Inch Cape Offshore Wind Farm

New Energy for Scotland

Offshore Environmental Statement:

VOLUME 2C

Appendix 10D: Proposed Methodology for Metocean and Coastal Processes Assessments

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SEAENERGY RENEWABLES LIMITED

INCH CAPE AND NEART NA GAOITHE OFFSHORE WIND FARMS

PROPOSED METHODOLOGY FOR METOCEAN AND COASTAL PROCESSES ASSESSMENTS

Report Reference. P1476_RN2550_Rev1.docm

Issued 16 February 2011

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DOCUMENT RELEASE FORM

Title:	INCH CAPE AND NEART NA GAOITHE OFFSHORE WIND FARMS PROPOSED METHODOLOGY FOR METOCEAN AND COASTAL PROCESSES ASSESSMENTS
Client:	SEAENERGY RENEWABLES LIMITED
Report Reference:	P1476_RN2550_REV1.DOCM
Date of Issue:	16 February 2011

		Hard Copy	***Digital***
Distribution:	SEAENERGY RENEWABLES LIMITED	No: 0	PDF
	MAINSTREAM RENEWABLE POWER LIMITED	No: 0	PDF
	METOC LIMITED	No: 0	PDF
	PARTRAC LIMITED	No: 0	PDF
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Rev No	***Date***	***Reason***	***Author***	***Checker***	***Authoriser***
Rev 0	21/01/2011	Original	KRM	CPM	DW
Rev 1	16/02/2011	Incorporating client comments	KRM	CPM	DW

COPY NUMBER: (applies to hard copies only)

SUMMARY

BACKGROUND

This report has been prepared for SeaEnergy Renewables Limited (SERL) by Intertek-Metoc. It describes the proposed approach for undertaking assessments of metocean and coastal processes relating to the Scottish Territorial Waters (STW) Forth and Tay offshore wind farm developments:

- The Inch Cape site will be developed by SERL. SERL is acting as the lead contact for the metocean and coastal processes assessments.
- The Neart na Gaoithe site will be developed by Neart na Gaoithe Offshore Wind Limited, a subsidiary company of Mainstream Renewable Power Limited (Mainstream).

The purpose of this report is to allow agreement to be reached on the proposed methodology between SERL, Mainstream, and other stakeholders in the planned developments.

Intertek-Metoc will undertake the required assessments supported by Partrac Limited.

STUDY OVERVIEW

The Forth and Tay STW wind farm developments will potentially affect both the meteorological / oceanographic (metocean) and coastal processes regimes in and around the development areas. Effects may range from short to long term; the assessment will consider timescales up to 25 years. The developers require an understanding of the magnitude and significance of these effects, with a view (if necessary) to implementing appropriate mitigation measures in order to minimise impacts. The study outputs will help to inform the technical design, installation, operation and decommissioning of the wind turbine foundations.

The assessment will initially aim to define baseline environmental conditions, against which the effects of each individual development, and the in-combination and cumulative effects of all developments, can be assessed. The study results will be reported separately, and will also be provided as a chapter of the Environmental Statement (ES) forming part of the required Environmental Impact Assessment (EIA) for each development.

DATA

Reliable, validated field data are essential to the successful delivery of the study. Metocean and sediment survey campaigns have been undertaken by the STW Forth and Tay developers specifically to support the proposed assessment and related activities. In addition, there are extensive metocean and sediment data already available for the area. These data sources will be used to:

- update the data review and gap analysis that has previously been undertaken;
- determine any additional field surveys that might be required;
- provide an overall understanding of the oceanography and sediment / morphological regimes of the study area;
- provide additional data for calibration / validation of the regional and local numerical models.

MODELLING AND IMPACT ASSESSMENT

Bespoke hydrodynamic, spectral wave and sediment models covering the two STW sites and the surrounding region will be developed, calibrated and validated. These models will comprise the Forth and Tay Modelling System (FTMS). Both the FTMS and the subsequent impact assessments will be developed and implemented according to industry best practice.

The FTMS, together with the available field data, will be used to assess the following:

- baseline conditions (an understanding of the metocean and sedimentological regimes as they are now);
- post-construction impacts from each individual wind farm (focusing on how metocean and sedimentological conditions are modified relative to the baseline);
- post-construction cumulative impacts from the two wind farms;
- post-construction long-term (25 year) in-combination impacts from the two wind farms, the proposed Round 3 Zone 2 (Firth of Forth) wind farm, and any other industries or developments that may be identified in the area;
- scour potential around individual structures and the need/justification for scour protection;

- short-term impacts on suspended sediment concentrations during the construction phase (such as from laying foundations or dredging cables);
- the possible implications of climate change to the impacts predicted by the metocean and coastal processes assessment.

Impacts will be assessed both in general terms, and with specific reference to sensitive receptors. Key receptors will be identified from existing designations, from field sampling data, and through discussion with the project teams and other stakeholders.

STUDY OUTPUTS

The results of the proposed assessments will be presented to the relevant stakeholders through a series of technical reports and briefing notes, supplemented by project update meetings and regular communication on progress.

The key reports anticipated are:

- Data Review and Gap Analysis Briefing Note;
- FTMS Calibration and Validation Report;
- Interim Technical/Design Briefing Note (covering baseline conditions, for input to the technical work streams);
- Interim Environmental Briefing Note (covering baseline conditions, for input to the EIAs as required);
- Final Technical/Design Report (covering the impact of the developments, for input to the technical work streams);
- Final ES Chapters (covering the impact of the developments, for input to the EIAs as required).

We will also provide the developers with relevant data sets, model set-up files and impact assessment results files, as required.

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LIST OF ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
AWAC	Acoustic Wave and Current profiler
BAP	Biodiversity Action Plan
BODC	British Oceanographic Data Centre
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
DECC	Department of Energy and Climate Change
EIA	Environmental Impact Assessment
ES	Environmental Statement
FM	Flexible Mesh
FTMS	Forth and Tay Modelling System
GWh	Gigawatt-hour
HD	Hydrodynamic
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
Mainstream	Mainstream Renewable Power Limited
MW	Megawatt
OWF	Offshore Wind Farm
SAC	Special Area of Conservation
SERL	SeaEnergy Renewables Limited
SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
STW	Scottish Territorial Waters
SW	Spectral Wave
UKHO	UK Hydrographic Office

1 INTRODUCTION

1.1 OVERVIEW

This report has been prepared for SeaEnergy Renewables Limited (SERL) by Metoc Limited (Intertek-Metoc). It describes the proposed approach for undertaking assessments of metocean and coastal processes relating to the Scottish Territorial Waters (STW) Forth and Tay offshore wind farm (OWF) developments.

The proposed methodology reflects the scope of work as set out in the Invitation to Tender (Document No. INC-OPS-PURC-ITT-002, Rev 3, 7 September 2010) and subsequent discussions.

The purpose of this report is to allow agreement to be reached on the proposed methodology between SERL, Mainstream Renewable Power Limited (Mainstream), and other stakeholders in the planned developments.

Intertek-Metoc will undertake the required assessments supported by Partrac Limited.

1.2 PROJECT BACKGROUND

The Forth and Tay STW wind farm developments will potentially affect both the meteorological / oceanographic (metocean) and coastal processes regimes in and around the development areas. Effects may range from short to long term; the assessment will consider timescales up to 25 years. The OWF developers require an understanding of the magnitude and significance of these effects, with a view (if necessary) to implementing appropriate mitigation measures in order to minimize impacts.

SERL is acting as the lead contact for the metocean and coastal processes assessments. The other developer is Mainstream. Previously, the proposed assessments also covered the Forth Array STW area, but the developer for this area has subsequently pulled out.

Figure 1.1 presents an overview of the study region, showing the STW wind farm areas and the UK Round 3 Zone 2 (Firth of Forth) wind farm area. The figure still shows the Forth Array site originally to be developed by Fred Olsen Renewables, but this site has presently been dropped from their development plans and it is presently not known whether the Crown Estate lease for the area will be re-let.

1.2.1 Inch Cape

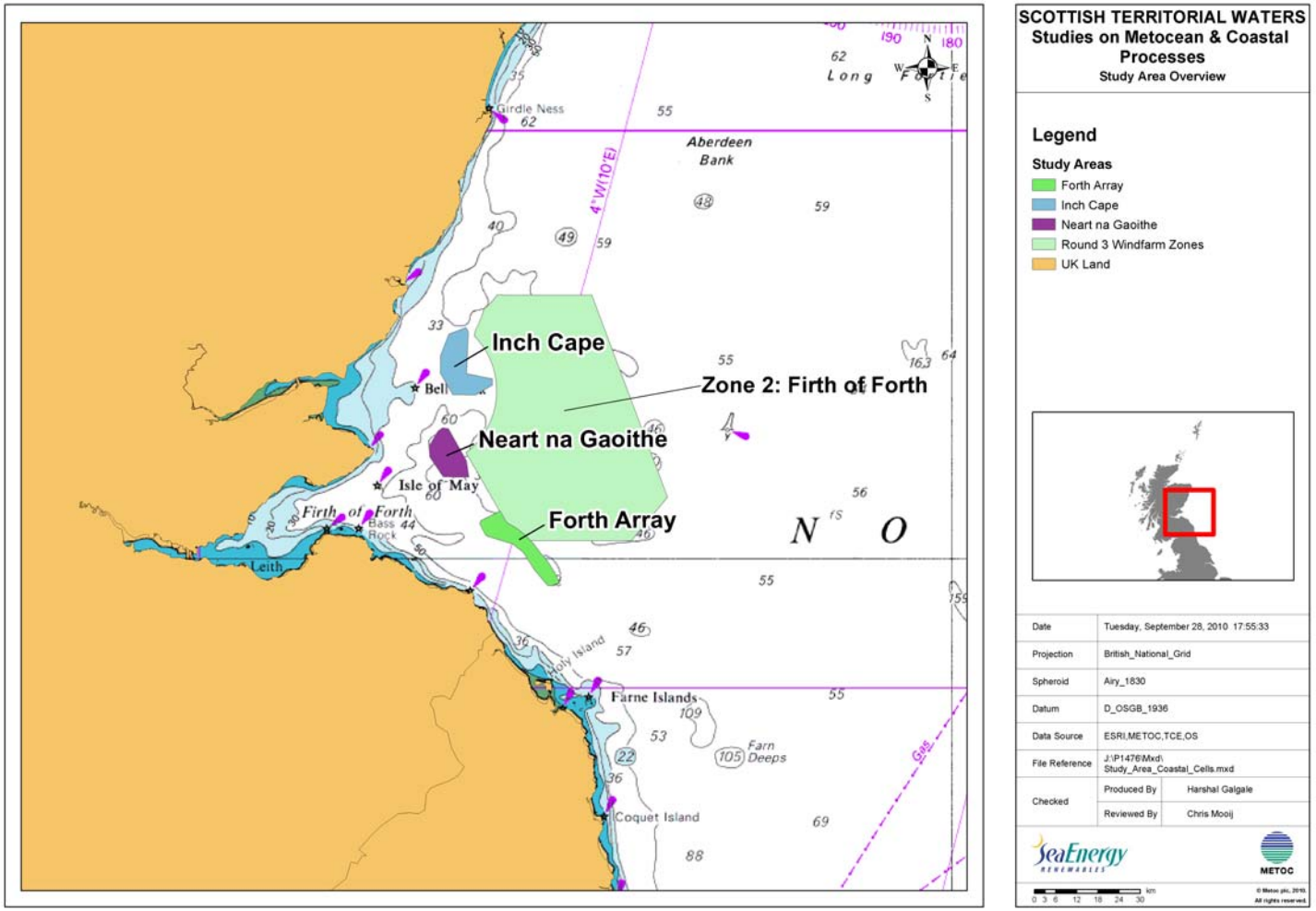
The proposed Inch Cape OWF will be developed by SERL. The site lies approximately 15-22 km to the east of the Angus coastline in Scotland, entirely within Scottish territorial waters, in water depths of 30-50 m relative to Lowest Astronomical Tide (LAT). It is anticipated that the development will consist of over 174 wind turbines covering an area of approximately 150 km^2, with a

potential installed capacity of over 1000 MW and a potential yield of over 3000 GWh per year.

1.2.2 Neart na Gaoithe

The proposed Neart na Gaoithe OWF will be developed by Neart na Gaoithe Offshore Wind Limited, a subsidiary company of Mainstream Renewable Power Limited. The site is located approximately 15 km off the Fife coast in water depths of 44-55 m LAT. The development is anticipated to cover an area of approximately 100 km^2. The OWF has the potential to generate 420 MW of renewable energy.

Figure 1.1: Study area overview



1.3 SCOPE OF DOCUMENT

This methodology document covers the following key areas to support discussions with consultees:

- the general study approach;
- available data and supporting field surveys;
- the modelling and assessment approach;
- communications and deliverables.

2 METHODOLOGY OVERVIEW

2.1 SCOPE OF ASSESSMENTS

The proposed assessments will provide the developers and other stakeholders with regional and site-specific characterisation of the metocean and sedimentological environment. This will allow the baseline environmental conditions to be determined, against which the effects of each individual development, and the in-combination and cumulative effects of all developments, can be assessed. The study results will be reported separately, and will also be provided as a chapter of the Environmental Statement (ES) forming part of the required Environmental Impact Assessment (EIA) for each development.

Bespoke Hydrodynamic (HD) and Spectral Wave (SW) models covering the region and the two STW sites will be developed, calibrated and validated. These will be built using the MIKE21 Flexible Mesh (FM) modelling system, and embedded in Intertek-Metoc's existing MIKE21 North Sea model, which will provide boundary conditions.

The models, together with a data and literature review, will be used to assess the following:

- baseline conditions;
- post-construction impacts from each individual wind farm;
- post-construction cumulative impacts from the two wind farms;
- post-construction long-term (25-year) in-combination impacts from the two wind farms, the proposed Zone 2 (Firth of Forth) wind farm, and any other industries or developments that may be identified in the area;
- scour potential around individual structures and the need/justification for scour protection;
- short-term impacts on suspended sediment concentrations during the construction phase (such as from laying foundations or dredging cables);
- the possible implications of climate change to the impacts predicted by the metocean and coastal processes assessment.

Impacts will be assessed both in general terms, and with specific reference to sensitive receptors. Key receptors will be identified from existing designations, from field sampling data, and through discussion with the project teams and other stakeholders.

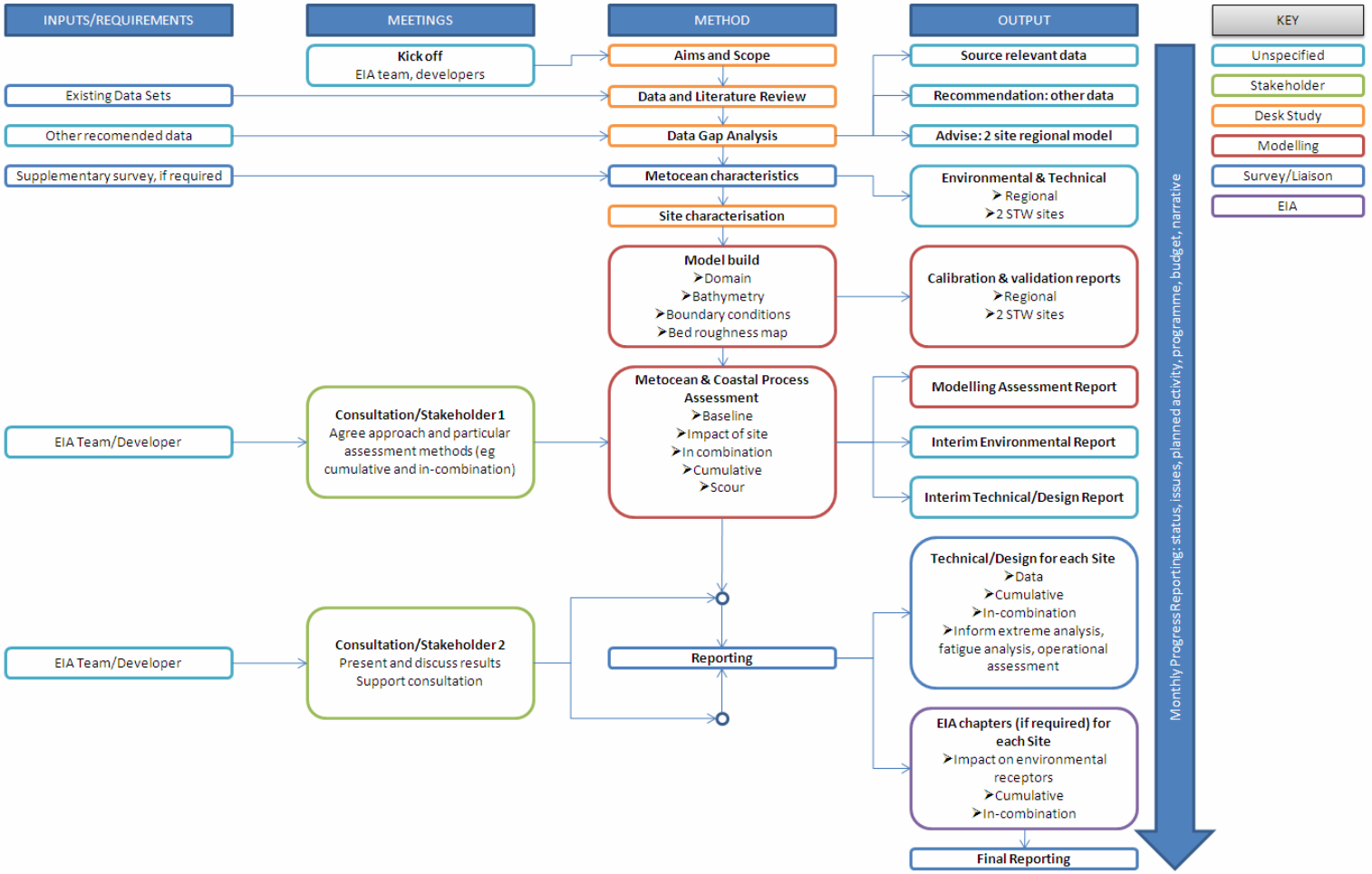
In addition, our assessment will provide the fundamental inputs for undertaking technical work streams, such as scour analysis and detailed metocean design and operating criteria assessments. The underlying model and associated outputs, together with the metocean data collated for the EIAs, will provide inputs for the technical design, installation, operation and decommissioning of the wind turbine foundations. The HD and SW models developed will also be available to help determine extreme and fatigue design requirements and operational statistics. The coastal processes study is anticipated to provide support to the technical work streams in the following key areas:

- assessment of the potential for scour, likely scour depths and the requirement for scour protection;
- analysis of the cumulative impacts between individual turbine structures, which might have implications for site layout;
- provision of the Forth and Tay Modelling System, which may have future applications for a detailed metocean design assessment (for example, it could help to assess the spatial variability of extreme wave and current conditions);
- additional data sets obtained during the study that could be used to inform other elements of the project, such as metocean and engineering design.

2.2 OUTLINE OF ACTIVITIES

Figure 2.1 outlines the key stages, inputs and outputs of the proposed assessments.

Figure 2.1: Project summary diagram



The key project activities are summarised as follows:

Ongoing stakeholder consultation

- Discussions with all relevant stakeholders, including clients, survey contractors and regulators, in particular to review in-combination and cumulative effects and other EIA requirements.

Data analysis and literature review

- Interpretation and review of the data collected as part of the STW metocean campaign.
- Collation of other extant data sets relevant to the assessment.
- A review of the gap analysis and subsequent advice on any additional survey requirements.
- Advice to clients on potential for modelling the two sites with existing data.

HD and SW model construction, calibration and validation

- Development of bespoke wave and current models of the region, with high resolution around the two STW sites – embedded within Intertek-Metoc's existing North Sea model – using MIKE21 FM.
- Calibration of the wave and current models against field data (primarily), and other appropriate data (i.e. existing calibrated and validated models).
- Validation of the wave and current models against independent field data, in particular the site-specific data obtained from the STW metocean campaign.

Baseline assessment

- Develop understanding of existing metocean conditions and sediment/morphological regime based on STW metocean campaign data, historical information and conceptual models.
- Dedicated wave and current model runs using the models for typical tidal and wave climate conditions.

Impact assessments

- Re-configure the wave and current models to account for single structures (for near-field impacts) and wind farm arrays (for far-field impacts).
- Undertake the dedicated wave and current model runs using the same scenarios but using the 'with-development' modified models.
- Assess the likelihood and scale of near and far-field impacts on metocean and coastal processes based on differences in wave and current regimes between baseline and impact assessment runs.
- Analyse the potential effects of climate change scenarios in respect of the predicted impacts from the developments.

Note – a detailed list of the impact assessment scenarios is provided in Section 3.6.

Reporting

- Technical/Design Report for each site – to include the effect of the developments on the near and far-field metocean and coastal process characteristics.
- ES chapters as required for each site – to include the effect of the developments on the near and far-field metocean and coastal process characteristics.

2.3 ENVIRONMENTAL UNDERSTANDING

In order to consider the impacts of a proposed offshore wind power development, the natural environment of the site must be established. The two STW developments will lie in a relatively exposed offshore environment, which poses quite distinct issues when compared with a near coast development.

The offshore environment normally has:

- deeper water, and is therefore generally less dynamic;
- less frequent exposure to seabed wave action;
- higher waves at the surface, due to the deeper water, longer fetch lengths and decreased sheltering from land;
- more spatial uniformity;
- larger sources and sinks of sediments;
- more gradual movement of sediment along broad pathways;
- less sensitivity to change.

Considerable work has already been carried out in the Forth and Tay area, which showed that metocean conditions can be extreme. A previous study carried out by Intertek-Metoc on the Round 3 Zone 2 (Firth of Forth) site, predicted 50-year return maximum wave heights in excess of 17 m. This is likely to be more extreme than coastal wind farm sites.

Offshore bathymetric charts are by their very nature liable to be less accurate than for coastal sites, as the Admiralty is primarily focused on identifying shallow areas due to their implications on navigation. Therefore, a careful review of the available bathymetry data will be carried out as part of the data review, and recommendations will be made for any further bathymetric survey required.

Similarly, sediment transport, fluxes, sources, sinks and pathways are likely to be less well defined in deeper water areas, albeit that offshore wind developments are likely to be very small in comparison to large scale sediment pathways.

The depth of water also means that the existing characterisation of the geophysical and geochemical properties of sediments is likely to be limited. This is compounded by long transport distances and the sorting process resulting from different particle sizes and weights, which is likely to lead to poorly characterised heterogeneous sediments. These issues draw attention to the importance of the STW Forth and Tay metocean and sediment characterisation survey campaign.

2.4 SENSITIVE AREAS

There are numerous protected areas designated around Inch Cape and Neart na Gaoithe wind farm zones. These include two large marine Special Areas of Conservation (SAC): Berwickshire and North Northumberland Coast SAC, and the Firth of Tay and Eden Estuary SAC, which cover areas of 650 km^2 and 154 km^2 respectively.

Berwickshire and North Northumberland Coast SAC extends from St. Abb's Head in the north to Alnmouth Bay in the south. It is one of the most varied stretches of coastline within the UK and incorporates rocky reefs, sand and mud flats, sea caves, and large shallow inlets and bays.

Another contributing factor to the designation of this SAC is its breeding colony of grey seal (*Halichoerus grypus*), which contributes 3% of the UK's annual grey seal births.

The Firth of Tay and Eden Estuary SAC extends from the region of Carnoustie, north of the Firth of Tay, to St Andrews on the southern boundary of the mouth of the River Eden. The two estuaries form an integral component of a large, geomorphologically complex area that incorporates a mosaic of estuarine and coastal habitats. The inner sections of both estuaries are relatively protected from wave action, while the outer areas, particularly of the Tay, are exposed to strong tidal streams. This gives rise to a complex pattern of erosion and deposition of the sandbank features at the firths' mouth. The SAC also supports 2% of the UK's population of common seal (*Phoca vitulina*), which utilise the SAC's sandbank habitat for breeding, hauling out, and as moulting sites.

Within the vicinity of the STW wind farm zones there are several habitats which have been designated as Special Protection Areas (SPA) due to their importance for bird species.

The SPAs incorporate important breeding and wintering areas for 23 species of birds, including species listed on the UK's Biodiversity Action Plan (BAP) list of priority species. The SPAs also protect internationally important assemblages of waterfowl and seabirds. For example, the Fowlsheugh SPA, located to the north of the wind farm zones, regularly supports up to 145,000 individuals, while the Firth of Forth SPA regularly supports up to 95,000 individuals. Many of the birds within the project area rely on sandeels as a major component of their diet – both of the wind farm zones fall within sandeel spawning and nursery grounds.

The majority of the coastline around the two wind farm zones is designated as Sites of Special Scientific Interest (SSSI). These areas have been designated to protect nationally important biodiversity and geological sites.

2.5 STAKEHOLDER LIAISON

Stakeholder liaison will form a key part of the ongoing assessment. In the past, Intertek-Metoc and Partrac have found that early discussions with stakeholders and regulators ensure that studies are addressing the correct issues. The early and direct involvement of other parties has been shown to help the delivery of studies to budget and time.

We have long experience of successful engagement with a very wide range of government agencies and regulators. These include:

- Marine Scotland;
- Scottish Natural Heritage (SNH);
- the Scottish Environment Protection Agency (SEPA);
- the Department of Energy and Climate Change (DECC);
- the Joint Nature Conservation Committee (JNCC);
- the Crown Estate.

We also recognise the experience of effective liaison with the STW developers – for example, with the EIA teams. This is another area where the Intertek-Metoc / Partrac team can demonstrate a string track record.

The key issues in the proposed assessments are likely to revolve around:

- changes to the wave regime;
- the impact of changes to sediment transport on local fisheries and on sensitive species within the areas of interest;
- the impacts of the turbines and associated structures on the ecology of the area;
- changes to sea bed stability and morphology.

3 DATA AND SURVEYS

3.1 REQUIREMENT

Reliable, validated field data are essential to the successful delivery of the proposed assessments. Intertek-Metoc and Partrac have worked closely on a variety of previous studies, and together we bring a comprehensive understanding of data issues, from initial planning, through collection and auditing, to final use in marine impact assessments.

Metocean and sediment survey campaigns have been undertaken by the STW Forth and Tay developers specifically to support the proposed assessment and related activities. In addition, there are extensive metocean and sediment data already available for the area. These data sources will be used to:

- update the data review and gap analysis that has previously been undertaken for the developments;
- determine any additional field surveys that might be required to undertake the assessment;
- provide an overall understanding of the oceanography and sediment / morphological regimes of the study area;
- provide additional data for calibration / validation of the regional and local numerical models.

3.2 DATA REVIEW AND GAP ANALYSIS

We will undertake a review of the existing data and gap analysis. This earlier study will be updated with a description and critical appraisal of new data sources, particularly those obtained through the STW Forth and Tay measurement campaign. The review will also assess other data sets that might be useful, and advise on options for incorporating metocean and bathymetry data from the Round 3 Zone 2 Firth of Forth development, should this information become available.

The whole body of metocean and sediment characteristic data, from both the STW survey and existing data sources, will be reviewed by our technical experts. These experts will provide interpretations of these data which will be an essential input to the subsequent modelling and metocean studies. At this point, any additional data collection and interpretation requirements will be defined. Our team of experts will provide guidance to resolve gaps in the data available to the study; these data may include geophysical, geological and benthic aspects.

Additional metocean data requirements could include the purchase of wave buoy data, wave hindcast model data, meteorological data, tidal elevations and temperature data. Partrac's sedimentology experts will review the sediment characteristic data collected in the survey campaign. Requirements for additional laboratory analysis and the purchase or gathering of additional data from previous studies may be defined.

This phase of the study will require close collaboration between clients, the survey contractor and our team of experts. The interpretation of the available data will be used as the basis of discussion to develop any additional survey

programme that might be required to meet the needs of both the studies for the EIA and the design, construction and operational requirements of the wind farms.

3.3 STW FORTH AND TAY SURVEY CAMPAIGN

The data available from the survey campaign at the STW wind farm sites will include:

- 4 x Acoustic Doppler Current Profiler (ADCP) datasets including wave and current measurements;
- 4 x directional pitch roll buoys – recorded wave measurements;
- 1 x Acoustic Wave and Current (AWAC) profiler datasets, including near-bed currents and turbulence and suspended sediments (from optical backscatter) – recorded near the Neart na Gaoithe site;
- 5 x water quality datasets – taken at the ADCP/AWAC locations;
- 5 x grab sample datasets – taken at the ADCP/AWAC locations;
- 1 x sediment trap at the Neart na Gaoithe site.

The STW developers have also obtained bathymetric data from the UK Hydrographic Office (UKHO), which will be used in the proposed assessment. Data are available for both the Inch Cape and Neart na Gaoithe sites.

3.4 ADDITIONAL SURVEY REQUIREMENTS

Best practice guidance for OWF coastal processes studies recommends that data collection should be site-specific, include direct impacts on hydrodynamics and sediment dynamics, and include indirect impacts on the wider environment (e.g. benthos, fisheries, coastal protection, water and sediment quality, and conservation sites).

It is assumed that the dedicated metocean and sediment survey campaign has been designed in line with these guidelines. Based on this assumption, and the additional extant data that is available, we do not anticipate any additional surveys will be required in order to undertake the assessment.

However, the update of the data review and gap analysis, which forms part of the proposed assessment, will inform the final decision of whether any additional surveys are required.

3.5 OTHER EXTANT DATA

In addition to the data that will be available from the dedicated survey campaign, a variety of existing data are also available:

- current velocity data held by the British Oceanographic Data Centre (BODC) at different depths through the water column;
- current velocity data held by Scottish Water;
- national tide gauge network elevations at Leith and tidal elevations at a number of secondary ports;
- wave buoy data from the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) WaveNet network (Firth of Forth site);

- wave time series and statistics (height, period, direction) data held by the UK Meteorological Office;
- wind time series and statistics (speed and direction) data held by the UK Meteorological Office.

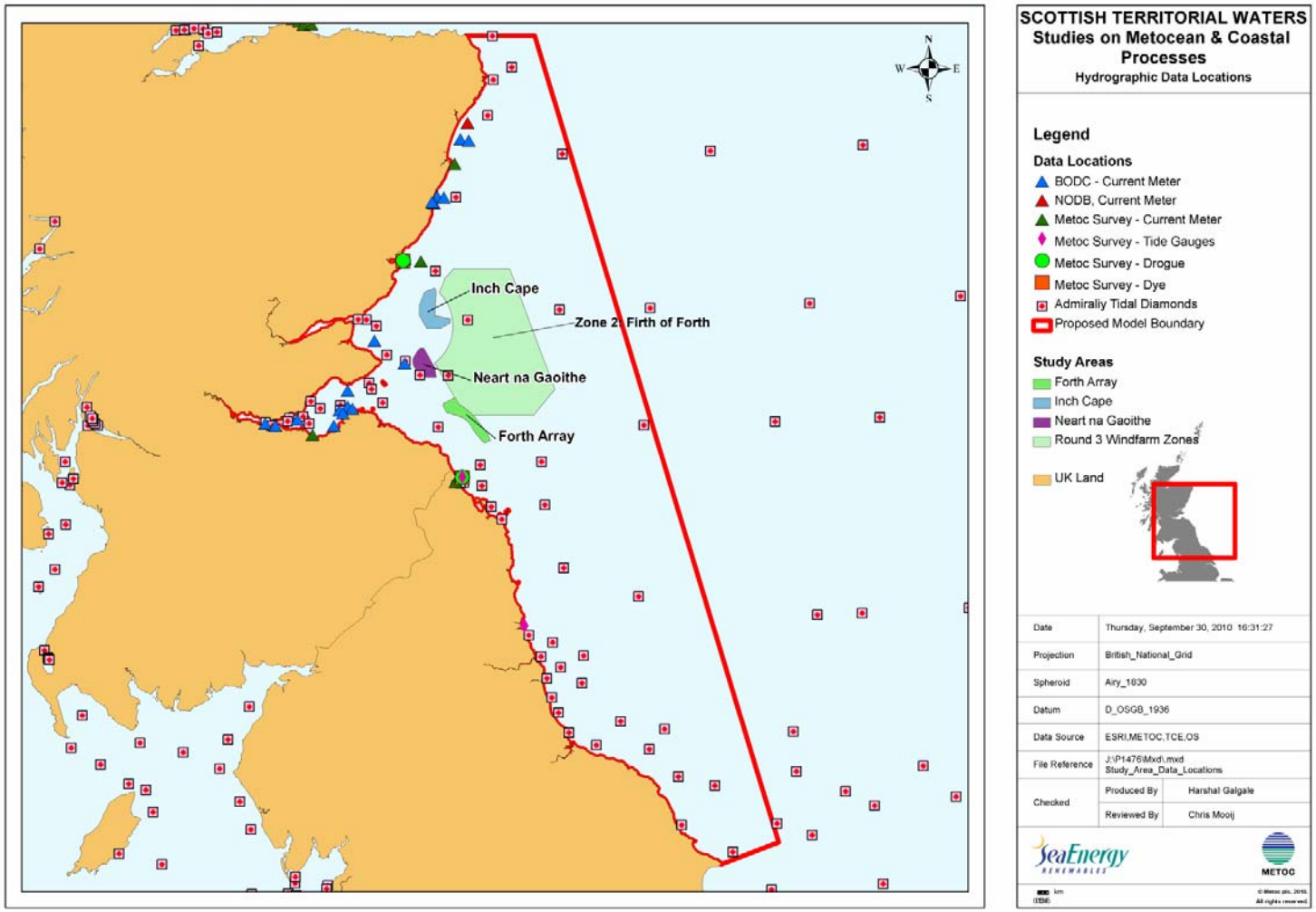
Figure 3.1 provides a overview of the main hydrographic data sets that are available in addition to the STW survey campaign.

We will carry out a detailed data review and literature search to identify any additional sources of tidal, wave or sediment data. We will quality control and validate all the relevant data (including that provided from the dedicated survey campaign), checking for data gaps and consistencies, in line with the best practice guidance. Specifically, we will review the different types of data with the following issues in mind:

- Waves – surface buoy and/or seabed mounted devices. It is important that the deployment be for months to provide information on seasonal variations.
- Tidal Currents – ADCPs. Again it is important that the deployment be for months to provide information on seasonal variations, and to allow harmonic analysis in order to separate out tidal and non-tidal components.
- Coastal Processes:
    - Sedimentology – analysis of bed samples for composition, geochemistry, contaminants and particle size. Analysis of water column samples for suspended sediment concentrations.
    - Sedimentary environment – study of literature, historical and current charts, bathymetry and side scan sonar to establish sediment re-suspension, sediment transport pathways, patterns and rates and sediment deposition.
    - Geomorphology – study of literature and historical and current bathymetry data to establish changes to channels, banks, large-scale bedforms, bioturbation, and depth of mixed layers.

The extent and time periods of the available data will be entered into a GIS database and shown as graphical output. This GIS database will play a key role in understanding the quality and distribution of available data.

Figure 3.1: Hydrographic data locations



3.6 SURVEY DATA MANAGEMENT

If any part of the survey campaign is ongoing during the proposed assessment, or if new surveys are undertaken, the Intertek-Metoc/Partrac team will support the management of the surveys and the review of data thus obtained.

The fundamental importance of good, reliable, validated field survey data to this study means that we will maintain close contact with the survey contractor throughout any ongoing or future survey campaign. Regular teleconferencing is likely to be the most efficient way of ensuring the smooth running of the survey. In conjunction with the survey team, we will develop a bespoke system to:

- Check survey data returns at frequent intervals. This will allow us to ensure that the right quality of data is being collected and to quickly rectify any problems.
- Review each component of the survey data after full recovery and post-processing by the survey contractor.
- Manage the upload of the survey data to the client(s) data system(s), in a format agreed with the client and survey contractor.

The output from these tasks will form part of the updated data review and gap analysis report. This will confirm the suitability of the data sets for use in the EIA and technical assessments.

3.7 PROVISION OF CLIENT DATA

Section 6 discusses various issues surrounding the provision of client data for the two OWF areas, and how these data fit into the project programme.

4 MODELLING AND ASSESSMENT APPROACH

4.1 OVERVIEW

The Forth and Tay modelling study will provide input to the environmental and technical work streams for the two STW sites, and for the wider region.

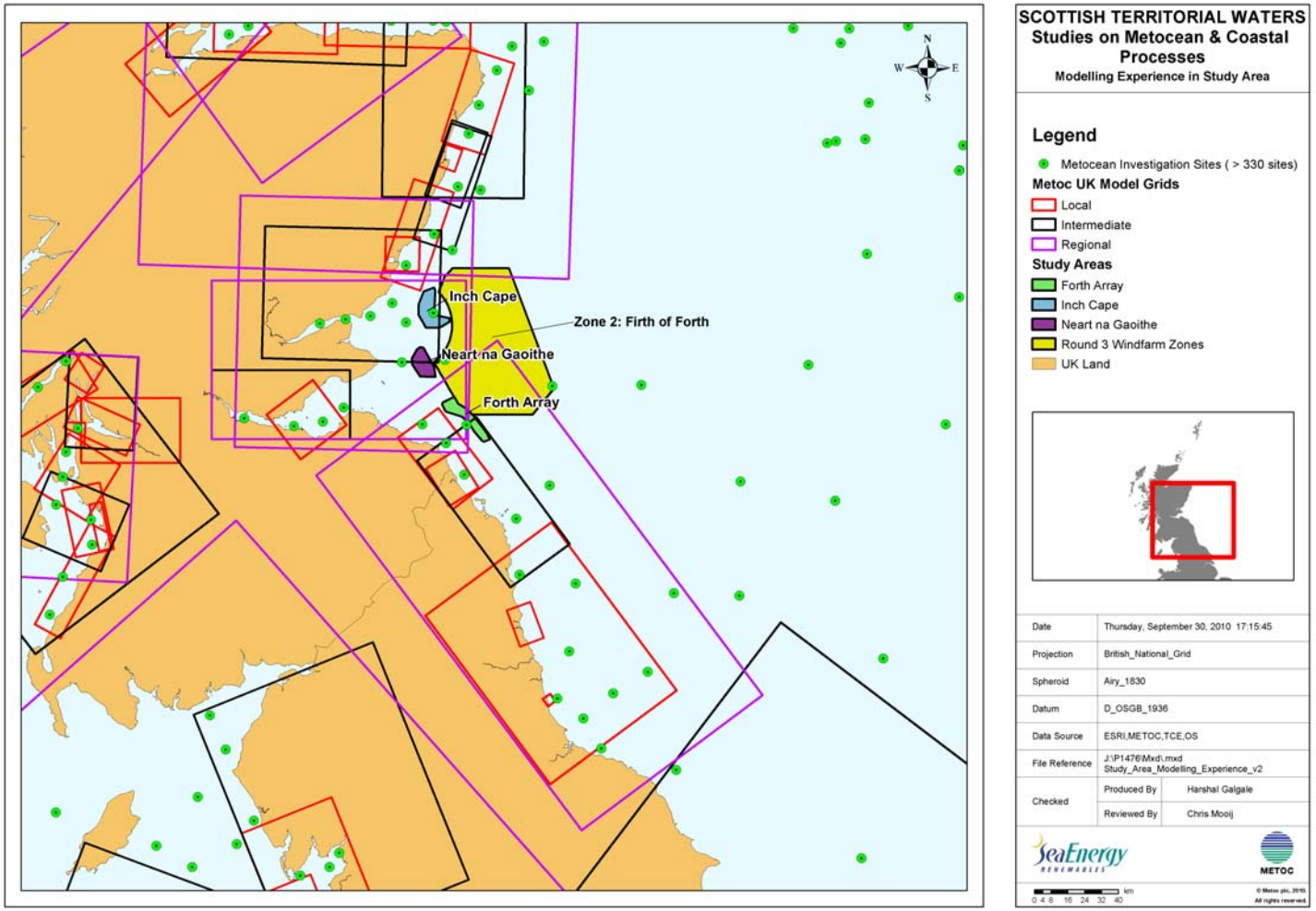
The modelling will address potential impacts on metocean and coastal processes. It will be supported by other studies as appropriate. For example, these will include a review of conditions for the baseline assessment based on existing information and historical data sets, and a scour assessment based on previously established empirical relationships.

Impacts will be assessed both in general terms, and with specific reference to sensitive receptors. Key receptors will be identified from existing designations, from field sampling data, and through discussion with the project teams and other stakeholders.

The Forth and Tay Modelling System (FTMS) will be constructed according to industry best practice.

Figure 4.1 illustrates Intertek-Metoc's modelling and metocean experience within the general study area.

Figure 4.1: Modelling experience in study area



4.2 MODELLING SYSTEM

4.2.1 Modelling Software

The FTMS will be developed using the MIKE 21 Flexible Mesh (FM) software. This is widely accepted throughout the UK as an appropriate platform for model development.

Intertek-Metoc has developed numerous analysis tools that add considerable value and flexibility to the basic MIKE system. These tools will be fully incorporated into the FTMS and will help to deliver a high quality assessment.

4.2.2 Forth and Tay Modelling System

The FTMS will comprise a suite of models covering the following environmental processes:

- hydrodynamics;
- wave processes (using the Spectral Wave module);
- sediment transport, erosion and deposition.

The hydrodynamic model will characterise tidal currents and elevations across the study areas.

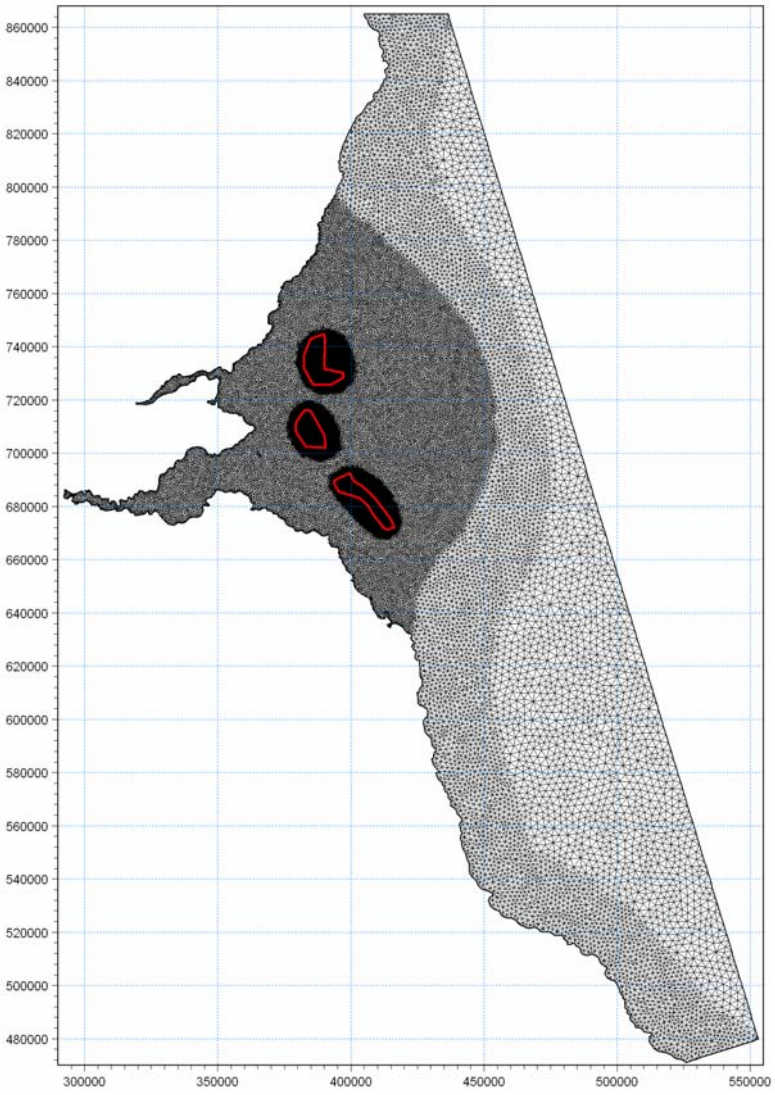
The wave model will provide details on the wave regime throughout the STW wind farm zones. This model will account for the key wave processes, including:

- refraction;
- shoaling;
- dissipation due to bottom friction and wave breaking;
- wind-wave generation;
- directional and frequency spreading.

The hydrodynamic, wave and sediment models will all be run within an unstructured mesh. This makes use of triangular elements in order that spatial resolution can be varied throughout the model domain. This approach provides the greatest flexibility for addressing environmental conditions throughout the study areas. The hydrodynamic, wave and sediment models are dynamically linked, allowing in-combination effects to be studied (e.g. the combined influence of currents and wave motions on sediment movement).

Figure 4.2 shows an example of the sort of unstructured (flexible) mesh that will be used in the proposed assessments.

Figure 4.2: Indicative example of FTMS unstructured model mesh



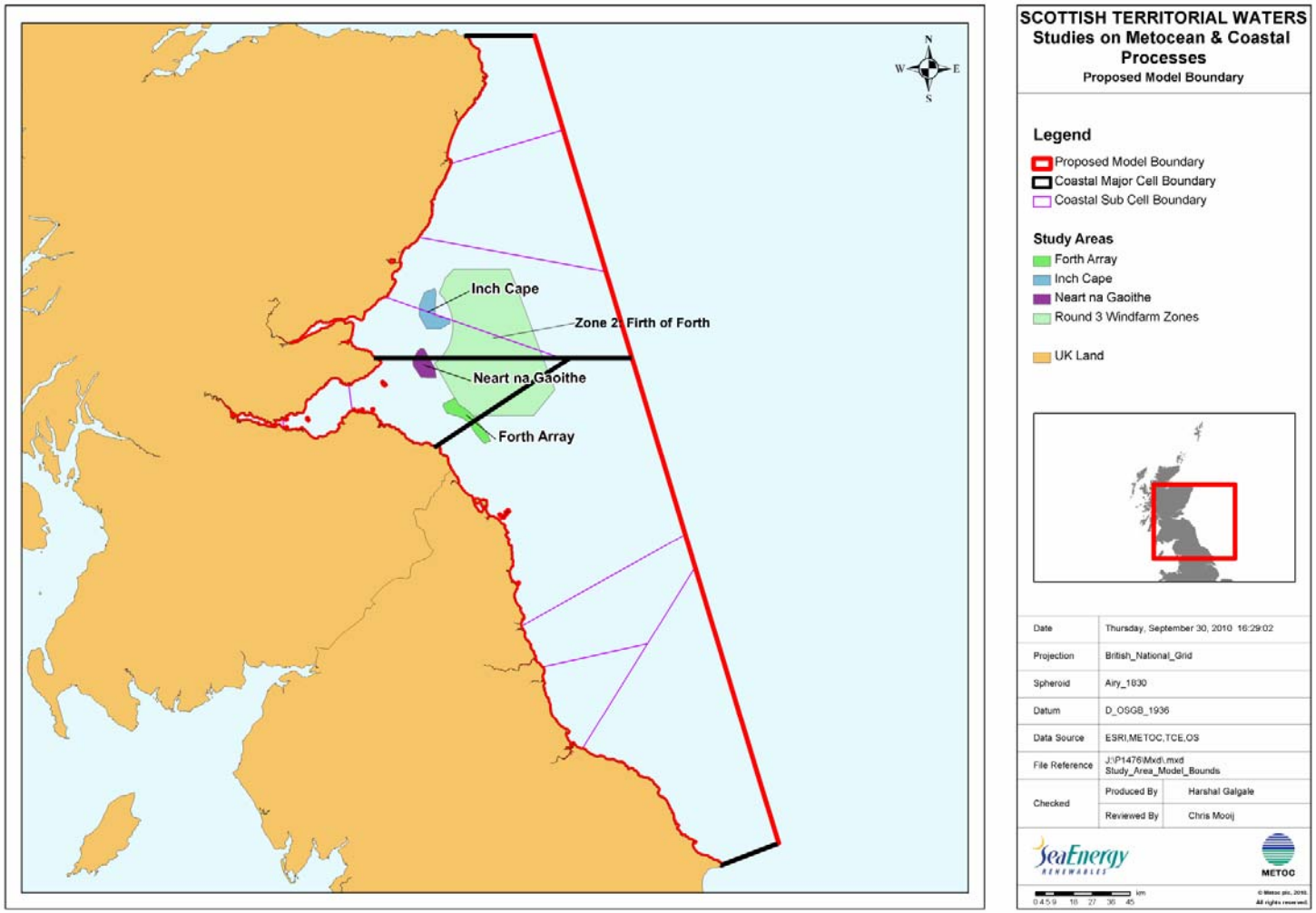
4.2.3 Model Definition

The FTMS domain will encompass:

- the two key STW wind farm areas (Inch Cape and Neart na Gaoithe) at high resolution;
- Round 3 Zone 2 (Firth of Forth) at lower resolution (which can be upgraded later if required, or if new data are acquired);
- a distance offshore to allow more regional metocean and impact effects;
- the entire coastal region from Flamborough Head (south of Scarborough) to north of Peterhead, to cover the coastal sediment transport cells that might potentially be affected by the STW developments.

Figure 4.3 illustrates the proposed model domain in relation to the coastal sediment cells.

Figure 4.3: Proposed model boundary and coastal sediment cells



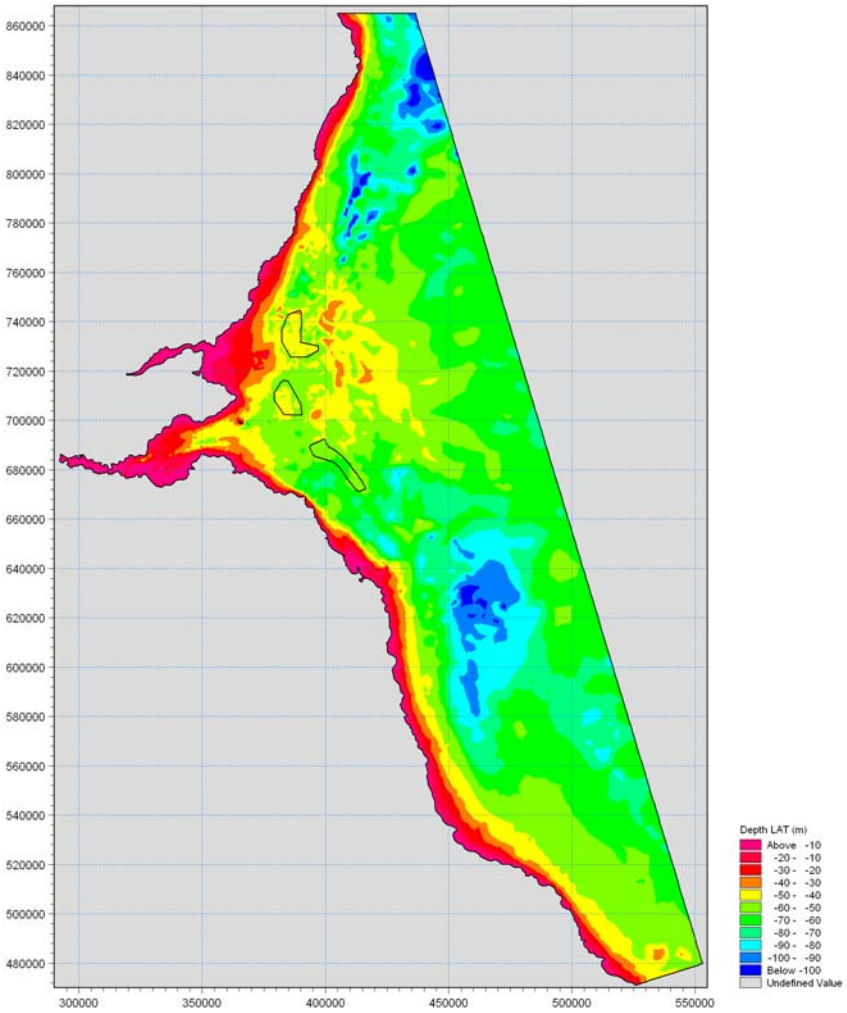
The resolution of the model will be tailored to fit the study requirements. The exact resolution will be determined at an early stage of the study, based on the possible layouts of the wind farms and the available bathymetric data. In general, the highest resolution will be applied in the wind farm areas (a resolution of 30 m or less is anticipated).

Medium resolution will be applied in the nearby coastal areas, and the coarsest resolution in offshore areas and locations furthest from the study sites.

4.2.4 Model Construction

Bathymetry data from the UK Hydrographic Office will be provided for the wind farm areas by the client. These data will be supplemented for the wider model area by digitised data from Admiralty charts. Intertek-Metoc holds a licensed copy of this entire data set, which will be used for the model construction. Figure 4.4 illustrates bathymetry variation across the proposed model domain.

Figure 4.4: Bathymetry across proposed model domain



Hydrodynamic model boundary conditions will be obtained from Intertek-Intertek-Metoc's North Sea Hydrodynamic Model. This is a fully calibrated and validated model covering the whole of the North Sea and English Channel. It has previously been accepted by the Environment Agency in England and

Wales for use in offshore impact assessments. Intertek-Metoc will make available the hydrodynamic data from this model to the client(s).

Figure 4.5 illustrates Intertek-Metoc's North Sea Hydrodynamic Model domain. Figure 4.6 shows calibration performance against tidal co-range lines.

Figure 4.5: North Sea hydrodynamic model domain

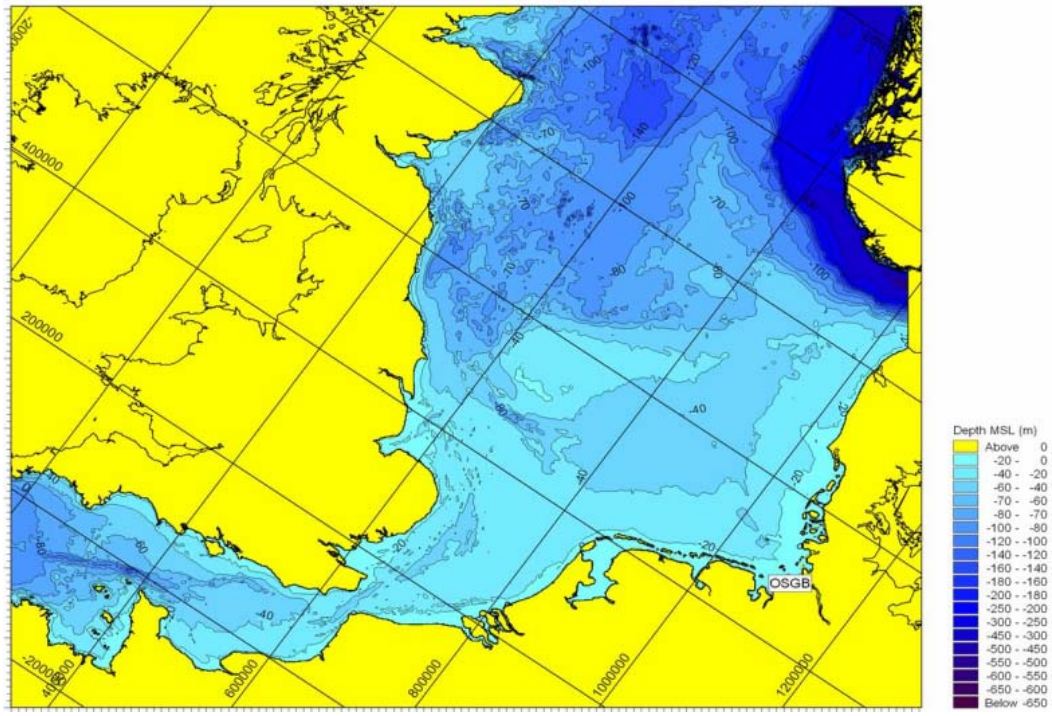
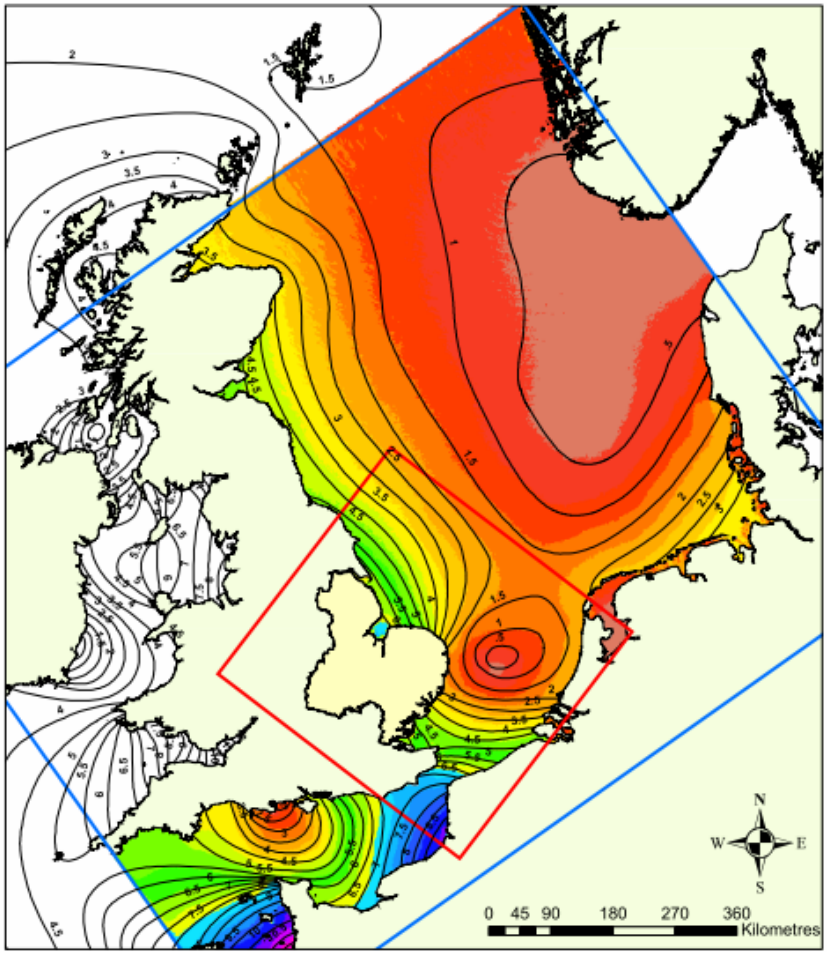


Figure 4.6: Calibration plot for North Sea hydrodynamic model



Wave model boundary conditions will be obtained from the UK Meteorological Office UK Waters model (12 km resolution). We have used data from this model in many previous studies, both for modelling and for detailed metocean engineering design. It is considered to be a robust source of metocean information, albeit on a relatively coarse scale (i.e. it is unable to resolve variations across the STW areas).

4.2.5 Characterisation of Structures

Individual structures (foundations, turbine piles etc.) will not be modelled explicitly within the FTMS. They will instead be characterised through the effect they have on the current and wave regimes (particularly, the changes they induce in current speed and direction, and wave height, period, direction and spreading). This is a standard approach for wind farm coastal process studies, as noted in the Cowrie best practice guidance. The alternative is to commit to expensive and time-consuming Computational Fluid Dynamic modelling assessments, which are generally not required and add little to study robustness.

Various sub-mesh parameterisation methods are available for characterising the wind farm structures. Intertek-Metoc will use the most suitable approach based on site conditions. The FTMS will include facilities for this within both the hydrodynamic and wave models.

4.2.6 Model Calibration and Validation

Environmental models are ideally calibrated on one set of data, and validated against a second, independent data set.

The FTMS hydrodynamic model will be calibrated and validated using suitable time series data obtained from:

- on-site measurement data provided by the client;
- historical current meter moorings in the area of interest;
- other public domain sources of current and elevation data;
- existing, calibrated and validated models held by Intertek-Metoc in the region.

The FTMS spectral wave model will be calibrated and validated using suitable data obtained from:

- on-site measurement data provided by the client;
- other potential sources of wave data (e.g. from the CEFAS Firth of Forth WaveNet mooring);
- sense-checking based on Intertek-Metoc's extensive metocean experience in UK coastal waters, including studies in the Forth and Tay region (e.g. Round 3 Zone 2).

Sediment dispersion and morphology models are typically very hard to calibrate and validate due to the lack of suitable data. The recommended approach is to characterise sediment processes based on empirical data from site-specific surveys, taking due account of industry best practice and previous investigations of a similar nature. The project team will also be able to draw on our extensive experience of coastal process assessments, and comprehensive understanding of the dispersive environment in and around the study area, based on the prior sediment transport and dispersion studies we have undertaken.

In all cases, calibration and validation will be undertaken with due regard to industry best practice and the specific requirements of the STW study.

4.2.7 Model Commissioning and Delivery

All model files, reports and associated outputs will be provided to the client for review and acceptance. We will also provide all raw data unless constrained by specific licensing issues (as is sometimes the case for data obtained from third parties such as the UK Meteorological Office). We will advise the client where this is the case.

We will agree data and file formats with the client at an early stage of the project. By default, all data will be provided in common, non-proprietary and easily accessible formats (e.g. ASCII text formats). Some model files will by necessity be provided in native file format.

4.2.8 Future Model Development

In the event that bathymetric or hydrodynamic data from Round 3 Zone 2 (Firth of Forth) are acquired at some stage in the future, it will be possible to update the FTMS bathymetry. This will allow the model calibration and validation to be re-visited, and any new validation data sets to be assessed.

Intertek-Metoc will report on the effect this upgrade has on model predictions, and advise on any requirement to undertake elements of the metocean study and impact assessment again in light of the new information.

4.3 MODELLING SCENARIOS

A variety of metocean and coastal process analyses are required for the study:

- baseline, construction phase and post-construction assessments;
- near-field and far-field;
- short-term and long-term;
- individual site, in-combination and cumulative impacts.

These analyses will all be undertaken in line with industry best practice.

Table 4.1 summarises the various impact investigations that will be undertaken during the baseline and impact assessments. These investigations are described in more detail in subsequent report sections.

Table 4.1: Summary of modelling scenarios for impact assessment

Scenario	Tidal currents	Waves	Sediments	Scour	Plume dispersion
Baseline	Literature review Modelled using FTMS HD model	Literature review Modelled using FTMS SW model	Literature review	Not required	Literature review of naturally occurring suspended sediment concentrations
Construction phase	Not required	Not required	Not required	Not required	Modelled using FTMS HD model
Post-construction – short-term assessment (site-specific assessment for each individual wind farm)	Near- and far-field – array modelled using FTMS HD model	Near- and far-field – array modelled using FTMS SW model	Near and far-field – assessed using difference in bed shear stress between baseline and impact scenarios (as determined by FTMS HD and SW models) Will be modelled using FTMS ST model if differences are significant	Near-field – assessed using empirical approach driven by currents/waves from FTMS HD and SW models Far-field – not required	Not required
Post-construction – short-term assessment (regional in-combination assessment; one scenario incorporating Inch Cape / Neart na Gaoithe wind farm areas)	Near-field – not required Far-field – modelled using both wind farm arrays in FTMS HD model	Near-field – not required Far-field – modelled using both wind farm arrays in FTMS SW model	Near-field – not required Far-field – assessed using difference in bed shear stress between baseline and impact scenarios (as determined by FTMS HD and SW models) Will be modelled using FTMS ST model if differences are significant	Not required	Not required
Post-construction – long-term assessment (regional cumulative assessment; one scenario incorporating all three STW wind farm areas plus proposed Zone 2 site)	Near-field – not required Far-field – modelled using all three STW wind farm arrays plus Zone 2 site in FTMS HD model	Near-field – not required Far-field – modelled using all three STW wind farm arrays plus Zone 2 site in FTMS SW model	Near-field – not required Far-field – assessed using difference in bed shear stress between baseline and impact scenarios (as determined by FTMS HD and SW models) Will be modelled using FTMS ST model if differences are significant	Not required	Not required

4.4 BASELINE ASSESSMENT

4.4.1 Overview

The baseline assessment will deliver a full understanding of the physical environment of the STW development areas and the surrounding region. This baseline will be used to assess the absolute and relative significance of any subsequent changes to the environment that occur as a result of the development activities.

The key components of the baseline assessment will comprise:

- an evaluation of the STW metocean campaign data, historical information and conceptual models in order to develop an understanding of existing metocean conditions and the sediment / morphological regime;
- model simulations within the FTMS in order to establish the typical tidal and wave conditions in the areas of interest, and how these conditions naturally vary within each wind farm site and between sites.

The model simulations will cover a full range of conditions (e.g. a comprehensive suite of incident wave heights, periods and directions). The same set of conditions will be modelled during the impact assessment in order to establish the potential impacts of the development under different environmental scenarios. The subsequent Sections describe the set of environmental conditions that will be modelled.

4.4.2 Tides

FTMS hydrodynamic model simulations will be carried out over an annual cycle. The model results will be analysed for harmonic constituents and re-predicted over a much longer period of time, which will allow more extreme statistics to be calculated. The output from this process will be further analysed to produce contour plots of information relating to tidal currents, including:

- statistics on predicted water depth (e.g. 99, 95, 75, 50, 25, 5, 1 percentiles)
- statistics on predicted current speeds (e.g. 99, 95, 75, 50, 25, 5, 1 percentiles)

In addition, time series will be produced at selected sites. These sites will include sufficient locations to fully characterise tidal current variation across the STW wind farm areas, plus any other locations of interest requested by the client.

4.4.3 Waves

The FTMS spectral wave model will be run to simulate a representative series of incident wave heights, periods and directions, based on analysis of offshore wave conditions at the model boundary (using data from the UK Meteorological Office UK Waters model). We propose to model wave conditions in 0.5 m height bands, 0.5 s period bands, and 10° directional bands. For those periods when waves are propagating offshore (out of the model domain), waves will be generated within the model by applying wind forcing. Wind-generated waves will be modelled in 1 ms^{-1} speed bands and 10° directional bands.

The model output will be collated to form a transformation matrix from which waves at any given location can be derived from the offshore wave conditions (or locally wind-generated waves). This will allow the generation of statistics at any location within the model, without the need for long-duration model simulations driven by regional wind and pressure fields.

The transformation matrix will be used to generate:

- wave height exceedence statistics (monthly and all year);
- wave height and wave period matrices (Hs/Tz, Hs/Tp);
- directional wave roses.

Figure 4.7 illustrates a typical spatial output from the FTMS spectral wave model, based on the propagation of a large wave into the model domain from the northeast. Figure 4.8 is a similar plot for a locally generated wave field caused by a strong southwesterly wind.

Figure 4.7: Example wave model output – large wave from northeast

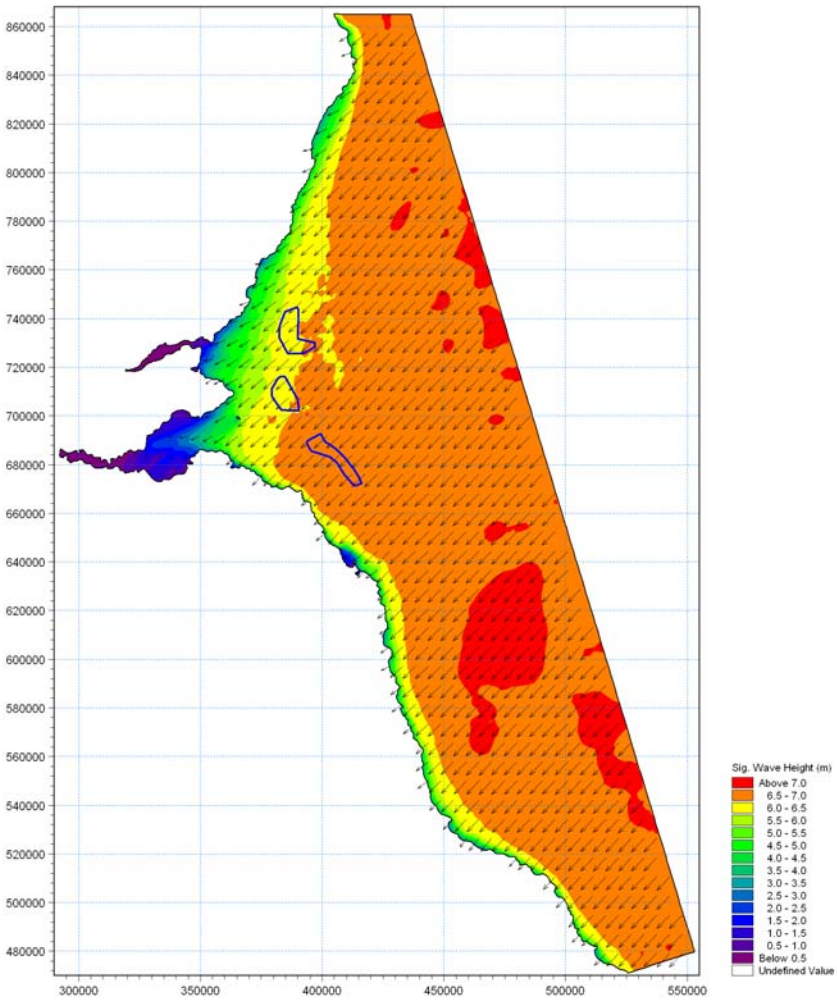
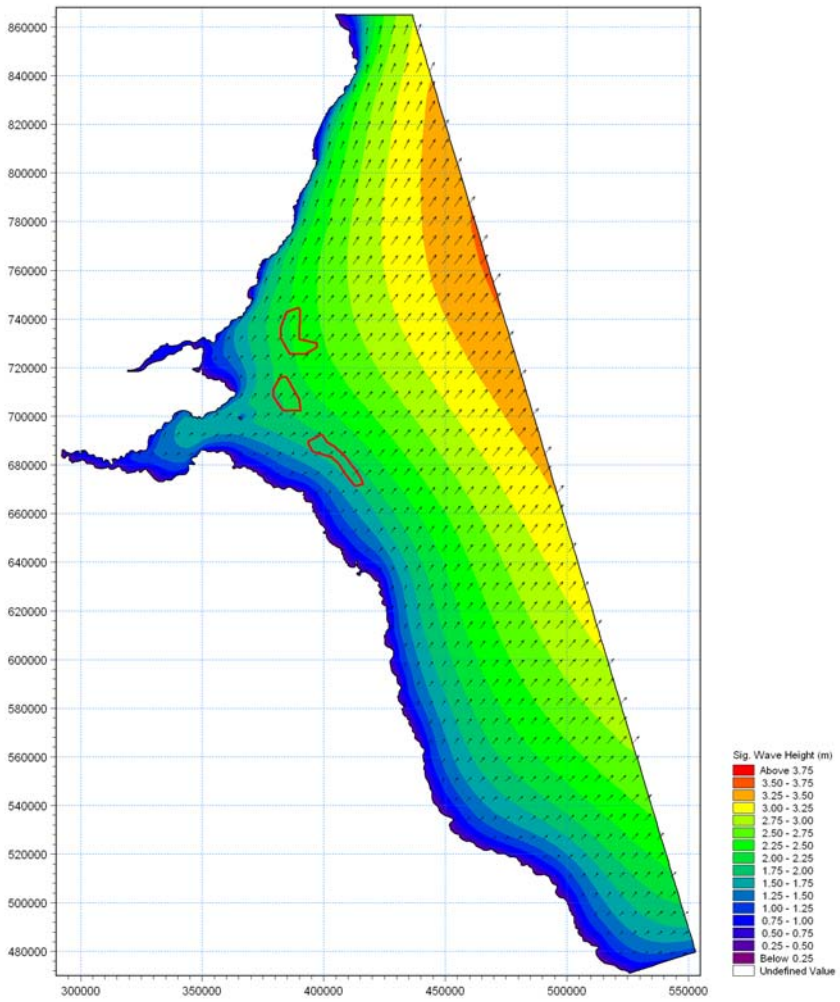


Figure 4.8: Example wave model output – wind-generated waves from southwest



4.5 IMPACT ASSESSMENT

4.5.1 Construction Phase Impacts

The FTMS will be used to predict the likely duration, spatial extent and magnitude of impacts caused by the release of suspended sediments into the water column during the construction phase. Sediment characteristics will be determined from data collected during the STW Forth and Tay field survey campaign presently, supported by secondary sources if appropriate. All available data will be considered in order to characterise the sedimentological environment as accurately as possible. For example, this will include sediment column information from geotechnical surveys, which will be used to characterise deeper sediment layers that may be disturbed when the foundations are installed.

The FTMS will be run for a representative range of environmental conditions (i.e. the range of current speeds and wave conditions likely to be encountered during installation).

The modelling will be able to simulate sediment discharges from all relevant construction activities, such as laying foundations or cable burial by ploughing,

jetting etc.. If suitable information is available (e.g. speed and overall duration of the operation), the discharge of sediment during cable burial will be modelled as a moving source. Cable route corridors will be defined for Inch Cape and Neart na Gaoithe based on the best available information. For example, it might be necessary to make some initial assumptions about the Inch Cape route corridor before more detailed information becomes available. The precise activities to be modelled will be confirmed with the client at an early stage of the project.

Impacts will be modelled over the short to medium term, until the suspended fractions settle out or disperse to the point that they are insignificant compared to natural background concentrations.

4.5.2 Scour Potential

Intertek-Metoc and Partrac will undertake an assessment of the potential for scour around individual structures, and the possible resulting requirement for scour protection.

Scour processes are well understood for monopiles, but less so for some of the emerging foundation types that are likely to be used increasingly in STW and Round 3 areas. We will undertake the assessment using a combination of empirical relationships and best practice guidance developed from previous case studies, theoretical considerations and physical modelling.

All available data will be considered in order to characterise the sedimentological environment as accurately as possible. For example, this will include sediment column information from geotechnical surveys, which will be used to characterise deeper sediment layers that may be released into the water column if the scour is deep enough.

We will consider the requirement for undertaking sensitivity testing and adopting reasonable conservatisms during this assessment. This represents a pragmatic approach for deeper waters where the scouring actions of waves are likely to have relatively less effect than nearer the coast.

Model predictions from the FTMS will be used to define current and wave conditions throughout the development sites. These data will be used to inform the scour assessment.

If the potential for scour is identified, a variety of approaches may be taken to prevent or mitigate against its effects, such as:

- rock armour placed on the seabed around the foundation, in the scour hole around the structure or on the seabed prior to foundation installation;
- sandbags/geotextile bags or concrete mattresses placed on the seabed around the foundation;
- frond mats placed on top of concrete mattresses or anchored directly to the seabed around the foundation;
- attachments to the foundation structure to inhibit the scouring due to vortex action at the bed.

4.5.3 Post-construction, Short-term Impacts

Following the baseline assessment, the structures associated with the proposed wind farm array developments will be added to the FTMS hydrodynamic and wave models, in the manner previously described and in line with accepted best practice. This will allow an assessment of the absolute and relative impacts of the wind farm structures in comparison to baseline conditions. In order to allow direct comparison, the same range of environmental conditions will be modelled as during the baseline study.

Specifically, the assessment of short-term post-construction impacts will comprise the following analyses:

- predicted impacts associated with each site individually;
- predicted cumulative impacts associated with the Inch Cape and Neart na Gaoithe wind farm areas.

For both of these analyses, Intertek-Metoc will adopt the following methodology in order to deliver the metocean and environmental impact deliverables required by the project scope:

1) Initially, we will complete model simulations for the same range of environmental conditions as the baseline assessment, covering all likely permutations of wave and tidal current condition. The range of conditions to be modelled has been detailed above.

2) The results of the baseline and impact assessment runs will be compared in order to identify absolute and relative changes to the wave and current regimes due to the wind farm developments.

3) A suite of maps, tables and associated presentations will be produced describing the change in metocean conditions due to the developments. These results will cover both near- and far-field and will be fully reported. The information will be sufficient to inform the metocean design basis, fatigue analysis and operational statistics for use in the technical design, installation, operation and decommissioning of the wind farms.

4) The metocean results will also be used to quantify the effect of the developments on near-bed currents and bed shear stresses (resulting from modifications to the wave and current regimes).

5) A suite of maps, tables and associated presentations showing the areas for which bed shear stress may be increased or decreased due to the developments. The presentations will show both the magnitude of change in shear stress (10%, 5%, 1% etc.), and the percentage of time for which these changes are likely to occur.

6) This output will be used in combination with the results of the sediment surveys, and using the project team's expertise in sediment dynamics to undertake a shear stress exceedence analysis. The analysis will establish the proportion of time for which the sea bed could be mobile. It will be undertaken for as many locations as is required to fully represent the environmental impacts of the wind farm structures. As previously, the differences between the baseline and impact assessment runs will be fully quantified and reported.

7) The results of the above analyses will be interpreted in order to quantify:

a) the additional sediment mobility resulting from the wind farm developments (each in isolation, and the two cumulatively);

b) the spatial extent of any such effects.

8) If the study demonstrates that there are significant or potentially significant changes to the sediment regime due to the developments, the FTMS sediment transport model will be employed. This will be used to evaluate the short-term impacts in the near- and far-fields, in terms of sediment entrainment, transport, deposition, and water column suspended sediment concentrations. The outputs from this study will include maps showing areas of sediment erosion and deposition; maps showing suspended sediment concentrations; and at-a-point analyses of changes to the sediment regime for key selected locations within the wind farm areas and surrounding waters.

9) The predicted changes in sediment mobility and suspended sediment concentrations caused by the wind farm developments will be referred to the baseline conditions (i.e. the sediment transport regime and suspended sediment concentrations identified during the baseline assessment). This comparison will establish the overall significance of the developments to the short-term sediment regime.

We will assess up to two different site configurations for each of the STW wind farm areas (when modelled in isolation), and up to two different configurations when both sites are modelled cumulatively.

Our approach to modelling has been developed in order to limit sediment transport modelling to just those simulations which are absolutely necessary. This is fully in line with the best practice guidance of the Cowrie report. Sediment modelling can be an expensive and time-consuming part of a coastal processes study, even in those cases where the results are ultimately limited by the availability of field data to parameterise the model.

4.5.4 Post-construction, Long-term Impacts

This element of the study will follow a very similar methodology to the post-construction, short-term impact study described in Section 4.5.3. The core of the assessment will be a comparison of model results between the baseline and impact assessment runs, and a quantification of the spatial and temporal effect of any predicted differences on the wave, current and sediment regimes.

The key differences of the long-term assessment compared to the short-term assessment are as follows:

1) The assessment will consider cumulative impacts from the two STW wind farms over a 25-year period in order to evaluate the long-term effects of the developments.

2) The assessment will consider in-combination impacts from the two STW wind farm areas, the proposed Round 3 Zone 2 site (Firth of Forth), and any other industries or developments that may be identified in the area.

3) The assessment will focus on regional impacts in the far-field. This will include effects in the near-coast zone, and the influence of the wind farm developments on sediment transport in the coastal sediment cells.

We will assess up to two different site configurations (i.e. two different configurations of the STW and Zone 2 wind farm sites, and other relevant industries or developments, when modelled in combination).

4.5.5 Climate Change Scenarios

We will undertake an assessment of the impacts of climate change on the developments. Our proposed method is summarised in the following steps.

1) Calculate typical and extreme values for waves wind, tide, etc..

2) Undertake desk research to identify appropriate predicted changes in the area due to climate change (e.g. sea level rises, increased storminess). Ideally these will be quantified (e.g. 10% increase in wind speeds).

3) Apply the climate change predictions on top of existing climatic conditions and recalculate the impacts in terms of metocean and coastal processes, with reference to the impact of the OWF developments. This will involve running the "with wind farms" model for both existing and future climatic conditions. The climate change modelling will not consider the "without wind farms" scenario, since it will not be easy to distinguish the impact of climate change from the impact of the developments.

4) Provide appropriate reporting of the analysis. This could be as part of other reports (e.g. technical design or ES chapters) or a single standalone report covering both sites, depending on client preferences.

4.5.6 Modelling Outputs

We will produce a full suite of modelling outputs in support of the metocean and coastal processes studies. The key technical outputs have already been described in the context of the baseline and impact assessments (Sections 4.4 and 4.5 respectively).

Model results and supporting data will be provided in a variety of file formats:

- where possible, data sets will be provided in ASCII formats such as TXT or CSV, which are readable with a broad range of software packages;
- tabulated data will be provided in Microsoft Excel or Word formats;
- model files will by necessity be provided in native MIKE formats such as DFSU, although where possible we will provide ASCII equivalents;
- plots and animations will be provided in standard graphics formats such as GIF, TIF, JPG and AVI;
- GIS data sets will be provided in Esri ArcGIS file formats such as SHP.

We recommend the above file formats, but are able to accommodate alternative formats if required (MapInfo, AutoCAD etc.).

5 COMMUNICATIONS AND DELIVERABLES

Clear communication between all the team members, the regulator and consultees is essential to this study. Clear and easy pathways for communicating information are essential and will facilitate the consenting process. This communication includes face-to-face meetings, teleconferencing and reporting.

5.1 REPORTING

A number of reports and briefing notes are proposed:

- Data Review and Gap Analysis Briefing Note – this note will detail the data and literature review, and updated gap analysis, and will detail any additional data that are required to provide a robust basis for the model and EIA assessments.
- Calibration and Validation Report – this report will detail the construction, calibration and validation of the FTMS hydrodynamic and wave models.
- Interim Technical/Design Briefing Note – this note will provide a brief overview of the baseline metocean and coastal process characterisation of each wind farm area for input to the technical work streams.
- Interim Environmental Briefing Note – this note will provide a brief overview of the baseline metocean and coastal process characterisation for each wind farm area for input to the EIAs.
- Final Technical/Design Report – this report will provide the detailed assessment of the impact of the developments on the metocean conditions and coastal processes for each wind farm area for input to the technical work streams.
- Final ES Chapters – this report will provide the detailed assessment of the impact of the developments on the metocean conditions and coastal processes for each wind farm area for input to the EIAs.

5.2 MEETINGS

We propose to hold three meetings through the project, covering:

1) Work package 1: Kick-off meeting – this meeting will be held to clarify data issues, ensure good exchange of information with other team members and to set dates for deliverables. This meeting is also intended to allow us to explain our programme of work and approach and gather information on the particular concerns of the stakeholders.

2) Work package 2: Modelling and impact assessment meeting – this meeting with other team members is to discuss the modelling impact assessment approach, and in particular to clarify the cumulative and in-combination methodology.

3) Work package 3: Reporting meeting – this meeting with other team members is to discuss the results of the impact assessments and the inputs to both the technical reports and the ES chapters.

6 DATA REQUIREMENTS

During the tender process it was noted that each of the STW wind farms would be on different development programmes. The consent application for Neart na Gaoithe is scheduled for December 2011, whereas Inch Cape is scheduled for quarter 3 or quarter 4 of 2012. We also note that concept engineering of structures has been completed for Neart na Gaoithe but not for Inch Cape.

We understand that geophysical, preliminary geotechnical and benthic surveys have been undertaken at Neart na Gaoithe. Geophysical surveys have been undertaken at Inch Cape, but benthic and geotechnical works have not been completed.

In order to meet with these differing programmes we request data/information ideally be provided according to the schedule given in Table 6.1. (Note that these dates are not fixed as sufficient progress is likely to be able to be made with the "design envelope" approach until such time as survey data can confirm the assumptions made.) We understand that the Neart na Gaoithe data are available now and we would assume that these could be made available to us shortly, along with the survey data from Inch Cape.

Table 6.1: Information schedule

Data / information	Neart na Gaoithe	Inch Cape
Bathymetry	01/01/2011 – 01/02/2011	01/01/2011 – 01/02/2011
Geophysical survey data	01/01/2011 – 02/05/2011	01/01/2011 – 02/05/2011
Preliminary geotechnical survey data	01/01/2011 – 02/05/2011	01/05/2011 – 02/05/2011
Structure types	01/01/2011 – 24/05/2011	01/05/2011 – 24/05/2011
Density of development / build-out plan / layout	01/01/2011 – 24/05/2011	01/05/2011 – 24/05/2011

All the bathymetry data should be available for input to the model build by February 2011 and the geophysical survey data should be available by May 2011. Similarly, the basic structure type(s) and development plans should be available by the end of May 2011. However, we recognise that the time available for obtaining new survey data, for use in considering foundation types, between now and April 2011 is unrealistic as surveys works are unlikely to be undertaken over the winter period. We will therefore progress works on a "design envelope" basis; where explicit survey data are not available, we will make working assumptions on these data until such time as they can be confirmed via survey.

We assume that the Inch Cape team will progress their design concepts and build-out plans to have sufficient information for the "design envelope" or explicit plans to be able to input to the impact assessment.

We anticipate that Neart na Gaoithe will advance more rapidly than Inch Cape initially. In order to minimise the impact of differing development programmes at these sites we propose to use Neart na Gaoithe to assist in defining a design envelope for the Inch Cape assessment. This design envelope will be based on reasonable assumptions of the similarities and differences between the sites and agreed with the individual site developers. The design envelope will be used to assess the Inch Cape development in advance of site-specific data becoming available.

The assumption made will be that if these assessments show minimal impact under the extremes of the design envelope, then there will be insignificant impact under actual site specific conditions. This means that the project can move forward with the confidence that when site specific data become available, only a validation exercise will be required.