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**Geological Survey of Ireland Research Programme  
- Short Call 2015, Final Report -**

|                           |                                                                              |
|---------------------------|------------------------------------------------------------------------------|
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|                    |                                                                                                                                |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Organisation name  | Gaelectric Developments Ltd.                                                                                                   |
| Organisation type: | <input type="checkbox"/> HEI <input type="checkbox"/> Public Sector (other) <input checked="" type="checkbox"/> Private Sector |
| Department/section | Offshore Wind                                                                                                                  |

|               |                                                                         |
|---------------|-------------------------------------------------------------------------|
| Project Title | Irish Sea Suitability Mapping for Novel Offshore Foundations (ISSMaNOF) |
| Contract No.  | 2015-sc-016                                                             |



# 1. Project information:

|                                                                     |                                                                                                |
|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Title of project                                                    | Irish Sea Suitability Mapping for Novel Offshore Foundations (ISSMaNOF)                        |
| Did you make any formal amendment to the project workplan / budget? | <input type="checkbox"/> yes <input checked="" type="checkbox"/> no<br>If yes, please specify: |

Project Report (max 1500 words, excluding figures and headings):

## (i) Objectives and scientific/engineering targets beyond the state of the art

At present Ireland is recognised as having one of the best offshore wind resources in Europe. However, since the completion of the Arklow Bank Project in 2004, the offshore wind industry in Ireland has been nascent. This is largely due to the lack of political incentive and a viable financial mechanism. In the interim, up to 3GW in other projects have been consented or are in planning for the Irish Sea area. Similarly, the INFOMAR project has been collecting valuable seabed data which is highly pertinent to the siting and developing of viable offshore wind projects. The aim of this project was to identify and analyse alternative sites for offshore renewable energy development hitherto un-investigated. This was carried out using existing INFOMAR data in addition to data housed at University College Cork and Gaelectric Developments Ltd. Table 1 highlights the INFOMAR surveys from which datasets were utilised and the types of dataset used.

| Survey Data Used | Dataset Types Used      |
|------------------|-------------------------|
| CV_07_02         | MBES bathymetry         |
| CV_13_01         | MBES backscatter        |
| CV_10_02         | Grab samples            |
| CV_09_03         | Vibro-core descriptions |
| CV_12_02         | Survey reports          |
| CV_13_01         | Pinger seismics         |
| CV_06_02         | Sparker seismics        |
| CV_01_03         |                         |
| CV_12_01         |                         |
| CV_05_03         |                         |
| CV_11_03         |                         |
| CV_11_01         |                         |
| CV_10_01         |                         |
| CV_05_02         |                         |
| CV_03_01         |                         |
| CV_08_03         |                         |
| KY_10_01         |                         |
| KY_09_02         |                         |
| CV_04_01         |                         |
| CV_07_01         |                         |
| CV_09_26         |                         |
| CV_09_05         |                         |
| CV_11_InisHydro  |                         |

Table 1 INFOMAR data used in this study

From these data, an evaluation was made of the Irish Sea to identify potential sites for further investigation (Fig. 1). Of these sites, four were selected for more detailed analysis based on the availability and quality of data. Subsequently, a data gap analysis was carried out for the area in general for recommendations to be made regarding future site surveying and data collection relevant to offshore renewable energy.

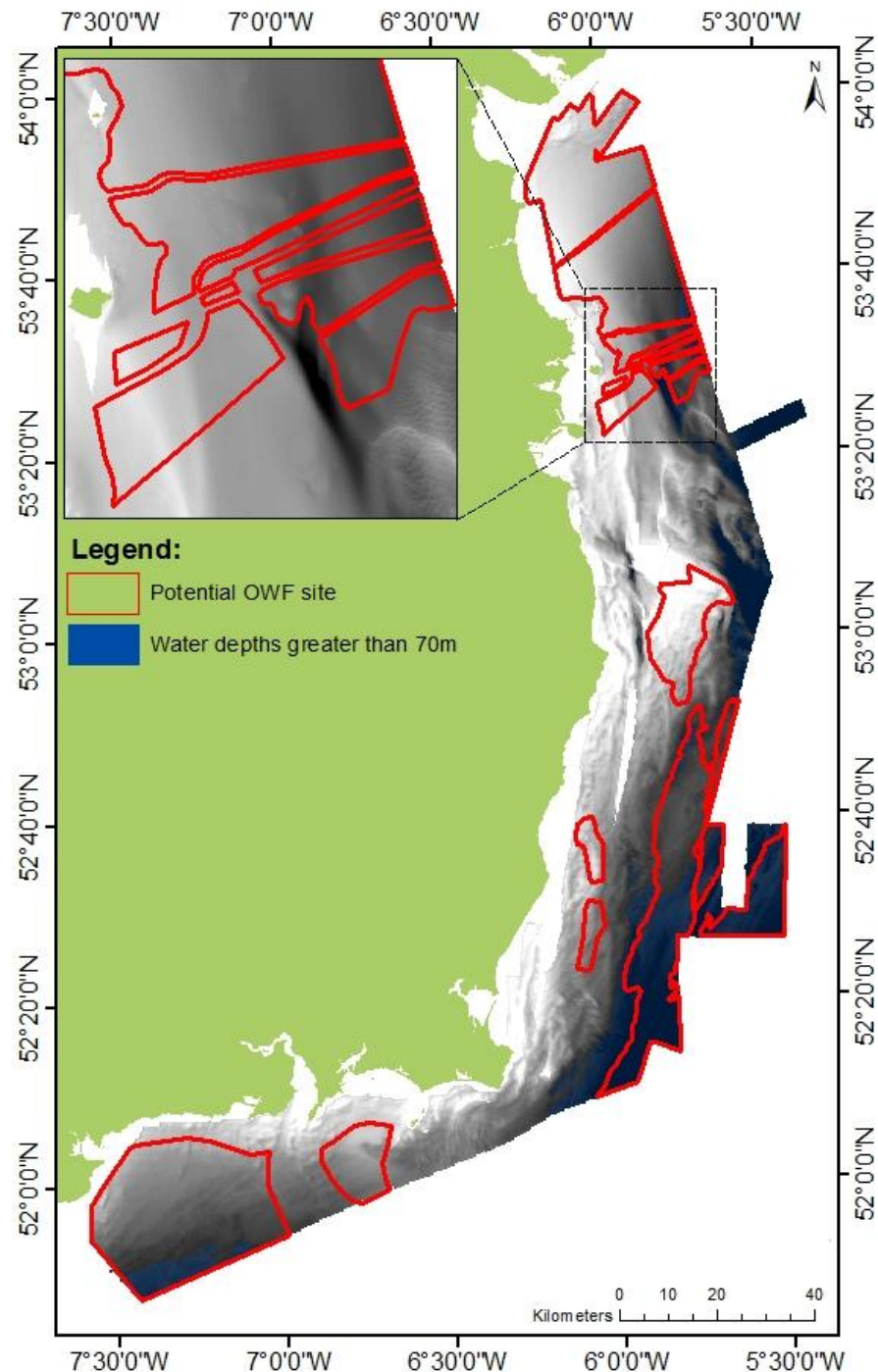


Figure 1 Potential offshore windfarm sites identified as part of ISSMaNOF based on existing INFOMAR data

The objective of ISSMaNOF was to deliver value-added products from this INFOMAR dataset that were pertinent to foundation type selection for these areas (see Outputs below). These objectives and scientific/engineering targets went beyond the state of the art as they generated more end-user friendly data products with additional information to the existing dataset as well as science-based interpretations. These products and interpretations considered novel foundation types aside from the traditional monopile solution which accounted for 91% of turbines deployed offshore in 2015 (EWEA, 2015). Monopile solutions, whilst cost effective at present and understood as a technology, are

restricted in the range of settings where they can be deployed. This can due to water depths or geological and geotechnical conditions. By considering alternative foundation types, ISSMaNOF was able to suggest sites for development which, otherwise, would not be viable through monopile solution alone. Additionally, by providing value-added products from the high-quality INFOMAR dataset, it was able to help de-risk future installation of foundations.

ISSMaNOF also complimented the QuISSION project of Prof. Andrew Wheeler and Dr. Zsuzsanna Tóth at University College Cork. Some of the outputs from ISSMaNOF fed into QuISSION and vice versa which was to the benefit of both projects in advancing our understanding of Quaternary offshore environments in Ireland.

Resultantly, ISSMaNOF met all the objectives set out in the project proposal.

(ii) Implementation (including reference to timelines, milestones, management)

Originally ISSMaNOF was divided into three phases, each with their own associated work packages (Fig. 2). This timeline was adhered to as closely as was possible. No major impediments to the implementation of this timeline was recorded and milestones were delivered on time. Staffing was also not an issue with a full time researcher (Paul Murphy) employed on the project with regular team meetings and updates. Access to data was similarly un-problematic.

| Month        | Jan '16 | Feb '16 | Mar '16 | Apr '16 | May '16 | Jun '16 | July '16 | Aug '16 | Sept '16 | Oct '16 | Nov '16 | Dec '16 | Jan '17 |
|--------------|---------|---------|---------|---------|---------|---------|----------|---------|----------|---------|---------|---------|---------|
| Phase 1      |         |         |         |         |         |         |          |         |          |         |         |         |         |
| Phase 2      |         |         |         |         |         |         |          |         |          |         |         |         |         |
| Phase 3      |         |         |         |         |         |         |          |         |          |         |         |         |         |
| Milestones   | M1      | M1      | M1, M2  | M3, M4  |         |         | M5       |         | M6       | M7      | M8      | M9      | M10     |
| Deliverables |         |         |         | D1      |         | D2      | D2       | D2      | D2       | D2, D3  | D2, D4  | D2, D4  | D4, D5  |

|              |     |                                                                                                                                                                           |
|--------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Milestones   | M1  | Collation of all relevant data and QC                                                                                                                                     |
|              | M2  | Completion of preliminary data assessment                                                                                                                                 |
|              | M3  | Completion of targeted site assessment                                                                                                                                    |
|              | M4  | Stakeholder engagement                                                                                                                                                    |
|              | M5  | Completion of seismic interpretations                                                                                                                                     |
|              | M6  | Completion of seabed characterisation                                                                                                                                     |
|              | M7  | Completion of foundation feasibility assessment/geotechnical evaluation                                                                                                   |
|              | M8  | Completion of deliverable products                                                                                                                                        |
|              | M9  | Completion of Final Report                                                                                                                                                |
|              | M10 | Project completion                                                                                                                                                        |
| Deliverables | D1  | Desktop study including assessment of INFOMAR data coverage and recommendation of areas for further investigation in the context of offshore renewable energy development |
|              | D2  | Presentation of preliminary results at national and international fora                                                                                                    |
|              | D3  | Interim Report of results                                                                                                                                                 |
|              | D4  | Data product deliverables                                                                                                                                                 |
|              | D5  | Final Report; results, conclusions and recommendations                                                                                                                    |

Figure 2 ISSMaNOF project management schedule with milestones and deliverables

The project commenced in earnest in February after a candidate had been selected following an advertising and interviewing stage. This candidate (Paul Murphy) was registered as an MRes student with the Marine Geology Working Group at University College Cork under the supervision of Prof. Andy Wheeler. The candidate, however, was based at Gaelectric offices in Dublin where Lead Investigator Dr. Mark Coughlan is based. A project kick-off meeting was held in Cork on 8<sup>th</sup> February to agree on the project timelines and deliverables. A data exchange also took place. Subsequently, and throughout the course of the project, weekly meetings were held between the Lead Investigator and MRes Candidate to discuss progress against the proposed timeline. Following Phase 1 of the project, an interim report was delivered in April along with a project update to the GSI. Following which a team meeting was organised via skype to discuss the results, progress and future work packages. Following this discussion it was agreed the Candidate would undertake much of Phase 2 in UCC to avail of the advice and expertise of Co-Applciant Dr. Zsuzsanna Tóth. Phase 2 continued and a group skype call was organised for 3<sup>rd</sup> July to assess progress. The M5 milestone was completed in August rather than July but with no detriment to the project. A second update was delivered to the GSI on 31<sup>st</sup> August. In September, following the completion of M7, a meeting was arranged with Archie Donovan, David Hardy and Sean Cullen of the GSI to discuss some of the results of ISSMaNOF and the final delivery of the project so as to ensure its relevance and applicability for INFOMAR needs. With the completion of M8 in November, another team meeting was organised in Dublin on 21<sup>st</sup> November to discuss the results and finalise the structure of the Final Report. The candidate is due to submit his Masters thesis in February 2017.

(iii) Outputs (please use bullet points)

- All Irish & Celtic Sea multibeam bathymetry mosaic (dataset)
- Review of contemporary & novel OWF foundations (report)
- Table on environmental OWF Foundation constraints (report)
- General environmental zones within Irish & Celtic Seas, using INFOMAR & related datasets (shapefile)
- Potential areas/sites for future OWF installations (shapefile)
- Foundation Suitability for sites 1-4 in terms of water depth (dataset)
- Foundation suitability for each foundation type in terms of water depth (dataset)
- Sediment movement for sites 1-4 (shapefile)
- Seabed features dataset for sites 1-4 (shapefile)
- Slope datasets for sites 1-4 (dataset)
- Seabed Classification for sites 1-4 (shapefile)
- RSOBIA seabed classification for sites 1 & 2 (dataset)
- Comparison of Manual, RSOBIA and QTC classification (report)
- Sparker seismic profile interpretations for sites 1-4 (IHS Kingdom output and report)
- Isopach maps for thickness of seismic units at sites 1-4 (metres & twt) (IHS Kingdom output)
- Isopach maps for depth to each horizon at Sites 1-4 (metres & twt) (IHS Kingdom output)
- Geological history interpretation for sites 1-4 (report)
- Foundation suitability tables for sites 1-4 (report)

Impact/value of the project (Max 500 words):

The ISSMaNOF project has had a significant impact, identifying a number of sites in the Irish Sea with the potential for offshore windfarm development. Four of these sites have been significantly de-risked through the generation of data products relevant to assessing and siting foundation types. These value-added products are based on existing INFOMAR datasets and help better constrain offshore seabed conditions in the Irish Sea and are also pertinent to other stakeholders interested in developing offshore infrastructure e.g. pipelines and cabling. In doing so it has greatly enhanced the baseline information

available for the sites studied.

The results from the ISSMaNOF have also been of value to the academic community, most notably the QuSISS project of Prof. Andy Wheeler and Dr. Zsuzsanna Tóth at UCC, particularly in relation to the offshore Quaternary stratigraphy on the South Coast of Ireland.

The ISSMaNOF project has also significantly strengthened the co-operation between the offshore wind sector and university partners through the collaboration of Gaelectric Developments Ltd and University College Cork. This project successfully built on previous collaborations between these parties in the form of the Irish Sea Marine Assessment (2009) and the deployment of the Geotechnical Offshore Seabed Tool (2014). Through collaboration on the ISSMaNOF a candidate (Paul Murphy) was employed and successfully trained in both offshore data collection and subsequent analysis of data pertinent to industry needs in a functioning work environment. Subsequently the candidate has gained a skill-set highly valued in the offshore renewable energy sector as well as seabed mapping in general.

#### **Appendix 1 – Publications & Presentations:**

See cover page for formatting.

Murphy, P., Coughlan, M., Tóth, Z. & Wheeler, A.J. 2016. *Irish Sea Suitability Mapping for Novel Offshore Foundations, Interim Report*. Geological Survey of Ireland. Unpublished Report.

Murphy, P., Coughlan, M., Tóth, Z. & Wheeler, A.J. 2016. *Irish Sea Suitability Mapping for Novel Offshore Foundations, Final Report*. Geological Survey of Ireland. Unpublished Report.

Murphy, P., Coughlan, M., Tóth, Z. & Wheeler, A.J. (2016). Irish Sea Suitability Mapping for Novel Offshore Foundations. *INFOMAR Seminar 2016* – Co. Galway, Ireland, 19-OCT-16.

Tóth, Z.; Wheeler, A.J.; McCarron, S.; Murphy, P.; Coughlan, M. & Monteys, X. (2016) Quaternary stratigraphy on the nearshore continental shelf of the Celtic Sea, SE Ireland *Atlantic Ireland Seminar 2016* – Dublin, Ireland, 01-NOV-16

Murphy, P., Coughlan, M., Tóth, Z. & Wheeler, A.J. (Accepted). Irish Sea Suitability Mapping for Novel Offshore Foundations. *Quaternary Research Association Discussion Meeting 2017* – Durham University, United Kingdom, 04-JAN-17.

Murphy, P. (In prep). *Irish Sea Suitability Mapping for Novel Offshore Foundations (working title)*. University College Cork. Unpublished Masters Thesis.

#### **Appendix 2 – Any additional information not included above:**