MaREI
Centre for Marine and Renewable Energy

MaREI at MRIA Forum 2016

Presentation Title: ESBi WESTWAVE Project
Presenter Name: Katie Lynch
Platform: Optimisation of MRE Conversion

Science Foundation Ireland sfi For what's next

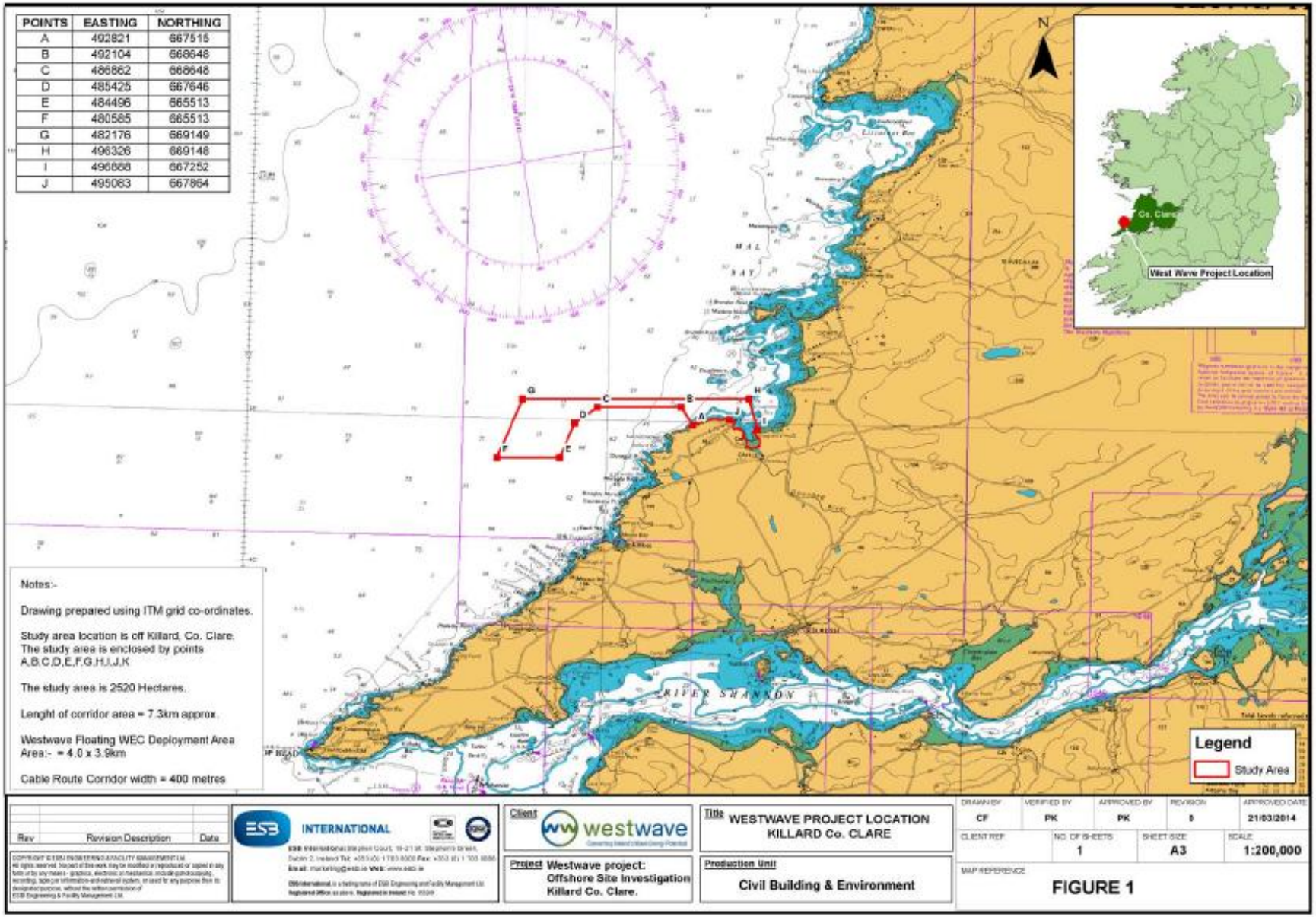
Presentation Outline:

- Introduction to WESTWAVE
- Project Work to Date
- Some results
- Planned Work

Introduction to WESTWAVE:

- Pilot Wave Energy Development
- Being developed by ESBi
  - with EU and National funding
- Killard Point, Co. Clare
- 5MW Total Capacity
- Two possible deployment sites:
  - Nearshore 10-20m water depth
  - Offshore 60+m water depth
- Final technology yet to be determined
  - Discussions are ongoing with a number of technology providers

Introduction to WESTWAVE:



Work to Date: Summary

- 24 month period: January 2014-December 2015
- Characterisation of the resource at the two deployment locations

- Produced a MIKE 21 SW Model of Killard Point for a 24 year hindcast

- Compared measured v modelled data

- Produced statistical data for both deployment locations:
  - Scatter Plots/Resource Tables
  - Wave directionality Analysis
  - Variability Analysis
  - Power Production analysis using AW Energy Wave Roller Device
  - Weather Window Analysis
  - Extreme Wave Analysis
  - Spectral Analysis

- Commented on IEC Standard (62600-101 TC114): “Wave energy resource assessment and characterization”

Work to Date: Model Development

Model development:

- Mike21 SW model: developed to fit IEC standard as much as possible
- Model Inputs:
  - Wave Data: MeteoGroup based on WW3 model: 23yrs of data: 1991-2014, for 3 locations along the model boundary
  - Wind resource: the M6 Weather Buoy, IOWAGA WW3 model (includes CFSR and ECMWF winds), and MERRA wind data
  - Tidal Elevation: from a MIKE21 tidal elevation simulation using recorded tidal gauge data at Carrigaholt, and expanded to cover the duration of the hindcast assessment
  - INFOMAR site bathymetric data
- Offshore Deployment Location: Validated using measured site data and model parameters were adjusted iteratively to best fit
- Nearshore Deployment Location: Future work to validate against measured data and provide more detailed nearshore modelling

Work to Date: Results

Model v Measured data analysis

- Looked at a number of wave data sources at different time steps
- Used Meteogroup data at 1hr timestep, and MERRA acquired wind data
- Comparison with measured data: Operational conditions
  - MeteoGroup data gave approximately equal statistical fit to the buoy dataset,
  - Good correlation of wave heights
  - Wave period and wave direction were generally over-estimated
- Comparison with measured data: Extreme conditions
  - Good representation of periods in storm conditions
  - Wave height in storm conditions were greatly over-estimated

Key Findings for wave farm developers:

- Model accuracy was very good for wave heights, less so for wave period and wave direction – impacts for power production estimates
- Use model data with care for extreme wave height or weather window prediction – impacts on design for survivability

Work to Date: Results

Adhering to IEC Standard (62600-101 TC114)

Mesh Area

- Mesh maximum area in the nearshore environment was altered to be 250m maximum area. (IEC Specifies 50m)
- Effects of IEC standard mesh were analysed:
  - Computationally costly (Run Time for 1332 time steps at DL1 now estimated at 200 hours. This was not feasible for the 20 year hindcast over 3 locations)
  - Caused model to fail
  - Did not result in improved accuracy (results did not vary significantly from those obtained using a 50,000m^2 maximum area)
  - Therefore it was not deemed worthwhile to comply with this aspect of the IEC standards in this instance

IEC recommended limits:

- Wave Height: specifies 0.1m in overall bias in Hm0 for design conditions. Model met 0.212m and 0.2809m for M1 and M6 respectively. Few models that are not specifically region calibrated and reanalysed would be able to meet this requirement
- Overall Wave period: specifies (Te) bias not exceeding 0.5s. Close to being met by the WW3 model in this case, with 0.6767s and 0.506s Bias in Tz for M1 and M6 respectively. Further reduction would be possible using a correction factor to shift the wave periods

Future Planned Work:

- 24 month period: January 2016 – December 2017
- FOCUS: The nearshore deployment location

- Validating the model with measured nearshore data

- Provide a more detailed understanding of the near-shore environment at the WESTWAVE site using Boussinesq modelling methods

- Assess the bathymetry at the near-shore site considering the placement of device foundations

- To provide confidences of weather window occurrence predictions using predicted and measured data for the site

- To provide a technology risk assessment for selected technology types at the WESTWAVE site

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