15 SHIPPING AND NAVIGATION

15.1 The table below provides a list of all the supporting studies which relate to the Shipping and Navigation impact assessment. All supporting studies are provided on the accompanying CD.

Details of study	Location on supporting studies CD
MeyGen EIA Coastal Processes Modelling – Modelling setup, calibration and results (DHI, 2012)	OFFSHORE\Seabed interactions
Navigation Risk Assessment MeyGen Inner Sound (Anatec, 2012)	OFFSHORE\Navigational Risk Assessment

15.1 Introduction

15.2 This section summarises the work undertaken as part of the Navigation Risk Assessment (NRA) to assess the potential impacts of the Project on shipping and navigation. The assessment has been undertaken by Anatec Ltd.

15.3 To gain a better overall understanding of the baseline and potential impacts consideration should also be given to the following Environmental Statement (ES) sections:

- Physical Environment and Sediment Dynamics (Section 9)
- Commercial Fisheries (Section 14); and
- Socio-economics (Section 21).

15.2 Assessment Parameters

15.2.1 Rochdale Envelope

15.4 In line with the Rochdale Envelope approach, this assessment considers the maximum ('worst case') Project parameters. Identification of the worst case scenario for each receptor (i.e. Environmental Impact Assessment (EIA) topic) ensures that impacts of greater adverse significance would not arise should any other development scenario be taken forward in the final scheme design. Table 15.1 describes the detail of the Project parameters that have been used in this assessment and explains why these are considered to be worst case. The potential impacts from alternative Project parameters have been considered in Section 15.9.

Project parameter relevant to the assessment		'Maximum' Project parameter for impact assessment	Explanation of maximum Project parameter
Turbine	Number	86 turbines	The COLLRISK modelling which has been used to inform the impact assessment is based on 86 turbines. From a navigation perspective the worst case scenario is based on the 86 turbines being a mix of 18m and 20m diameter rotor turbines. A 20m diameter rotor turbine is used at turbine locations with the layout where an 8m underwater clearance to LAT can be maintained, the remainder are 18m rotors.
	Layout	86 turbines; an indicative turbine layout has been used to inform the modelling (see Figure 15.17)	An indicative layout for 86 turbines has been used to inform the collision modelling (Figure 15.17). The indicative layout is based on 45m cross-flow spacing and 160m down-flow spacing.
	Rotor diameter	18-20m	The COLLRISK modelling which has been used to inform the impact assessment is based on a mix of 18m and 20m rotor diameter turbines. From a navigation perspective the worst case scenario is based on the 86 turbines being a mix of 18m and 20m diameter rotor turbines. A 20m diameter rotor turbine is used at turbine locations with the layout where an 8m underwater clearance to LAT can be maintained, the remainder are 18m rotors.
	Number of rotor blades	N/A	The COLLRISK model assumes any vessel's hull passing through the area of water swept by the rotor blades will be involved in a collision.
	Minimum clearance between sea surface and turbine blade	8m	A minimum clearance of 8m below water level at LAT will be maintained at all turbine locations. At some turbine positions the underwater clearance will be greater than 8m and this is taken into account within the COLLRISK model.
	Minimum spacing between seabed and turbine blade	N/A	This Project parameter does not influence the shipping and navigation impact assessment.
	Decommissioning	All turbines removed at decommissioning	All turbines will be removed at decommissioning.
Turbine support structure	-	N/A	This Project parameter does not influence the shipping and navigation impact assessment.
Cable connection to shore	Maximum cable footprint on seabed	86, 120mm unbundled cables each 1,300m in length with split pipe armouring	The maximum physical area of the seabed occupied by the cables has been calculated as $0.027km^2$. Based on a maximum 1.3km of cable from Horizontally Directionally Drilled (HDD) bore exit to turbine, and a cable diameter of 120mm (x2 to account for split pipe armouring) for 86 turbines.
	Decommissioning	86, 250mm unbundled cables, each 1,300m in length	All cables laid on the seabed will be fully removed at decommissioning.
Cable landfall	-	N/A	This Project parameter does not influence the shipping and navigation impact assessment.
Vessels	Safety zone during installation	500m radius area around installation activity	The size of the safety zone during construction will influence where vessels can navigate and how much space is available for vessels using the Inner Sound. The larger the safety zone the closer vessels may have to move towards the shore when travelling south of the Project, reducing the area available through which to navigate.
	Installation vessel physical presence	1 Dynamic Positioning (DP) vessel for the duration of the installation for year 1 and 2 2 DP vessels for year 3 installation	Installation activities will be carried out by a single DP vessel during year 1 and 2, all installation activities to be undertaken using a single DP vessel. If other smaller vessels used to undertake some of the work of the DP vessel, no concurrent multiple vessel activities will take place, i.e. no more than one vessel on site at any one time. Year 3 installation will require a maximum 2 DP vessels for TSS installation. These two vessels may be present on site at the same time during year 3.
	Maintenance vessel	1 DP vessel present every	Based on a maximum 86 turbine array, 1 DP vessel

Project parameter relevant to the assessment		'Maximum' Project parameter for impact assessment	Explanation of maximum Project parameter
	physical presence	2.8 days	will be present a maximum of 130 times (i.e. single slack tide operation) per year i.e. the DP vessel present on site every 2.8 days.
Onshore Project components	-	N/A	Onshore Project parameters do not influence the shipping and navigation impact assessment.

Table 15.1: Rochdale Envelope parameters for the shipping and navigation assessment

15.2.2 Area of assessment

15.5 It is also important to define the geographical extent of the assessment area. The focus of the impact assessment is potential impacts on the shipping and navigation using the Inner Sound, including potential displacement of shipping into the Outer Sound.

15.3 Legislative Framework and Regulatory Context

15.3.1 Legislation

15.6 This section considers the legislative framework and regulatory context relevant to the Project.

15.7 The EIA Regulations are the only legislation directly relevant to this assessment. However, there are a number of guidance documents available which provide further detail on the aspects of the Shipping and Navigation environment that should be assessed and how the assessment should be undertaken.

15.3.2 Primary guidance

15.8 The primary guidance used followed in the assessment was:

- DTI/BERR (in association with MCA and DfT) Methodology for Assessing the Marine Navigational Safety Risks of Offshore Windfarms, 7th September 2005; and
- MCA Marine Guidance Notice 371(M+F) – Offshore Renewable Energy Installations (OREIs) Guidance on UK Navigational Practice, Safety and Emergency Response Issues.

15.9 The guidance, which was predominantly prepared with a view to offshore wind farms, has been adapted where necessary for the Project, e.g., to take account of under keel clearance.

15.3.3 Other guidance

15.10 Other forms of guidance used in this assessment are listed as follows:

- MCA Marine Guidance Notice 372 (MGN 372 M+F) Offshore Renewable Energy Installations (OREIs) Guidance to Mariners Operating in the Vicinity of UK OREIs (2008);
- Department of Environment and Climate Change (DECC) Guidance Notes on Safety Zones, DECC (2007);
- IALA Recommendation O-139 On The Marking of Man-Made Offshore Structures, Edition 1, Dec 2008; and
- International Maritime Organisation (IMO), Guidelines for Formal Safety Assessment (FSA) (2002).

15.4 Assessment Methodology

15.4.1 Scoping and consultation

15.11 Since the commencement of the Project, consultation on shipping and navigation issues has been ongoing. Table 15.2 summarises all consultation relevant to shipping and navigation. In addition, relevant comments from the EIA Scoping Opinion are summarised in Table 15.3, together with responses to the comments and reference to the ES sections relevant to the specific comment.

Date	Stakeholder	Consultation	Topic / specific issue
8th and 9th of March 2011	Local fisheries interests The Crown Estate Marine Energy Developers	The Crown Estate's Pentland Firth and Orkney Waters Fisheries Meetings	Fisheries issues and concerns discussed at a meeting chaired by The Crown Estate's Fisheries Liaison Officer.
7th April 2011	Marine Scotland and Scottish Natural Heritage (SNH)	Pre-Scoping meeting	EIA surveys and studies required and the data needs for each EIA study.
6th May 2011	Local fishermen	Local fisherman's visit to view the Atlantis turbine at Invergordon	Turbine technology and discussions with fishermen regarding their concerns.
27th May 2011	Marine Scotland, statutory consultees and non statutory consultees	Submission of EIA Scoping Report	Request for EIA Scoping Opinion from Marine Scotland and statutory consultees and request for comment from non statutory consultees.
30th June – 2nd July 2011	Local stakeholders	Public Event - EIA Scoping	Public event to collate information/opinions on proposed EIA scope.
7th July 2011	Maritime and Coastguard Agency (MCA)	Meeting	The scope of work for the NRA was discussed with the MCA including the various data sources planned to be used to characterise baseline traffic levels.
16th August 2011	Scottish Fishermen's Federation (SFF)	Meeting	To obtain feedback on the Project and discuss which fishermen and organisations to consult with directly.
18th August 2011	Orkney Fisheries Association (OFA)	Telephone	Consultation on whether any Orkney skippers fish the Inner Sound.
24th August 2011	Five local fishing skippers (3 John o' Groats & 2 Scrabster)	Meeting	To identify local fishing activity that takes place in the site and concerns about project and effective mitigation through information circulation and other means.
24th August 2011	Wick Royal National Lifeboat Institute (RNLI)	Meeting	Review of historical incidents and potential issues with Project.
24th August 2011	Wick Harbour	Meeting	Review of current traffic visiting Wick, potential future developments and any issues with Project.
24th August 2011	Scrabster Harbour Trust	Meeting	Review of current traffic visiting Scrabster, port re-development and any issues with Project.
24th August 2011	Gills Harbour	Meeting	Discussion of current traffic visiting Gills and potential future developments, including possible use as a base for the MeyGen project.
25th August 2011	Pentland Ferries	Meeting	Information obtained about route between Gills and St Margaret's Hope, specification of the *Pentalina* and future plan. (Subsequent teleconference held with Master of *Pentalina* on 4th October 2011).
25th August 2011	Thurso Royal National Lifeboat Institution (RNLI)	Meeting	Review of historical incidents responded to by the station and any potential issues associated with the Project.
12th September 2011	Bremner Fishing	Telephone	Discussion with skipper of *Boy Andrew* fishing vessel regarding their transiting of the Inner Sound and Outer Sound.

Date	Stakeholder	Consultation	Topic / specific issue
12th September 2011	Marine Scotland Compliance, Fishery Office, Scrabster	Telephone	Consultation about fishing vessel activity in the Inner Sound and availability of data collected by Marine Scotland.
22nd September 2011	Wick RNLI, Fishing and Sailing representatives, Scrabster Harbour, Gill's Harbour, Pentland Ferries, John o' Groats Ferries	Hazard Review workshop	Navigational hazards were identified, discussed and potential risk control measures reviewed at this meeting involving a cross-section of local stakeholders.
29th September 2011	John o' Groats Ferries	Email	Correspondence to confirm how frequently the ferry passes near the Project area and if there would be any impacts on their route during Installation.
31st September 2011	Marine Scotland, The Highland Council (THC), statutory consultees and non statutory consultees	Receipt of EIA Scoping Opinion	Receipt of response to EIA Scoping Report and other comments from non statutory consultees.
3rd October 2011	Marine Scotland	Project update meeting	Report on EIA progress and presentation of key findings of the impact assessment.
3rd October 2011	Aberdeen MCA	Telephone	Discussion about how information on the MeyGen project could be included in Maritime Safety Information broadcasts by HM Coastguard.
12th October 2011	MCA	Meeting	The draft findings of the NRA were presented to the MCA. Specific comments were made which have been incorporated into the final NRA.
24-27th October 2011	Pentland Canoe Club, Caithness Kayak Club	Telephone & Email	Discussion about usage of the Inner Sound by sea kayakers and how information could be circulated to local clubs to minimise the impacts.
6th – 7th December 2011	Local stakeholders	Public Event – pre application consultation	Public event to communicate the findings of the EIA to local stakeholders.
26th January 2012	Northern Lighthouse Board (NLB)	Meeting	The draft findings of the NRA were presented to the NLB. Specific comments were made which have been incorporated into the final NRA, including draft plans for marking and lighting.
Various Dates	Royal Yachting Association (RYA) (Scotland), Cruising Association and Local Yachtsmen	Telephone & Email	Discussion of recreational vessel activity in the area and potential impacts of the MeyGen project.

Table 15.2: Details of consultation meetings undertaken in relation to shipping and navigation

Name of organisation	Key concerns	Response	ES section within which the specific issue is addressed
Chamber of Shipping	The area is of vital importance to both local and international commercial traffic and projects should be located in such a way that they do not pose unacceptable safety risks to vessels or cause significant rerouting.	Re-routeing and safety risks considered within the NRA for both local vessels and transiting vessels from further afield.	Section 15.6 Impacts during Construction and Installation Section 15.7 Impacts during Operations and Maintenance and Section 15.8 Impacts during Decommissioning
Chamber of Shipping	As identified in the PHA, there are clearly issues to be addressed regarding under keel clearance (UKC). MeyGen's target of ensuring device rotor sweep arcs are at least 8m below chart datum is likely to be insufficient if estimates of maximum vessel drafts of 6-8m are accurate. The Chamber ordinarily recommends a minimum clearance of 20m between the highest point of the device and chart datum at Lowest Astronomical Tide (LAT) in order to ensure sufficient UKC. With this is mind, we are somewhat concerned that that proposed location of the tidal array will not allow satisfactory clearance to be achieved and would therefore pose an unacceptable safety risk to local traffic.	Detailed under keel clearance modelling has been carried out as part of the NRA. This identifies that local vessels are at minimal risk of collision with the subsea turbine. A proportion of transiting vessels with deeper draughts are at risk in certain conditions of waves and tide but this can be managed through circulation of information to allow vessels to re-route within the Inner Sound or via the Outer Sound.	Section 15.7.1 Impact 15.4: Powered collision with subsea turbine Section 15.7.2 Impact 15.5: Drifting vessel collision with subsea turbine
MCA	A NRA will need to be submitted in accordance with MGN 371 (and 372) and the DTI/DfT/MCA Methodology for Assessing Wind farms. The standard methodology for assessing wind farms will be applied to tidal energy developments.	The NRA has been completed and is summarised in this ES section.	Section 15.5 Baseline Description
MCA	Particular attention should be paid to cabling routes and burial depth for which a Burial Protection Index study should be completed and, subject to traffic volumes, an anchor penetration study may be necessary.	Cables will not be buried as the substrate is rock but will be protected by drilling and using natural crevices where possible. There are no shipping anchorage areas in the vicinity.	Section 15.7.5 Impact 15.8: Anchor interaction
MCA	Potential cumulative and in combination issues should be carefully considered.	Details on all known developments have been gathered and considered within the NRA.	Section 15.1010 Cumulative Impacts
MCA	Casualty information from the MAIB and RNLI would also be good data sources, in establishing the risk profile for the area.	The most recent accident data sets from MAIB and RNLI have been analysed for the Project.	Section 15.5.8 Maritime incidents
MCA	Given that the layout of the individual wave generators within the farm have not been decided the principles of the Rochdale envelope should be used in the EIA.	An indicative layout for 86 turbines has been used to inform the collision modelling (Figure 15.17). The indicative layout is based on 45m cross-flow spacing and 160m down-flow spacing.	Section 15.2 Assessment Parameters and Table 15.1
MCA	The shipping and navigation study should include radar and manual observations in addition to AIS data to ensure vessels of less than 300gt are captured.	AIS track data, radar count data, visual observations during monitoring work and extensive local consultation have been combined to characterise the vessel activity in the Inner and Outer Sounds.	Section 15.5.3 AIS data analysis and Section 15.5.4 Radar data analysis
MCA	Particular consideration will need to be given to third party approval of the devices and associated mooring arrangements.	The candidate tidal turbines will be subject to 3rd party verification. Turbine Support Structures (TSSs) will be either gravity-based, pin pile or monopile and will be subject to 3rd party verification. Monitoring, alerting and emergency response plans will be in place to guard against loss of station.	Section 15.7.4 Impact 15.7: Loss of station
MCA	The offshore human environment should also include recreational and other sport activities. Any application for safety zones will need to be carefully	Recreational activity (including kayaking) have been identified and considered within the NRA. Safety zones during work on the site, e.g.,	Section 15.5.7 Recreational vessel activity analysis and Section 15.6.2 Impact

Name of organisation	Key concerns	Response	ES section within which the specific issue is addressed
	assessed and additionally supported by experience from the development and construction stages.	Installation, are discussed in the NRA. There are no plans for safety zones during normal operation.	15.2: Traffic re-routeing due to work vessels and associated safety zones
Marine Scotland / MCA	The ES should include details on collision risk, navigational safety, risk management and emergency response, marking and lighting of the Project and information to mariners, effect on small craft navigational and communication equipment, weather and risk to recreational craft which lose power and are drifting, adverse conditions, evaluation of the likely squeeze of craft into routes of larger commercial vessels, visual intrusion and noise.	The Navigational Risk Assessment has been completed taking these issues into account by following the MCA and DECC Guidance.	Section 15.6 Impacts during Construction and Installation, Section 15.7 Impacts during Operations and Maintenance and Section 15.8 Impacts during Decommissioning
NLB	We would require a formal Navigational Risk Assessment be made in accordance with MGN 371, and that shipping, fishing and leisure data information be used to formalise any risk and mitigation measures. We note that visual observation and radar data would assist in giving a more accurate reflection of the marine traffic transiting the area.	The Navigational Risk Assessment has been completed in accordance with MGN 371.	Section 15.5 Baseline description and Section 15.3 Legislative Framework and Regulatory Context
NLB	Such an assessment must take into account the available depth of water over the installed turbines and the effect of heavy seas and vessel movement in relation to under keel clearance of marine traffic. The cumulative effect of developments must be considered and information shared with other developers.	Subsea collision risk has been modelled taking into account the underwater clearance and the effect of waves, tides, ship draught and squat. Cumulative effects have also been assessed.	Section 15.7.1 Impact 15.4: Powered collision with subsea turbine Section 15.7.2 Impact 15.5: Drifting vessel collision with subsea turbine
Orkney Islands Council (OIC)	The proposed area is clear of Orkney Harbour Authority waters but in relative closed proximity the southern approaches to Scapa Flow. It is very unlikely any vessel bound for Scapa Flow would be affected by the proposed development when considering passage planning other than encountering increased vessel traffic in Outer Sound area. The possible displacement of marine traffic from Inner Sound into Outer Sound would have a possible impact safe routing on laden tankers inwards and outwards from Scapa flow.	The potential for traffic to be re-routed from the Inner Sound to the Outer Sound, and the consequent risks in terms of increased collisions, have been considered within the NRA and summarised within Navigation ES section.	Section 15.6 Impacts during Construction and Installation, Section 15.7 Impacts during Operations and Maintenance and Section 15.8 Impacts during Decommissioning
OIC	The Pentland Firth is an exceptionally busy sea lane essential to international navigation. The main shipping channel, however, lies to the north of Stroma, between the island and Orkney. Larger cargo vessels and tankers transit the region using this route and so do not pass through the lease area (except on occasion). However, the recommended route for smaller vessels, when approaching the Firth during the south east-going stream, is through the Inner Sound.	The numbers and sizes of vessels using the Inner Sound have been considered within the NRA.	Section 15.5 Baseline Description
RYA	In summary the RYA's concerns with offshore energy developments and recreational boating relate to: Navigational safety - 1. Collision risk, particularly in adverse weather conditions 2. Risk management and emergency response, for example in response to units breaking free in a storm 3. Marking and lighting 4. Weather		Section 15.6 Impacts during Construction and Installation, Section 15.7 Impacts during Operations and Maintenance and Section 15.8 Impacts during Decommissioning
RYA	Of key importance is the minimum depth over the rotor blades. RYA is opposed to unnecessary exclusion zones and notes that these can only be effective when their existence is fully promulgated and there is enforcement. Although the document states that the rotors not surface piercing, we would wish to be reassured that the rotors are below keel depth at all times even in wave troughs when there is a combination of low water springs, high pressure and strong winds. If they are always below keel depth then there will be no need for vessels to avoid the area.	Further consultation with RYA Scotland during the NRA has confirmed they are satisfied with the planned minimum underwater clearance of 8m (LAT). There are no plans for safety zones during normal operation at the site.	Section 15.6 Impacts during Construction and Installation, Section 15.7 Impacts during Operations and Maintenance
Scottish Canoe Association	Sea kayakers make regular use of the waters in the Pentland Firth. Devices which break the surface of the water will be considered as a major navigational safety issue.	There are no plans to install any structures that break the surface of the water.	Section 5 Project Description
Scottish Canoe Association	If underwater structures are to be put in place by the use of tethered barges then there would be concerns for the safety of boat users in the area during this construction phase.	Consultation has been carried out with the local clubs and appropriate mitigation has been identified during construction work.	Section 15.6 Impacts during Construction and Installation, Section 15.7 Impacts during Operations and Maintenance
Scottish Fisherman's Federation (SFF)	Although the Inner Sound is not a traditional fishing ground for the pelagic fleet, it is a frequented route on passage from east to west and vice versa. The Pentland Firth is a dangerous stretch of water even on a fine day; the sea can be very confused and therefore difficult to keep the ship on a steady heading. One could only imagine that securing 20 quite large turbines on the seabed in the Inner Sound would have an effect on how the water flows through the Pentland Firth, adding to the unpredictable sea state. We need assurances that safe navigation will take priority over energy generation.	Navigational safety risks to fishing vessels are considered in the NRA. The NRA also summarises the findings of the work carried out on the potential effects of the turbines on waves and tidal currents. This indicated no significant concerns.	Section 15.6 Impacts during Construction and Installation, Section 15.7 Impacts during Operations and Maintenance

Table 15.3: Scoping and consultation relevant to shipping and navigation

15.4.1 Desk based study

15.12 The main desk-based data sources used to identify the baseline navigational features and activity in the Pentland Firth were as follows:

- Admiralty Charts;
- Admiralty Sailing Directions, North Coast of Scotland Pilot (NP 52);
- Fishing Vessel Surveillance Patrol Data (2006-10) (Marine Scotland Compliance);
- Fishing VMS Data (2008-10)(Marine Scotland Compliance);
- Clyde Cruising Club Sailing Directions for North Scotland (Clyde Cruising Club, 2010);
- RYA Cruising Atlas;
- Maritime Accident Investigation Branch (MAIB) Incident Data (2001-10); and
- RNLI Incident Response Data (2001-10).

15.4.2 Field survey

15.13 Information on vessel navigation in the area came from a number of sources aimed at covering the full range of vessel activity in the Inner Sound. The primary source of data came from Automatic Information System (AIS) vessel tracking. A total of 16 weeks was analysed, covering the following periods to ensure it was seasonally and tidally weighted:

- 28 days summer 2010 (June to July);
- 28 days winter 2010 (October-December);
- 28 day winter 2011 (February to March); and
- 28 days summer 2011 (July to August).

15.14 AIS is now fitted on the vast majority of commercial ships operating in UK waters including all ships of 300GT and upwards engaged on international voyages, all passenger ships, and fishing vessels of 45m length and over. It is also carried by a proportion of small vessels voluntarily, including a proportion of fishing and recreational vessels.

15.15 The means of covering smaller vessels (non-AIS) was discussed with the MCA, who suggested contacting local ports about their radar coverage. Radar count data was obtained from Scapa Vessel Traffic Services (VTS) operated by OIC Marine Services. The data came from the radar scanner on Sandy Hill, South Ronaldsay. The effective survey period was 42 days during August and September 2011. The fact it is summer only data is considered to be conservative as small vessel activity is likely to be busier during summer. Also smaller vessels, because of their shallower draughts, are only likely to be affected during work on the site. Installation activity will not take place during the winter months.

15.16 Other sources of small vessel activity used in the NRA included visual logs from onshore and vessel-based surveys conducted on behalf of the Project, fishing vessel surveillance data and publications such as the RYA Coastal Atlas and Clyde Cruising Club Sailing Directions. The findings of the analysis were corroborated by local knowledge gained through the extensive local consultation.

15.4.3 Significance criteria

15.17 The shipping and navigation impacts assessment methodology has been carried out in line with the IMO's Formal Safety Assessment (FSA) process and the DECC / MCA Guidelines (see NRA for full details on supporting CD). It does not therefore necessarily follow the significance criteria set out in Section 8. Hazards (impacts) have been categorised using the frequency and consequence categories below.

15.18 The categorisation was carried out based on the discussion at the Hazard Review Workshop involving local stakeholders, together with the baseline data analysis and other consultation.

Rank	Description	Definition
1	Negligible	< 1 occurrence per 10,000 years
2	Extremely Unlikely	1 per 100 to 10,000 years
3	Remote	1 per 10 to 100 years
4	Reasonably Probable	1 per 1 to 10 years
5	Frequent	Yearly

Table 15.4: Frequency bands

Rank	Description	Definition			
		People	Environment	Property	Business
1	Negligible	No injury	<£10k	<£10k	<10k
2	Minor	Slight injury(s)	Tier 1: Local assistance required	£10k-£100k	£10k-£100k
3	Moderate	Multiple moderate or Single serious injury	Tier 2: Limited external assistance required	£100k-£1M	£100k-£1M Local publicity
4	Serious	Serious injury or single fatality	Tier 2: Regional assistance required	£1M-£10M	£1M-£10M National publicity
5	Major	More than 1 fatality	Tier 3: National assistance required	>£10M	>£10M International publicity

Table 15.5: Consequence bands

15.19 The consequence scores are averaged (for a single impact there could be a range of potential consequences) and multiplied by the frequency to obtain an overall ranking (or score) which determined the hazard's position within the risk matrix (Table 15.6).

		Frequency				
		5	4	3	2	1
Consequence	5	High	High	High	Moderate	Moderate
	4	High	High	Moderate	Moderate	Low
	3	High	Moderate	Moderate	Low	Low
	2	Moderate	Moderate	Low	Low	Low
	1	Moderate	Low	Low	Low	Low

Where:

	Broadly Acceptable Region (Low Risk)	Generally regarded as insignificant and adequately controlled. None the less the law still requires further risk reductions if it is reasonably practicable. However, at these levels the opportunity for further risk reduction is much more limited.
	Tolerable Region (Moderate Risk)	Typical of the risks from activities which people are prepared to tolerate to secure benefits. There is however an expectation that such risks are properly assessed, appropriate control measures are in place, residual risks are as low as is reasonably practicable (ALARP) and that risks are periodically reviewed to see if further controls are appropriate.
	Unacceptable Region (High Risk)	Generally regarded as unacceptable whatever the level of benefit associated with the activity.

Table 15.6: Risk matrix

15.20 For the purposes of EIA impact significance ranking, hazards in the Broadly Acceptable (Low Risk) region are not considered to result in significant impacts. Hazards in the Tolerable (Moderate Risk) and Unacceptable (High Risk) regions are considered to result in significant impacts.

15.21 Selected hazards were subject to more detailed collision risk assessment using Anatec's COLLRISK model, which has been widely used for UK energy projects (oil & gas, marine renewables and nuclear), including subsea collision risk assessments in Orkney Waters, the North Sea, Irish Sea and Bristol Channel. Full details on the approach taken are provided in the NRA.

15.4.4 Data gaps and uncertainties

15.22 It is recognised that small vessel activity is variable and dependent on numerous factors including weather conditions, tides, seasonal factors, and in the case of fishing vessels, quotas and the migration of fish species.

15.23 This variability has been taken into account as far as possible by using long-term desk-based research, radar count data and a high level of consultation with local stakeholders to inform an up-to-date baseline. However, over the life of the Project the activity could vary from that identified in the past few years.

15.5 Baseline Description

15.24 The baseline presents an assessment of the existing navigational features, metocean conditions and shipping activity recorded within and adjacent to the Project.

15.5.1 Navigational features

15.25 The Project is located in the Pentland Firth, which separates the Scottish mainland from the Orkney Islands. The Pentland Firth is well known as a challenging environment for mariners, with Admiralty Charts of the firth including general recommendations on navigation and more specific advice for laden tankers, due to strong tidal streams which give rise to eddies and races. The Project area lies outside of the worst of these, such as The Merry Men of Mey and The Swilkie.

15.26 There is a voluntary reporting system in the Pentland Firth. Laden vessels should report to Aberdeen Coastguard on VHF Channel 16 at least 1h before ETA and on final departure of the Pentland Firth. This includes giving details on Name, Course, Speed, Draught and Destination. From discussions with Aberdeen Coastguard, in practice, the majority of commercial vessels, both laden and ballast, tend to report.

15.27 Because of the very strong tidal streams, the eddies and races to which these give rise and the extraordinary violent and confused seas which occur at times, navigation in the firth requires careful preparation. These are such that some mariners may find it advantageous to adjust their arrival at the firth so as to pass through under favourable tidal conditions, or alternatively to use the Fair Isle Channel.

15.28 The Pentland Firth is divided into two passages by the island of Stroma. The principal and usual route through the firth by day and night, recommended for larger vessels, is the 2.5nm wide, deep and well-marked Outer Sound between Stroma and Swona. The Inner Sound between Stroma and the mainland is approximately 1.25nm wide, shallower, poorly marked, and its use by larger vessels is not recommended at any time, particularly in high winds or at night. However, it may be used by slow or smaller vessels with local knowledge in certain weather or in order to avoid proceeding against a stronger contrary stream in the Outer Sound.

15.29 Admiralty Sailing Directions suggest a mid-channel route through the Inner Sound when transiting with the tidal stream. When heading eastbound against the stream, keeping close in to either Stroma or Gills Bay is recommended to take advantage of comparatively slack water either side of mid-channel. For the westbound passage against an east-going tidal stream, the track favours the mainland shore through Inner Sound. However, the directions state that the coast between Ness of Duncansby and Gills Bay should not be approached too closely as it is generally poorly surveyed and in a number of places is fringed by dangerous or drying rocks.

15.5.2 Metocean data

15.30 Wave and tidal data for the Inner Sound was used as input to the under keel clearance (UKC) assessment and risk of collision with the subsea turbines (Section 15.7.1).

15.31 Based on recorded levels during a 30 day Acoustic Wave and Current (AWAC) recorder deployment within the Project area, two years of tidal level data for 2011-12 were predicted using harmonic analysis. Figure 15.1 presents the exceedence probability of tidal height above LAT. This shows that 97% of the time the tidal height is at least 1m above LAT (i.e., minimum UKC of 9m) and 80% of the time it is at least 2m above LAT (minimum UKC of 10m).

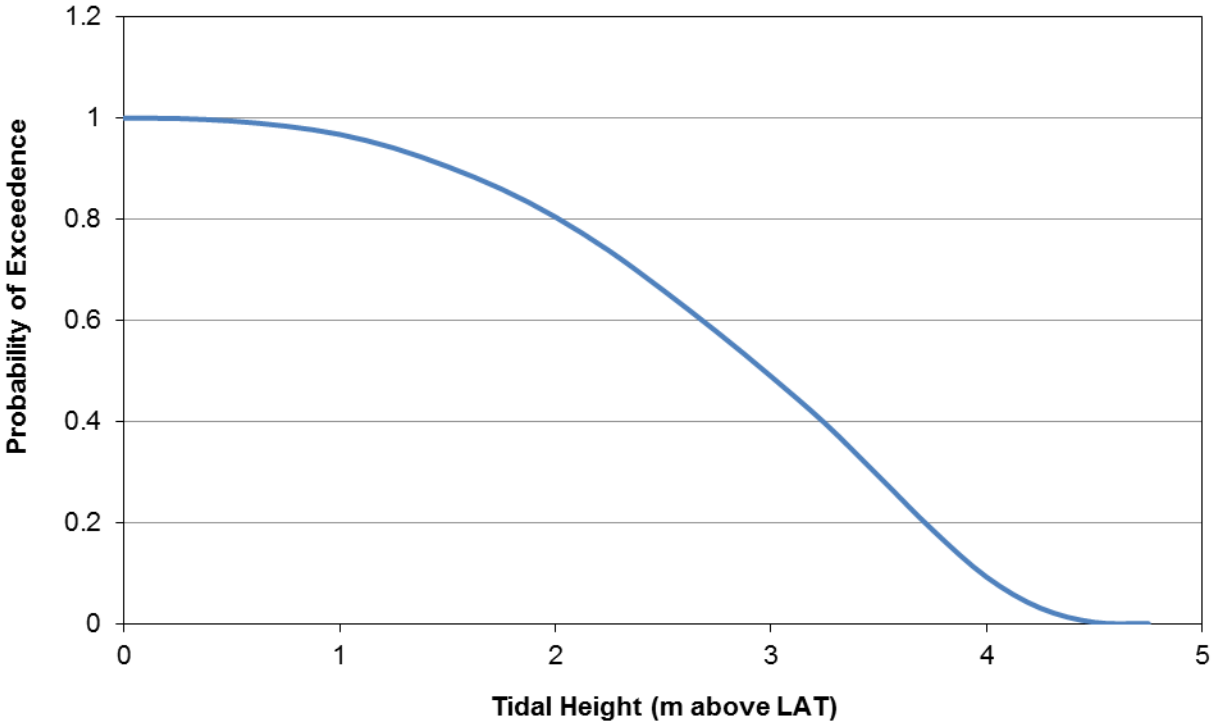

Figure 15.1: Tidal height exceedence probability (2011 to 2012)

15.32 In terms of tidal speeds and directions, the flows recorded exceeded 4.5m/s and analysis of the data indicated that they could exceed 5m/s during an equinoxial tide. The ebb tide runs in a generally westerly direction and the flood tide runs in an easterly direction.

15.33 Wave data were obtained from the DHI/EMEC Mike21 model for a location within the Project area at three-hourly intervals for 1986 to 2005 (EMEC wave data 1986 – 2005). Significant and maximum wave height probability distributions calculated based on this data are presented in Figure 15.2. The average values over the 20 years were 0.9m (significant) and 1.7m (maximum). The highest values were 3.2m (significant) and 6.0m (maximum).

15.34 This data has a relatively coarse resolution at the Project site and comparison with other data sets indicates it may under-predict extreme wave heights in the Inner Sound. Therefore, the maximum wave height data was used in the risk modelling, which is conservative.

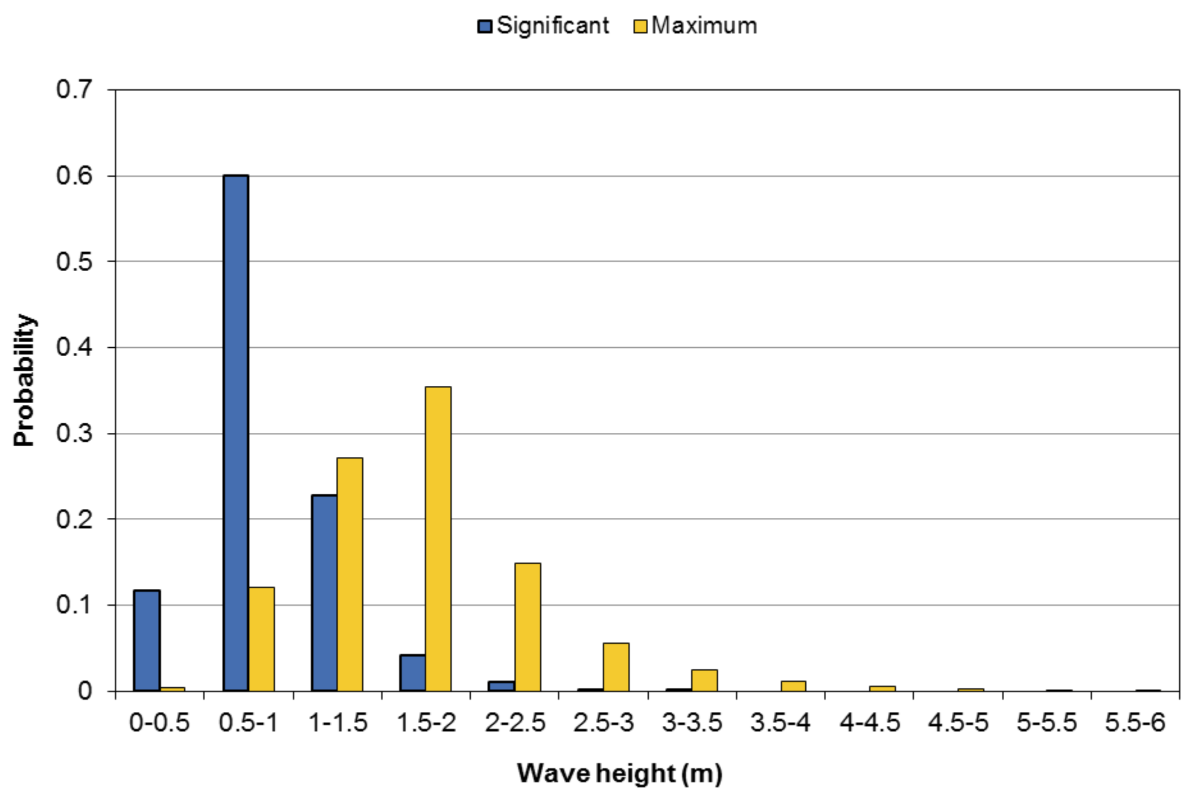

Figure 15.2: Wave height data for the Project

15.5.3 AIS data analysis

15.35 A combined dataset of 16 weeks seasonally and tidally weighted AIS survey data from 2010 -11 was used for the baseline shipping analysis. This exceeded the minimum required by MCA MGN 371 of 4 weeks in order to provide a comprehensive picture of the traffic in the Inner Sound.

15.36 This was analysed for the Project area and its surroundings, covering both the Inner and Outer Sounds. A plot of ship tracks recorded during the survey period, colour-coded by vessel type, is presented in Figure 15.4.

15.37 An illustration of the relative traffic density within the area is presented in Figure 15.5 based on the combined AIS track data.

15.38 Visible during all the periods are the tracks of the *Pentalina* ferry, operated by Pentland Ferries between Gills Bay and Saint Margaret's Hope with three return trips per day. These regular transits are the reason for the higher density in the vicinity of the Project. A combined plot of all the *Pentalina* tracks over the 16 weeks is presented in Figure 15.6. The shortest route is west of Stroma which is seen from the AIS data to be most frequently used with approximately two-thirds of transits. However, from consultation with one of the Masters it was indicated that the choice is also influenced by the wind and tidal conditions. In easterlies the ferry will tend to pass west of Stroma whilst in westerlies the route east of Stroma is preferred. On the one-third of sailings east of Stroma the ferry usually crossed over the Project area.

15.39 All the periods also showed consistently heavy east-west traffic via the Outer Sound between the islands of Stroma and Swona. The number of vessels using the Outer Sound averaged 14 per day, with around 11 per day heading east-west. The east-west traffic transiting the Inner Sound is low-to-moderate by comparison, averaging less than 1 vessel per day (approx. 4% of the Outer Sound traffic). The sizes of vessels in the Inner Sound also tended to be smaller.

15.40 More detailed analysis of the east to west transiting traffic through the Inner Sound over the 16 week survey period was performed. In total, 43 different vessels were recorded using the Inner Sound making a total of 63 transits (average of 1 transit every 2 days). The number of vessels varied slightly between the periods with marginally more traffic in winter.

15.41 A number of these same vessels were also recorded using the Outer Sound during the survey, which suggests vessels can use both channels, although their choice is likely to depend on weather, tides and departure / destination ports.

15.42 The type distribution of east-west transiting vessels (excluding unspecified) is presented in Figure 15.3. The majority were fishing vessels (57%). Figure 15.7 presents all the east-west transiting vessels colour-coded by type.

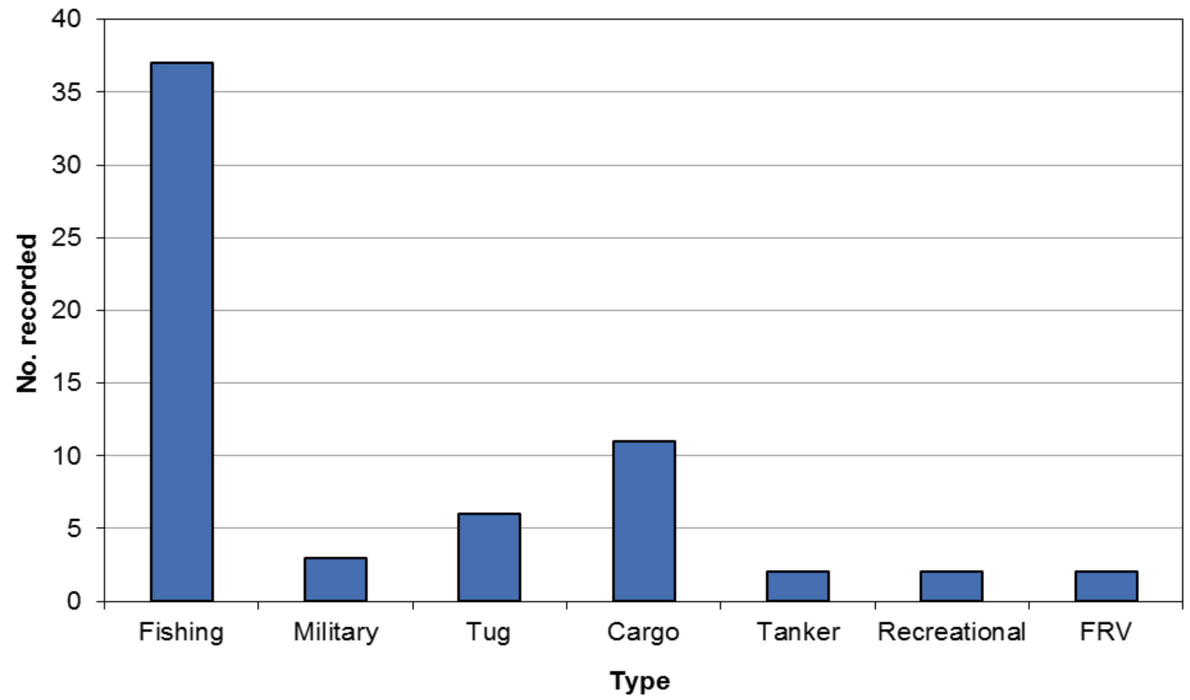

Figure 15.3: Inner Sound East-West Transiting Traffic Vessel Type Distribution – 5nm (2010 to 2011)

15.43 A total of 29 of the 63 vessels were broadcasting their draught on AIS. The draughts of a further 23 vessels were conservatively estimated based on researching their maximum draught or depth. A combined plot of the transiting traffic by draught is presented in Figure 15.8. Draughts for 62 of the 63 vessels have therefore been ascertained.

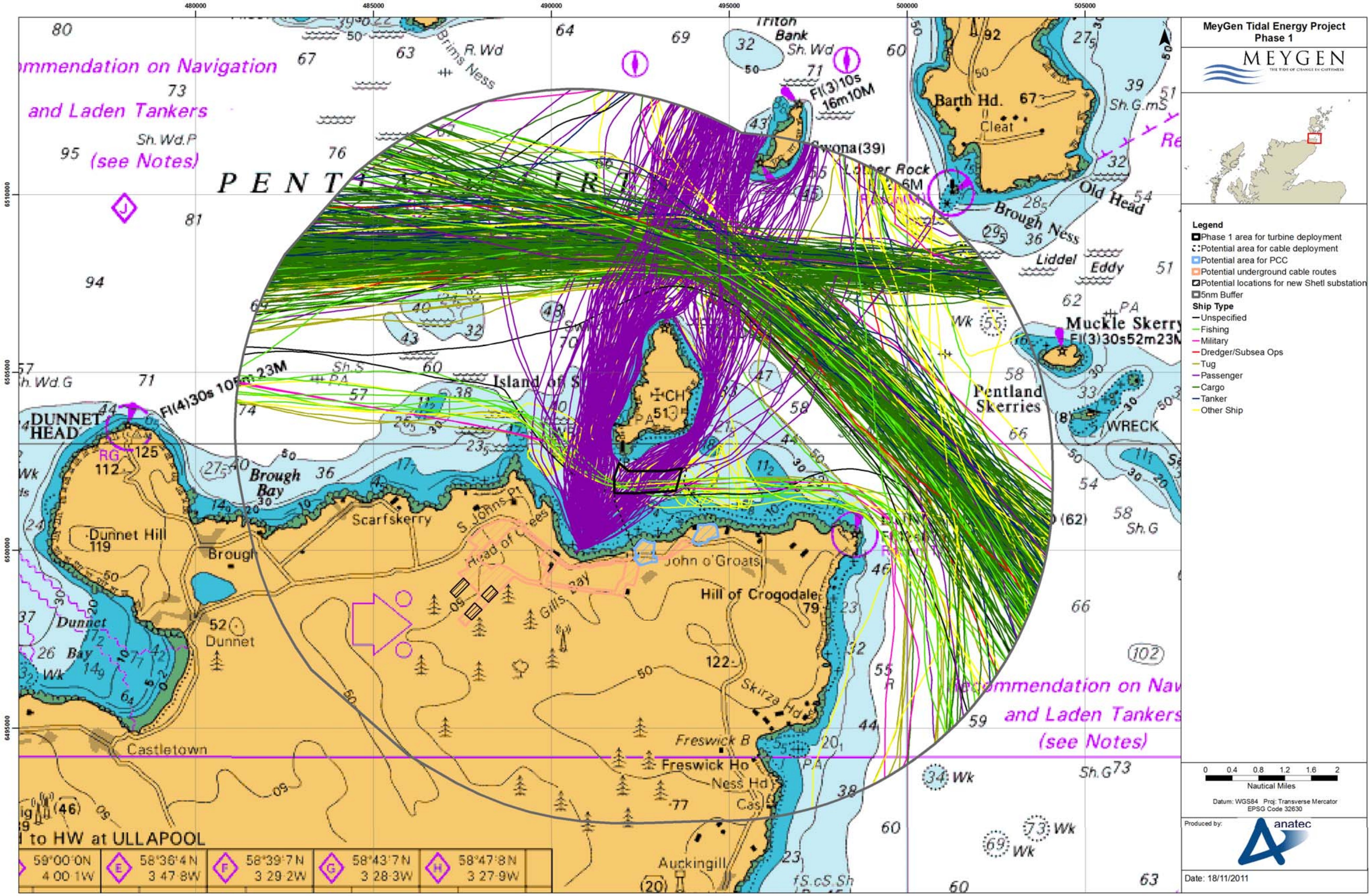

Figure 15.4: AIS tracks by ship type within 5nm of the Project (Summer, 2011)

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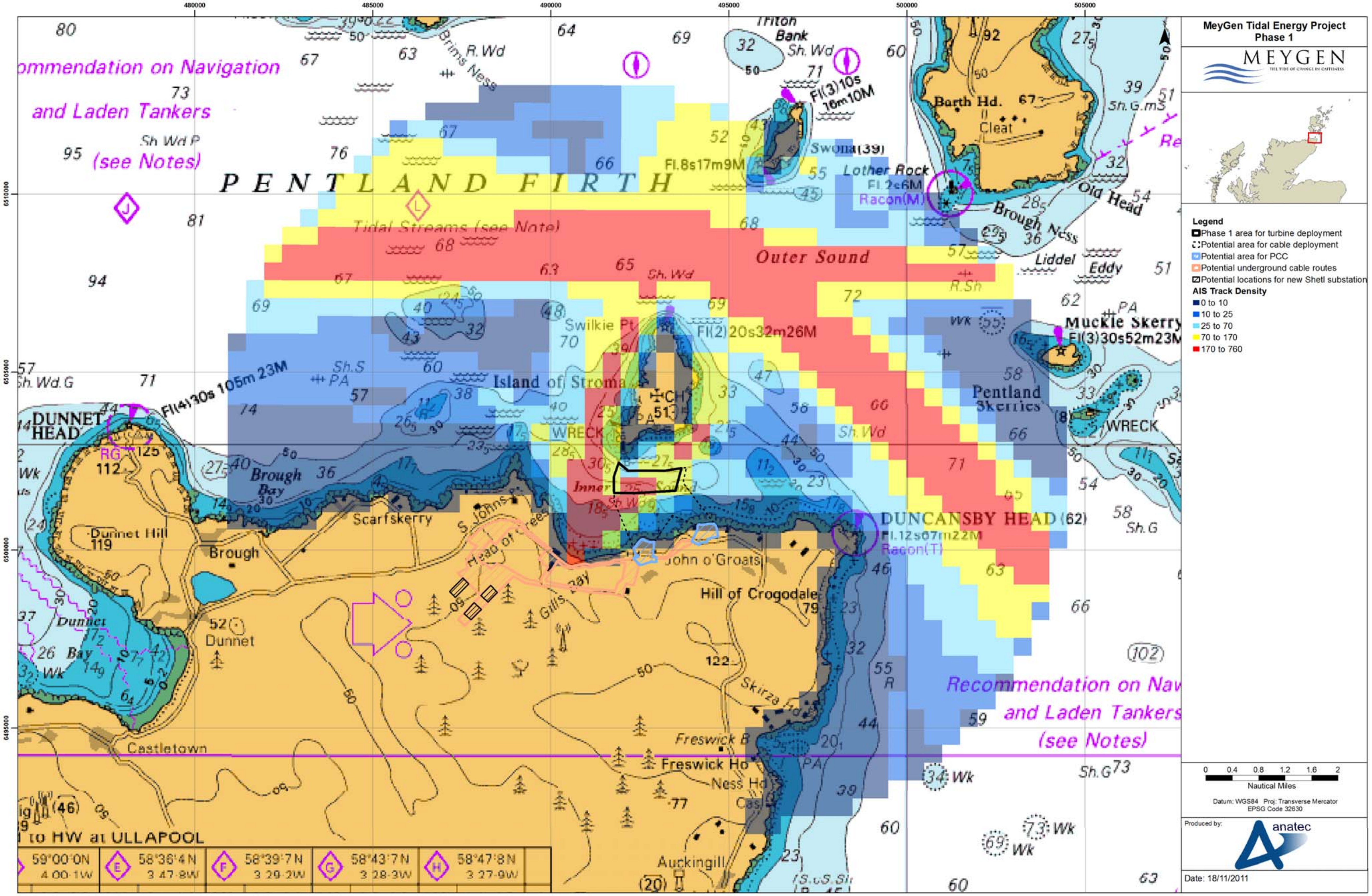

Figure 15.5: AIS density (2010 and 2011)

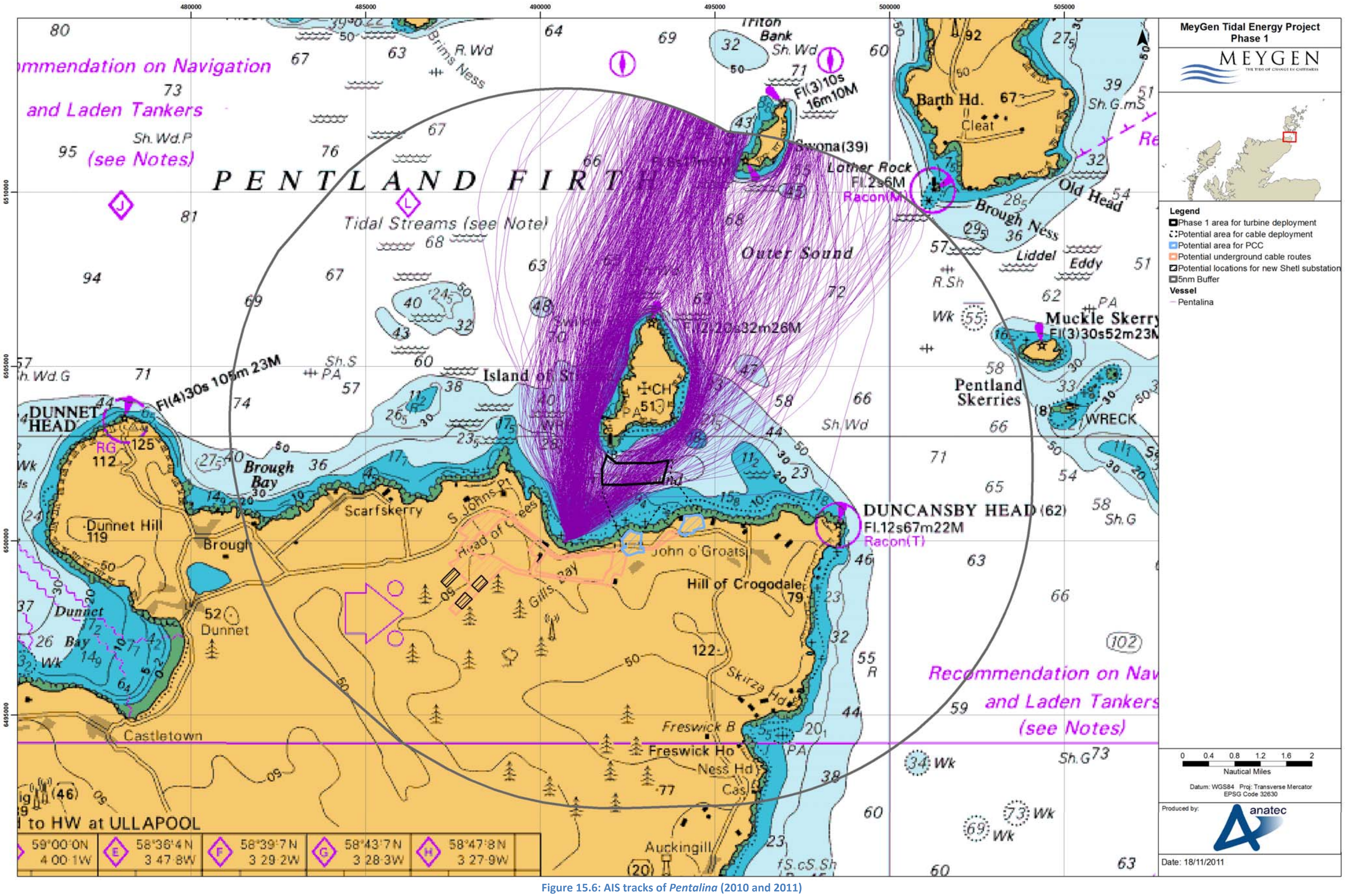

Figure 15.6: AIS tracks of *Pentalina* (2010 and 2011)

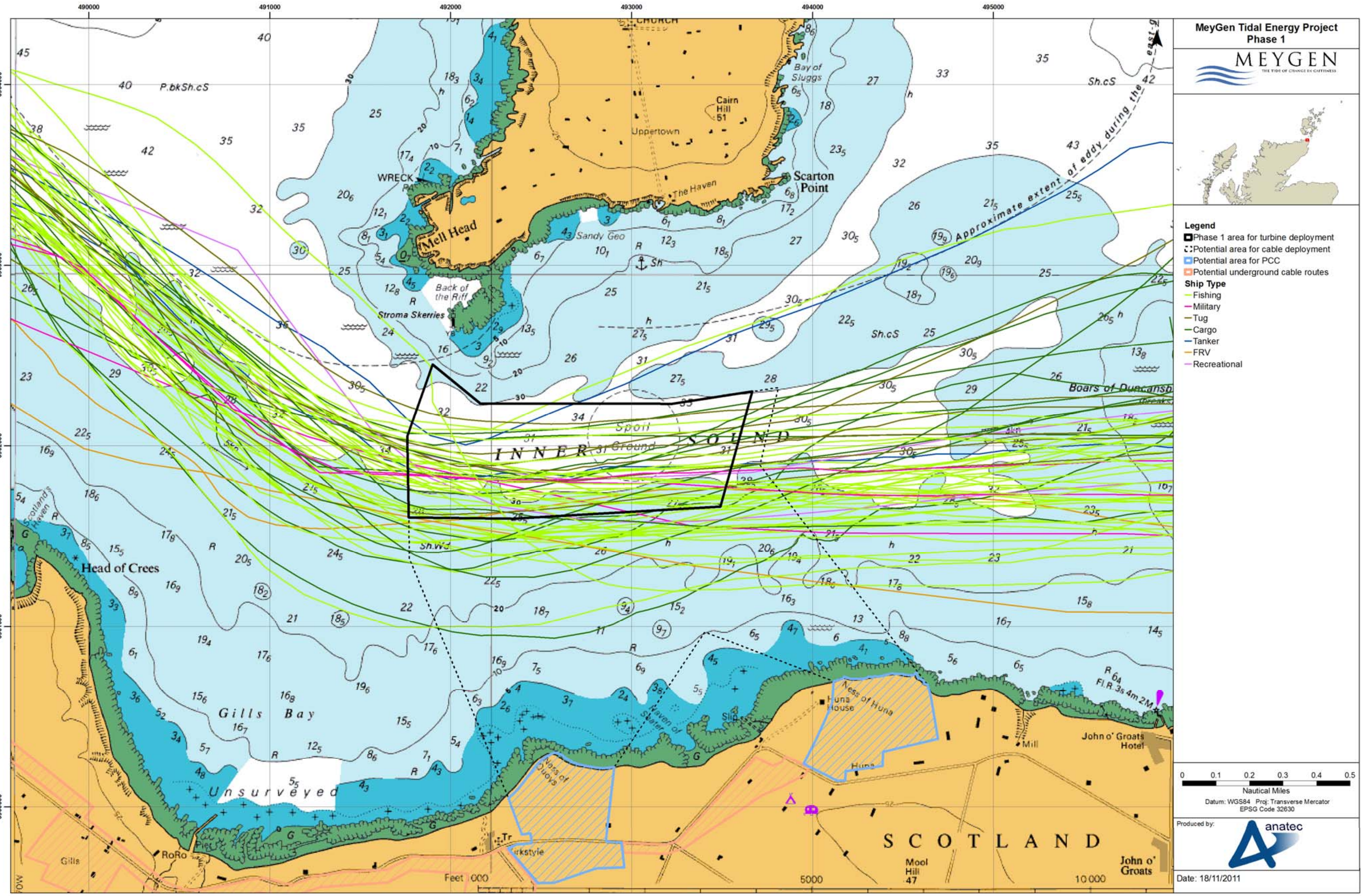

Figure 15.7: AIS tracks by ship type within Inner Sound (2010 and 2011)

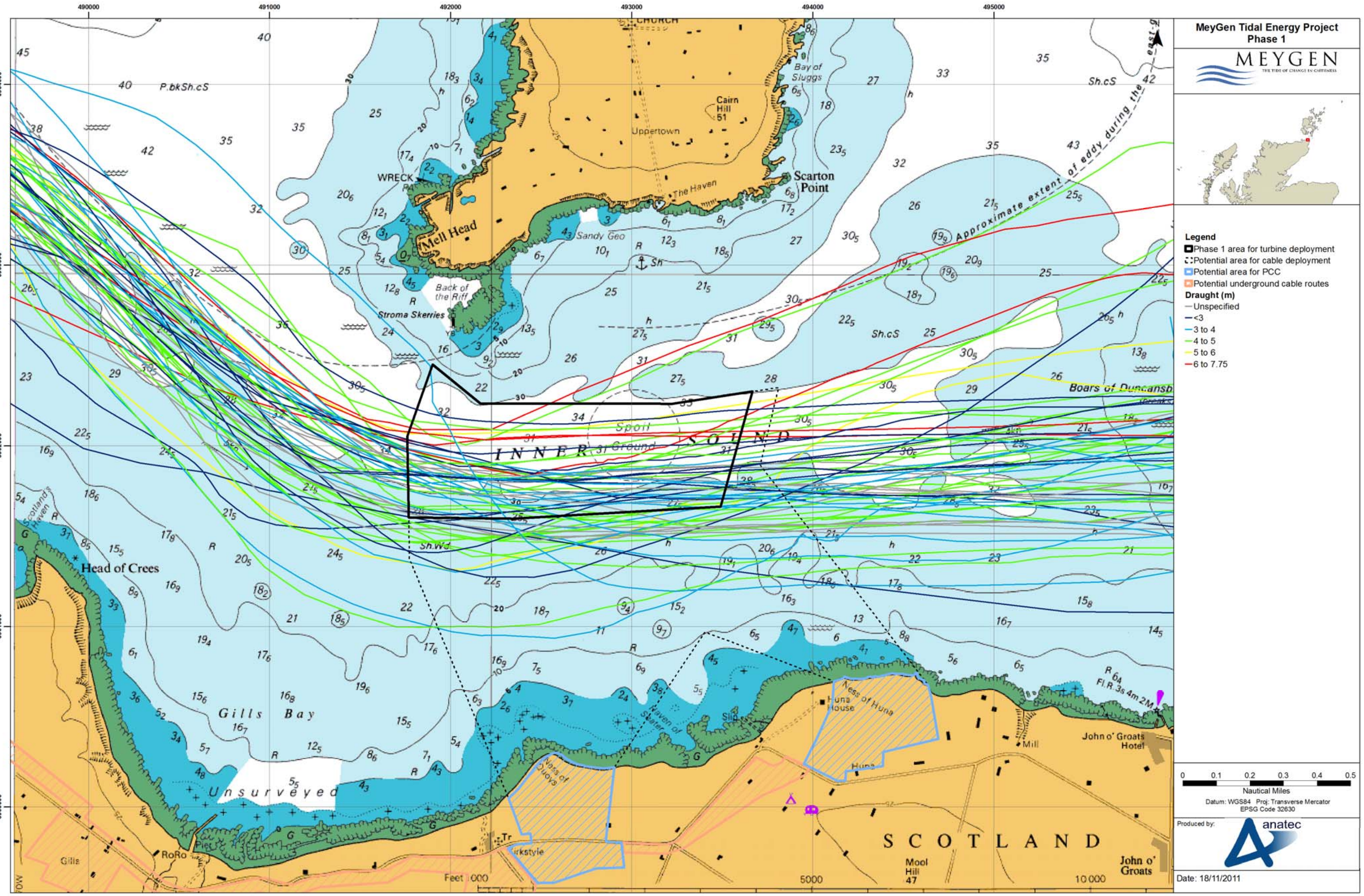

Figure 15.8: AIS tracks by draught within Inner Sound (2010 and 2011)

15.44 The draught distribution of transiting vessels (excluding unspecified) is presented in Figure 15.9.

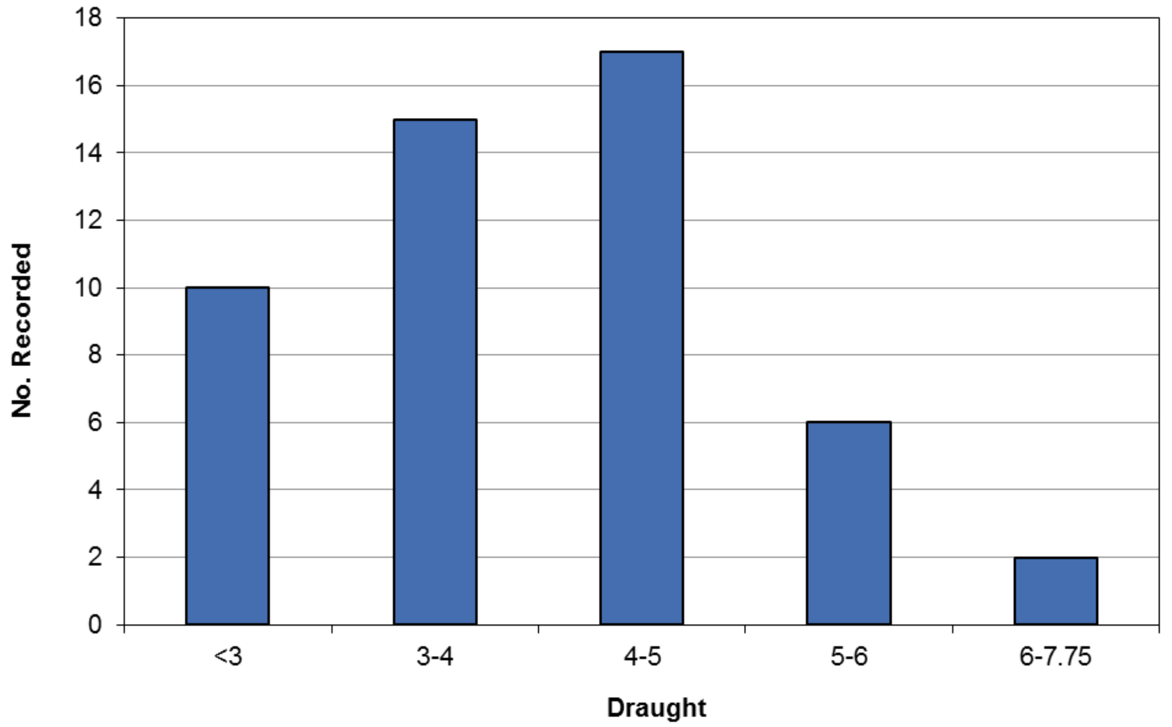

Figure 15.9: Draught Distribution within Inner Sound (AIS 2010 to 2011)

15.45 The average draught was 3.9m and the deepest draught vessel was the pelagic trawler *Pathway PD165* at 7.75m.

15.5.4 Radar data analysis

15.46 Small vessel activity not represented on AIS, such as fishing and recreational vessels, was acquired from Scapa Vessel Traffic Services (VTS) operated by OIC Marine Services for a 42 day period in August-September 2011. This included both AIS and radar (non-AIS traffic) crossing count lines setup crossing the Outer Sound and Inner Sound (refer to supporting studies CD Anatec, 2012).

15.47 Discussion with the VTS Manager indicated that coverage in the Outer Sound is very good in summer for radar targets, as there is generally less sea clutter and spurious tracks. The Inner Sound has a blind spot but by offsetting the count line an estimate of transiting traffic was obtained.

15.48 The numbers of vessels crossing both lines are summarised in Figure 15.10 and Figure 15.11 divided into AIS and Radar (non-AIS).

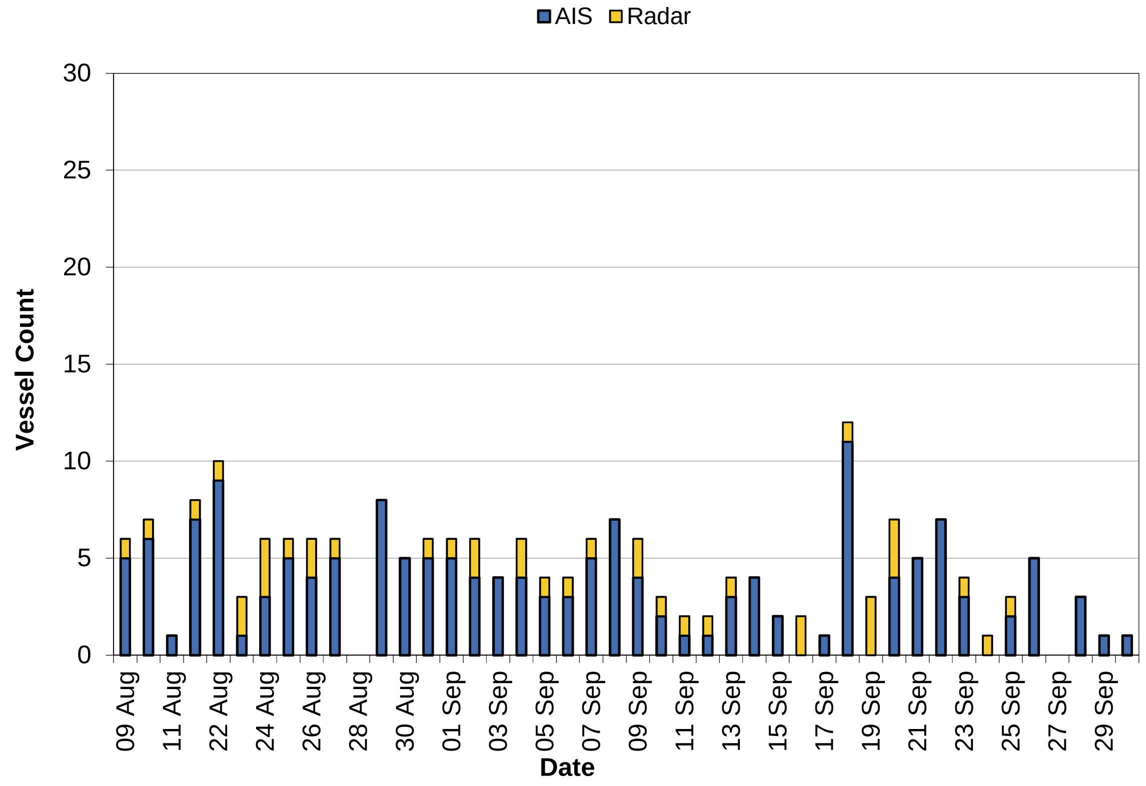

Figure 15.10: Vessels per Day crossing the Inner Sound Count Line

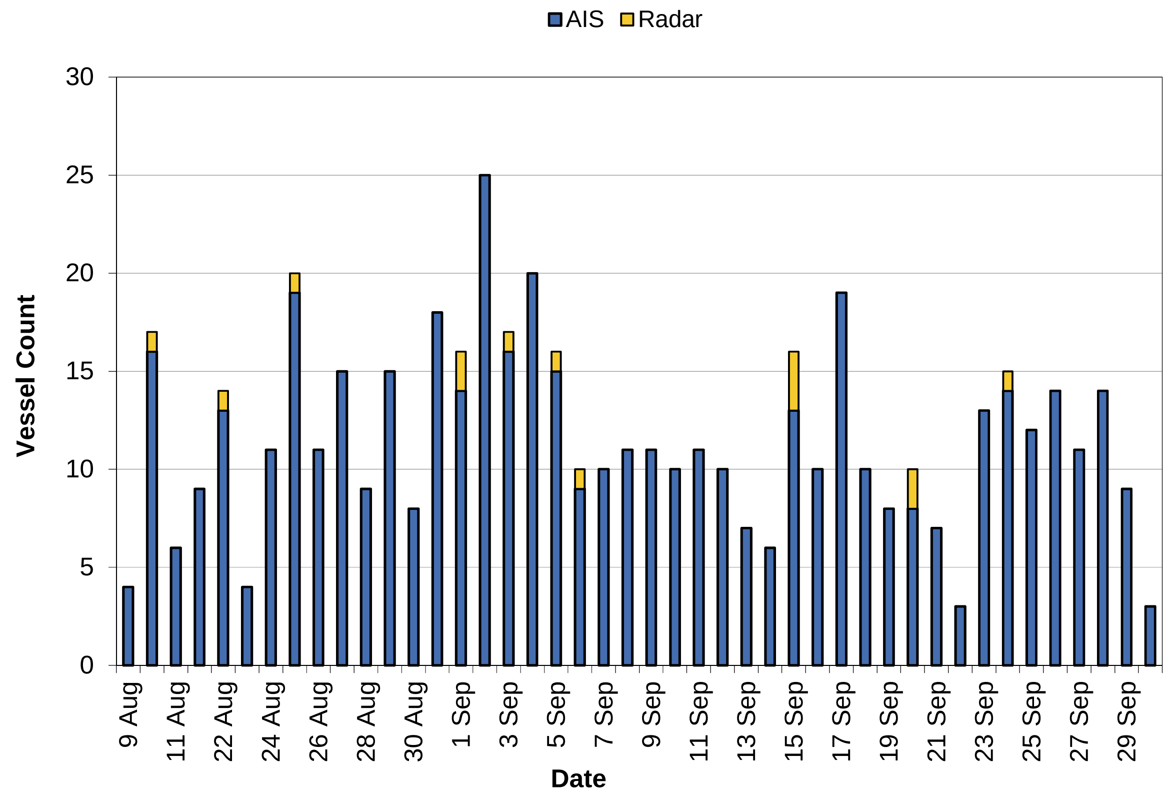

Figure 15.11: Vessels per Day crossing the Outer Sound Count Line

15.49 A total of 515 vessels crossed the Outer Sound line over the effective 42 days survey period, averaging 12.3 per day. There were 501 AIS vessels (around 11.9 per day) and 14 radar targets not broadcasting on AIS (around 0.3 per day). Again, the most regular vessel on AIS crossing the line was the Pentalina with an average of two crossings per day. Excluding the ferry, the daily number of AIS crossings is approximately 10 per day, which shows good agreement with the 16 weeks AIS survey data.

15.50 A total of 199 vessels crossed the Inner Sound line over the effective 42 days survey period, averaging 5 per day. There were 159 AIS vessels (around 4 per day) and 40 radar targets not broadcasting on AIS (around 1 per day). The *Pentalina* was the main AIS target recorded crossing the Inner Sound count line typically 3 times per day when routeing east of Stroma. Excluding this ferry and some working vessels associated with the Project, the number of AIS tracks drops to between 0.5 and 1 per day. This is in-line with the AIS survey data.

15.51 Overall, the Outer Sound had much higher traffic levels than the Inner Sound, which is in agreement with the AIS surveys. However, smaller (non-AIS) vessels tracked on radar tended to favour the Inner Sound, with an average of just under one vessel per day, compared to one every three days through the Outer Sound.

15.52 Combining the AIS and radar (non-AIS) traffic, it was estimated there are 535 vessels per annum transiting the Inner Sound east-west, an average of 1-2 per day.

15.5.5 Ferry vessel activity

15.53 As presented in Figure 15.6, the Pentland Ferries vessel *Pentalina* (draught - 3m) was tracked on AIS crossing the Inner Sound on average six times per day (three return-trips between Gills Bay and Saint Margaret's Hope). The John o' Groats ferry *Pentland Venture* passes in the vicinity of the Project area during summertime wildlife cruises around Stroma. Both ferries are relatively shallow draught and therefore are only likely to be affected by work vessel activity within the site during installation and maintenance. Consultation with both ferry operators indicated no significant problems with the Project. MeyGen plan to continue communications with the operators throughout the Project.

15.5.6 Fishing vessel activity analysis

15.54 All the fishing vessel tracks recorded during the combined AIS survey period (16 weeks from 2010 to 2011) are presented in Figure 15.12. In total, 37 vessels used the Inner Sound and 96 used the Outer Sound, i.e., approximately 1 in 4 via the Inner Sound. All were transiting as opposed to fishing.

15.55 This showed reasonable agreement with analysis of VMS data, which covers fishing vessels of 15m length and over, with position reports received every two hours on average. Analysis of 2009 data indicated around 1 in 3 vessels via the Inner Sound, as shown in Figure 15.13 (2008 and 2010 data of UK vessels also showed a similar pattern).

15.56 It is likely that the majority of radar (non-AIS) vessels counted crossing the Inner Sound by Scapa VTS were also UK fishing vessels.

15.57 Sightings data based on over-flights and Royal Navy patrols were also analysed and tended to corroborate the other data sets. All the sources agreed that vessels tended to transit the Inner Sound as opposed to fishing, and that the vast majority were UK-registered.

15.58 From local consultation, three John o' Groats based skippers (using four vessels) were identified to fish in the Inner Sound. The creel boats they use are less than 12m in length and have draughts up to about 1.5m. They are not equipped with AIS or VMS units. These local vessels use creels to catch lobsters, brown crabs and velvet crabs. They also fish areas to the west, around Stroma and further east. There is no precise fishing pattern and the positioning of pots is variable due to the conditions (tidal and weather) in the Inner Sound being unpredictable. The centre of the Inner Sound where the turbine deployment area is located is infrequently fished. However, fishing is limited as it requires a combination of neap tides and good weather, due to the time it takes to deploy and haul creels between tides (see Section 14).

15.59 From conversations with Marine Scotland Compliance, including the Senior Fisheries Officer in Scrabster, it is understood that Marine Scotland Compliance are performing a research study into the fishing in the area which should be available in early 2012 (this was not available for the NRA).

15.5.7 Recreational vessel activity analysis

15.60 Figure 15.14 presents the recreational vessel tracks recorded during the 16 week shipping survey. There were two transits of the Inner Sound and 5 of the Outer Sound. This indicates a proportion of recreational vessels are carrying AIS voluntarily, although they may not always be broadcasting. The two transits of the Inner Sound were made by *Komale*, a custom-built rowing boat and *Skellig of Sark*, a RIB. Further research indicated both were involved in fund-raising events for charity.

15.61 The latest RYA Coastal Atlas data indicated the Project area does not fall within any Racing or Sailing Areas. In terms of facilities, the nearest harbours / marinas are at Scrabster and Wick. The closest club and training centre is the Pentland Firth Yacht Club in Scrabster.

15.62 No cruising routes are shown through the Inner Sound but there is a medium-use cruising route through the Outer Sound of the Pentland Firth. Medium use cruising routes are defined as "popular routes on which some recreational craft will be seen at most times during summer daylight hours".

15.63 However, a review of the Clyde Cruising Club Sailing Directions, and consultation with RYA (Scotland) and local yachtsmen experienced in sailing through the Pentland Firth identified that the Inner Sound is preferred to the more open Outer Sound when heading east-west. Estimates of the number of transits varied from 1 or 2 yachts per month during summer season and very rarely during winter, to a conservative upper limit of 100 per year.

15.64 The Sailing Directions state that passage should not be undertaken in swell, spring tides, wind against tide, fog and wind force over 4.

15.5.8 Maritime incidents

15.65 Maritime incidents recorded by the MAIB and RNLI in the vicinity of the Project area between 2001 and 2010 have been analysed (some were recorded by both sources).

15.66 The MAIB incident locations are presented in Figure 15.15, colour-coded by type. A total of 14 unique incidents were reported in the area within 5nm of the boundary of the Project, corresponding to an average of 1 to 2 per year.

15.67 No incidents were recorded within the Project area over the 10 years analysed. The closest incident was recorded approximately 0.3nm to the east of the boundary. In April 2004 a fishing vessel suffered machinery failure when its main engine stopped due to dirty fuel oil causing a blockage.

15.68 Figure 15.16 presents the geographical locations of RNLI incidents colour coded by casualty type. A total of 34 launches were carried out in response to 23 unique incidents (excluding hoaxes and false alarms). This equates to an average of 2-3 incidents per year with some incidents being responded to by two or three lifeboats.

15.69 No incidents were recorded within the Project area over the 10 years analysed. The closest incident to the site occurred approximately 0.2nm south of the boundary. This incident occurred on 3rd July 2004 and involved a fishing vessel which became stranded, leading to a person being in danger. This incident was responded to by the Thurso all-weather-lifeboat (ALB).

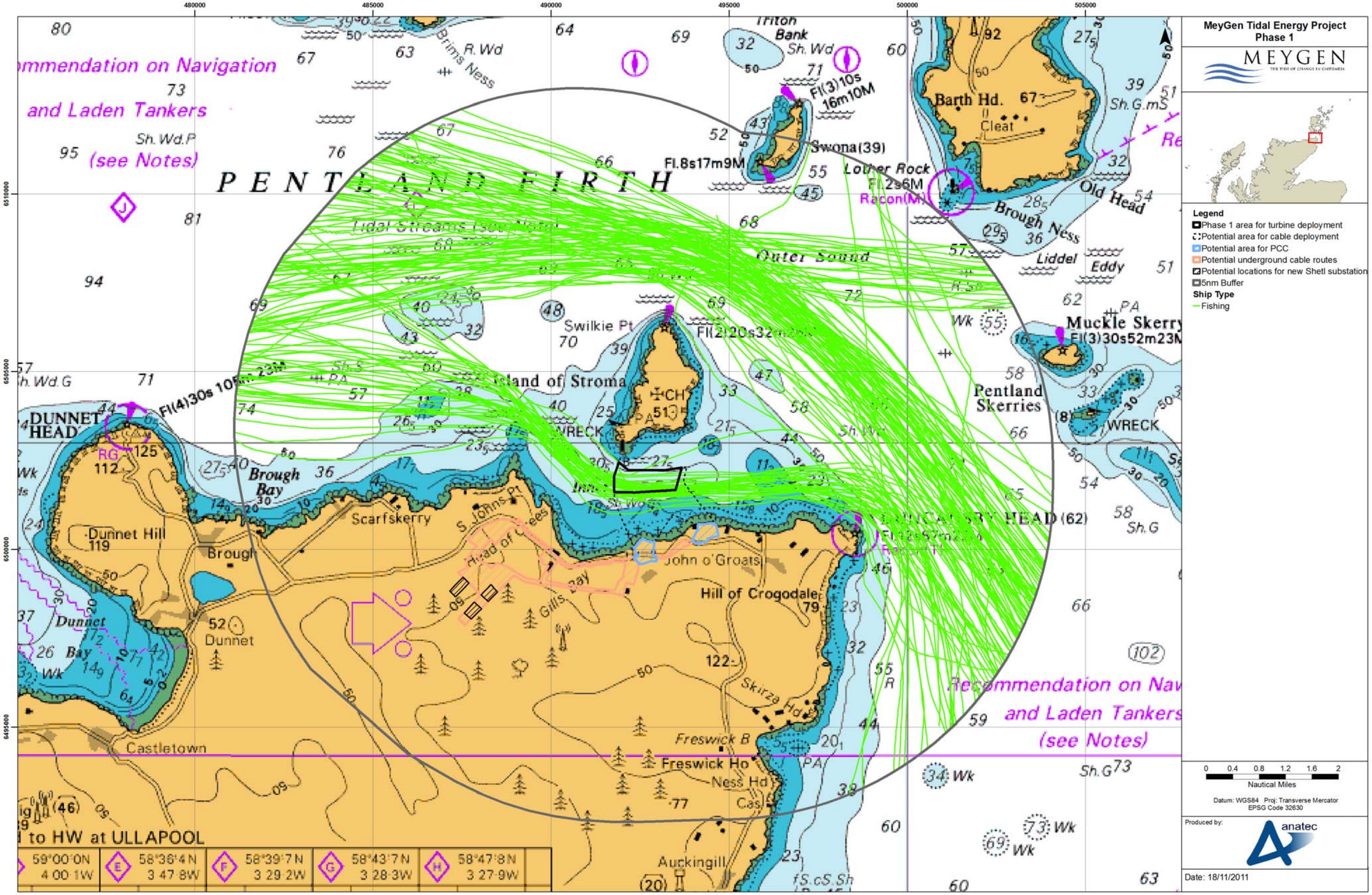

Figure 15.12: Fishing vessels tracked on AIS (2010 and 2011)

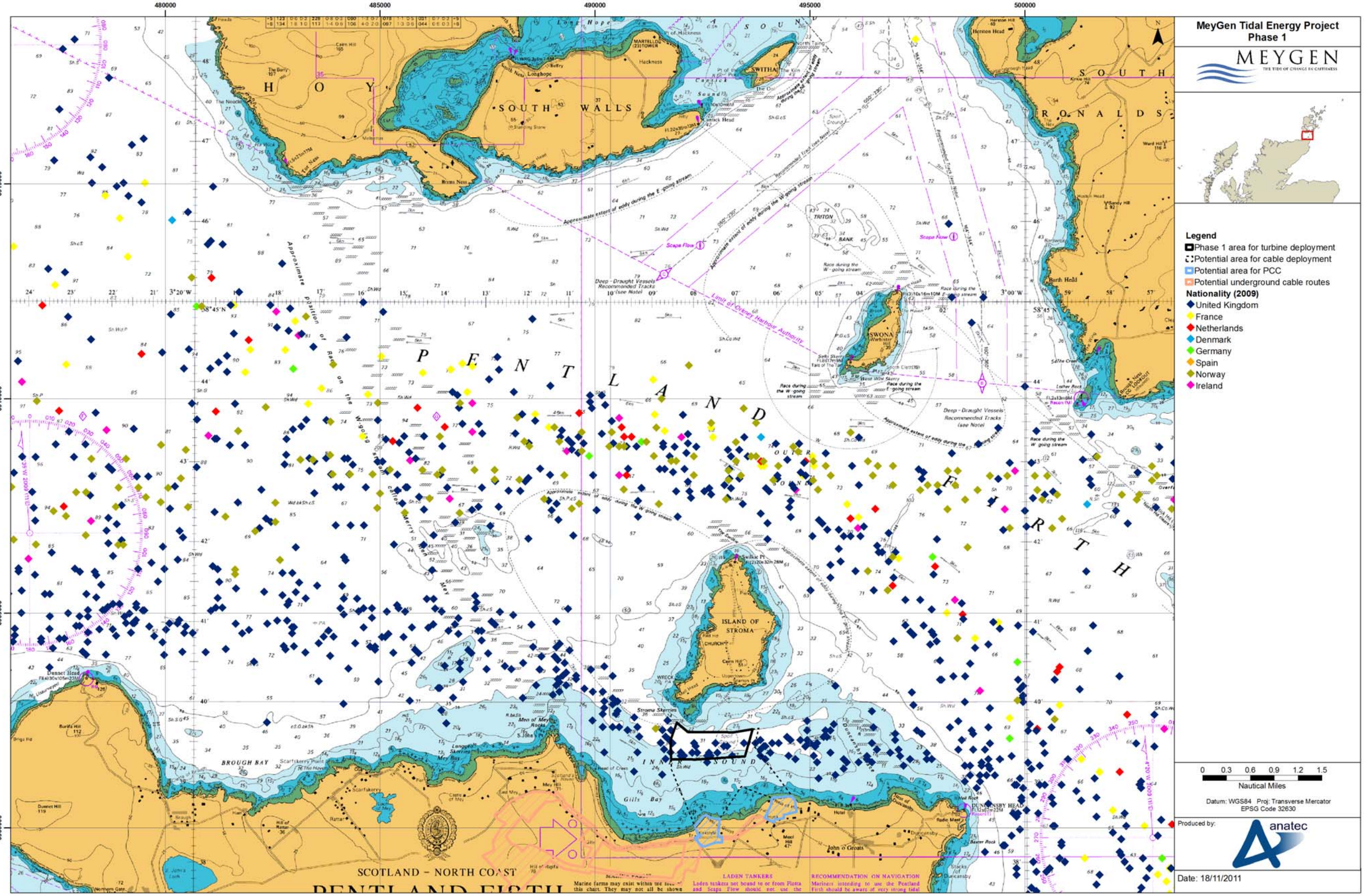

Figure 15.13: Fishing vessel satellite positions relative to the Project (2009)

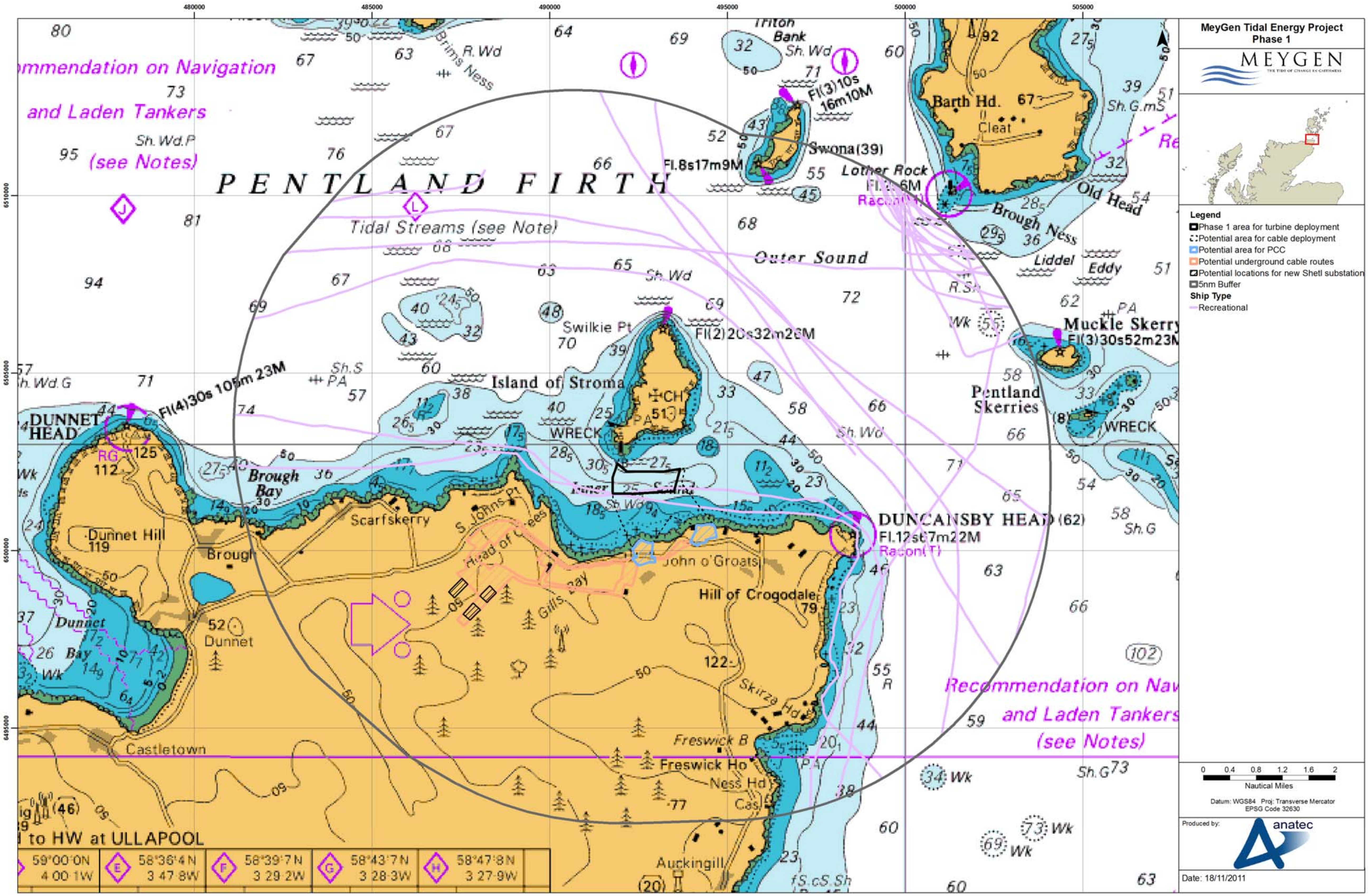

Figure 15.14: Recreational vessels tracked on AIS (2010 and 2011)

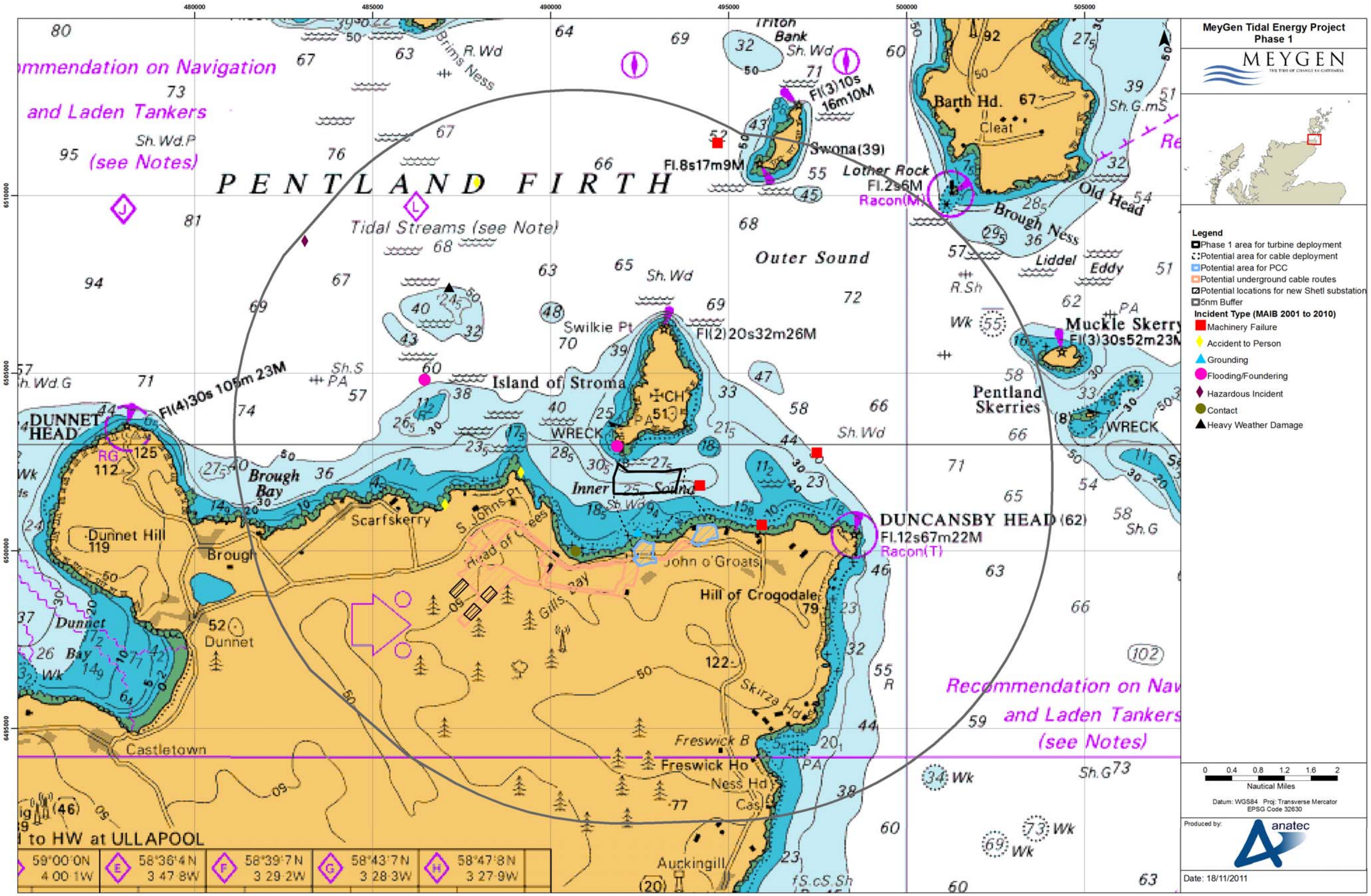

Figure 15.15: MAIB incident locations by type within 5nm of the Project (2001 to 2010)

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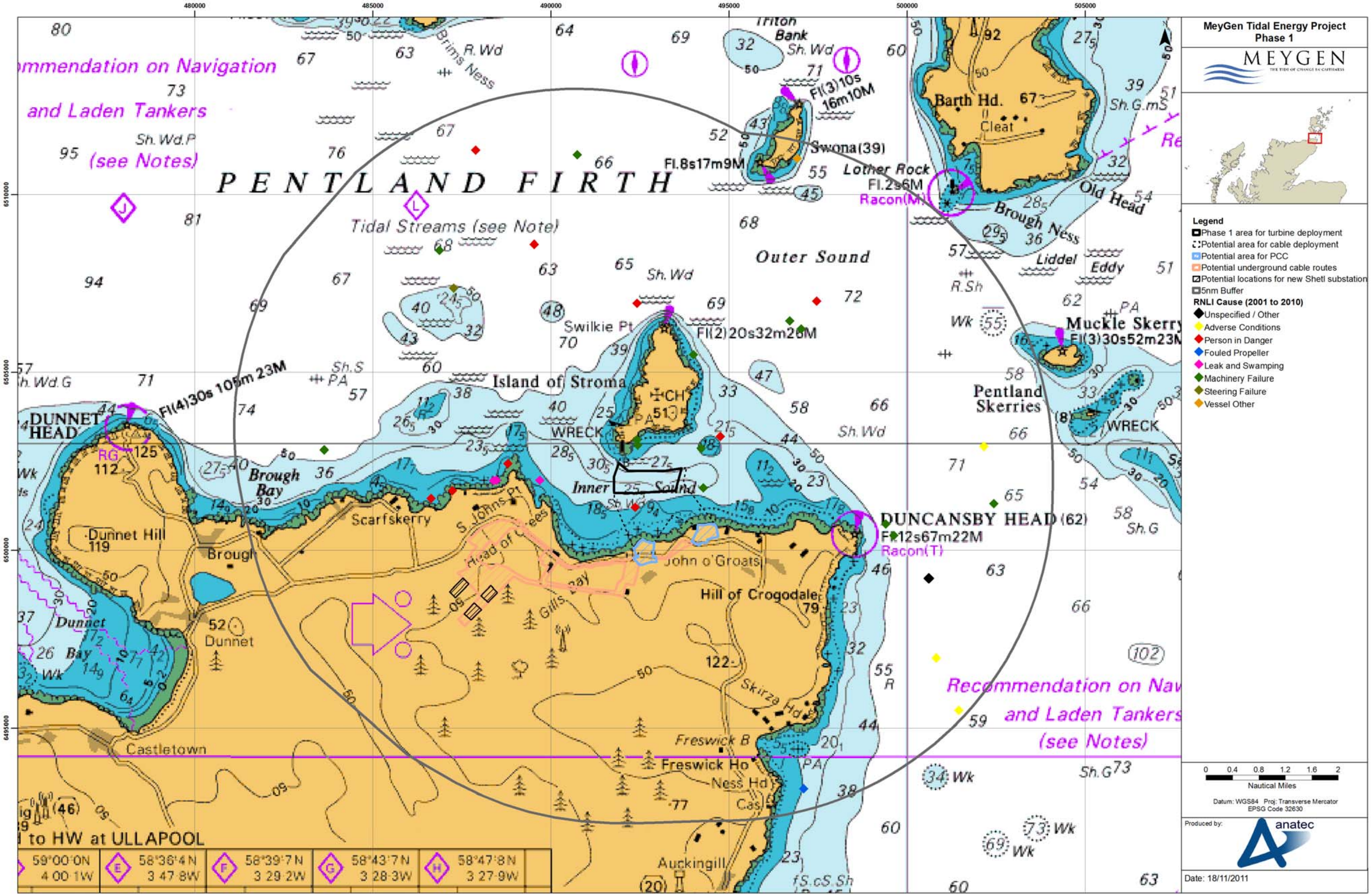

Figure 15.16: RNLI incident locations by casualty type within 5nm of the Project (2001 to 2010)

15.70 There have been two notable maritime incidents responded to by RNLI near Stroma in 2011 (not covered in the above data period):

- On 7th September the Thurso and Longhope RNLI lifeboats responded to a fishing vessel (*Golden Promise*) aground on the west coast of Stroma, which sent a Mayday call to Aberdeen Coastguard; and
- On 27th July the Thurso lifeboat rescued 12 people from rocks after a tour boat (*North Coast Explorer*) got into difficulties while in a sea cave on the island of Stroma. The pleasure boat was not recovered.

15.71 Historical incidents in the Pentland Firth brought up during consultation are described in the NRA and include:

- The chemical tanker Multitank Ascania drifting towards Dunnet Head on fire in 1999;
- The loss of two crew members on the FR8 Venture in 2006 due to severe waves west of Swona after departing Scapa Flow; and
- The loss of fishing gear from the purse seiner Krossfjord in 2008 which fouled the propeller of a passing Scottish trawler.

15.5.9 Search and rescue

15.72 A review of the assets in the area of the Project identified that the closest SAR helicopter base is located at Lossiemouth, operated by the RAF, approximately 57nm to the south of the Project. This base has Sea King HAR3/3A helicopters with a top speed of 125 knots and a radius of action up to 250nm, which is well within the range of the Project area.

15.73 The Royal National Lifeboat Institution (RNLI) maintains a fleet of over 400 lifeboats of various types at 235 stations around the coast of the UK and Ireland. The nearest RNLI stations in the vicinity of the Project, and the ones that responded to the historical incidents in the Inner Sound, are at Wick, Thurso and Longhope. At each of these stations crew and lifeboats are available on a 24 hour basis throughout the year. From conversations with the coxswains, the time for an all-weather lifeboat to reach the Project area would be approximately 45 minutes.

15.6 Impacts during Construction and Installation

15.74 Work vessels will be required during construction and installation of the project. The intention is for a Dynamic Positioning (DP) construction vessel to install foundations and turbines, while a construction vessel or a cable-laying vessel will install the shore-to-array cables and a lightweight vessel with Remotely Operated Vehicle (ROV) will install the short lengths of jumper cable between the turbine bases and the shore-to-array cables. It is anticipated that these activities will not run in parallel.

15.75 The works will be temporary and periodic. All activities will be defined by suitable weather conditions and in some cases by tidal conditions, i.e., periods of slack water. The activities are expected to take place between 2013 and 2015, primarily during spring, summer and autumn.

15.6.1 Impact 15.1: Collision risk with work vessel

15.76 The work vessel(s) could pose a surface collision risk and an obstruction to navigation for all vessels, irrespective of their draught.

15.77 It is noted that much of the work activity will be restricted to windows of time around slack water and the change of the tide. Analysis of tide and current data in the vicinity of the Project indicated that the vessels recorded on AIS transiting the Inner Sound did so at a range of different times and that the peak times did not correspond with slack water. Therefore, only a minority of transiting vessels are likely to encounter working vessels when they are restricted in manoeuvrability in the Project area during these limited tidal windows.

15.78 By pre-warning mariners in advance of the activity, it will allow them the choice of altering their transit to use the Outer Sound rather than the Inner Sound. It is noted that the work vessel(s) will monitor passing traffic and have collision risk management procedures in place to help ensure they move out of the way if a vessel is detected on a potential collision course and has not responded to attempts at communication.

Risk significance

15.79 For both local and transiting vessels:

Frequency	Consequence	Risk	Significance
Extremely unlikely	Moderate	Low (Broadly acceptable)	Not Significant

15.80 The above assessment assumes industry good practice will be applied to minimise this impact. Despite the impact being rated as low risk, mitigation is still proposed to ensure that this remains the case. Standard measures and additional mitigation identified during consultation and at the Hazard Review Workshop are presented below:

MITIGATION IN RELATION TO IMPACT 15.1

- Experience and lessons learned from other marine renewables projects will be taken into account.
- Workshops will be held before the activity takes place involving the Construction company and maritime stakeholders to review the hazards and plan how the work can be safely conducted.
- Marine Safety Information broadcasts will be issued by HM Coastguard to inform mariners of the activity at the Project area (8 broadcasts per day covering Fair Isle, Cromarty and Hebrides Areas).
- The Project area will be depicted on Admiralty Charts produced by the UKHO.
- Navtex and Notices to Mariners will be issued including details of the MeyGen work.
- Information on the work activity at the site will be circulated directly to local ports, ferry operators (e.g., Pentland Ferries), fishermen and recreational clubs.
- Details of the Project will be included in updated Kingfisher fishermen’s awareness charts and FishSAFE.
- Details of the Project will be included in updated Sailing Directions.
- There will be liaison with local Harbour Masters to ensure they are aware of the activity and can notify visitors to their port.
- A working VHF channel will be provided to local users.
- Safety zone of appropriate dimensions will be applied for to protect working vessels on the site when restricted in manoeuvrability.
- Operating procedures will be established to ensure work vessels do not block the channel when they are not actively working on the site. If it is not practicable for the work vessel to depart from the site they will use AIS and marks to indicate that any safety zone is not operational if they are not restricted in manoeuvrability.
- Collision risk management procedures will be developed to be used by working vessels specifying

- traffic monitoring and emergency response procedures.
- An Emergency Response Cooperation Plan (ERCoP) will be prepared for the Project following the template provided by the MCA in MGN 371. This will be submitted to the MCA for comment and approval.
- There will be a dedicated watchkeeper onboard working vessel(s) or onshore.
- Local knowledge will be used during the work whenever possible.
- Local harbours will be used for the work where practicable.
- Radio broadcasts will be given as necessary to warn approaching vessels about the work activity.

15.6.2 Impact 15.2: Traffic re-routeing due to work vessels and associated safety zones

15.81 A major concern raised at the Hazard Review Workshop was the potential for work vessels and their associated safety zones to severely restrict the sea room available to vessels transiting east-west through the Inner Sound.

15.82 Standard safety zone dimensions are 500m but DECC Guidance makes clear that all applications will be assessed on a case-by-case basis taking into account site specific conditions. The NRA has recommended the Developer seeks only to establish the minimum safety zone required to ensure the safety of working vessels, in consultation with Marine Scotland, the MCA, DECC, the appointed contractor and local stakeholders.

15.83 An indicative "maximum case" 500m zone centred on one of the southernmost turbines is presented in Figure 15.17. It can be seen that this could reduce the sea room to the south of the safety zone to 910m from land, and 510m from the 5m water depth contour. In year 3, if there were two work vessels present simultaneously, each with a 500m safety zone, the sea room could be further restricted over a longer stretch of the Inner Sound.

15.84 Hence vessels may be re-routed close to shore or displaced into the Outer Sound. This could lead to increased vessel-to-vessel encounters / collisions as well as a higher risk of grounding. The change in collision risk was modelled assuming two scenarios, firstly, all vessels re-route to the south within the Inner Sound and secondly, all vessels re-route from the Inner Sound to the Outer Sound. (More details on the modelling are provided in Section 15.7.3.)

15.85 Local vessels could also be affected and have to deviate slightly, for example, the *Pentalina*, if routeing to the east of Stroma. By minimising the safety zone radius and providing advanced warning to local users of the activity on the site it is considered that this impact can be minimised and any increase in journey will be of only a few minutes.

Risk significance

Frequency	Consequence	Risk	Significance
Remote	Moderate	Tolerable (moderate risk)	Significant

15.86 The above assessment assumes industry good practice will be applied to minimise this impact. Additional measures identified to those described for Impact 15.1 are listed below:

MITIGATION IN RELATION TO IMPACT 15.2

- Further consultation will be carried out on the safety zone dimensions with Marine Scotland, the MCA, DECC, the appointed contractor and local stakeholders prior to the application being made to DECC.
- Safety zones will be established on a 'rolling' basis, covering only the area of the site in which activity is taking place at a given time. Once that activity has been completed in that specific location, the safety zone will then 'roll on' to cover the next specific location (not the whole Project area).
- Work vessels will indicate their status on AIS and using appropriate marks/lights, e.g., if restricted in manoeuvrability. This will signify to passing traffic whether a Safety Zones is in place or not.

Residual risk

15.87 It is considered that by applying the standard mitigation measures, applying for the minimum size of safety zone required and ensuring as far as possible that both local and transiting vessels are made aware of the work on site prior to their transit of the Inner Sound, the residual impact will be Tolerable (moderate risk). All reasonably practicable steps will have been taken to minimise the risk and obstruction to vessels, i.e., the risks are assessed to have been reduced to ALARP (As Low As Reasonably Practicable).

Frequency	Consequence	Risk	Significance
Remote	Moderate	Tolerable (moderate risk)	Significant

15.6.3 Impact 15.3: Working vessel gets into difficulty

15.88 There is a risk a working vessel gets into difficulty due to adverse conditions, e.g., strong tides and heavy seas, either when working in the Project area of heading to and from the site. This risk is under the management of the developer, and therefore is not a direct 3rd party impact. However, it could lead to more call-outs for the emergency services such as the RNLI.

15.89 The most likely scenario is the working vessel temporarily has difficulty making way and has to suspend operations and seek shelter or return to port (minor consequences). More serious consequences could include vessel damage and, worst case, capsizing of a vessel.

Risk significance

Frequency	Consequence	Risk	Significance
Frequent	Minor	Tolerable (moderate risk)	Significant

15.90 This assumes industry good practice will be applied to minimise this impact. Standard measures and additional mitigation identified during consultation and at the Hazard Review Workshop are presented below:

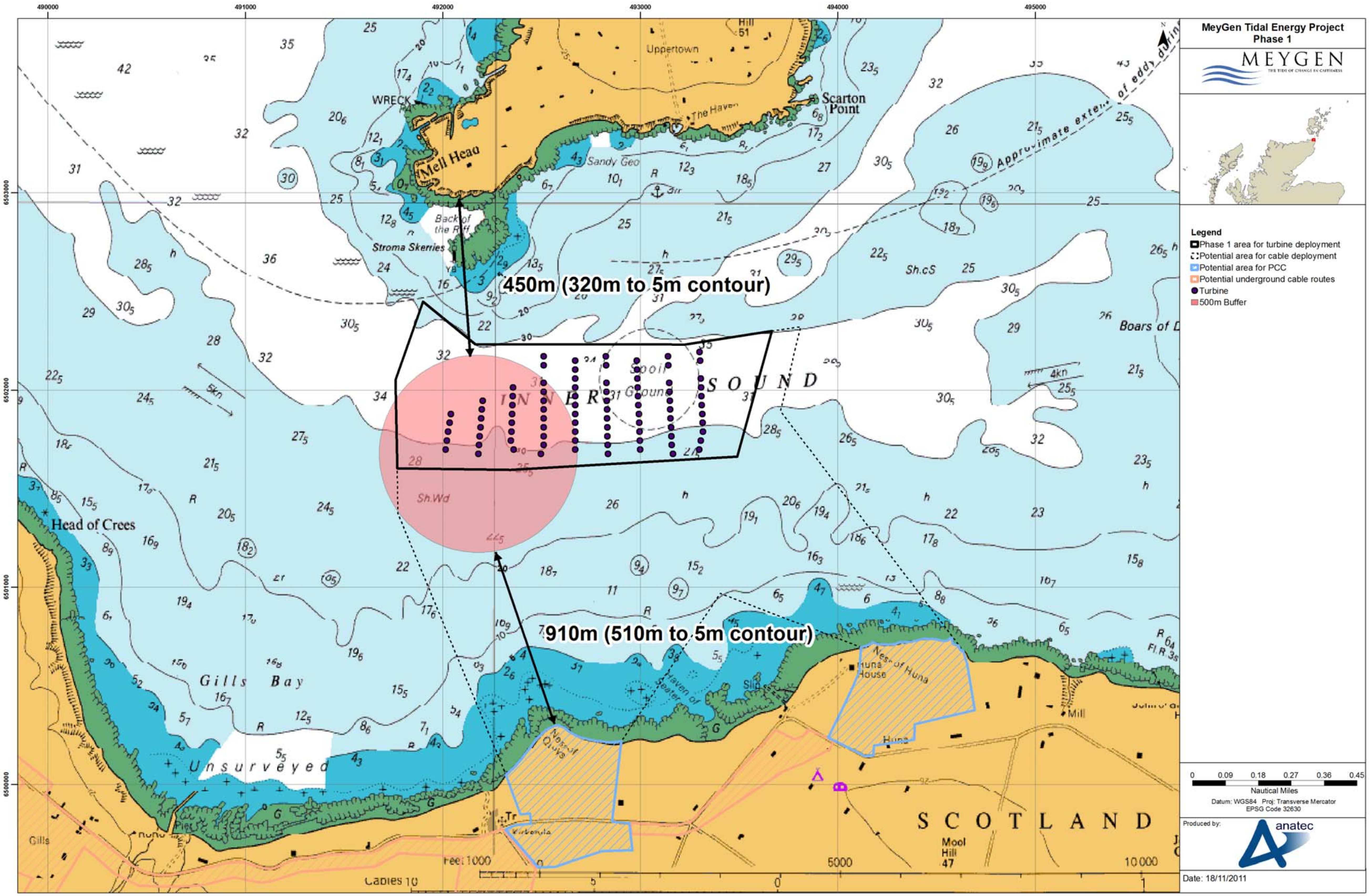

Figure 15.17: Potential area occupied by 500m radius safety zone around working vessel at southern end of the Project

MITIGATION IN RELATION TO IMPACT 15.3
▪ Working vessels are selected and audited based on suitability for the job and the conditions in the Pentland Firth. ▪ Marine operating procedures are developed specifying allowable wave, tide and weather criteria. ▪ Procedures specify that work vessels should seek shelter (or return to base) when not working at the site. ▪ Working personnel are trained in offshore survival and have suitable Personal Protective Equipment (PPE). ▪ The Construction company operates a Safety Management System. ▪ Passage plans are developed for vessels routeing between the Project area and the onshore base. ▪ Work vessel movements are monitored from an onshore control centre, e.g., on AIS and VHF. ▪ An Emergency Response Cooperation Plan (ERCoP) will be prepared for the Project following the template provided by the MCA in MGN 371. This will be submitted to the MCA for comment and approval.

Residual risk

15.91 Based on applying these mitigation measures, and by following industry good practice, it is considered that the residual impact will remain significant. However, the risk is considered tolerable (moderate risk). All reasonably practicable steps will have been taken to minimise the risk, i.e., the risks are assessed to have been reduced to ALARP (As Low As Reasonably Practicable).

Frequency	Consequence	Risk	Significance
Reasonably probable	Minor	Tolerable (moderate risk)	Significant

15.7 Impacts during Operations and Maintenance

15.7.1 Impact 15.4: Powered collision with subsea turbine

15.92 During operation, the turbines will be a minimum of 8m under the level of lowest astronomical tide, although the actual underwater clearance will vary depending on tide and wave conditions. There is a risk of collision with the turbines for vessels of sufficient draught. As well as using the semi-quantitative risk matrix approach, the risk of powered and drifting vessel collision has been modelled using Anatec's COLLRISK software. The NRA discusses the method used which considered the following factors:

- Vessel Draughts (see Figure 15.9) and Squat[1];
- Turbine Elevation relative to Water Depth;
- Tidal Height Variations (see Figure 15.1);
- Wave-induced Vessel Motion (see Figure 15.2);
- Surge; and
- Sounding Accuracy

15.93 An illustration of some of the factors taken into account by the model is presented in Figure 15.18.

15.94 There are also operational impacts associated with vessels re-routeing because they are constrained by their draughts from passing over the turbine array. Other impacts are associated with the subsea cables and potential loss of station of a device.

15.95 The operational impacts are assessed in more detail below

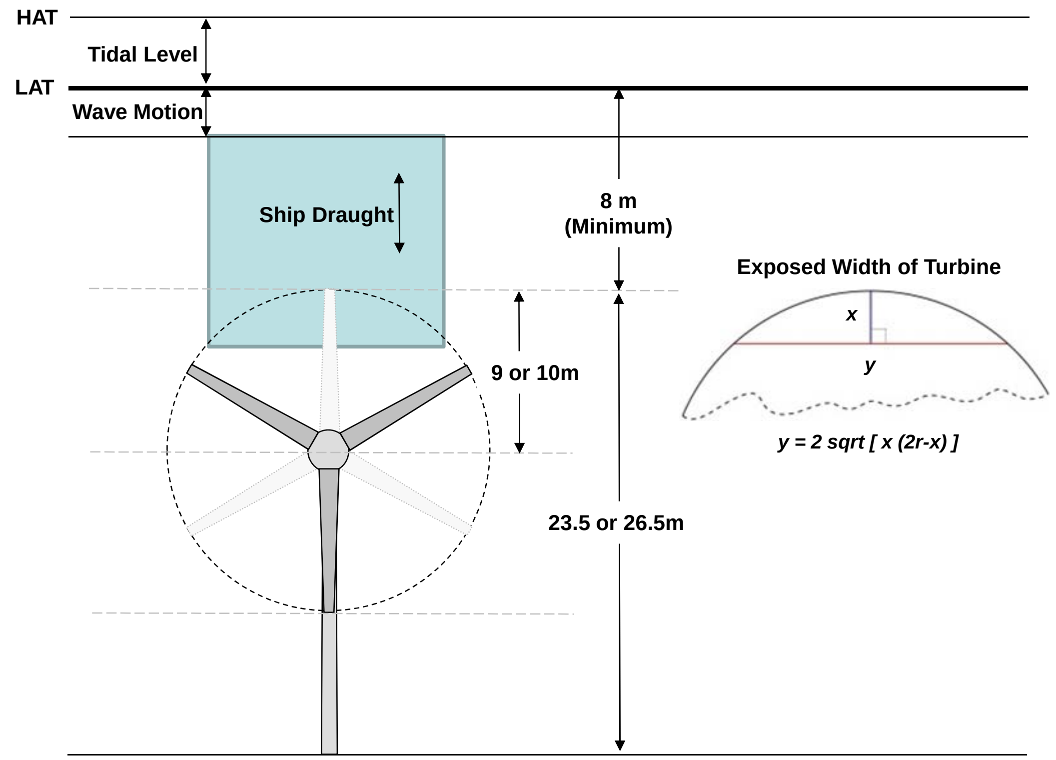

Figure 15.18: Illustration of factors affecting turbine/ship keel interaction[2]

15.96 The risk of vessels under power colliding with the subsea turbines was assessed using COLLRISK.

15.97 The vessel draught distribution assumed in the modelling for the east-west Inner Sound traffic was conservatively based on the AIS draught distribution (larger vessels). Modelling was also performed for the *Pentalina* based on the specific routeing pattern, number of transits and dimensions of this vessel. (Other local vessels such as the John o' Groats creel boats have draughts below 2m and the risk of subsea collision is considered to be minimal.)

15.98 Various scenarios were modelled. Using the most realistic (but still conservative) inputs and including standard mitigation such as chart marking and information circulation, the collision frequency for east-west traffic was estimated to be 1 in 18,400 years. For the Pentalina the collision risk was estimated to be negligible (less than 1 in 1 million years) due mainly to its relatively shallow draught (maximum of 3m).

[1] The squat effect occurs when a vessel travelling at speed in enclosed or shallow waters displaces water from underneath the vessel, thus creating an area of low pressure under the hull, resulting in vertical sinkage.

[2] The factors taken into account by the model represent the 'worst case scenario'. From a navigation perspective the worst case scenario is based on the maximum 86 turbines being a mix of 18m and 20m diameter rotor turbines. The turbine deployment area was selected to ensure that there is always a minimum of 8m clearance from blade tip to Lowest Astronomical Tide (LAT). A 20m diameter rotor turbine is used at turbine locations with the layout where an 8m clearance to LAT can be maintained, the remainder are 18m rotors. Hence the radius of the turbine blades is considered to be between 9 and 10m.

Risk significance

Impact	Frequency	Consequence	Risk	Significance
Collision risk with turbine – local vessel (shallow draught, up to about 3m)	Negligible	Moderate	Low (broadly acceptable)	Not significant
Collision risk with turbine – transiting vessel (a proportion of which are moderate to deep draught, up to approx. 8m)	Extremely unlikely	Moderate	Low (broadly acceptable)	Not significant

15.99 The above assessment assumes industry good practice will be applied to minimise this impact. Standard measures and additional mitigation identified during consultation and at the Hazard Review Workshop are presented below:

MITIGATION IN RELATION TO IMPACT 15.4

- The turbines will have a minimum underwater clearance of 8m relative to LAT.
- The Project area will be depicted on Admiralty Charts produced by UKHO with an associated note on the available underwater clearance.
- Details of the Project will be included in updated fishermen's awareness charts and on FishSAFE.
- Details of the Project will be included in updated Sailing Directions.
- There will be liaison with local Harbour Masters to ensure they are aware of the activity and can notify visitors to their port.
- Marking and lighting of the site will be decided by NLB once they have reviewed the NRA and consulted as appropriate. Discussions to date have indicated that they consider the Project area is effectively marked by the southern part of the island of Stroma and the whole coastline is conspicuous on radar. Therefore, they do not foresee a need for additional marking and lighting. Floating aids to navigation are not considered suitable given the strong tides.
- Survey, Deploy and Monitor strategy, i.e., turbines will be installed over a number of years which allows the effect on vessel navigation to be monitored.
- An Emergency Response Cooperation Plan (ERCoP) will be prepared for the Project following the template provided by the MCA in MGN 371. This will be submitted to the MCA for comment and approval.

15.7.2 Impact 15.5: Drifting vessel collision with subsea turbine

15.100 The risk of a vessel losing power and drifting into a subsea turbine was assessed using Anatec's COLLRISK model. This model is based on the premise that propulsion on a vessel must fail before a vessel will drift. The model takes account of the type and size of the vessel, number of engines and average time to repair in different conditions. Additionally, the factors illustrated in Figure 15.18 must be such that the under keel clearance is insufficient to prevent a collision.

15.101 The exposure times for a drifting scenario are based on the ship-hours spent in proximity to the site estimated based on the traffic levels and speeds. The exposure is divided by vessel type and size to ensure these factors, which based on analysis of historical accident data have been shown to influence accident rates, are taken into account within the modelling.

15.102 Using this information the annual drifting ship collision frequency with the 86 turbines was estimated to be 8.3×10^{-5} per year corresponding to an average of one drifting ship collision in 12,000 years (Anatec, 2012).

15.103 This very low frequency reflects the fact that traffic in the vicinity of the Project area is relatively light, engine breakdown is not a common event, if it were to occur there is a reasonable prospect of recovery before reaching the array and only a proportion of vessels would be capable of interacting with the underwater turbines for a proportion of time (based on the combination of vessel draught, wave and tide).

Risk significance

Impact	Frequency	Consequence	Risk	Is the impact significant or not significant
Collision risk with turbine – local vessel (shallow draught, up to about 3m)	Negligible	Moderate	Low (broadly acceptable)	Not significant
Collision risk with turbine – transiting vessel (a proportion of which are moderate to deep draught, up to approx. 8m)	Negligible	Moderate	Low (broadly acceptable)	Not significant

15.104 Despite no significant risk being identified mitigation is still proposed to ensure this remains the case. The above assessment assumes industry good practice will be applied to minimise this impact. Standard measures and additional mitigation identified during consultation and at the Hazard Review Workshop are presented below:

MITIGATION IN RELATION TO IMPACT 15.5

- The turbines will have a minimum underwater clearance of 8m relative to LAT.
- The Project area will be depicted on Admiralty Charts produced by UKHO with an associated note on the available underwater clearance.
- Marking and lighting is being discussed with NLB (refer to mitigation for Impact 15.4).
- Turbines could be stopped to maximise underwater clearance.
- An Emergency Response Cooperation Plan (ERCoP) will be prepared for the Project following the template provided by the MCA in MGN 371. This will be submitted to the MCA for comment and approval. This will include information on tug availability for potentially recovering a drifting vessel.

15.7.3 Impact 15.6: Increase in vessel-to-vessel collision risk due to re-routeing

15.105 The Project could impact upon vessel-to-vessel collision risk due to reduced sea room in the Inner Sound and / or re-routeing of traffic into the Outer Sound. An assessment of actual vessel-to-vessel encounters was carried out by replaying at high-speed 8 weeks of AIS survey data from summer and winter 2010 and identifying where vessels passed within one nautical mile, which has been assumed as a nominal encounter distance. There were a total of 171 encounters, an average of 3 per day. Most encounters occurred in the Outer Sound where the traffic is much heavier, although the channel is wider, as shown in Figure 15.19. Within the Inner Sound, there were just two occasions when vessels passed within 1nm.

15.106 Anatec's COLLRISK model was used to estimate background (without the Project) and predicted (with the Project) collision risk within 5nm of the Project. The background vessel-to-vessel collision risk level is in the order of 1 major collision in 94.52 years. It is emphasised the model is calibrated based on major incident data at sea which allows for benchmarking but does not cover all incidents, such as where the consequences were minor.

15.107 When the turbines are installed, it is assumed a proportion of vessels will re-route either within the Inner Sound or via the Outer Sound, as they may be constrained by draught. For the Inner Sound re-routeing scenario, the mean position of the transiting east-west route is assumed to be displaced to the south due to avoidance of the Project area and the route has been narrowed due to the reduction in sea room. The *Pentalina* route is assumed to remain the same. Based on vessel-to-vessel collision risk modelling of the revised routes, the overall collision risk was estimated to be 1 in 94.46 years, i.e., a very small increase of 6×10^{-6} (one additional major collision in 167,000 years). The change is very low as only a small number of vessels are affected and the probability of two vessels transiting the channel at the same time, as seen from the encounter analysis, is relatively low.

15.108 For the Outer Sound scenario, all the east-west transiting traffic through the Inner Sound was re-routed via the Outer Sound. The *Pentalina* route is assumed to remain the same. Based on vessel-to-vessel collision risk modelling of the revised routes, the overall collision risk was estimated to be 1 in 88.3 years, i.e., an increase over the background risk without the Project of 7×10^{-4} (one additional major collision in 1,350 years). This change is higher, which is a combination of the increased voyage distances and the fact that vessel congestion and encounter frequency is already much higher in the Outer Sound.

15.109 In reality, it is expected there will be a combination of the two effects, with some vessels, particularly those with shallower draughts, choosing to remain in the Inner Sound and others, particularly those with deeper draughts, re-routeing via the Outer Sound. It was seen from the survey data analysis that several vessels already use both channels on different occasions. The choice is also likely to be dependent on the weather conditions and tides at the time of the passage.

15.110 In order to assess the risk associated increases in vessel to vessels collisions it is the change in the risk that is the important figure. For the Inner Sound there is one additional major collision in 167,000 years and for the Outer Sound one additional major collision in 1,350 years. Therefore, the frequencies that are considered in the assessment are negligible for the Inner Sound and extremely unlikely for the Outer Sound.

Risk significance

Impact	Frequency	Consequence	Risk	Significance
Re-routeing via Inner Sound	Negligible	Moderate	Low (broadly acceptable)	Not Significant
Re-routeing via Outer Sound	Extremely unlikely	Moderate	Low (broadly acceptable)	Not Significant

15.111 The above assessment assumes industry good practice will be applied to minimise this impact. Standard measures and additional mitigation identified during consultation and at the Hazard Review Workshop are presented below:

MITIGATION IN RELATION TO IMPACT 15.6

- Despite no significant risk being identified mitigation is still proposed to ensure this remains the case.
- Vessels will have increased awareness of the Project area due to the notification measures carried out before and during Installation (described under the mitigation of Impact 15.1).
- The turbines will have a minimum under water clearance of 8m relative to LAT which means a proportion of vessels will not need to re-route as they will have safe under keel clearances when passing over the turbines.
- The Project area will be depicted on Admiralty Charts produced by UKHO with an associated note on the available underwater clearance. This will allow vessels to revise their passage in advance, taking into account information on the Project, before setting off from Port.
- Details of the Project will be included in updated Sailing Directions.
- There will be liaison with local Harbour Masters to ensure they are aware of the Project and can notify visitors to their port.

15.7.4 Impact 15.7: Loss of station

15.112 If part of a device loses station it could pose a risk to other vessels navigating through the Inner Sound. This was raised as a concern during consultation and at the Hazard Review Workshop due to the strong tidal flows through the Inner Sound.

15.113 The incident involving the Norwegian purse seiner *Krossfjord* was highlighted as an example of the hazards that can result from foreign objects within shipping lanes. The nets fouled the propeller of one vessel and were narrowly avoided by a ferry. The only potentially neutrally or positively buoyant parts of the turbine are the turbine nacelle and blades depending on the final manufacturer and design. If these were to become detached they could pose a hazard to vessels navigating in the area, especially during the hours of darkness. Negatively buoyant components will remain on the seabed and will be recovered where possible.

Risk significance

Frequency	Consequence	Risk	Significance
Reasonably probable	Minor	Moderate (tolerable)	Significant

15.114 The above assessment assumes industry good practice will be applied to minimise this impact. Standard measures are presented below:

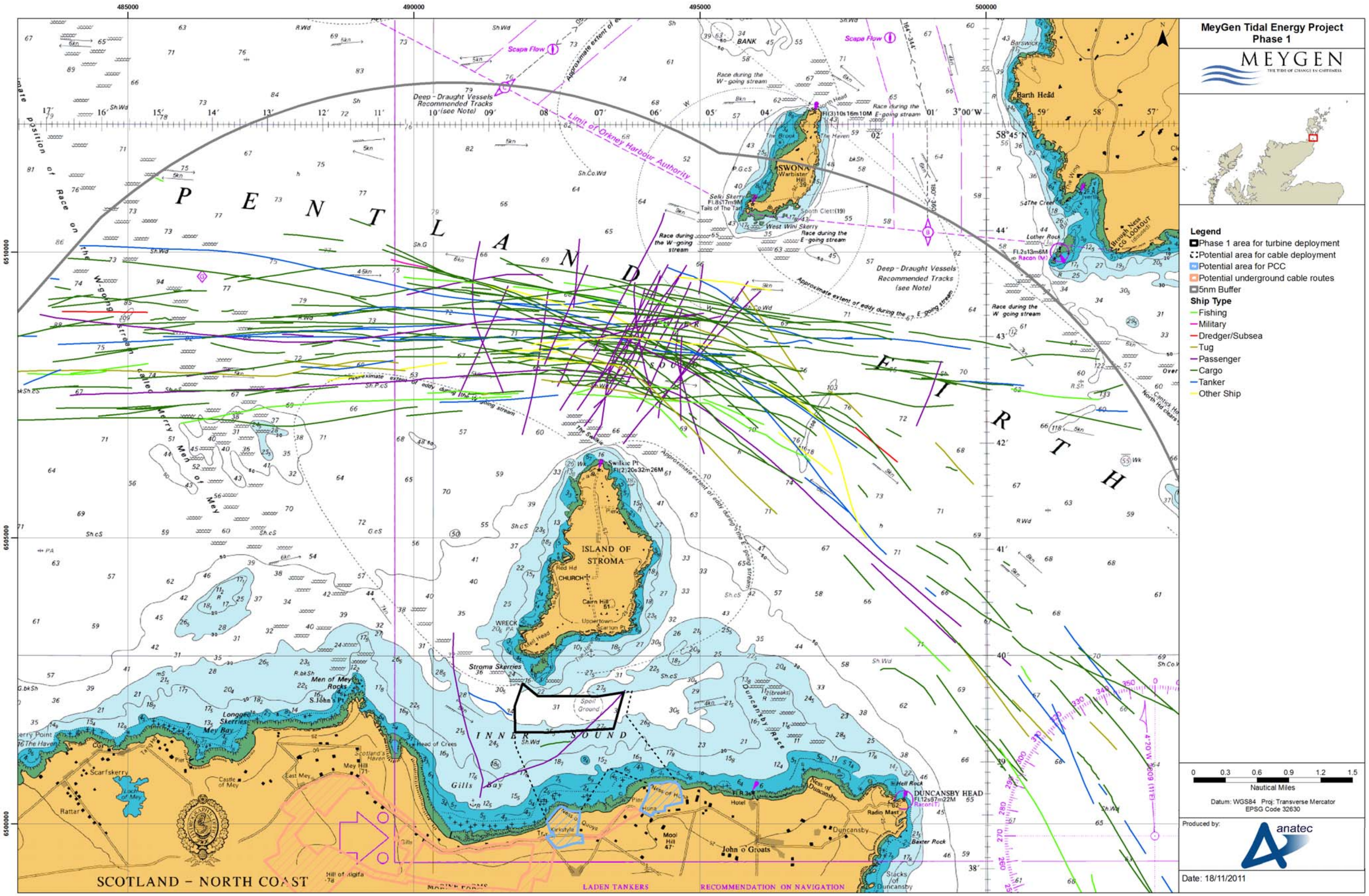

Figure 15.19: AIS tracks of encounters (2010)

MITIGATION IN RELATION TO IMPACT 15.7
▪ The turbines have been subjected to engineering design and third-party verification to ensure they are suitable for deployment in the Inner Sound. ▪ The Survey, Deploy and Monitor strategy will ensure any initial problems are identified and rectified before the full tidal array is in the water. ▪ The Project will be using tried and tested equipment and techniques to minimise the risks associated with the high tidal flow environment. ▪ Most parts will be negatively buoyant. ▪ Turbine nacelle designs that use buoyancy as part of the installation and maintenance strategy have failsafe locking systems for the connection between the nacelle and the TSS to prevent accidental release. ▪ On-site monitoring via SCADA will alert the 24-hour control room operations team of turbine failure or an object hitting the turbine. ▪ Emergency Response Cooperation Plan (ERCoP) to be prepared and agreed with the MCA. Emergency response would include informing HM Coastguard, RNLI, Harbours and local users (e.g., Pentland Ferries) so that vessels in the area are alerted to the potential hazard.

Residual risk

15.115 Based on applying these mitigation measures, and by following industry good practice, it is considered the residual impact will remain significant. However, the risk is considered tolerable. All reasonably practicable steps will have been taken to minimise the risk, i.e., the risks are assessed to have been reduced to ALARP (As Low As Reasonably Practicable).

Frequency	Consequence	Risk	Significance
Reasonably probable	Minor	Moderate (tolerable)	Significant

15.7.5 Impact 15.8: Anchor interaction

15.116 There is a risk of anchor interaction with the turbines, turbine support structures, inter-array cabling and cables to shore.

15.117 No vessels were observed to be anchoring in the Inner Sound during the AIS surveying. Stakeholder consultation and the discussion at the Hazard Review Workshop confirmed that merchant vessels do not anchor in the Pentland Firth. Also the seabed of the Project area is mainly bedrock (Benthic Habitats and Ecology, Section 10), which is not suitable holding ground for anchors.

15.118 The risk of a vessel anchoring over the site in an emergency, or a vessel from east or west of the Pentland Firth dragging anchor towards the site is minimal.

15.119 Anchorage locations for yachts are mentioned as Gills Bay, John o' Groats and south of Stroma (where an anchorage is indicated on Admiralty Charts). Yachts would not anchor mid-channel in water depths of over 30m where the turbines will be located.

Risk significance

Frequency	Consequence	Risk	Significance
Extremely unlikely	Minor	Low (broadly acceptable)	Not Significant

15.120 Despite no significant impact being identified, mitigation is still proposed to ensure this remains the case.

15.121 The above assessment assumes industry good practice will be applied to minimise this impact. Standard measures are presented below:

MITIGATION IN RELATION TO IMPACT 15.8
▪ Project area will be depicted on charts. Turbine and cables areas will be depicted on appropriate scale charts. ▪ Cables will be grouped (where feasible) to minimise the overall footprint area on the seabed. ▪ HDD bores will provide protection for at least part of the cable length from shore. ▪ Natural crevices will be used to avoid exposed cables being on the seabed surface as far as practicable. ▪ Additional material weighting will be used where necessary to ensure cable stability on the seabed.

15.8 Impacts during Decommissioning

15.122 Impacts during decommissioning would be considered to be the same as those experienced during the construction and installation phase of the Project, except that the Project should be well known to all vessels using the area by that time. The mitigation would be the same as that presented in Section 15.6.

15.9 Potential Variances in Environmental Impacts

15.123 Consideration of the maximum potential impact has been undertaken throughout the navigation risk assessment. This has considered the entire footprint of offshore construction and installation activity including a maximum safety zone of 500m radius. It is likely that the safety zone will be reduced to allow navigation of the Inner Sound to be still available to vessels transiting the Pentland Firth.

15.124 The indicative turbine layout used for this assessment is considered to be worst case although changes to layout are likely to be based on further project development. However these are unlikely to be significant and would not alter the outcome of the assessment.

15.125 Future increases in vessel traffic using the Inner Sound and Pentland Firth may vary from those identified in the baseline assessment; however these are unlikely to be significant and would therefore not have a major impact on the assessment.

15.10 Cumulative Impacts

15.126 MeyGen has, in consultation with Marine Scotland and The Highland Council, identified a list of other projects (MeyGen, 2011), which together with the Project may result in potential cumulative impacts. The list of these projects including details of their status at the time of the EIA and a map showing their location is provided in Section 8; Table 8.3 and Figure 8.1 respectively.

15.127 Having considered the information presently available in the public domain on the projects for which there is a potential for cumulative impacts, Table 15.7 below indicates those with the potential to result in cumulative impacts from a Shipping and Navigation perspective. The consideration of which projects could result in potential cumulative impacts is based on the results of the project specific impact assessment together with the expert judgement of the specialist consultant.

Project title	Potential for cumulative impact	Project title	Potential for cumulative impact	Project title	Potential for cumulative impact
MeyGen Limited, MeyGen Tidal Energy Project, Phase 2	✓	SHETL, HVDC cable (onshore to an existing substation near Keith in Moray)	×	OPL, Ocean Power Technologies (OPT) wave power ocean trial	×
ScottishPower Renewables UK Limited, Ness of Duncansby Tidal Energy Project	✓	Brough Head Wave Farm Limited, Brough Head Wave Energy Project	×	MORL, Moray Offshore Renewables Ltd (MORL) offshore windfarm	×
Pelamis Wave Power, Farr Point Wave Energy Project	×	SSE Renewables Developments (UK) Limited, Costa Head Wave Energy Project	×	SSE and Talisman, Beatrice offshore Windfarm Demonstrator Project	×
Sea Generation (Brough Ness) Limited, Brough Ness Tidal Energy Project	✓	EON Climate & Renewables UK Developments Limited, West Orkney North Wave Energy Project	×	BOWL, Beatrice Offshore Windfarm Ltd (BOWL) offshore windfarm	×
Cantick Head Tidal Development Limited, Cantick Head Tidal Energy Project	✓	EON Climate & Renewables UK Developments Limited, West Orkney South Wave Energy Project	×	Northern Isles Salmon, Chalmers Hope salmon cage site	×
SSE, Caithness HVDC Connection - Converter station	×	ScottishPower Renewables UK Limited, Marwick Head Wave Energy Project	×	Northern Isles Salmon, Pegal Bay salmon cage site	×
SSE, Caithness HVDC Connection - Cable	×	SSE Renewables Developments (UK) Limited, Westray South Tidal Energy Project	×	Northern Isles Salmon, Lyrawa salmon cage site	×
RWE npower renewables, Stroupster Windfarm	×	EMEC, Wave Energy test site (Billia Croo, Orkney)	×	Scottish Sea Farms, Bring Head salmon cage site	×
SSE, Gills Bay 132 kV / 33 k V Substation Phase 1: substation and overhead cables (AC)	×	EMEC, Tidal energy test site (Fall of Warness, Orkney)	×	Northern Isles Salmon, Cava South salmon cage site	×
SSE, Gills Bay 132 kV / 33 k V Substation Phase 2: HVDC converter station and new DC buried cable	×	EMEC, Intermediate wave energy test site (St Mary's Bay, Orkney)	×	Scottish Sea Farms, Toyness salmon cage site	×
SHETL, HVDC cable (offshore Moray Firth)	×	EMEC, Intermediate tidal energy test site (Head of Holland, Orkney)	×	Northern Isles Salmon, West Fara salmon cage site	×

Table 15.7: Summary of potential cumulative impacts

15.128 The following sections summarise the nature of the potential cumulative impacts for each potential project phase:

- Construction and installation;
- Operations and maintenance; and
- Decommissioning.

15.10.1 Potential cumulative impacts during construction and installation

15.129 Cumulative impacts arising from installation of multiple marine renewable projects at the same time is only considered to be a potential issue for the Ness of Duncansby site. MeyGen Phase 2 will be after Phase 1, whilst construction traffic associated with the Brough Ness and Cantick Head developments is not expected to use the Inner Sound and any effects should be localised.

15.130 The Ness of Duncansby site is a minimum of 1.6nm east of the Project area. The main cumulative impact would be if the installation activities were to overlap between the two projects. This is likely to be the case given the extended deployment duration of the Project. This could lead to transiting vessels temporarily having to avoid surface vessels (and associated safety zones) at both sites. However, provided the safety zones at both sites are "rolling" zones (i.e., centred on where the work activity is taking place) of maximum 500m radius, the impacts are considered to be manageable. Liaison between the two developers will assist this process.

15.10.2 Potential cumulative impacts during operations and maintenance

15.131 The MeyGen Tidal Energy Project Phase 2 will introduce a further 312MW in the Inner Sound. The exact turbine number, location and layout within the Agreement for Lease (AfL) area is not defined and will incorporate lessons learned from and technology advancements beyond Phase 1 of the Project. These factors will influence the potential for, nature of and significance of any cumulative impacts. The larger overall area will mean that the *Pentalina* will be passing over the turbines when routeing both west and east of Stroma. Other local vessels such as the creel boats will also be crossing the area more frequently, as will the John o' Groats ferry when sailing to and from Stroma. Assuming a consistent minimum clearance depth under Phase 2 as Phase 1, this should not pose a problem for these shallow draught vessels during normal operations.

15.132 In terms of east-west transiting traffic, the width of the Inner Sound channel occupied by Phase 2 is similar to Phase 1 and therefore it is considered to be well-aligned. However, it will increase the duration that east-west passing vessels constrained by draught have restricted sea room.

15.133 The Ness of Duncansby tidal array would have a capacity of 95MW based on 95 x 1MW Hammerfest Strøm HS1000 tidal turbines within the area. Due to the proposed depths of the turbines (40-70m), they are not thought to pose a significant risk to those vessels using the Inner Sound that could be impacted by the Project. Navigational effects are stated as being confined to the activities in which a surface vessel is required on site. During normal operations, the cumulative impact with the Project is considered to be minimal.

15.134 The Open-Centre Turbines planned to be used at Cantick Head Tidal Array Ness are located directly on the seabed, supported by a subsea base structure. Given the water depth of the planned deployment, the under keel clearance should be such that it will not affect surface navigation during normal operations. During work activity at the site, its location is such that it should only have a localised impact on coastal traffic. It is not expected to alter shipping routes to and from Scapa Flow or within the Outer Sound.

15.135 The Brough Ness site is 5.9nm NE of the Project area. Marine Current Turbines Ltd (MCT) is planning to deploy 66 SeaGen tidal turbines off Brough Ness in three phases between 2016 and 2020. The SeaGen turbine rotor blades are mounted on wing-like extensions either side of a tubular steel monopile some 3m in diameter. Given that the turbines have a surface element; this project has the potential to displace traffic during normal operations. However, given its position within 1nm of the South Ronaldsay coast, it will mainly affect small inshore vessels. There could also be some narrowing of the traffic lane between Brough Ness and Muckle Skerry, but this will not affect any traffic re-routeing from the Inner Sound to the Outer Sound because of the Project which will be well to the south.

15.136 Maintenance vessels will also be present on occasion within all the proposed sites but these would not be expected to require safety zones so any effects should be localised to the individual sites.

15.10.3 Potential cumulative impacts during decommissioning

15.137 As with installation, the main cumulative impact would be if the Ness of Duncansby decommissioning work overlaps with the Project. If so, the same issues would apply as described in Section 15.10.1.

15.138 In theory, MeyGen Phase 1 and 2 could be decommissioned at the same. This could lead to additional vessels in the area at the same time which would need further consultation with stakeholders and development of appropriate procedures to minimise any impacts.

15.10.4 Mitigation requirements for potential cumulative impacts

15.139 In addition to the Project-specific mitigation, the following measures have been identified to minimise potential cumulative impacts:

- Liaison with ScottishPower Renewables UK Limited should installation or decommissioning activities overlap at the Ness of Duncansby site; and
- Consultation with stakeholders and development of appropriate procedures should MeyGen Phase 1 and 2 be decommissioned simultaneously resulting in increased work vessel activity in the Inner Sound.

15.11 Proposed Monitoring

15.140 Traffic will be monitored on AIS during construction and operation of the devices to assess the effect the Project has on passing traffic and the proportion of vessels that re route either within the Inner Sound or via the Outer Sound. Any other changes in vessel behaviour compared to the baseline traffic data will be reviewed, e.g. transit times relevant to tide.

15.12 Summary and Conclusions

15.141 There are two channels available for vessels transiting the Pentland Firth. The Outer Sound is the recommended route used by the vast majority of vessels. The Inner Sound, containing the MeyGen Project area, is mainly used by local ferries (regularly by *Pentalina* and occasionally by the seasonal ferry *Pentland Venture*) and creel boats, which are all shallow draught.

15.142 Due to their shallow draughts, the risk of collision with local vessels is assessed to be minimal. A collision would only be possible given a combination of low tide and extreme wave conditions, in which local vessels are unlikely to be out at sea. Pentland Ferries who operate the *Pentalina*, the deepest draught local vessel (approx. 3m), have no issues with the Project.

15.143 East-west transiting traffic levels through the Inner Sound are low, with an average of 1-2 vessels per day, most of which are fishing vessels and too small to be carrying AIS.

15.144 The risk of collision for east-west transiting vessels during normal operations was assessed to be low due to the low traffic levels and 8m minimum clearance.

15.145 During normal operations, any vessels constrained by their draught will have to re-route to the south of the array (reduced sea room) or via the Outer Sound. This will lead to increased encounters and hence collision risk but the overall change from the baseline risk levels was low for both options.

15.146 Installation activities involving surface vessels could further restrict sea room, especially if a standard safety zone of 500m is applied.

15.147 Most work activity, when the DP vessel will be restricted in manoeuvrability and a safety zone may apply, will be around the time of slack water. A review of the times of transiting AIS vessels indicated only a minority of vessels were transited the MeyGen area at these times.

15.148 The most effective mitigation is considered to be circulating information about the development, and installation activities, in order to pre-warn vessels. This will allow vessels to revise their passage plan, or timing of their voyage, in advance of encountering the site.

15.149 Other mitigation measures have been identified and are summarised in the NRA (Anatec 2012). Many of these are standard industry measures but others require to be given further consideration by MeyGen, such as the safety zone radius. Further consultation is planned with Marine Scotland, the MCA and others.

15.13 References

BERR (2007). Applying for Safety Zones around offshore energy installations guidance notes, August 2007.

Clyde Cruising Club (2010). Clyde Cruising Club Sailing Directions and Anchorages – Part 5; N & NE Scotland and Orkney Islands.

EMEC (2006). EMEC Wave Data at 3 hourly intervals from 1 January 1986 to 31st December 2005 for Location 58°39'23.23"N, 003°07'34.19"W.

MAIB (2011). Incident data (2001 – 10).

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