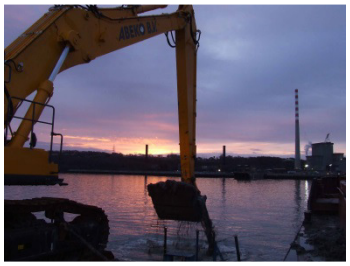
Leading Maritime Archaeology

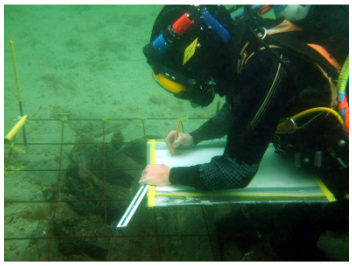
Archaeological Impact Assessment (AIA) and Marine Geophysical Data Review

Emerging Preferred Route
Cross Shannon 400kV Cable Project

River Shannon Estuary
Carrowdotia South Td, Co. Clare
Coolnanoonagh and Kilpaddoge Tds, Co. Kerry

17D0070, 17R0164, 17R0168



Archaeological Impact Assessment (AIA) and Marine Geophysical Data Review

Emerging Preferred Route
Cross Shannon 400kV Cable Project

River Shannon Estuary
Carrowdotia South Td, Co. Clare
Coolnanoonagh and Kilpaddoge Tds, Co. Kerry

17D0070, 17R0164, 17R0168

24 January 2020

Project Manager [redacted]
Project Archaeologists [redacted] and [redacted]

CONTENTS

EXECUTIVE SUMMARY

The Archaeological Diving Company Ltd (ADCO) was commissioned by Mott MacDonald Ireland, consulting engineers on behalf of EirGrid, to undertake archaeological assessment in advance of the proposed Cross Shannon 400kV Cable project. Four (4) submarine cables are to cross the Shannon Estuary between the townlands of Carrowdotia South and Poulnadaree (Co. Clare) and the townlands of Kilpaddoge and Coolnanoonagh (Co. Kerry). The archaeological survey considered three possible crossings, from which a preferred route option has been selected (Route Option 2).

Assessment included the intertidal foreshore in anticipation of possible cable landfall locations in counties Clare and Kerry, and marine geophysical survey data interpretation of a comprehensive dataset acquired across the marine survey area. This work was completed under licence from the National Monuments Section, Department of Culture, Heritage and the Gaeltacht, 17D0070 and 17R0164 for intertidal elements, and 17R0168 for marine geophysical survey.

Foreshore assessment included systematic visual inspection of the intertidal and upper foreshore at each of the potential landfall areas; Areas N1-N3 and S1. This work was conducted on a Low Water Spring tide (07-08 June 2018) to maximize exposure of the foreshore. A metal-detection survey of sample areas at each location was included.

Eight (8) features of archaeological/historical interest were encountered as part of the intertidal inspection (Features F01-F08). The majority of these features are related to the nineteenth-century exploitation of the estuary (Landfall Survey Areas N3 and S1): F01 (quay/slip), F02 (curvilinear structure), F03 (wall foundations), F05 (dwelling/boat house), F06 (berth/slipway), and F07 (lime kiln). Two (2) features present greater antiquity. Feature F04 (Landfall Area 3) is a section of submerged woodland and peat-saltmarsh that is likely to date back to prehistory. Feature F08 (Landfall Area S1) appears to from part of a *souterrain*, or underground passageway that typically dates to the Early Medieval period (*c*. 500-110 AD). An Area of Potential (AP1) is also identified for Landfall area N2, corresponding to the location of a cartographic feature adjacent to Money Point Quarry.

The marine geophysical survey extended over a wide area and presents new survey data of the seabed across the Shannon. Multibeam bathymetry, side-scan sonar, magnetometry and sub-bottom profile data sets have been acquired and the primary data files and supporting information reviewed and interpreted archaeologically by ADCO.

No archaeologically significant features were observed in the data sets and there were no clearly defined features associated with shipwreck. A series of thirty-one (31) side scan sonar

anomalies were identified, along with ten magnetometer anomalies that for the most part are considered to comprise rocks and modern debris. The data does highlight two areas that could be of further interest. Side scan sonar anomaly ss18 in the southern sector of the survey area, off Carhoonakineely townland in Glencoosagh Bay is a stone alignment that lies close to a former fishtrap and may be related to it. Secondly, the magnetometer data highlights the inshore area at the north side of the survey area in the vicinity of landfalls N2 and N3 as a busy sea area that can be expected with the presence of the former quarry sites and quays to the east of Moneypoint Power Station.

A comprehensive report, detailing the above licenced archaeological work, was presented in advance of the permit of consent being sought to undertake intrusive site investigation works (vibrocoring/cone penetration tests); this work was required to assist in the identification a preferred route. A programme of vibrocoring and cone penetration testing (CPT) was subsequently carried out in November/ December 2019. The vibrocore/CPT locations avoided any of the acoustic anomalies identified. The vibrocore logs were presented to ADCO for archaeological review. No deposits or inclusions therein were encountered as part of the Marine SI works that would suggest the presence of buried *in situ* archaeological material.

Following the site investigation work, an emerging preferred route option was selected. No further marine geophysical survey was required, while archaeological field survey of the upper foreshore/ adjacent land areas at the two (2) associated landfall locations was carried out on 11th December 2019.

The current report absorbs the findings from the corpus of archaeological data previously gathered and presents the additional work undertaken on confirmation of the preferred cable route. It includes an impact assessment and a set of specific mitigation measures relating to the pre-construction and construction phases of the proposed project.

The report identifies no archaeological reason for the project not to proceed.

Foreshore Consent is now being sought for the Cable project. As part of this process, further consultation with the Department of Culture, Heritage and the Gaeltacht was undertaken. A programme of test-excavation is required at the two (2) landfall locations (N2/S2). This work will take place post-planning submission but pre-construction and is to coincide with proposed foreshore site investigation works. The archaeological work is to be archaeologically-led.

The principal archaeological mitigation during construction will be archaeological monitoring, with particular attention being paid to the landfall areas, and with the proviso to resolve fully any archaeological material observed at that point. Archaeological input will continue as the project programme develops, with the facility to conduct further pre-construction assessment as and when necessary.

Where a Foreshore Consent is granted, an Archaeology Management Plan will be in place to establish the protocols for the implementation of the archaeological mitigation required for the project.

The recommendations of this report are subject to the approval of the National Monuments Service of the Department of Culture, Heritage and the Gaeltacht (DCHG).

LIST OF FIGURES

LIST OF PLATES

foreshore at ITM 502554E, 652174N (centre-point).

Plate 15: West-facing view along disused concrete outfall, where it protrudes from foreshore a short distance above the HWM.

Plate 16: West-facing view along concrete encased outfall pipe, where it protrudes from foreshore at the HWM.

Plate 17: East-facing view of active concrete encased outfall pipe that extends across foreshore at ITM 502580E, 652122N (centre-point).

Plate 18: South-facing view of exposed bedrock forming foreshore on the southeast side of the survey area between ITM 502620E, 652032N - ITM 502623E, 651965N.

Plate 19: Southeast-facing view of a small, curved, inlet has formed between bedrock to the north and a rock-armour platform located *c.* 60m to the south.

Plate 20: East-facing view of shelving bedrock forming the intertidal zone and attendant cliff that delineates the upper foreshore on west side of Landfall Survey Area N2.

Plate 21: West-facing view of intertidal zone and high bedrock cliff that delineates the upper foreshore on the east side of Landfall Survey Area N2.

Plate 22: North-facing example shot showing composition of bedrock cliff that extends along the upper foreshore within Landfall Survey Area N2.

Plate 23: West-facing view of rock-armour placed along western limit of Landfall Survey Area N2.

Plate 24: East-facing view of shelving bedrock that forms the intertidal foreshore along west side of Landfall Survey Area N2.

Plate 25: Example shot of bedrock extending below the LWM into the subtidal zone.

Plate 26: East-facing view along foreshore on east side of Landfall Survey Area N2.

Plate 27: Northwest-facing view of an abandoned nineteenth-century quarry (Money Point Quarry) located adjacent to Landfall Survey Area N2.

Plate 28: North-facing view of large quantity of semi-dressed flag stones that form a steep plie (8m+ in height) of quarried stone that overspills the quarry on its southern side.

Plate 29: Detail shot showing composition of quarried stone pile; see previous plate also.

Plate 30: Southwest-facing view at western limit (survey start point) of Landfall Survey Area N3.

Plate 31: Northeast-facing view along foreshore at point 130m along Landfall Survey Area N2.

Plate 32: Northwest-facing view of shelving bedrock that forms a gorse-covered cliff that delineates the upper foreshore for a distance of *c. 360m* from the survey start point.

Plate 53: East-facing view of bank that delineates the upper foreshore (Landfall Area Survey S1) at a point where it increases in height; *c.* 800m along survey area.

Plate 54: East-facing view of intertidal foreshore along eastern limit of survey area for Landfall S1; note shelving bedrock now extending across foreshore.

Plate 55: North-facing façade of Feature F05 (rectangular building/ boathouse) located at ITM 504291E, 648552N.

Plate 56: Southwest-facing view of Feature F05.

Plate 57: Detail view of northern façade of Feature F05; note rubble-stone construction and modern repair to window.

Plate 58: South-facing view of arched entrance to boathouse structure that adjoins Feature F05

Plate 59: Residue of stone-lining that once formed floor of boathouse structure; Feature F05.

Plate 60: South-facing view of a series of wooden posts that from a field-boundary fence that once extended north across intertidal foreshore.

Plate 61 West-facing view of series of boulders placed along upper foreshore to east of Feature F05.

Plate 62: South-facing view of location of Mullally's Berth (Feature F06), positioned on the upper foreshore at ITM 504528E, 648497N.

Plate 63: South-facing view of the remains of Feature F06 (probable lime kiln) located on the upper foreshore at ITM 504788E, 648544N.

Plate 64: Southeast-facing view of upstanding remains of the western façade of Feature F06 (probable lime kiln).

Plate 65: Animal burrow located near base of *c.* 3m high bank that delineates the upper foreshore along much of Landfall survey Area S1.

Plate 66: Detail view of stone structure (Feature F08) forming side wall of animal burrow shown in previous plate. This structure appears to be part of possible *souterrain*. Feature located at ITM 504800E, 648557N.

Plate 67: Southeast-facing view along intertidal foreshore at centreline of proposed Northern Landfall N2.

Plate 68: Example shot of the composition for intertidal foreshore at proposed Northern Landfall N2.

Plate 69: Detail shot showing exposed clay (glacial till) located below the foreshore deposits at proposed Northern Landfall N2.

Plate 70: West-facing view of intertidal foreshore taken from the centreline of proposed Northern Landfall N2.

Plate 71: North-facing view of upper foreshore and cliff-face at centreline of proposed Northern Landfall N2.

Plate 90: East-facing view of agricultural trackway providing access the rough-pasture fields surrounding the ESB sub-stations at Southern Landfall S2.

Plate 91: North-facing view along the cable route at approximate location the proposed cable joint bay associated with Southern Landfall S2.

Plate 92: South-facing view along the cable route at approximate location the proposed cable joint bay associated with Southern Landfall S2; land located between the two ESB sub-stations.

Plate 93: Side scan sonar image of seabed at ITM 502707E 650155N, showing large sand ripples as the covering deposit (Figure 19, sb1).

Plate 94: Side scan sonar image of seabed at ITM 502349E 648913, showing rock exposed in gravel area (Figure 19, sb5).

Plate 95: Side scan sonar image of seabed at ITM 502186E 652065N, showing boundary between shingle bed on bottom of picture, and sand/silt area on top of picture (Figure 19, sb8).

Plate 96: Side scan sonar image of seabed at ITM 502628E 651044N, showing line of piles associated with current quaysides at Moneypoint (Figure 19, sb7).

Plate 97: Side scan sonar image of seabed at ITM 503204E 649800, showing four of the six cables laid in 2009 crossing over an area of sand ripples (Figure 19, sb4).

Plate 98: Detail of Figure 20 showing the magnetometer profiles as recorded in the vicinities of Landfalls N2 and N3, with the multibeam bathymetry underlaid.

Plate 99: Detail from sub bottom profile survey line L348 that crosses the survey area from East to West, showing the ridge of seabed that runs North-South, at ITM503044E 650233N.

Plate 100: Detail from sub bottom profile survey line L345 that crosses the cable laid in 2015-2016.

Plate 101: Detail from sub bottom profile survey line L272 at the location where cable laying in 2015-2016 revealed a series of timber stakes indicative of an former fishtrap feature.

LIST OF ABBREVIATIONS

ADCO	The Archaeological Diving Company Ltd
ACA	Architectural Conservation Area
AIA	Archaeological Impact Assessment
CLV	Cable Laying Vessel
CPT	Cone Penetrating Test
DCHG	Department of Culture, Heritage, and the Gaeltacht
DAU	Development Applications Unit
E	Easting
N	Northing
ITM	Irish Transverse Mercator
HWM	High Water Mark
LAT	Lowest Astronomical Tide
LWM	Low Water Mark
Mag	Magnetometer
MFE	Mass Flow Excavator
NGR	National Grid Reference
NIAH	National Inventory of Architectural Heritage
OS	Ordnance Survey
PLG	Pre-lay Grapnel
RMP	Record of Monuments and Places
RPS	Record of Protected Structures
SBP	Sub Bottom Profile
SSS	Side Scan Sonar
UAU	The Underwater Archaeology Unit

1.0 INTRODUCTION

The Archaeological Diving Company Ltd (ADCO) was commissioned by Mott MacDonald Ireland, consulting engineers on behalf of EirGrid, to undertake archaeological assessment in advance of the proposed Cross Shannon 400kV Cable project. The assessment included the intertidal foreshore in anticipation of cable landfall locations in counties Clare and Kerry, and marine geophysical survey data interpretation of a comprehensive dataset acquired across the marine survey area. The assessment work was completed under licence from the National Monuments Service, Department of Culture, Heritage and the Gaeltacht, 17D0070 and 17R0164 granted to [redacted] for intertidal elements, and 17R0168 granted to [redacted] for marine geophysical survey.

The submarine cables are to cross the Shannon Estuary between the townlands of Carrowdotia South and Poulnadaree (Co. Clare) and the townlands of Kilpaddoge and Coolnanoonagh (Co. Kerry) (Figures 1-2).

An existing cable crossing in the same area has been the subject of archaeological assessment and this report draws on that work to provide background insight.[1] New work has also been carried out for the present project. The foreshore assessment included systematic visual inspection of the intertidal and upper foreshore at each of the potential landfall areas; Areas N1-N3 and S1 (Figure 2). The work was conducted on a Low Water Spring tide on 07-08 June 2018 to maximize exposure of the foreshore. A metal-detection survey of sample areas at each location was included. The marine geophysical survey extended over a wide area that included some of the previously surveyed footprint and also reached further west, resulting in new survey data of the seabed across the Shannon. Multibeam bathymetry, side-scan sonar, magnetometry and sub-bottom profile data sets have been acquired and the primary data files and supporting information provided to ADCO for review and archaeological interpretation.

Eight (8) features were observed on the foreshore/intertidal zone and thirty-one (31) acoustic anomalies were recorded as part of the marine geophysical survey data.

A detailed report on the licensed work was completed to permit consent to proceed with the intrusive site investigation works (vibrocoring/cone penetration tests) that were required to identify a preferred cable route corridor. Permission was granted and the site investigation

[1] [redacted], 'Archaeological Interpretation of Marine Geophysical Survey Data, Tarbert-Moneypoint Cable Route. 07R2258', unpublished report of ADCO for Mott MacDonald and EirGrid, 2009; [redacted], 'Underwater and Intertidal Archaeological Assessment, Cable Landfall Locations, River Shannon, Carrowdotia South Td, Co. Clare, Kilpaddoge and Cloonanoonagh Td, Co. Kerry. Tarbert to Moneypoint 220kV Submarine Cable Project. 09D061, 09R155', unpublished report of ADCO for Mott MacDonald and EirGrid, 2009; [redacted] 'Licence 15E0477, summary results', no date, pdf file received 2017.

woks were carried out between 26th November and 19th December 2019, with the resulting geotechnical data being subject to archaeological review by ADCO.

Following an assessment of the geotechnical data and a detailed appraisal of the findings from the archaeological work, a preferred route option was selected; Route Option 2 (Figure 3). The route selection necessitated additional fieldwork, with archaeological assessment of the upper foreshore and pastureland adjoining at the two (2) landfall locations being carried out (Figures 4-5). This work was undertaken by ADCO on the 11th December 2019.

The current report absorbs the findings from the corpus of archaeological data previously gathered by ADCO and presents the additional assessment work undertaken following selection of a preferred cable route. The report includes an impact assessment and a set of specific mitigation measures relating to the pre-construction and construction phases of the proposed project.

2.0 PROPOSED DEVELOPMENT[2]

The Cross Shannon 400 kV Cable project is a Capital Project (Reference CP0970) and is being developed in accordance with EirGrid's Framework for Grid Development.

2.1 Project Requirement[3]

High levels of renewable generation are currently being integrated into the transmission and distribution systems in the south and west of Ireland. At times of high wind generation output, it is expected that wind generation will displace conventional (e.g. thermal power station) generation on the system in order of economic merit, while respecting operational constraints. As a consequence of this, at times of high wind, large bulk power flows are expected to flow from the west and south-west towards the large load centres on the east coast. System reinforcement is required to facilitate these projected power flows, as well as to resolve other network issues including voltage collapse, large phase angles and thermal issues. As part of a regional solution to meet this need EirGrid is proposing the Moneypoint-Kilpaddoge 400 kV circuit.

2.2 Subsea Cable Route

The proposed development is for a new (predominantly) subsea cable route between Moneypoint Power Station and Kilpaddoge 220 kV Substation on the north and south shores

[2] This section provides a summary account of proposed development, for a detailed description of the cable installation process the reader is directed to Subsection 8.1 of this report.

[3] Information as detailed in 'Step 4, Development Options Report Cross Shannon 440kV Cable', October 2019, Mott McDonald, p.1.

respectively of the Shannon Estuary. A series of pre-construction surveys were carried out to locate a suitable route that would permit suitable conditions for the burial of the single circuit 400 kV AC cable. Three (3) routes were initially under consideration within the wider survey footprint for the project; Route Options 1-3. The routes extend the full width of the Shannon Estuary, with three (3) potential landfalls on the northern shore of the Shannon and a single area under consideration for the southern landfall, as shown in Figures 1-2. The Grid References (Irish Transverse Mercator) for the northern and southern landfall sites associated with the route selection phase of the project are provided in Table 1.

Landfall ID	Eastings (m)	Northings (m)
Area N1	502547	652177
Area N2	504292	651252
Area N3	505701	651892
Area S1 (eastern end)	504479	648533
Area S1 (western end)	505371	648777

Table 1: Grid References for the selection phase landfall locations. Co-ordinates in ITM (Irish Transverse Mercator).

An emerging preferred cable route (Route Option 2) has now been selected, as shown in Figure 3. The estimated overall length of the submarine route is 2.8km. The north landfall (N2) is located at a point 112m to the east of Moneypoint Power Station, within the townland of Carrowdotia South (Figure 4). The southern landfall (S2) will link the cable to the existing ESB Substation, located in Kilpaddoge townland (Figure 5). The Grid References (Irish Transverse Mercator) for the northern and southern landfall sites associated with the emerging preferred cable route are provided in Table 2.

Landfall ID	Eastings (m)	Northings (m)
N2 (selected)	504359	651234
S2 (selected)	505342	648758

Table 2: Grid References for the two (2) landfall locations associated with the emerging preferred cable route (Route Option 2). Co-ordinates in ITM (Irish Transverse Mercator).

The proposed cable configuration within the subsea area will comprise 4 no. cables, spaced up to 60m apart. At a point *c.* 500m from the LWM at each landfall, the cable spacing will gradually reduce downwards until equidistantly spaced 4m apart. Where the river/estuary bed is soft, the cables are to be buried to a depth between 1m and 3m. This will be achieved using water jetting and/or a cable trenching machine. Where the river/estuary bed is too hard to allow for burial to be achieved economically, the cables are to be covered with a layer of protective rock; the preferred protection measure being the use of rock-filter bags. The subsea installation process does not require the deliberate dredging or disposal of material within the maritime area.

Four (4) trenches are to be excavated across the intertidal zone at Landfall N2. In addition, a concrete slipway structure will be constructed to facilitate the cable pull/ installation works.

Upon completion of the cable installation, the slipway will be back-filled (as appropriate) and will be encased with a pre-cast concrete slab. Trenching will also take place on approach to respective cable jointing bays, located above the HWM. It anticipated that rock-breaking will be required in order to facilitate this requirement.

The final design of the southern landfall (S2) will be subject to further assessment during detailed design. However, it is anticipated that cable burial at the landfall will require the following items: excavation of four (4) trenches across the intertidal foreshore; excavation at the upper foreshore (located a short distance above the HWM); installation of rock-filled gabion bags and/or backfilling (including re-use of excavated material) of the trenches; and placement of rock protection.

The proposed cable installation process is detailed in Section 8.0 of the report.

3.0 RECEIVING ENVIRONMENT

The Shannon Estuary is the largest inlet located along the Irish coastline and constitutes an exposed inter-tidal zone around 200km in length (combined length of both sides of the river). The estuary is part of a dynamic landscape that includes raised bogland, freshwater fens, salt marshes and intertidal mudflats. Research conducted in the 1990s highlighted the archaeological importance of the Shannon estuary since earliest times.[4] The work conducted by the Discovery Programme focused attention on the role that the estuary played in providing economic potential in terms of coastal exploitation for fishing and communications since the later Mesolithic period, before people exploited the landscape directly for agrarian production. The study area was concentrated on the intertidal mudflats on the Fergus and Meelick rivers and around Carrigdirty, Co. Limerick, upriver from the present survey area. The work brought attention to the archaeological potential of the larger estuary area. Estuarine environments are sensitive to sea-level change and large areas of prehistoric foreshore have been submerged by relatively small fluctuations in that level. The inter-tidal environment provides for an extremely rich archaeological holding content and archaeological/ palaeoenvironmental evidence of Mesolithic, Neolithic, Bronze Age and post-medieval date has been recovered. Large sections of the estuary provide suitable environmental conditions for the preservation of archaeological material along its intertidal zone, where deep deposits of estuarine mud provide an anaerobic environment within which archaeological material is preserved. Areas of submerged Neolithic forest have been identified, buried deep within the estuarine clays. The distribution of known medieval and early modern/nineteenth-century fortifications along the estuary was well known, but the new work highlighted the as-yet

[4] Aidan O'Sullivan, *Foragers, farmers and fishers in a coastal landscape. An intertidal archaeological survey of the Shannon estuary*, Discovery Programme Monograph 5 (Dublin, 2001).

undocumented foreshore areas with relict fish weirs and old piers as features that can retain significant and early phases of use.

In the area between Moneypoint and Kilpaddoge, the Shannon estuary is approximately 2.5km wide and begins to broaden gently on its west side as it starts its approach to the Atlantic Ocean. The waters run swiftly across the deep depths of the main channel. The estuarine topography differs from that further east and in the most part does not provide for the form of preservation seen to the east of Kilkerrin Point. The upper foreshore and inter-tidal zones on the north side around Moneypoint are predominantly composed of shelving bedrock, shingle, and rock deposits, with small areas of sand and silt in natural inlets, while Glencoosagh Bay on the south side provides a narrow band of sand and silt deposits inshore.

3.1 Cartographic Information

Examination of the OS historic mapping gives insight to land-use and foreshore adaptation over time. The structures that are typically included on the OS mapping include slipways, jetties, quays, harbours, boathouses, flood embankments, fish-traps, and fish weirs. Topographic indicators are also shown that include areas of shingle, shelving bedrock and intertidal mudflats.[5] The historic mapping relating to each of the four landfall areas under assessment is described below.

Landfall Survey Area N1 (East side of Ballymacrinan Bay)

The OS First Edition (1842) 6-inch to the mile map depicts a gently curving intertidal foreshore composed of shingle with occasional areas of bedrock outcropping along the upper foreshore (Figure 6A). The intertidal zone is shown extending in a south-westwardly direction to the Low Water Mark (LWM) for a distance of c. 50m, although in places the foreshore is shown to extend further, with up to c. 80m of exposure. A finger of exposed shingle, measuring up to c. 60m width, is also shown extending from the LWM in a westerly direction for a distance of c. 400m (Map Item 1). A sub-rectangular spit/islet of bedrock is depicted a short distance to the south (c. 170m), located c. 58m southwest of the LWM (Map Item 2). This cartographic feature measures c. 166m in length x c. 62m in width and is annotated Visible at Low Water'.

A roadway, the present-day N67 (Killimer road), runs immediately adjacent to the upper foreshore for a distance of c. 640m before continuing westwards at an increasing distance from the shoreline. A number of small rectangular dwellings are dotted along the north side of the roadway. A second road conjoins with the former, at a point approximately one quarter of

[5] ADCO carried out a study of the cartographic indicators along the full estuary as part of the Shannon Integrated Framework Project: [redacted], Shannon Integrated Framework Project. Cultural Heritage Assessment' unpublished report for RPS consulting engineers, 2012.

the way around Ballymacrinan Bay (travelling east-west); travelling northwards through the townlands of Ballymacrinan and Dysert. Small holdings are also located along this roadway, positioned on either side of the road.

Three earthworks are depicted within the vicinity of Ballymacrinan Bay; one located close to its northwest extent of the foreshore assessment area (Map Item 3), the other two positioned c. 140m to the north (Map Item 4), and c. 400m to the north-northeast (Map Item 5). An area of exposed bedrock, forming a possible quarry, is also shown at a point c. 278m north of the assessment area (Map Item 6); this item measures c. 78m length x c. 40m width.

The wider landscape depicted on the OS 25-inch to the mile map (1888-1913) is largely similar to that shown on the earlier map series. However, a number of alternations/additions to previous cartographic features are evident (Figure 6B). Foreshore topography remains largely unchanged, comprising a shingle beach with an intertidal extent that ranges between c. 45m and c. 86m. There is a sizeable reduction in the size of a shingle finger that extends from the LWM (Map Item 7) and an alteration in the size/shape of a nearby bedrock spur/islet (Map Item 8), now annotated 'Carrigogore' and shown to be a shingle deposit rather than exposed bedrock. Clearly the tidal-dynamic along this stretch of the bay has changed over time, resulting in the removal of material from the former and the deposition of material at the latter. In addition, shelving bedrock is now depicted at the southeast extent of the bay area, comprising the full extent of the intertidal area at that location (Map Item 9). It is reasonable to assume that the shingle deposits originally covering this area of foreshore bedrock were removed and re-deposited elsewhere during the intervening period between the two map editions. A short distance (c. 27m) to the northeast of this area of bedrock, there is now a foreshore structure recorded; annotated 'Salmon Weir' (Map Item 10). The fishtrap is orientated roughly east-west and measures 83m in length; extending 38m across the intertidal foreshore and 45m across the sub-tidal zone. No other structures are depicted on the OS 25-inch map for the area under assessment.

The three earthworks, as shown on the First Edition Map (Map Items 3-5), are also included on this map edition although they are now depicted in slightly greater detail – Map Item 4 now forms a clearly defined ringfort. In addition, the possible quarry feature (Map Item 6) is now confirmed as such, annotated as 'Quarry (Disused)'. It has two rock extraction areas with trackways leading between the two areas, and three associated building structures (Map Item 11).

Landfall Survey Area N2 (foreshore east of Money Point)

The OS First Edition (1842) map of the shoreline to the east of Money Point depicts a rocky, narrow foreshore extending a maximum of c. 30m from the High Water Mark (HWM) (Figure

7A). A cliff-face delineates the HWM and is shown as irregularly-shaped spurs of bedrock that protrude in a northwest direction from the upper foreshore. A large quarry, located immediately adjacent to the shoreline, presents the most noteworthy cartographic feature within this map area. The feature measures c. 100m in length (east-west) x c. 90m in width (north-south) and is annotated 'Flag Slate Quarry' (Map Item 12). A laneway provides access to a number of buildings located on the west side of the quarry and the upper foreshore further to the west; adjacent to the western limit of the foreshore assessment area. Another much smaller quarry is also indicated at a location c. 170m northwest of Money Point (Map Item 13).

Given the reference to 'Flag Slate', the quarry was probably a source of flag stones for use in the construction of roofs and as a flooring medium. Indeed, reference from 1838 notes that:

> Moneypoint Quarry produces a fine, hard, close grained gritty flag, varying from 1 ½ to 4 inches thick from 10 to 20 superficial feet...[and that the flags]… are shipped from the quarry.[6]

Despite this contemporary reference to the shipping of quarried stone direct from Money Point, no slipway of jetty structure is shown on the Frist Edition Map. In contrast, the OS 25-inch (1888-1913) map records a small 'Quay' and associated 'Slip' (Figure 7B; Map Items 14-15). The quay measures c. 15m in length along its seaward façade. It is shown extending roughly one quarter of the way down the intertidal foreshore, presumably allowing boat access to the quay structure between mid-water and high tide. The quarry is now recorded as 'Money Point Quarry' and is mapped in some detail, showing the various quarry faces, access paths, steps, and associated buildings (Figure 7B; thumbnail). It also notes the presence of two 'Cranes'. The smaller quarry located closer to Money Point (Map Item 13) is now referred to as 'Quarry (Disused)'.

Landfall Survey Area N3 (foreshore west of Money Point)

As with the previous landfall location, the OS First Edition (1842) map of this area records a narrow and rocky foreshore that ranges between *c.* 36 and *c.* 64m in width (Figure 8A). A cliff-face delineates the southwestern half of the assessment area, giving way to a series of fields that bound the upper foreshore to the north. A small quarry is depicted near the southern limit of the foreshore assessment area (Map Item 16), measuring *c.* 80m in length x *c.* 30m in width. At a point 300m to the northeast, roughly mid-point along the assessment area, a tidal fish-trap is depicted, annotated 'Weir' (Map Item 17). This structure measures *c.* 40m in length and extends from the HWM to a point just short of LWM. A dog-leg return is present at the structure's seaward terminus and measures 14m in length.

[6] *Second Report from the Commissionaires appointed to consider and recommend a general system of Railways for Ireland*, Alexander Thom, 86 Abbey Street, Dublin 1838; *Mines and Quarries worked by other parties than the mining company*, p. 67.

Another foreshore structure, a 'Boat Quay' (Map Item 18), is located close by, at a point 80m to the northeast of the fish-trap feature. The structure measures *c.* 34m in length and is shown traversing the foreshore, crossing three quarters of its mapped extent. A small rectangular building (possible boat-house) is positioned a short distance to the northwest of the quay, immediately west of an access road that leads onto the foreshore. In addition, a nineteenth-century estate house and gardens, 'Besborough' are located *c.* 274m to the northeast of the assessment area (Map Item 19). A narrow laneway is also shown providing estate access to the foreshore and quayside. Exposed bedrock, extending the full width of the foreshore, delineates the northeast limit of the assessment area (Map Item 20).

The OS 25-inch (1888-1913) map depicts a similar foreshore topography to that presented on the First Edition map; any changes relate to man-made development rather than natural changes to the foreshore environment (Figure 8B). Most notable is the expansion of the quarry originally depicted on the First Edition map (Figure 8A, Map Item 16). The quarry is now recorded as 'Salthill Quarry (Disused)' and encompasses a 90m-long section of the shoreline. Quarrying activity has also extended the site 71m into the adjacent field. A rectangular building is located within the confines of the quarry, close to the HWM, and an associated quay structure ('Quay') is shown (Map Item 21). The quay measures *c.* 15m long x *c.* 17m wide.

Moving northwards, the previously depicted quay structure (Figure 8A, Map Item 18) and adjacent building remain present, while the tidal fish-trap is no longer included. However, a large 'Salmon Weir' has been added to the foreshore, close to the northeast limit of the assessment area (Map Item 22). This structure measures *c.* 105m in length and is shown extending due south from a point just above the LWM, positioned *c.* 5m west of a large section of exposed bedrock. Further development to Besborough house and grounds is also noted with the addition of several new buildings, a well house, two pumps and a summer house (Map Item 23). The summer house is located within a small wooded area at a point *c.* 87m north of the foreshore assessment area.

Landfall Survey Area S1 (foreshore Glencloosagh Bay)

The First Edition Map (1837) map of Glencloosagh Bay depicts a shingle beach forming an intertidal zone that extends up to c. 90m from a low-lying cliff that delineates much of the upper foreshore (Figure 9). Exposed section of shelving bedrock is shown towards the east of the foreshore assessment area, forming fingers of bedrock that are orientated northeast-southwest (Map Item 24). A stream (annotated 'Glencloosagh') drains onto the foreshore at the innermost point along the bay's extent and forms the townland boundary between Coolnanoonagh Td. and Kilppadoge Td (Map Item 25). There is no indication on the First

Edition map of the presence of any foreshore structures or landing places, although the map does note that there is 'Good Anchorage' off Glencloosagh Bay, annotated a point *c*. 260m from the shoreline (Map Item 26).

The OS 25-inch (1890) map of the bay depicts a foreshore topography that remains largely unchanged (Figure 10). However there are a number of structures located within the foreshore assessment area that are now recorded. These include a salmon weir, an associated building (probable boat-house), a lime kiln, and a gravel pit (Map Items 27-30).

The salmon weir extends northwards across the intertidal foreshore for a distance of *c*. 62m, before continuing a further *c.* 36m m into the subtidal zone (Map Item 27). A square building is located in proximity to the fish-trap, positioned on the upper foreshore at a point *c.* 20m to the west (Map Item 28). The structure measures *c.* 10m x 10m and appears to be sub-divided into two rooms/areas. The building's north façade provides access to the foreshore, a short distance above the HWM. It is likely that this structure is associated with the nearby salmon weir and may have been also used for the storage of small boats fishing in the bay.

Moving eastwards along the shoreline, a 'Lime Kiln (Disused)' is located on the upper foreshore, some 14m from the HWM (Map Item 29). The kiln chimney measures *c*. 5m x 5m and has walls that extend a further 5m from either side of the kiln's entrance; located on the south side of the structure. Another rectangular structure is depicted a short distance (*c*. 15m) west of the lime kiln. This structure is not named and its purpose remains unclear.

A '*Gravel Pit (Disused)*' is located on the upper foreshore to towards the eastern extent of the foreshore assessment area (Map Item 30). The pit is located in the northwest corner of a field that bounds the shoreline. The features west side is defined by a field boundary and a bedrock cliff, which delineates the upper foreshore, to its north. The mapped extent of gravel extraction at this location covers an area roughly 40m x 30m in size.

3.2 Sites and Monuments Record

The Record of Monuments and Places (RMP) is a list of archaeological sites based on the Sites and Monuments Record (SMR) files, maintained by the National Monuments Service at the DCHG.[7] SMR entries include detailed descriptions of archaeological sites based on site visits and historic studies and associated mapping where available. The SMR focuses on sites that are pre-1700AD in date, and so includes the ringforts and associated features recorded on the OS maps. However later buildings, including the fishtraps and historic house

[7] Accessible online via www.archaeology.ie

and foreshore buildings are not typically included in the archive, yet all structures that are more than 100 years old are considered as archaeological sites today.

Thirty-nine (39) RMP sites are listed in the vicinity of the foreshore areas under assessment (1.5km radius), although only one (CL067-030; Earthwork) is located in close proximity to one of the landfall assessment areas (Land fall Area N1) (Table 3, Figures 11-12). At a remove from the shoreline, but within 1.5km radius of the coastline, is a series of other archaeological sites that provide clear evidence of the early medieval settlement of the townlands located on either side of the estuary. A number of *souterrains* and a ringfort in Kilpaddoge townland, Co. Kerry, attest to this occupation. The picture is mirrored on the north side of the estuary with ringforts and associated structures located in the townlands of Carrowdotia North and Carrowdotia South.

RMP Number	Coordinates [ITM]	Townland	Site Type	Proximity to nearest assessment area
CL068-022	506492E, 652965N	Burrane Lower	Rath	1.1km northeast of landfall survey area N3.
CL068-024-001	506752E, 652724N	Burrane Lower	Church	1.08km northeast of landfall survey area N3.
CL068-024-002	506752E, 652724N	Burrane Lower	Graveyard	1.08km northeast of landfall survey area N3.
CL068-025	506947E, 652729N	Burrane Lower	Holy Well	1.2km northeast of landfall survey area N3.
CL068-026	507019E, 652914N	Burrane Lower	Holy Well	1.3km northeast of landfall survey area N3.
CL068-028	507326E, 652602N	Burrane Lower	Cashel	1.45lm northeast of landfall survey area N3.
CL067-026	501457E, 652597N	Moyne	Rath	365m west of landfall survey area N1.
CL067-30	501936E, 652483N	Ballymacrinan	Earthwork	18m north of landfall survey area N1/
CL067-33	502222E, 652639N	Ballymacrinan	Rath	138m north of landfall survey area N1/
CL067-34	502415E, 652949N	Ballymacrinan	Rath	456m north of landfall survey area N1/
CL067-35	502632E, 652756N	Ballymacrinan	Earthwork	459m north of landfall survey area N1/
CL067-38	503749E, 652938N	Carrowdotia North	Rath	1.8km northwest of landfall survey area N2.
CL067-39-001	503823E, 652848N	Carrowdotia North	Souterrain	1.6km northwest of landfall survey area N2.
CL067-39-002	503823E, 652848N	Carrowdotia North	Cashel	1.6km northwest of landfall survey area N2.
CL067-40	503663E, 652377N	Carrowdotia North	Hut Site	1.4km northwest of landfall survey area N2.
CL067-41	503794E, 652241N	Carrowdotia South	Rath	1.25km northwest of landfall survey area N2.
CL067-42	503873E, 652293N	Carrowdotia South	Rath	1.24km northwest of landfall survey area N2.

RMP Number	Coordinates [ITM]	Townland	Site Type	Proximity to nearest assessment area
CL067-43	504011E, 652166N	Carrowdotia South	Rath	1.08km northwest of landfall survey area N2.
CL067-45	504194E, 652388N	Carrowdotia North	Rath	1.16km northwest of landfall survey area N2.
CL067-48	504728E, 652642N	Doonagurroge	Rath	1.1km northwest of landfall survey area N2.
CL067-50	504709E, 651742N	Carrowdotia South	Rath	483m north of landfall survey area N2.
CL067-51	504822E, 651837N	Carrowdotia South	Rath	716m west of landfall survey area N3.
CL067-52	504825E, 652443N	Poulnadaree	Rath	930m northwest of landfall survey area N3.
CL067-54	504992E, 652668N	Doonnagurroge	Enclosure	1.07km northwest of landfall survey area N3.
CL067-55	505080E, 652377N	Poulnadaree	Rath	867m northwest of landfall survey area N3.
CL067-56	505138E, 652547N	Poulnadaree	Rath	899m northwest of landfall survey area N3.
CL067-57	505513E, 652507N	Poulnadaree	Holy Well	636m north of landfall survey area N3.
KE003-01	506954E, 649254N	Tarbert	Bastioned Fort	1.2km east of landfall survey area S1.
KE003-02	507616E, 649525N	Tarbert Island	Battery	1.95km northeast of landfall survey area S1.
KE003-03	506080E, 647848N	Kilpaddoge	Holy Well	1.2km northwest of landfall survey area S1.
KE003-04	502946E, 649234N	Carhoonakineely	Rath	1.3km west of landfall survey area S1.
KE003-05	502881E, 648348N	Carhoonakineely	Earthwork	1.2km west of landfall survey area S1.
KE003-06	503249E, 648266N	Carhoonakineely	Rath	1km southwest of landfall survey area S1.
KE003-07	503696E, 647845N	Coolnanoonagh	Rath	572m southwest of landfall survey area S1.
KE003-08-000	503610E, 647639N	Carhoona	Church	1.1km southwest of landfall survey area S1.
KE003-08-001	503610E, 647639N	Carhoona	Graveyard	1.1km southwest of landfall survey area S1.
KE003-09	504979E, 647858N	Kilpaddoge	Rath	742m south of landfall survey area S1.
KE003-10	505373E, 648004N	Kilpaddoge	Rath	730m south of landfall survey area S1.
KE003-11	505852E, 647977N	Kilpaddoge	Rath	1.1km south of landfall survey area S1.
KE003-12	506723E, 647988N	Tarbert	Moated Site	1.4km southeast of landfall survey area S1.
KE003-13	506910E, 648012N	Tarbert	Cashel	1.5km southeast of landfall survey area S1.
KE003-18	503804E, 647334N	Cockhill	Holy Well	1.35km south of landfall survey area S1.

RMP Number	Coordinates [ITM]	Townland	Site Type	Proximity to nearest assessment area
KE003-121	505037E, 647533N	Farranwana	Rath	1km south of landfall survey area S1.

Table 3: Known sites and monuments listed in the RMP within a 1.5km radius of foreshore areas under archaeological assessment (Landfall Areas N1-N3 and S1).

3.3 National Inventory of Architectural Heritage

The National Inventory of Architectural Heritage (NIAH) is a county-by-county database that identifies, records, and evaluates the post-1700 architectural heritage of Ireland as an aid to the protection and conservation of the nations' built heritage.[8] The NIAH surveys provide the basis for the recommendations of the Minister for the DCHG to the planning authorities for the inclusion of particular structures in their Record of Protected Structures (RPS). There are no entries listed in the NIAH for the townlands under assessment.

3.4 Topographical Archive

The topographical files held at the National Museum of Ireland record objects that have been reported to the Museum or form part of its national collections. The records have been catalogued according to county and townland. There are currently no entries in the Topographic Archive relating to the area under assessment.

3.5 Historic Shipwreck Inventory

The Historic Shipwreck Inventory at the DCHG is a national archive that seeks to include all shipwreck events recorded in Ireland since records began to be made systematically since *c.* 1750 AD.[9] It does not claim to represent a systematic record of wrecking prior to this date. The Inventory is made up principally of recorded incidents of wrecking. The locations of these wrecking incidents are not absolute and refer to the nearest headland or other known topographic feature. There are far fewer known locations of shipwreck, where wreckage has been identified on the seabed from sources such as marine geophysical survey, diver-truthing, fishermen's records or combinations of these and related sources.

In relation to the present survey area, the headlands considered for the assessment include Moneypoint, Money Point, Burrane Point, Clonderalaw Bay, Kilkerin Point, Bolands Rocks and Colman's Point on the Clare side, and Ballydonohue Point, Tarbert, Carrigaduaun, and Ardmore Point on the Limerick/Kerry side. The Inventory records only ten wrecking events, and none of these have been confirmed in terms of specific coordinates for actual wreckage

[8] Online via http://www.buildingsofireland.ie/
[9] Online via https://dahg.maps.arcgis.com/apps/webappviewer

surviving *in situ* (Table 4).[10] It should also be noted that despite comprehensive marine geophysical survey conducted in 2008 for a previous cable lay between Tarbert and Moneypoint, there were no observations made of shipwreck material.[11] There are significantly more events of historic wrecking recorded downriver at Scattery Island and upriver at Foynes. Tarbert is a tricky anchorage and suffers from a strong ebb-tide. This may explain the absence of shipwrecking incidents noted in the Tarbert and Moneypoint area.

Vessel Name	Date	Location	Description
Aid	24/12/1852	Tarbert Road, Shannon	Vessel was stranded in Force 10 wind. Was got off and taken to Limerick.
Britannia or Liverpool	08/11/1825	Rocks between Tarbert and Glynn	Went onto rocks, spars and rigging saved.
Diana	06/02/1820	Rock near Tarbert	Vessel lost while *en route* from London to Limerick.
Mary of Millford	1875	Boland Rocks, Kilrush	75-tonne schooner, wrecked.
Osprey	08/09/1851	Between Tarbert and Glyn	Went ashore.
Topaz	28/12/1900	1 mile below Glin Pier	Wooden Brigantine, 196 tonnes, with cargo of wood. Stranded and total loss.
Unknown	11/1839	The Beeves, near Tarbert	----------
Unknown	*c.*20/11/1850	Between Kilrush and Tarbert	Ferry boat operating between Kilrush and Tarbert was caught in a gale and sank.
Unknown	15/08/1892	Off Tarbert	18-foot rowing vessel, travelling to Kilrush and onward to Kilkee.
Unknown	8/10/1896	Tarbert Roads	12-tonne iron lighter, moored at Tarbert with a general cargo, founded in SW Force 1 and became a total loss.

Table 4: Instances of shipwrecking within general area based of the DCHG shipwreck Inventory.

3.6 Excavations Bulletin

The excavations bulletin provides an annual published and online summary of accounts of archaeological excavations undertaken throughout Ireland.[12] Summaries may also be submitted for inter-tidal survey, underwater assessments, and the archaeological monitoring of marine/ riverine dredging works. Archaeological monitoring for the previous cable-lay between Tarbert and Moneypoint did observe two series of timber posts or stakes in the nearshore sands off Kilpaddoge, Co. Kerry (Table 5).[13] Four stakes were considered to be associated with a previously unrecorded nineteenth-century salmon weir, and three other

[10] The online web viewer indicates additional recorded wreckings in the wider area, highlighting the broad area of Moneypoint as a reference for wreckage in 57 instances; while three events are associated with Ardmore Point and two with the west side of Tarbert Island. These numbers do no alter the findings being described above.
[11] [redacted] 'Archaeological interpretation of marine geophysical survey data'.
[12] Accessed online via www.excavations.ie
[13] [redacted], 'Licence 15E0477'.

stakes may have been associated with a weir and part of a rope fragment recovered from dredge spoil associated with this second set of stakes was dated to the Bronze Age, at 1815+/- 55CAL BC.

Ref	Easting	Northing	Detail
Stake	504661	648551	One of four wooden stakes recovered in excavator bucket associated with Cable 6. Stakes are eroded at one end and are 300-500mm long, rectangular in profile (80x40mm) and taper to a point.
Stake	504623	648589	One of four wooden stakes recovered in excavator bucket associated with Cable 6. Stakes are eroded at one end and are 300-500mm long, rectangular in profile (80x40mm) and taper to a point.
Stake	504603	648608	One of four wooden stakes recovered in excavator bucket associated with Cable 6. Stakes are eroded at one end and are 300-500mm long, rectangular in profile (80x40mm) and taper to a point.
Stake	504733	648619	One of three wooden stakes observed in Trench 1 and left *in situ*. Withy rope associated and recovered from spoil.
Stake	504741	648610	One of three wooden stakes observed in Trench 1 and left *in situ*. Withy rope associated and recovered from spoil.
Stake	504739	648607	One of three wooden stakes observed in Trench 1 and left *in situ*. Withy rope associated and recovered from spoil.

Table 5: Locations of stakes associated with fish weirs recorded as part of 15E0477.

3.7 Conclusion

It may be concluded that the archaeological potential within the study area, based on existing data, highlights the two shorelines as locations that retain historic structures such as simple quays and former fish traps. Equally, there are no known archaeological or historic features within the corridor of the emerging preferred cable route (Figure 13).

Intertidal archaeology is still a young discipline and much of the material remains tends to belong to the recent past, which has not been the focus of more traditional archaeological approaches. Moreover, as demonstrated during the archaeological monitoring of the previous cable-lay across the estuary in 2017, the potential to observe new material during construction remains high. The inshore environment retains expanses of soft sediment, and features such as buried fishtraps remain invisible to marine geophysical prospection.

4.0 INTERTIDAL SURVEY

4.1 Methodology

The archaeological assessment considered a series of the landfall sites (N1-N3 and S1), most recently focusing on the landfalls associated with the emerging preferred route option (Route Option 2; landfall sites N2 and S2). The work recorded topography and related features to provide a detailed account of the existing intertidal environment. Systematic non-disturbance walkover included inspection of both the intertidal zone (undertaken during Low Water Springs) and the adjacent lands extending above the HWM.

A DGPS unit was available to position-fix any features encountered and a Fisher *Aquanaut* 1280U and Tesoro *Compadre* metal detectors were used for the magnetometer surveys. A photographic and written record was made and the included use of a drone to gathered aerial views of the shoreline and features present. A finds retrieval strategy dealing with conservation issues, cataloguing, and locational recording was also in place to deal with any artefacts recovered during the survey.

The primary onsite assessment, focusing on the three (3) pre-selection route options, was carried out by a team of two archaeologists on the 7th and 8th June 2018 under licence from the DCHG, licence numbers 17D0070, 17R0164. Large areas of the foreshore at each location were inspected (Table 6, Figure 14). The results of the work are presented in Subsections 4.1-4.7 of this report.

Landfall Survey Areas	Coordinates of onsite survey [ITM]:	Survey Extent
N1	501948E, 652439N [western extent] – 502594E, 651873N [southern extent]	1.02km of intertidal foreshore inspected
N2	504266E, 651251E [western extent] – 504743E, 651194N [eastern extent]	485m of intertidal foreshore inspected
N3	505407E, 651449E [southwest extent] – 505880E, 651921N [northeast extent]	731m of intertidal foreshore inspected
S1	504174E, 648602 [western extent] – 505733E, 648998N [eastern extent]	1.7km of intertidal foreshore inspected

Table 6: Extent of intertidal assessment across Landfall Survey Areas N1-N3 and S1.

The Shannon coastline was revisited on the 11th December 2019 in order to re-assess the location of the two (2) landfall sites associated with the emerging preferred route option; Route Option 2, N2 and S2 (Table 7, Figures 15-16). The results of this additional work are presented in Section 5.0 of this report.

Proposed Landfall Sites	Coordinates of onsite survey [ITM]:	Survey Extent
N2	504266E, 651251E [western extent] – 504743E, 651194N [eastern extent]	485m of upper foreshore and adjacent land area inspected
S2	505178E, 648717E [western extent] – 505492E, 648841N [eastern extent]	330m of upper foreshore and adjacent land area inspected

Table 7: Extent of field assessment across upper foreshore/ adjacent land areas at Landfall Sites N2 and S2 (Route Option 2).

4.2 Terminology

When referring to the degree of compaction observed for foreshore deposits under inspection, the terms loose, medium, and hard are relative and do not relate to the measured properties of these deposits. All dimensions in this report are provided in either millimetres or meters

according to scale. When referring to sediment grain size, the Wentworth scale has been adopted, as detailed in Table 8.

Size (mm)	Grade
>256	Boulder
>64	Cobble
>4	Pebble
>2	Granule (gravel)
>1	Very coarse sand
>1/2	Coarse sand
>1/4	Medium sand
>1/8	Fine sand
>1/16	Very fine sand
>1/32	Coarse silt
>1/64	Medium silt
>1/128	Fine silt
>1/256	Very fine silt
<1/256	Clay

Table 8: Sediment grain size categories as applied to the seabed/riverbed deposits discussed in this report.

4.3 Landfall Survey Area N1 (East side of Ballymacrinan Bay)

Name	Landfall Survey Area N1
Townland(s)	Ballymacrinan, Carrowdotia North
ITM	501948E, 652439N - 502594E, 651873N

Extent	1.02km of intertidal foreshore
Feature(s)	None [RMP CL067-300; Earthwork located 16m to northwest]
Figure(s)	1-2, 6, 11, 14
Plate(s)	1-19
Status	Area de-selected as potential landfall location

Foreshore Topography

The shoreline along the east side of Ballymacrinan Bay extends 35m (min.) to 53m (max.) from the upper foreshore to the LWM. A *c.* 8m-high cliff delineates the first 140m of the survey area (ITM 501952E, 652463N - ITM 502089E, 652461N) (Plate 1). Glacial till forms the main body of the cliff-face (first 6-7m) with a deposit of topsoil deposit forming the upper 1m-2m. The foreshore along this section comprises a shingle beach of carboniferous limestone and shale cobbles/boulders (Plate 2). Sub-rounded boulders (>300mm) are most frequent, forming roughly 60% of the foreshore deposit at this location (Plate 3). These are interspersed with sub-angular cobbles (<100mm) and pebbles (<60mm), comprising *c.* 30% of the foreshore. The boulders overlie a deposit of small pebbles (<10mm), angular gravel (<3mm), and coarse sand (<2mm). Frequent Bladderwrack (*Fucus vesiculosus*) provides a thick covering of seaweed across much of the intertidal zone, extending from the LWM to a point *c.* 5m below the HWM.

To the east, the cliff-face is replaced by a low bank structure that extends along the upper foreshore for a distance of *c.* 100m before being replaced by a poured-mass concrete wall/embankment (Plate 4). The bank structure ranges in height from 500mm to 800mm and is composed of glacial till with overlying topsoil. The concrete wall measures several metres in height and extends along a *c.* 400m section of the upper foreshore, where the adjacent roadway is closest to the shoreline (Plate 5). In turn, the concrete walling is replaced (ITM 502552E, 652222N) by a low-wall built using rubble-stone and roughly poured concrete (Plate 6). This structure measures up to 600mm in height (max.). Moving further around the bay to the southeast and adjacent Money Point Power Station, rock-armour consolidates the upper foreshore; delineating the last 167m of the survey area at Landfall N1 (Plate 7).

Changes in foreshore composition are evident along the survey area. While larger boulders and cobbles predominate along the western side of the bay, the eastern foreshore has more uniform deposits (Plates 8-9). These comprise rounded to sub-rounded limestone cobbles (<160mm) and pebbles (<60mm) that appear to be graded in size; smaller pieces forming the upper half of the intertidal zone and larger pieces being present towards the LWM.

Silty-sand (approx. 60%/40% mix) is visible along two areas of the foreshore. The first area forms a shallow depression (lagoon type area) within the intertidal zone at a point 256m along

the survey area, ITM 502222E, 652460N (centre-point) (Plate 10). The area of exposed silty-sand measures *c.* 50m east-west x 30m north-south. Frequent shell inclusions and Bladderwrack seaweed is evident across this area (Plate 11). The second area is located on the east side of the bay at ITM 502531E, 652184N, extending along the LWM at a point directly opposite a small islet that is exposed at Low Water (Plate 12). This area measures 48m in length (northwest-southeast) x 20m in width (east-west) and is composed of a coarse sandy-slit (80%/20% mix) with crushed shell and gravel inclusions (Plate 13). Both these areas have formed as a result of localised tidal erosion/removal of the overlaying shingle deposits.

A disused concrete outfall is located immediately to the southwest (Plate 14). The visible extent of the outfall measures 12m in length x 1.90m in width and is upstanding to a height 500mm at its terminus (Plate 15). A second, active, outfall is located 55m further along the foreshore (travelling to the southwest). It is a concrete-encased pipe (Plate 16), measuring 15m in visible length x 900mm in width and is upstanding to a maximum height of 1.90m from the foreshore. An iron grate has been fitted to the terminus of the pipe and rock-armour protection has been placed along both sides of the outfall's discharge point (Plate 17).

A large section of shelving bedrock occupies the foreshore on the southwest side of the survey area, extending across a 64m north-south x 54m east-west area (ITM 502620E, 652032N - ITM 502623E, 651965N) (Plate 18). To the south of this a small curved inlet has formed between the bedrock to the north and a rock-armour platform located *c.* 60m to the south (Plate 19). A deposit of rounded pebbles and gravel forms the intertidal area at this location.

Visual Survey and Assessment

No features of archaeological of historic interest were observed as part of the field-walking of this stretch of the shoreline along Ballymacrinan Bay. This includes the location of a Salmon Weir depicted on the OS 25-inch map of the shoreline; no visible remains are evident across the intertidal zone (Figure 3; Map Item 10). However, it is important to note the presence of RMP Site CL067-030 (Earthwork), which is located in close proximity (16m northwest) to the western extent of the foreshore survey area (Figure 14).

4.4 Landfall Survey Area N2 (foreshore west of Money Point)

Name	Landfall Survey Area N2
Townland	Carrowdotia South (Money Point)
ITM	504266E, 651251E - 504743E, 651194N
Extent	485m of intertidal foreshore
Feature(s)	Area of Potential AP1; cartographic feature
Figure(s)	1-2, 7, 11, 14
Plate(s)	20-29
Status	Emerging preferred route selected within this area; Landfall N2

Foreshore Topography

The shoreline at this location is delineated by a steep-sided, gorse-covered cliff composed of shelving-bedrock of shale composition (Plates 20-21). Frequent evidence of faulting is visible within the cliff-face, which measures between 7-8m in height (Plate 22). A sparse band of Bladderwack seaweed (*Fucus vesiculosus*) is located across the HWM towards the base of the cliff-face. Limpets (*Patella vulgate*) were also visible across the HWM.

Rock-armour, forming the eastern boundary of Moneypoint Power Station, delineates the western limit of the survey area (Plate 23). Moving west, shelving bedrock forms much of the foreshore along first 95m of the survey; rising at a *c.* 20º angle to sea (Plate 24). This bedrock

was also observed below the LWM, forming the channel side as it dips into the sub-tidal zone (Plate 25).

The remainder of the foreshore area is for the most part composed of a deposit of shale cobbles (*c.* 50% of foreshore) lying alongside large, sub-angular, mudstone flags with an average size of 500mm x 300mm x 120mm (Plate 26). These flagstones comprise roughly *c.* 30% of the foreshore, with angular rocks and pebbles forming *c.* 18%, and smaller clasts forming the remaining *c.* 2%. Clast-size increases towards the LW M, reflecting the strong currents and high-energy environment present across this foreshore location. Occasional large boulders, measuring up to 1.1m length x 700mm width x 300mm depth, are visible along the base of the cliff-face. The boulders represent collapsed material from the cliff face. Evidence of fossilized seabed rippling was evident on the upper face of a number of these erratic boulders. The inter-tidal zone slopes at an average 30º angle across the foreshore.

The remains of a quarry, as depicted on the OS historic mapping (Figure 7A; Map Item 12), are located a short distance inshore of the assessment area (ITM 504442E, 651260N; centre-point) (Plate 27). A large quantity of semi-dressed flagstones form a steep pile (8m+ in height) of quarried stone that overspills the quarry on its southern side (Plates 28-29). The pile of stone/offcuts is located at the point where a nineteenth-century quay structure is thought to have once stood (ITM 504432E, 651219N); as indicated on the OS 25-Inch mapping (Figure 7B; Map Item 14). It is possible that the full or partial remains of that quay structure, originally used to facilitate the seaward transportation of the quarried stone, may still remain buried here. As such, this area of foreshore is included in the mapping as an Area of Potential (Figure 14; AP1).

Visual Survey and Assessment

No features of archaeological of historic interest were encountered as part of the field-walking. However, an area of potential (Area AP1) has been identified where a mound of quarried stone overspills onto the foreshore from an abandoned nineteenth century quarry (Money Point Quarry) at ITM 504429E, 651216N (Figure 14). The debris occupies the position of a cartographic feature (Figure 7; Map Item 14) recorded on the OS 25-inch map; a structure that comprised a masonry quay that once facilitated the shipment of flagstones from the quarry (Figure 7; thumbnail). The potential for remains of the quay structure to lie buried beneath the area of quarry debris is likely and an area of potential is assigned to this location.

4.5 Landfall Survey Area N3 (foreshore east of Money Point)

Name	Landfall Survey Area N3
Townland	Carrowdotia South, Poulnadaree
ITM	505407E, 651449E - 505880E, 651921N
Extent	731m of intertidal foreshore
Feature(s)	F01-F04
Figure(s)	1-2, 8, 11, 14
Plate(s)	31-47
Status	Area de-selected as potential landfall location

Foreshore Topography

A small, curved, shingle beach forms the western limit of the landfall survey area, marking the first point at which an intertidal foreshore is present on the east side of the Money Point shoreline. The beach is composed of flat, sub-rounded, cobbles (<200mm in size) (Plate 30). Moving northeast, the foreshore retains a similar composition, the cobbles increasing slightly in size and becoming more angular in appearance (Plate 31). In addition, boulders (<600mm) occur sporadically along the mid to low water marks. Low-lying bedrock (shale) cliffs delineate the upper foreshore for a distance of *c.* 360m (Plate 32). After this the composition of the cliff changes to show a high cliff formed of two distinct layers; shale bedrock forming its base, while a compacted/ lithified deposit of glacial till forms the top half (Plates 33-34). This unusual geology is present for a distance of *c.* 90m, before giving way to a low-lying,

foreshore topography lined by small trees and gorse bushes (Plate 35). The foreshore along this area is composed of sub-rounded cobbles (<150mm) and boulders (300mm) interspersed with pebble (<30mm) and gravel (<3mm) inclusions (Plate 36). The deposits overlie a sub-stratum of peat that is likely to have once formed part a saltmarsh (Plate 37). Moreover, a series of tree bowls were noted protruding from the foreshore, at locations that stretch from the HWM to the LWM and below (Plates 38-39). This indicates that this section of foreshore was once wooded and raised above the tidal influence of the Shannon. Submerged landscapes are relatively common along the Shannon and have been dated elsewhere to the Mesolithic period. These areas are of particular interest to palaeoenvironmental studies and provide useful data sets for comparative dendrochronological analysis.

The section of submerged woodland stretches across a 142m-long section of the foreshore on the northeast side the Landfall Area N3. It is bounded on its east side by an area of shelving bedrock (67m north-south x 45m east-west) that occupies the full extent of the foreshore and forms the eastern limit of the survey area (Plate 40).

Visual Survey and Assessment

A number of nineteenth-century features were encountered on the east side of the foreshore survey area and Landfall N3. The remains of a boat quay/slip (F01) were observed, as indicated on the OS historic mapping (Figure 8; Map Item 18); a curvilinear structure (F02) of rough-cut limestone is buried within the foreshore deposit; and a line of wall foundation stones (F03) delineate the upper foreshore. A natural feature (F04) was also recorded, that is a submerged peat horizon with a series of tree bowls (submerged woodland) and is of significant palaeoenvironmental interest.

Feature F01 (boat quay/slip) extends in a southeast direction from the HWM to a point several metres below the LWM; ITM 50680E, 651877N - 505706E, 651850N (Plate 41). The feature is partially preserved, only the lowest, foundation elements of the structure being retained (Plate 42). The visible remains of Feature F01 measure 32m in length (northwest-southeast) x 16m in width (northeast-southwest). A short section (*c.* 5.6m) of drystone walling is located adjacent to Feature F01, positioned along the upper foreshore between ITM 50670E, 651882N and ITM 505674E, 651888N (Plate 43). This walling is thought to be a later addition to the foreshore and is probably late nineteenth or early twentieth century date.

Features F02 and F03 are located 44m and 67m further along the foreshore respectively (travelling northeast, Plate 44). Feature F02 forms a curvilinear structure that comprises a course of eighteen (18) visible rough-cut limestone blocks (measuring up to 500mm x 400m in size) (Plate 45). It is unclear as to the exact nature of this foreshore feature. However, it is considered to retain archaeological interest and is probably nineteenth century in date.

Feature F03 is comprises a series of twenty-two (22) limestone blocks that are thought to have once formed the foundations of a retaining wall that delineate the upper foreshore at this location (Plate 46). The feature measures *c.* 58m in length and extends between ITM 505738E, 651919N and ITM 505794E, 651931N. The structure is contemporary to the adjacent boat quay/slip (Feature F01).

Feature F04 is a section of submerged peat (saltmarsh) and woodland that extends across a 142m-long section of the foreshore, as indicated in Figure 10; ITM 505718E, 651895N, 505855E, 651906N (Plate 47). The area extends across the full extent of the foreshore and a series of water-eroded tree bowls are visible at locations along the HWM, mid water mark, and the LWM (see Plates 37-39).

4.6 Landfall Survey Area S1 (foreshore Glencloosagh Bay)

Name	Landfall Survey Area S1
Townland	Coolnanoonagh, Kilpaddoge
ITM	504174E, 648602N - 505733E, 648998N
Extent	1.7km of intertidal foreshore
Feature(s)	F05-F08
Figure(s)	1-2, 9, 10, 12,14

Plate(s)	48-66
Status	Emerging preferred route selected within this area; Landfall S2

Foreshore Topography

The shoreline of Glencloosagh Bay extends up to 60m from the upper foreshore and the LWM (Plate 48). The foreshore is composed of a high-density deposit of carboniferous limestone and shale cobbles/boulders (Plate 49); forming a shingle beach. Sub-angular cobbles are predominant (*c.* 60% of deposit) along the foreshore, measuring <200mm in size, and frequent sub-rounded boulders (<400mm) are also present (*c.* 30% of deposit). Occasional large boulders were also noted (>600mm), most situated above the HWM. Patches of finer material (*c.* 10% of deposit) were also noted at various locations, both above and below the HWM. These comprise pebbles (<50mm) and small cobbles (<80mm), interspersed with angular gravel (>4mm). Bladderwrack (*Fucus vesiculosus*) seaweed is sporadically present across the intertidal zone, concentrated towards the LWM. The shingle deposits overly a compact sub-stratum of glacial till (boulder clay) that is light grey to orange in colour (Plate 50). The shingle deposit is of limited depth, with an average thickness of 150mm. A low-lying bank delineates much of the upper foreshore along the west side of the bay (first *c.* 900m of the survey area). It is composed of glacial till, is roughly vertical in profile, and varies in height between 400mm-2m (Plates 51-52). Further to the east, bank height increases to from a small cliff-face that is up to 4m high (Plate 53). At this point distinct stratigraphic layers can be seen within the bank matrix, representing the sequential deposition of glacial till at this location. Towards the eastern limit of the survey area (ITM 505480E, 648825N) the upper foreshore is delineated by exposed sections of shelving bedrock, above which deposits of glacial till are also present (Plate 54). Bedrock also becomes frequently visible across the intertidal zone, with bedrock fissures extending the full extent of the foreshore area in a number of places.

Visual Survey and Assessment

Four features of archaeological/historic interest were encountered as part of the intertidal survey of Glencloosagh Bay. Features F05-F07 are related to the nineteenth-century use of the foreshore area, while Feature F08 relates to the potential buried remains of an Early Medieval souterrain.

Feature F05 is located at ITM 504291E, 648552N (centre-point) and represents the remains of a building depicted on the OS 25-inch map of 1890 (Figure 10; Map Item 28). The structure is a single-story rectangular dwelling with an arched boat house to one side (Plates 55-56). The building has been constructed using rubble stone, with cut-stone masonry adorning its corners. A single rectangular profile window is present on its northern façade (Plate 57). The opening has a concrete repair and timber surround, indicating use of the building in the twentieth century. The adjoining boat house appears to be integral to the structure and retains

a segmental archway constructed using red brick (Plate 58). In addition, the partial remains of a stone-lined floor is evident at the entrance to the boat house (Plate 59). A modern field boundary fence is located a short distance to the west of this feature and a series of boulders are placed along the upper foreshore to the east (Plates 60-61).

Feature F06 is the location of a nineteenth-century slipway once used to cross the Shannon between Glencloosagh Bay and Money Point (ITM 504528E, 648497N). No visible remains of this structure are present. The site is marked by a memorial placed at the location in 2014 (Plate 62). The memorial reads:

> Pray for the souls of the seventeen people who crossed the Shannon on the 15th August 1893 and perished on the return journey to this berth. “so long as we live, they too shall live as we remember them” erected 15th august 2014.

A stone-built field boundary wall delineates the east side of the memorial and a number of boulders have been placed as a surround.

Feature F07 is the partially upstanding remains of a nineteenth-century lime kiln, situated on the upper foreshore at ITM 504788E, 648544N (Plates 63-64). The feature corresponds to a cartographic feature on the OS25-inch map of 1890 (Map Item 29). The south, east and west façades stand to a height of *c.* 2.2m (max.), while the northern side of the structure is missing; presumably collapsed due to erosion of the shoreline at this location.

Feature F08 was observed when inspecting an animal burrow (350mm opening) on the northwest face of a boulder-clay cliff face that delineates the upper foreshore at this location (Plate 65). A neatly constructed wall, comprising six (6) visible courses, forms the south side of the burrow, curving in an easterly direction (Plate 66). This structure is thought to be the partial remains of a buried *souterrain* or similar passageway structure and is likely to date to the Early Medieval Period.

4.7 Metal-detection Survey

Sample metal detection was undertaken at each intertidal survey location (Survey areas N1-N3 and S1) to gain a sense of the degree of metallic targets present across the foreshore areas. A medium to high target ration of 3-4 hits per m² was encountered at each of the locations, attesting to the degree of modern debris that lies buried with these shingle deposits. All inspected targets proved to be of modern origin and included barbed wire fragments, pieces of tin, bottle tops, a series of iron nails, lead fishing weights, aluminium drinks cans, barrel fragments, etc.

4.8 Conclusion

Eight (8) new features of archaeological/historical interest were identified by ADCO as part of the 2018 intertidal inspection. The majority are related to the nineteenth-century exploitation of the estuary while a section of submerged woodland and peat-saltmarsh (Feature F04) is likely to date back to prehistory, and a possible *souterrain* (F08) on the southern shore would date to the Early Medieval period (*c*. 500-110 AD).

The route selection process actively sought to avoid any of the cultural heritage assets located along the intertidal zone. As such, none of the eight (8) newly identified features will be impacted by the proposed development.

5.0 PROPOSED LANDFALL SITES

A preferred route option has now been chosen. The route selection process was cognisant of findings from the desktop assessment and intertidal surveys previously undertaken by ADCO (2018); as detailed in Sections 3.0 and 4.0 of this report. As such, the two (2) proposed landfalls sites do not impact upon any known or newly discovered cultural heritage sites arising from that work. Moreover, following selection of the preferred route, additional archaeological surveys were carried out (2019) to assess the upper foreshore/ land areas that lie within the proposed development corridor at each landfall. The findings from the latest onsite assessment have been combined with the information gathered a part of the 2018 surveys to provide the fullest picture of the existing foreshore environment present at the two proposed landfalls sites (N2/S2); as detailed below in Subsections 5.1 and 5.2 of this report.

5.1 Northern Landfall (N2)

Name	Northern Landfall N2 (Route Option 2)
Townland	Carrowdotia South (Money Point)
ITM	504266E, 651251E - 504743E, 651194N
Extent	485m section of upper foreshore/ adjacent land area inspected
Feature(s)	F09-F011, Area of Potential AP1; cartographic feature
Figure(s)	1-4, 13-15
Plate(s)	67-81
Status	Proposed Landfall Site for emerging preferred route

Topographic Summary

The subsea cables will make landfall on the northern side of the Shannon Estuary at ITM 504361E, 651219N (centrepoint). The intertidal zone is composed of shale cobbles, lying alongside large, sub-angular, mudstone flags with an average size of 500mm x 300mm x 120mm (Plates 67-68). These flagstones comprise roughly *c.* 30% of the foreshore, with angular rocks and pebbles forming *c.* 18%, and smaller clasts forming the remaining *c.* 2%. Clast-size increases towards the LWM, reflecting the strong currents and high-energy environment present across this particular foreshore location. A substratum of compact clay is also exposed in a number of places (Plate 69). This deposit, which resembles glacial till, is present within the many fissures in the shelving bedrock that extends across this section of foreshore. The inter-tidal zone slopes at an average 30º angle across the foreshore.

The upper foreshore is delineated by a by a steep-sided, gorse-covered, cliff composed of shelving-bedrock of shale composition, measuring 7-8m in height (Plates 70-72). Occasional large boulders, measuring up to 1.1m length x 700mm width x 300mm depth, are visible along the base of the cliff-face; representing collapsed material from the cliff structure. Evidence of fossilized seabed rippling was evident on the upper face of a number of these erratic boulders.

A small, irregular-shaped (roughly-triangular), field extends landward (north) from the edge of the cliff (Plate 73). The field comprises rough pastureland and measures *c.* 83m (east-west) by *c.*100m (north-south). It is delineated along its west and northwest sides by a gorse-topped earthen bank which provides a buffer between the pasture field and the eastern boundary of Money Point power station (Plate 74). The land immediately to the west is also elevated, giving the field a slightly sunken appearance. This is in part due to the natural topography present, but is also a result of historic quarrying activity from the adjacent quarry (Money Point Quarry); a mass of quarried stone/flag slate off cuts having artificiality raised the surrounding ground levels.

The remains of the quarry, as depicted on the OS historic mapping (Figure 4A; Map Item 12), are located a short distance inshore (*c.* 80m northeast) of the proposed landfall location; ITM 504442E, 651260N (centrepoint) (Plate 75). As previously identified as part of the 2018 assessment, a large quantity of semi-dressed flagstones form a steep sided pile (8m+ in height) of quarried stone that overspills the quarry area on its southern side (Plates 76-77). The pile of stone/offcuts is located at the point where a nineteenth-century quay structure is thought to have once stood (ITM 504432E, 651219N); as indicated on the OS 25-Inch mapping (Figure 7B; Map Item 14). It is possible that the full or partial remains of that quay structure, originally used to facilitate the seaward transportation of the quarried stone, may still remain buried here. As such, this area of foreshore is included in the mapping as an Area of Potential (Figures 14-15; AP1).

A series of rambling, low-slung, wall structures of dry-stone construction are also present across this area (Figure 15; Features F09-F11); located to the east of the landfall corridor, positioned between the cliff edge to the south, and the remnants of the quarry to the north (Plates 78-79). These features have been neatly constructed using the abundance of flag stone off-cuts that surround the quarry area (Plate 80-81). They are thought to comprise the remnants of rudimentary animal enclosures/shelters of early-mid twentieth century date.

Visual Survey and Assessment

No known features of archaeological of historic interest are located within the development boundary identified for proposed Northern Landfall N2. The current landfall development boundary avoids/circumvents the Area of Potential (cartographic feature AP1) identified as

part of the previous assessment in 2018. The remains of three (3) agriculture structures (F09-F11), identified a part of the more recent assessment and thought to date from the early-mid twentieth century, are also located outside the development footprint. Moreover, a very poor archaeological holding content can be ascribed to the area under assessment, with shelving bedrock lying close to surface deposits along much of the shoreline. In addition, a sterile compact clay, most likely glacial till (boulder clay), is frequently visible beneath the cobbles, boulders, and flagstone off-cuts that form the upper deposit of the foreshore at this location; the glacial till occupying the large gaps and fissures in the underlying bedrock.

5.2 Southern Landfall (S2)

Name	Southern Landfall S2 (Route Option 2)
Townland	Kilpaddoge (Glencloosagh Bay)
ITM	505492E, 648717N - 505492E, 648841N
Survey Extent	330m section of upper foreshore/ adjacent pastureland inspected
Feature(s)	None
Figure(s)	1-3, 5, 13-14, 16
Plate(s)	82-92
Status	Proposed Landfall Site for emerging preferred route

Topographic Summary

The cables will make landfall on the southern side of the Shannon Estuary at ITM 505339E, 648758N (centrepoint). The intertidal zone at the proposed landfall extends *c.* 43m between the LWM and the HWM (Plate 82-84). The foreshore is composed of a high-density deposit of carboniferous limestone and shale cobbles/boulders (Plate 85); forming a shingle beach. Sub-angular cobbles are predominant (*c.* 60% of deposit) along the foreshore, measuring <200mm in size, and frequent sub-rounded boulders (<400mm) are also present (*c.* 30% of deposit). Occasional large boulders were also noted (>600mm), most situated above the HWM. Patches of finer material (*c.* 10% of deposit) were also noted above and below the HWM (Plate 86). These comprise pebbles (<50mm) and small cobbles (<80mm), interspersed with angular gravel (>4mm). The shingle deposit is of limited depth, with an average thickness of 150mm, that overlies a compact sub-stratum of glacial till (boulder clay) of light grey to orange colour. Bladderwrack (*Fucus vesiculosus*) seaweed is sporadically present across the intertidal zone, concentrated towards the LWM.

A low berm or cliff-face, measuring 3m-4m in height, delineates the upper foreshore across the east-west extent of landfall works corridor (Plate 87). The cliff-top is lined with low-lying vegetation, including gorse and brambles bushes. A compact silty-clay, dark grey/brown in colour, comprises the upper *c.* 300mm of the structure. Below this, the main body of the cliff structure is composed of a glacial till (boulder clay) with pebble, cobble, and boulder sized inclusions (Plate 88). Towards the east side of the works corridor, bedrock is visible extending from the base of the cliff (Plate 89). Moving further east, bedrock becomes frequently visible across the intertidal zone, with bedrock fissures extending the full extent of the foreshore area.

An agricultural track is located to the west of the ESB sub-station and the proposed landfall location (Plate 90). The trackway provides access to a series of small pasture fields that bound this section of the estuary coastline. An L-shaped tract of boggy land (used for rough-pasture) is located within the landfall corridor itself, situated on the approach to the proposed location of a proposed cable transition joint bay (Plates 91-92); a structure that is to be built close to the two existing ESB sub-stations. These recently constructed (2016) sub-stations were commissioned as part of EirGrid's Transmission Development Plan 2012-2022. These structures appear slightly sunken within the surrounding landscape, field clearance/ rock-breaking having been required to create a suitable (level) platform upon which the sub-stations could be built. This appearance has been accentuated with the insertion of low-lying bunds that surround each of the structures.

Outside the curtilage of the two sub-stations, the surrounding topography undulates to follow the rise and fall of the underlying bedrock present. A thin (<300mm) layer of silty-clay soil

supports the growth of flora that is typical of a costal environment, including: moss and liverwort species, tufted-grasses, brambles, and gorse bushes.

Visual Survey and Assessment

As per the Northern Landfall, the development boundary associated with the proposed Southern Landfall site (S2) will avoid any archaeological features previously identified as part of the survey across Landfall Area S1, undertaken in 2018; the nearest features being situated 520m and 486m to the west (F07 and F08 respectively).The foreshore is composed of a shallow single beach deposit, overlying a substratum of glacial till. Exposed sections of shelving bedrock are also visible. In addition, archaeological inspection of the pastureland adjoining the upper foreshore did not reveal any surface features of archaeological or historic interest. Moreover, the paucity of the topsoil present and shallow nature of the underlying strata (glacial till and bedrock) does not provide conditions particularity suitable for the retention of archaeological material, features, or deposits. As such, a relatively poor holding-content can be ascribed to the intertidal foreshore and adjacent pasturelands that are located within the proposed landfall corridor.

5.3 Conclusion

Recent archaeological assessment, combined with the 2018 intertidal survey, provides a detailed account of the foreshore and wider coastal environment at the two (2) landfall sites associated with the emerging preferred route (Route Option 2). No surface features or deposits of archaeological/ historic interest were encountered within the footprint of the proposed landfall works corridor. The selection of sites N2 and S2 as preferred landfall locations is considered optimal from a cultural heritage perspective; the chosen sites avoiding all known and recently discovered archaeological features recorded within the various foreshore areas (Survey Areas N1-N3, S1/S2) and their adjoining literal zones.

6.0 MARINE GEOPHYSICAL DATA REVIEW

6.1 Sources available

The sources for assessment included:

- Project Drawing showing survey area.
- Multibeam bathymetry shape file.
- Side-scan Sonar Data digital record.
- Magnetometer model map.
- Sub-Bottom Profile Data digital record.
- Shape files showing trackplots of side-scan sonar, magnetometer and sub-bottom profile surveys.
- Daily logs of survey work.

6.2 Nature of record

The record is comprehensive. The project was managed by RINA and the data was acquired and assembled for interrogation by GEOxyz, a Belgian-based hydrographic, geophysical and geotechnical survey company. The results provide a detailed sequence of data sets that are geo-referenced and assembled onto ITM, permitting interrogation between the different instrument surveys.

The archaeological licence to facilitate the survey was 17R0168 held by Niall Brady. The survey vessel was *Dulra na Mara* and the survey was conducted from Kilrush Marina between 27/07 and 24/08/2018. Niall Brady visited the project on 22/08 to ensure that the various data sets and information transfer would operate seamlessly,

The equipment used included:

- Trimble BD982 positioning system.
- R2Sonic 2024 Multibeam.
- Edgetech 4200 MP side scan sonar.
- Geometrics G882 magnetometer.
- Innomar SES2000-compact single beam sub-bottom profiler.
- Teledyne Odom Echotrac CV2000 + 4th Neptune transducer sub-bottom profiler.

The data amounts to an intensive survey of the study area. The survey has provided overlap and the ability to view the same areas of seabed from different directions. The magnetometer used was the same make and model as that used in the 2008 survey for the previous cable.

6.3 Bathymetry

The multibeam bathymetry describes a deep channel area that crosses through the survey area just to the north of the central area (Figure 17). The seabed is relatively shallow on both shores and slopes gently seaward except at Money Point itself, where deep water is encountered within 200m of the shore. On the Kerry side, this deep water is not encountered until one has travelled out almost 1.2km from the shoreline, and Glencoosagh Bay is noticeably wide and shallow. A ridge crosses north/south through the deeper water between Ardmore Point in the south and the west side of Money Point.

The trenches of the 2008 cable lay are clearly visible in the multi-beam data when zoomed in, and the trenches are traceable for up to 300m from the north shore and almost 600m from the south shore. It demonstrates the detail that such survey can identify and record. However the multibeam data does not show any obvious indications of the fishtraps and associated features identified in the historic mapping or during the intertidal assessment. Nor does it show the stakes left *in situ* after the monitoring work reported in Licence

15E0477. The timbers would be too insubstantial to be recorded as an acoustic detail in their own right.

6.4 Side scan sonar

The side scan sonar data was acquired working from East-West and West-East in a zig-zag pattern and with line-spacing at between 20m and 40m intervals, and survey range set not less than 50m on port and starboard sides (Figure 18). This ensured that the same area of the seabed was surveyed from different directions and that there was ample overlap between survey lines. The high resolution data is a robust dataset that allows for detailed insight. The survey extended outside the three corridor areas and included the large spaces between; in doing so the survey covered much of the area surveyed in 2008.

The seabed is varied and includes wide expanses of sand that creates sand ripples in places (Plate 93). Expanses of rock (Plate 94) and shingle (Plate 95) are also quite evident. So too are manmade features, including the piled quays at Moneypoint (Plate 96), and the cables as laid in 2015-2016 (Plate 97).

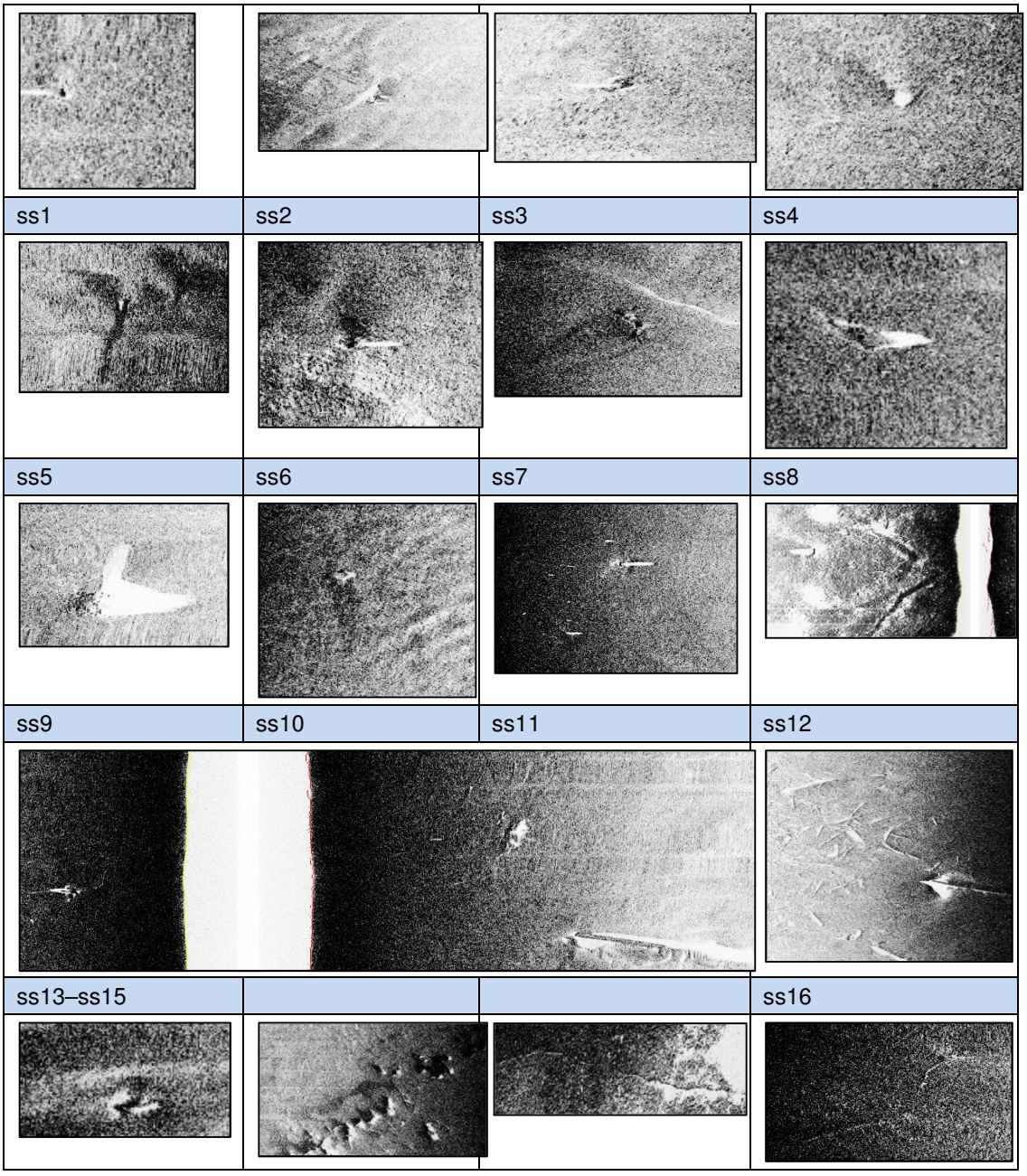
There are only a few anomalies identified in the data set that cannot be more readily explained in terms of natural features or obvious modern artificial features and structures. A list of thirty-one is identified (Tables 9-10). There is no clear indication from any of the anomalies that they are associated with shipwreck or other human intervention, and it is likely that they are either natural elements such as rock or are debris that is essentially of recent date, with one possible exception (anomaly ss18). The distribution of these anomalies is presented in Figure 19. For comparison, this figure also shows the distribution of side scan sonar anomalies detected in 2008 before the laying of that cable. There is no particular clustering or spatial patterning within or between both sets of anomalies. The concentration of features off the north shore (ss13, ss14, ss16) relate to a particular concentration of debris that is most logically associated with Moneypoint Power Station, and this cluster lies outside the current area of consideration. A stone alignment was recorded close to the south shore (ss18) and within 126m of a fishtrap feature recorded on the OS first edition map (Figure 19, Weir 3). The alignment may be of interest.

Ref	Description	Lat N	Long W	ITM E	ITM N	Impact Area
ss1	Short anomaly with distinct shadow. No magnetic variation here	52 35 47.069	09 26 49.124	501970	650443	Outside corridor
ss2	Localised disturbance. No magnetic variation here	52 35 34.267	09 25 15.025	503734	650012	Outside corridor
ss3	Rock? No magnetic variation here	52 35 36.206	09 25 02.512	503970	650067	Outside corridor
ss4	Rock? No magnetic variation here	52 35 34.241	09 24 29.064	504598	649994	Central corridor

Ref	Description	Lat N	Long W	ITM E	ITM N	Impact Area
ss5	Rock?	52 35 31.348	09 27 07.730	501610		Outside corridor
ss6	Rock? No magnetic variation here	52 35 36.208	09 25 01.594	503987	650067	Outside corridor
ss7	Debris? No magnetic variation here	52 35 23.402	09 24 57.132	504064	649670	Western corridor
ss8	Rock? No magnetic variation here	52 35 09.415	09 24 43.586	504310	649233	Western corridor
ss9	Rock? No magnetic variation here	52 35 48.886	09 26 37.811	502185	650495	Western corridor
ss10	Rock. No magnetic variation here	52 35 12.202	09 24 57.640	504048	649324	Western corridor
ss11	Rocks. Weak magnetic variation adjacent	52 35 11.492	09 25 46.118	503134	649320	Western corridor
ss12	V-shaped formation. No magnetic variation here. Probably natural	52 35 59.914	09 24 26.282	504666	650787	Central corridor
ss13	Existing cable artefact? Corresponds with a magnetic variation	52 36 08.904	09 25 23.312	503599	651086	Outside corridor
ss14	Existing cable artefact? Corresponds with a magnetic variation	52 36 10.5	09 25 23.696	503592	651135	Outside corridor
ss15	Existing cable artefact? Corresponds with a magnetic variation	52 36 10.806	09 25 22.602	503613	651144	Outside corridor
ss16	Debris scatter. Corresponds with a magnetic variation. Associated with modern quay area.	52 36 11.690	09 25 21.698	503631	651171	Outside corridor
ss17	Rock? No magnetic variation here	52 36 08.843	09 26 08.626	502746	651101	Western corridor
ss18	Rock alignment. No magnetic variation here	52 34 54.049	09 24 49.646	504187	648760	Western corridor
ss19	Cable. Corresponds with a magnetic variation	52 35 56.603	09 24 08.576	504998	650678	Outside corridor
ss20	Cable and (?) block. Corresponds with magnetic variations	52 36 07.695	09 25 03.488	503971	651041	Outside corridor
ss21	V-shaped feature. Corresponds with a magnetic variation	52 36 12.049	09 23 45.580	505440	651147	Eastern corridor
ss22	Metal length? Corresponds with a magnetic variation	52 36 30.008	09 23 29.428	505754	651696	Eastern corridor
ss23	Box and cable. Corresponds with a magnetic variation	52 36 18.965	09 23 33.304	505675	651356	Eastern corridor
ss24	Metal object? Slight magnetic variation adjacent	52 36 08.933	09 24 31.795	504568	651068	Central corridor
ss25	Cable lay artefact? Corresponds with a magnetic variation	52 35 42.633	09 25 35.197	503359	650279	Wester corridor
ss26	Rock? No magnetic variation here	52 35 29.179	09 23 49.967	505331	649824	Eastern corridor
ss27	Rock? No magnetic	52 35	09 23	505339	649829	Eastern

Ref	Description	Lat N	Long W	ITM E	ITM N	Impact Area
	variation here	29.341	49.570			corridor
ss28	Cable. Corresponds with a magnetic variation	52 35 56.693	09 24 07.821	505012	650681	Outside corridor
ss29	Debris. Corresponds with a magnetic variation	52 36 29.659	09 23 30.508	505734	651686	Eastern Corridor
ss30	Debris. No magnetic variation here	52 35 29.255	09 23 49.762	505335	649826	Eastern corridor
ss31	Square-shaped item. No magnetic variation here.	52 35 14.495	09 24 24.296	504676	649383	Western corridor

Table 9: List of side scan sonar anomalies observed in the data set and indication of which survey corridor they are located on [Lat/Long coordinates are in Degrees, Minutes and Seconds/ Conversion to ITM via OSi converter].



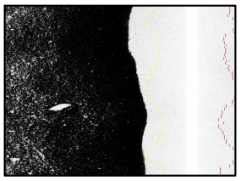
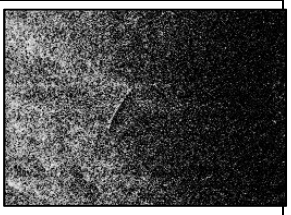
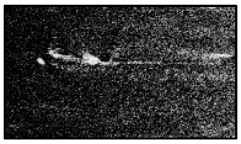
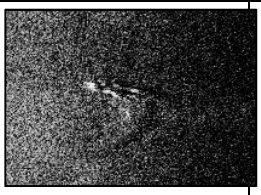
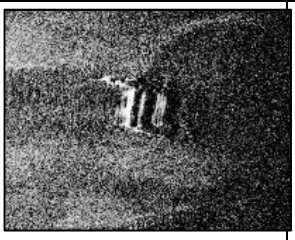
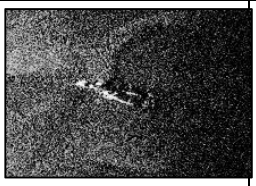
ss17	ss18	ss19	ss20
			
ss21	**ss22**	**ss23**	**ss24**
			
ss25	**ss26**	**ss27**	**ss28**
			
ss29	**ss30**	**ss31**	

Table 10: Images of side scan sonar anomalies observed in the data set.

6.5 Magnetometry

The magnetometer survey was acquired on an identical grid to that of the side scan sonar (Figure 20). This has resulted in data being acquired along lines at approximately 40m intervals, and sometimes less. The data represents another comprehensive data set. Table 9 identifies a correlation between the side scan sonar and the magnetometer surveys, where the side scan anomaly target list includes a statement on whether there is also a magnetic anomaly identified. It helps to clarify whether the side scan sonar anomaly has a ferrous metal content or not. There is also a series of magnetometer anomalies that stand alone and are not associated with side scan sonar anomalies. There are ten instances of such (Table 11, Figure 19). The anomalies are spread randomly across the survey area. The absence of seabed surface features suggests that the magnetic anomaly is buried and as such is not visible.

Ref	ITM E	ITM N	Note
mg1	502254	651203	-----
mg2	502124	650989	-----
mg3	502701	650830	-----
mg4	503005	650563	Natural feature
mg5	504415	649240	110m to ss8
mg6	504291	648722	86m from ss18, 46m from Weir 3
mg7	505453	649605	-----
mg8	505815	650259	-----
mg9	505688	650508	-----
mg10	504487	651079	-----

Table 11: List of magnetometer anomalies that do not correspond with side scan sonar anomalies, which indicates that the source of the anomaly lies buried within the seabed deposits.

There is also a focus of anomalous magnetometer readings in the very northeast corner of the survey area hugging the coastline, and close to but east of Moneypoint Power Station (Figure 20, Plate 98). These have not been individually listed and included in Table 10. Rather, they correspond with the foreshore features associated with Salthill Quarry and the quays in Poulnadaree townland. They attest to an active inshore sea area that highlights this area and the associated landfalls N2 and N3 as areas of activity. The striking linear anomaly extending south from landfall N2 traces the cables laid in 2015-2016.

6.6 Sub bottom profile

The sub bottom profile survey data was acquired over a different grid, with line-spacing in the order of 50m apart (Figure 21). The survey tracklines followed the axes of the survey area lengths, with an additional series of crosslines at 500m separations.

The detail revealed in the data helps to understand the nature of the seabed deposits at depth, and can show large defined features as, for example, the north-south ridge that crosses the section of deeper water on the west side of the survey area (Plate 99). However the profiler is less able to show smaller detail. As indicated on Plate 100 where the profiler crossed over the cables laid in 2015-16, it is challenging to see anything clearly in the data set that is associated with trenching work. Closer inshore there is some indication of trenching, as revealed in Plate 101, which shows a series of dipping elements. This location is also where timber stakes were recovered in the previous cable lay indicative of a former fishtrap, but there is no indication of such timbers in the sub bottom profile data.

6.7 Conclusions

The marine geophysical survey has been comprehensive and has sought to present clear and unambiguous insights to the nature of the seabed surface and its buried deposits. There are no clearly defined features associated with shipwreck, and while most of the anomalies identified may be considered to be either natural items such as rocks or modern debris, the data does highlight two areas that could be of further interest. Side scan sonar anomaly ss18 in the southern sector of the survey area, off Carhoonakineely townland in Glencoosagh Bay is a stone alignment that lies close to a former fishtrap and may be related to it. Secondly, the magnetometer data highlights the inshore area at the north side of the survey area in the vicinity of landfalls N2 and N3 as a busy sea area that can be expected with the presence of the former quarry sites and quays to the east of Moneypoint Power Station. In neither instance should the geophysical data frustrate the present project; rather they help to highlight the need for works to continue to be mindful of the archaeological risk associated with the Shannon estuary.

Selection of the emerging preferred route sought to avoid all impacts with recorded marine geophysical survey anomalies. The selection of the central route (Route 2) as the preferred corridor results in only three recorded side-scan sonar anomalies being considered (ss4, ss12 and ss24). None of these features correspond with detections in the magnetometry survey. In each instance, the project will avoid direct and indirect impacts with these features. No further assessment is therefore required.

7.0 MARINE SITE INVESTIGTAION[14]

A programme of vibrocoring and cone penetration testing (CPT) was carried out to further inform the engineering design and aid route selection. This work was carried out by RINA Consulting on behalf of Mott McDonald Ireland. The vibrocore/CPT locations avoided the acoustic anomalies identified as part of the marine geophysical data review (Figure 22). The closest vibrocore location to a recorded anomaly was in the northeast sector where vibrocore No. 44 was positioned 35m west of side scan sonar anomalies ss22 and ss29, which are metal debris. The closest vibrocore to ss18 was in the south section was 190m to its east (Vibrocore No. 21). The results of the site investigation works were subject to archaeological review. The scope of works undertaken and summary observations area included below in Subsections 7.1-7.2. No deposits or inclusions therein were encountered as part of the Marine SI works that would suggest the presence of buried *in situ* archaeological material.

[14] This section absorbs the findings from the Marine Geotechnical site investigation works as detailed in 'Step 4, Development Options Report Cross Shannon 440kV Cable', October 2019, Mott McDonald, pp.48-70.

7.1 Scope of Works

Intrusive site investigation was carried out between 26th November and 19th December 2019. This work was undertaken in order to:

1. ground truth previously gathered non-intrusive geological data;
2. Identify the location and extent of any sand waves/ areas of significant sediment mobility;
3. obtain samples for environmental testing;
4. obtain the geotechnical properties of materials encountered to inform the design and cable installation method.

Onsite geotechnical operations comprised the following items:

1. the gathering of fifty-five (55) Vibrocore samples;
   A). taken at twenty-nine (29) locations to a target depth of 6 m;
   B). and at twenty-six (26) locations to a target depth of 8 m.
2. Cone Penetration Tests (CPTs), twenty-seven (27) in number, carried out to a target depth of 10m.

7.2 Observations

The geotechnical investigation confirmed that shallow bedrock (<3 m) deposits are located across the northern sections of the cable routes N2-S2 and N3-S2. In addition, that bedrock outcropping is located across the northern and southern shorelines associated with the three (3) potential cable routes. A total of six (6) observable strata were identified as part of the SI works, as detailed in Table 12 below. However, it should be noted that the depositional environments which formed these strata are transitional in nature. As such, distinct boundaries between the deposits are not often present; gradational boundaries up to 2m in thickness being noted for theses deposits.

Stratum Number	Type	Typical Description	Observations
1	Fine to coarse, gravelly, Sand	Medium dense to dense yellowish-brown, slightly silty, gravelly medium to coarse Sand, with abundant medium sand sized shell fragments.	This material is generally located in the centre of the estuary across all three proposed cable routes where the thickest superficial deposits were encountered. However, this material is most prevalent along the N1-S1 route.
2	Dark grey, fine to medium, Sand	Very loose to medium dense dark grey slightly silty fine to medium sand with frequent shell fragments (decrease in abundance with depth) with interbedded clay bands	The fine sand is encountered below the coarse sands (most common on N1-S1 route) or from the surface (more common along N2-S2 and N3-S2 routes). Like the coarse sands, they are limited to the centre of the estuary though do extend to the nearshore area on the N1-S1 route; as indicated in samples VC04 and VC22.
3	Brownish-grey, Silt-Sand	Low to medium strength brownish-grey Silt or Low to medium strength brownish-grey silty Clay	The silt is encountered in a select number of vibrocores (samples VC33, VC35, VC36, VC49 and VC56) located in and around the

Stratum Number	Type	Typical Description	Observations
			channel that intersects the N2-S2 and N3-S2 routes; positioned in the south eastern corner of the site. It is found at the top or within the grey clay and is typically 1m in thickness. The depth at which this deposit is encountered varies and is dependent on the seabed elevation of the borehole.
4	Grey Clay	Low strength greenish-grey Clay with occasional laminations of fine sand	Grey clay is encountered across all three routes, although it is limited in extent within the nearshore areas. It is typically described as a low strength (based on penetrometer and tor vane testing), greenish-grey, clay with laminations of fine sand recorded throughout the deposit. The clay is almost always encountered at a depth of >2m; with the exception of VC40 were it was encountered from the surface. The depth to the clay increases in the centre of the estuary on the N1-S1 route, due to the thicker sand deposits located above. The thickness of the clay is unclear due to limited exploratory holes penetrating the base of the strata; however, it is expected to be thickest in the centre of the estuary.
5	Slightly sandy gravelly Clay	Grey slightly sandy gravelly Clay. Gravel is fine to coarse sub rounded of mudstone and sandstone.	This gravelly clay deposits is limited to nearshore areas and the deepest sections of the N2-S2 and N3-S2 routes. The material is typically described as slightly sandy gravelly Clay, with sub-rounded gravel inclusions that are fine-coarse and of mudstone and sandstone composition. The material is thought to be derived from Glacial Till which has become softened and transported a short distance.
6	Clayey Sandy Gravel	Fine to coarse clayey sandy gravel. Gravel is sub-angular to sub-rounded of mudstone and sandstone.	Like the gravelly clay (stratum 5), the gravel was only encountered in nearshore exploratory locations. It typically comprises a fine to coarse clayey sandy-gravel; sub-angular to sub-rounded mudstone and sandstone composition. Occasional cobbles are also present within the deposit. In CPT27a the gravel was encountered above the grey clay, indicating it is not weathered bedrock, but more likely has the same glacial origin as the gravelly

Stratum Number	Type	Typical Description	Observations
			clay.

Table 12: Summary of strata encountered as part of the Marine SI works undertaken November-December 2019.

8.0 IMPACT ASSESSMENT[15]

Direct impacts to the intertidal and seabed areas along the proposed route will arise from the cable installation works. This has the potential to expose new (sub surface) material of archaeological interest and therefore archaeological mitigation is required.

A summary of the cable installation process is provided below in Subsection 8.1, with anticipated cable burial depths shown in Table 13. The various impacts arising from the proposed installation methodology, and corresponding archaeological mitigation, have been tabulated Subsection 9.1; Table 14.

8.1 Cable Installation Works[16]

The cable laying process will comprise the following works:

- Item 1, excavation and civil works at the two (2) landfall sites (N2/S2).
- Item 2, route clearance (pre-lay grapnel run) along the four (4) cable alignments.
- Item 3, seabed preparation works along all four (4) cable alignments.
- Item 4, subsea works for each cable alignment (starting with Cable number 1, most westerly alignment):
  a). sand wave re-profiling/dispersal by Mass Flow Excavation (MFE);
  b). post-MFE route clearance (secondary pre-lay grapnel run);
  c). Northern Landfall (N2) cable pull-in;
  d). cable installation above LAT [KP 0.0 to KP 0.2];
  e). cable installation below LAT using cable plough [KP 0.2 to KP 2.2];
  f). Southern Landfall (S2) cable pull-in.
- Item 5, repeat item number 4 for Cable numbers 2-4.
- Item 6, post-lay subsea cable installation for all four cables [KP 2.2 to KP 2.8].
- Item 7, landfall and subsea cable protection installation for all four (4) cable alignments.
- Item 8, post construction survey campaigns (cable burial depth and bathymetric surveys).

Cable Landfalls (Item 1): engineering works are required at the Northern Landfall (N2) in order to re-profile the existing shoreline to the final design profile and enable the cable pull to take place. Four (4) trenches are to be excavated across the intertidal zone to accommodate the four (4) corresponding cables. In addition, a concrete slipway structure will be constructed

[15] This section does not purport to relate to precise engineering details but is rather an attempt to understand the nature of the impact on the potential archaeological environment, based on the data provided.

[16] Information extracted from 'Cable Installation Methodology, Technical Notes, EirGrid Cross Shannon 400kV Cable project', Mott McDonald, October 2019.

to facilitate the cable pull/ installation works. Upon completion of the cable installation, the slipway will be back-filled (as appropriate) and will be encased by a pre-cast concrete slab. Rock protection will be installed on the seaward side of the slipway, across its toe area, to prevent any possible erosion taking place.

Earthworks are also required at the Southern Landfall (S2) in order to re-profile the exiting foreshore to the final design profile. Four (4) cable trenches will be excavated to accommodate the four (4) corresponding cables. Once the cables are installed, the trenches will be backfilled using rock/gravel filled gabion bags and/or other backfill material. It is anticipated that a degree of rock-armour protection will also be required. At present, the final design of the southern landfall is subject to further assessment during detailed design.

Estuary Crossing (Items 2-8): a series of pre-lay grapnel runs (Item 2) will be undertaken using a pre-lay grapnel tool (PLG). The PLG will be deployed along the full subsea extent of the four (4) cable alignments, clearing any obstructions to the use of a cable plough; items such as end-of-life cables, fishing nets, ropes, lines, etc.

Seabed preparation works (Item 3) will be required to reduce the slope angles for the cable installation purposes, where slopes are greater than 10-25 degrees. This will be achieved through the placement of rock-filter bags or similar.

A mass-flow excavation (MFE) tool will be deployed along cable route for the purpose of sea-bed preparation (Item 4a); flattening seabed sand waves with amplitudes of more than 0.5m to allow later burial of the cable using a cable plough of jetting tool. It is anticipated that sand wave re-profiling is required along approximately a 2km chainage of each cable alignment. The excavation width will be wide enough to allow the cable plough/ jetting tool to pass and therefore will involve several passes with the MFE tool. The duration will vary depending on ground conditions and target excavation depth. A secondary route clearance with a PLG tool will take place along cable following the recovery of the MFE tool (Item 4b). MFE tools incorporate the use of gyroscopic stability, variable motors, and real-time sonar monitoring with sub-sea cameras to allow for greater monitoring and control from the operating crew.

The cables are to be deployed from a Cable Laying Vessel (CLV), commencing from a position *c.* 100m from the shoreline at Moneypoint (Landfall N2). A messenger wire will be transported by a support vessel to shore and passed through the cable quadrant, over onshore cable rollers, and up to the cable winch. The winch will then pull the cable from the CLV to a point beyond the cable transition joint bay (Item 4c). Once the cable is aligned, the cable floats will be deflated or manually cut to lower the cable under self-weight to the seabed. This will be done one section at a time, starting from an offshore position and moving

south towards the shoreline (Items 4e-4d). This above process will be repeated at the South Landfall (Item 4f).

Post-lay burial of the cables between KP2.2 and KP2.8 will be required (Item 6). A cable plough or jetting tool will be employed for this task; either remotely operated (ROV) or pulled by a combination of the onshore winch and/or marine vessel. This technique will fluidise the seabed beneath the cable, allowing the cable to bury itself under its own-weight. On completion of the cable burial works, additional subsea cable protection will most likely be required (Item 7). The will include the use of rock-filter bags. A programme of post-construction surveys will be required to confirm the target burial depth has been achieved (Item 8). Anticipated burial depths for the cable route are included below in Table 11.

Chainage (KP)	Anticipated Burial Depth (m)	Comments
KP 0.0 to 0.2	0.00	Northern Landfall N2 (KP 0.0). Cable to be installed onto seabed with additional protection identified.
KP 0.4 to 0.6	2.15	----
KP 0.6 to 0.8	2.50	----
KP 0.8 to 1.4	1.00	Additional protection identified.
KP 1.4 to 2.2	2.50	----
KP 1.4 to 2.2	1.50	Additional protection identified.
KP 2.2 to 2.3	0.00	Cable installed onto seabed with additional protection identified.
KP 2.3 to 2.8	1.50	Southern Landfall S2 (KP 2.8), additional protection identified.

Table 13: Target cable burial depths based on preliminary burial assessment, source: Mott McDonald.

9.0 RECOMMENDATIONS

9.1 Archaeological Mitigation

Archaeological test-excavation within the development corridor identified for two (2) landfall sites (N2 and S2) is anticipated; including the land adjacent to the existing Kilpadogge substation. The testing will take place post planning submission, but pre-construction. It is to coincide with geotechnical investigation at the landfalls sites, and it will be archaeologically-led. Depending on the results of this work, additional pre-construction mitigation may be necessary.

The principal archaeological mitigation measure identified for the proposed cable project is archaeological monitoring during construction, with the proviso to resolve fully any archaeological material observed at that point. Archaeological monitoring is recommended for all ground and seabed disturbances. This is to include, as/when feasible, items such as the Pre-lay Grapnel Runs (Item 2) and the use of the Mass-flow Excavation (Item 4); items

which from part of the seabed clearance and preparation works. Monitoring of the Pre-lay Grapnel Runs provides the opportunity to inspect any debris recovered as part the clearance works. In addition, use of a Mass-flow Excavator may provide the opportunity to view live images of the seabed along the cable route; this equipment often having the capability to provide real-time sonar and camera imaging of the seabed during the excavation process.

The various development items, associated impacts, and the archaeological mitigation process are tabulated in Table 14.

Item Number	Installation Process	Nature of Impact	Mitigation
Item 1	• Landfall preparatory works.	• Foreshore trenching. • Topsoil stripping. • Construction of cable transition joint-bay. • Construction of concrete slipway at Landfall N2.	• Pre-construction archaeological investigation (test-trenches) across foreshore impact areas at N2/S2 and adjacent lands at Kilpaddoge sub-station. • Archaeological monitoring during construction.
Item 2	• Seabed clearance along cable route.	• Pre-lay grapnel runs across seabed.	• Archaeological Monitoring.
Item 3	• Seabed preparation works.	• Installation of rock-filter bags or similar on seabed slopes.	• None required
Item 4	• Subsea works along cable alignments.	• Use of mass-flow excavation (MFE) tool to remove sand waves/ripples above 0.5m height. • Installation using cable plough/ jetting machine and/or trenching [KP 0.0 to KP 2.2].	• Archaeological Monitoring of during use of use of MFE tool and cable jetting works.
Item 5	• Repeat of Item 4 until all alignments included.	• As indicated above.	• As indicated above.
Item 6	• Pre-lay burial of cables.	• Burial of cable using plough/ jetting machine [KP 2.2 to KP 2.8].	• Archaeological Monitoring during cable burial.
Item 7	• Additional cable protection (as required).	• Installation of rock-filter bags or similar.	• None required.
Item 8	• Post construction surveys.	• None	• Marine geophysical data subject to archaeological review.

Table 14: Proposed impacts and archaeological mitigation identified for the Cross Shannon 400Kv Cable project.

9.2 Pre-construction Measures

A preferred cable route option has now been selected. It has been subject to a comprehensive archaeological assessment and a preliminary strategy for pre-construction archaeological test-excavation has been agreed. This work is required to assess fully the archaeological potential for sub-surface deposits at the two (2) landfall locations (Landfalls N2 and S2). The work will be licensed by the National Monuments Service. Geotechnical investigations are to coincide with the above foreshore-testing and will also be undertaken under archaeological supervision. Further consultation will occur with the Department of Culture, Heritage and the Gaeltacht following completion of the pre-construction phase archaeological measures.

9.3 Construction Phase Measures

Archaeological monitoring in accordance with the terms of Section 5 of the National Monuments Act (2004 Amendment) is recommended during all ground and seabed disturbance activities on land and on water associated with the cable installation phase of the wider project, with the proviso to resolve fully any archaeological material observed. This measure will ensure that any sub-surface remains of archaeological or historic value are dealt with in an appropriate archaeological manner. The work will be licenced by the National Monuments Service.

9.4 Archaeological Management Measures

RETAINING AN ARCHAEOLOGIST/S. An archaeologist should be retained by the client for the duration of the relevant works. The archaeologist should be familiar with and experienced in river/estuarine environments and have a good understanding of riverine archaeology and its associated features. The archaeologist will work with the project team to assist in the pre-construction site investigation work at the two (2) landfall sites and will conduct the construction phase archaeological monitoring.

The archaeologist will prepare an ARCHAEOLOGY MANAGEMENT PLAN that will set out the protocols to be followed during construction works, to ensure that archaeological monitoring is progressed effectively and that any observations are resolved properly.

THE TIME SCALE for the construction phase should be made available to the archaeologist, with information on where and when ground disturbances and/or dredging will take place.

SUFFICIENT NOTICE. It is essential for the developer to give sufficient notice to the archaeologist/s in advance of the construction works commencing. This will allow for prompt arrival on site to monitor the ground disturbances. As often happens, intervals may occur

during the construction phase. In this case, it is also necessary to inform the archaeologist/s as to when ground disturbance works will recommence.

DISCOVERY OF ARCHAEOLOGICAL MATERIAL. In the event of archaeological features or material being uncovered during the construction phase, it is crucial that any machine work cease in the immediate area to allow the archaeologist/s to inspect any such material.

ARCHAEOLOGICAL MATERIAL. Once 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 would be recommended. The extent and duration of excavation would be a matter for discussion between the client and the statutory authorities.

ARCHAEOLOGICAL TEAM. It is recommended that the core of a suitable archaeological team be on standby to deal with any such rescue excavation. This would be complimented in the event of a full excavation.

SECURE SITE OFFICES and facilities should be provided on or near those sites where excavation is required.

FENCING of any such areas would be necessary once discovered and during excavation.

ADEQUATE FUNDS to cover excavation, post-excavation analysis, and any testing or conservation work required should be made available.

MACHINERY TRAFFIC during construction must be restricted as to avoid any of the selected sites and their environs.

SPOIL should not be dumped on any of the selected sites or their environs.

PLEASE NOTE: All of the above recommendations are based on the information supplied for the proposed Cross Shannon 400kV Cable Project. Should any alteration occur, further assessment maybe required.

PLEASE NOTE: Recommendations are subject to the approval of The Department of the Culture, Heritage, and the Gaeltacht.

10.0 ACKNOWLEDGEMENTS

Thanks are extended to [redacted] and [redacted] Senior Environment Scientists at Mott McDonald Consulting Engineers. Thanks are also extended to [redacted] (Project Manager, EirGrid), [redacted] (Lead Planner, EirGrid), [redacted] (Ex. Technical Director Environment at Mott McDonald), and to [redacted] of RINA and [redacted] of GEOxyz for their assistance in making the marine geophysical survey data sets available. The archaeological survey for the foreshore was undertaken by [redacted] and [redacted]. [redacted] FSA has been project manager and has reviewed the marine geophysical survey. The report was written by [redacted] and [redacted], with [redacted] responsible for the desktop assessment and intertidal work (landfall sites), and [redacted] for the marine geophysical data review. Project Figures 1-16 are prepared by [redacted]; Figures 17-22 by [redacted] and [redacted].