intervention pit is required, the proposed location will be assessed for scour risk prior to construction of the pit. The impact of scour within areas of stronger current flow (i.e. within the channel) will be reduced by protecting the surface sediments with temporary sand bags, concrete mattressing or other temporary scour protection measures.

11.6 Any significant scour areas will be in-filled by back filling with the surrounding surface sediments deposited within the channel. This will preserve the current hydrodynamic regime of the estuary (i.e. the existing flow post-construction). Impacts will be temporary and imperceptible.

11.7 Construction methods will be agreed in advance with the relevant authorities to minimise disturbance to the migration of salmonids and resident/over-wintering birds.

11.8 To minimise the interruption of adult and smolt salmonid migration and that of other anadromous[(4)] fish in the estuary, the flow within the main channel will be maintained to allow the passage of fish during construction. The channel will be monitored for turbidity during the construction period with any pumped pit water discharges limited to acceptable concentration levels. Impacts will be temporary and imperceptible.

[(4)] fish that swim upstream into freshwater rivers from the sea for breeding such as salmon

11.9 If an intervention pit is required, the acoustic impact to marine mammals will be minimised by ensuring that sensitive species are not within close proximity prior to the commencement of construction (i.e. piling operations). Intervention pit construction will adhere to Marine Notice No. 15 of 2005. *Guidelines for correct procedures when encountering whales and dolphins in Irish coastal waters* Department Of Communications, Marine and Natural Resources. This will also be applied to seals and otters, if observed in close proximity during construction. Impacts will be short-term and imperceptible.

11.10 The surface sediments of the two crossings of Sruwaddacon Bay will be reinstated to their original condition by replacing any excavated material and preserving the surface sediment type. Epifauna and flora attached to large stones at the temporary jetty point 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. This will preserve the habitats on the upper shore line and protect foraging areas for resident and over-wintering birds. Impacts will be slight, localised and temporary.

12 SUMMARY

12.1 In summary, the impact on the marine environment within Sruwaddacon Bay will be avoided by constructing using micro-tunnelling. In the remote possibility that an intervention pit is required, this marine environmental assessment demonstrates that the habitats within the bay are of low sensitivity to the proposed works and that any impact would be localised, imperceptible and temporary.

12.2 There will be no discernible residual impacts on the marine environment once the pipeline is constructed.

12.3 Should a surface intervention pit be required a relatively localised area of impact will occur to the soft surface sediments due to scour and temporary changes in hydrodynamics. However, the existing population of surface invertebrate fauna is generally poor for both crossing points due to natural stresses and sediment dynamics. Localised changes will be negative, temporary and of low significance. These minor temporary changes will not significantly impact this population or their significant as a food supply to the bird population. A scenario of "greatest physical impact" mostly applies to sediments outside the foraging areas of the SPA (i.e. below the low water mark), so an impact will be temporary, neutral and imperceptible.

12.4 Localised sediment changes 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 short period of time.

12.5 With the exception of the over-wintering bird population (covered in the Terrestrial Ecology statement) and the migratory salmonids (chapter 13 and 14 of the EIS), the biological abundance and diversity of the estuary (benthic community, fishery and marine mammal population) are naturally poor and lower than other estuaries of this type in western Ireland. There will be no impact on transient or highly mobile species, such as fish (including migrating salmon), seals and possible cetaceans during normal tunnelling operations. Should an intervention be required, impacts to these groups will be minimised using mitigation, with no residual impacts expected once the pipeline is in operation. If an intervention pit is required during a seasonal period of salmon migration, any impact will be minimised through mitigation and will be classed as temporary, negative but imperceptible.

12.6 Based on the impact assessments carried out in the bay as a whole and along the three proposed crossing points I am confident that the Corrib Onshore Gas Pipeline can be constructed and operated without significant impact to the marine environment.