MARINE ENERGY WALES

MARINE ENERGY TEST AREA (META)

Environmental Impact Assessment

Appendix 12.1. - Navigational Risk Assessment

EOR0730

Marine Energy Test Area

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RPS ENERGY CONSULTANTS LIMITED

MARINE ENERGY TEST AREA (META) PROJECT NRA

Report Number: 18UK1496 -META
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MARINE AND RISK CONSULTANTS LTD

RPS ENERGY CONSULTANTS LIMITED

MARINE ENERGY TEST AREA (META) PROJECT NRA

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05 June 2019

EXECUTIVE SUMMARY

RPS Energy Consultants Limited (RPS) commissioned Marine and Risk Consultants Ltd (Marico Marine) to undertake a Navigation Risk Assessment (NRA) for the Marine Energy Test Area (META) Project, on behalf of Marine Energy Wales (MEW).

Specifically, 3 test sites for the testing of wave and tidal energy devices are proposed within and close to the Milford Haven Waterway (hereafter referred to as 'the Waterway'). This project is closely linked to a separate project to redevelop part of Pembroke Dock (Pembroke Dock Marine) which will provide a base port for the testing activities and therefore a joint NRA process has been undertaken for both projects. The META and Pembroke Dock projects are reported separately but based on the common NRA process.

The joint assessment was guided by the Maritime and Coastguard Agency's (MCA's) MGN 543 standard for assessing Offshore Renewable Energy Installations (OREIs) as this provides best practice advice. However, as two of the META sites and the port redevelopment are situated within the Statutory Harbour Authority (SHA) area of Milford Haven Port Authority (MHPA), some of the advice in the MGN is not applicable. The MCA has advised that the MGN does not apply within SHA areas, but it has been agreed that following the guidance where possible demonstrates best practice.

The NRA has comprehensively reviewed existing traffic densities within the proposed test areas and considered how navigation will be affected by the introduction of test devices within the three project areas. Quantitative assessments have been undertaken for all three areas.

Existing conditions were assessed by means of assessing data including:

- AIS Traffic records for both winter and summer periods
- Port Authority traffic data
- Incident data (MAIB and Port Authority)
- Additional traffic data (RYA, ferry schedules)
- Extensive stakeholder consultation (local groups and individuals, MHPA, MCA, Trinity House)

Current and potential future hazards were identified, as well as existing and possible future control measures. All hazards assessed were scored as ALARP or Low. The operation of the test areas either individually or in combination with each other is not expected to increase the risk associated with any of the identified navigation hazards to an unacceptable level, assuming all existing risk controls are maintained.

There is an opportunity to reduce risk still further, and additional risk controls have been proposed.

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ABBREVIATIONS

Abbreviation	Detail
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ATBA	Area to be Avoided
AtoN	Aid to Navigation
CGOC	Coastguard Operations Centre
DECC	(Former) Department of Energy and Climate Change
ERCoP	Emergency Response and Cooperation Plan
GT	Gross Tonnage
HAT	Highest Astronomical Tide
HMCG	Her Majesty's Coast Guard
HSE	Health and Safety Executive
HW	High Water
IALA	International Association of Lighthouse Authorities
IMO	International Maritime Organisation
km	Kilometre
kt	Knot (unit of speed equal to nautical mile per hour, approximately 1.15 mph)
LAT	Lowest Astronomical Tide
LNG	Liquefied Natural Gas
LOA	Length Over-All
LW	Low Water
m	Metre
MAIB	Marine Accident Investigation Branch
Marico Marine	Marine and Risk Consultants Ltd
MCA	Maritime and Coastguard Agency
META	Marine Energy Test Area Project
MGN	Marine Guidance Note
MHPA	Milford Haven Port Authority
MHWN	Mean High Water Neaps
MHWS	Mean High Water Springs
ML	Most Likely
MLWN	Mean Low Water Neaps
MLWS	Mean Low Water Springs

Abbreviation	Detail
MW	Megawatt
nm	Nautical Mile
NRA	Navigation Risk Assessment
NTM	Notice To Mariners
O&M	Operations and Maintenance
OREI	Offshore Renewable Energy Installation
PIANC	Permanent International Association of Navigation Congresses
PMSC	Port Marine Safety Code
RNLI	Royal National Lifeboat Institution
RORO	Roll-On Roll-Off (Vehicle Carriers)
RPS	RPS Energy Consultants Limited
RYA	Royal Yachting Association
SAR	Search and Rescue
SHA	Statutory Harbour Authority
SMS	Safety Management System
STCW	Standards of Training Certification and Watchkeeping
TEC	Tidal Energy Converter
THLS	Trinity House Lighthouse Service
UKC	Under Keel Clearance
UKHO	UK Hydrographic Office
VHF	Very High Frequency (radio communication)
VLCC	Very Large Crude Carrier
VMS	Vessel Monitoring System
VTS	Vessel Traffic Service
WC	Worst Credible
WEC	Wave Energy Converters
WGS	World Geodetic System

1 INTRODUCTION

RPS Energy Consultants Limited (RPS) has commissioned Marine and Risk Consultants Ltd (Marico Marine) to undertake a Navigation Risk Assessment (NRA) for the Marine Energy Test Area (META) Project.

Specifically, 3 test sites for the testing of wave and tidal energy devices are proposed within and close to the Milford Haven Waterway (hereafter referred to as 'the Waterway'). This project is closely linked to a separate project to redevelop part of Pembroke Dock (Pembroke Dock Marine) which will provide a base port for the testing activities and, therefore, a joint NRA process has been undertaken for both projects. The META and Pembroke projects are reported separately but based on the common NRA process.

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This report describes the META test sites and includes the formal NRA applicable to that project.

2 STUDY AREA

Figure 1 shows the Study Area under assessment. The Study Area includes all Shipping and Navigation receptors within an area which has the potential to be affected by the META project. The Study Area encompasses the three META project areas and extends to include the context of the wider Waterway and immediate approaches.

The META project areas comprise three discrete sites:

- Warrior Way (site 6), upstream of the Cleddau Toll Bridge;
- Dale Roads (site 7), at the north-western end of the Waterway; and
- East Pickard Bay (site 8), outside the Waterway and SHA area and south of the eastern entrance headland.

Each area is considered separately due to their geographical separation and differing characteristics.

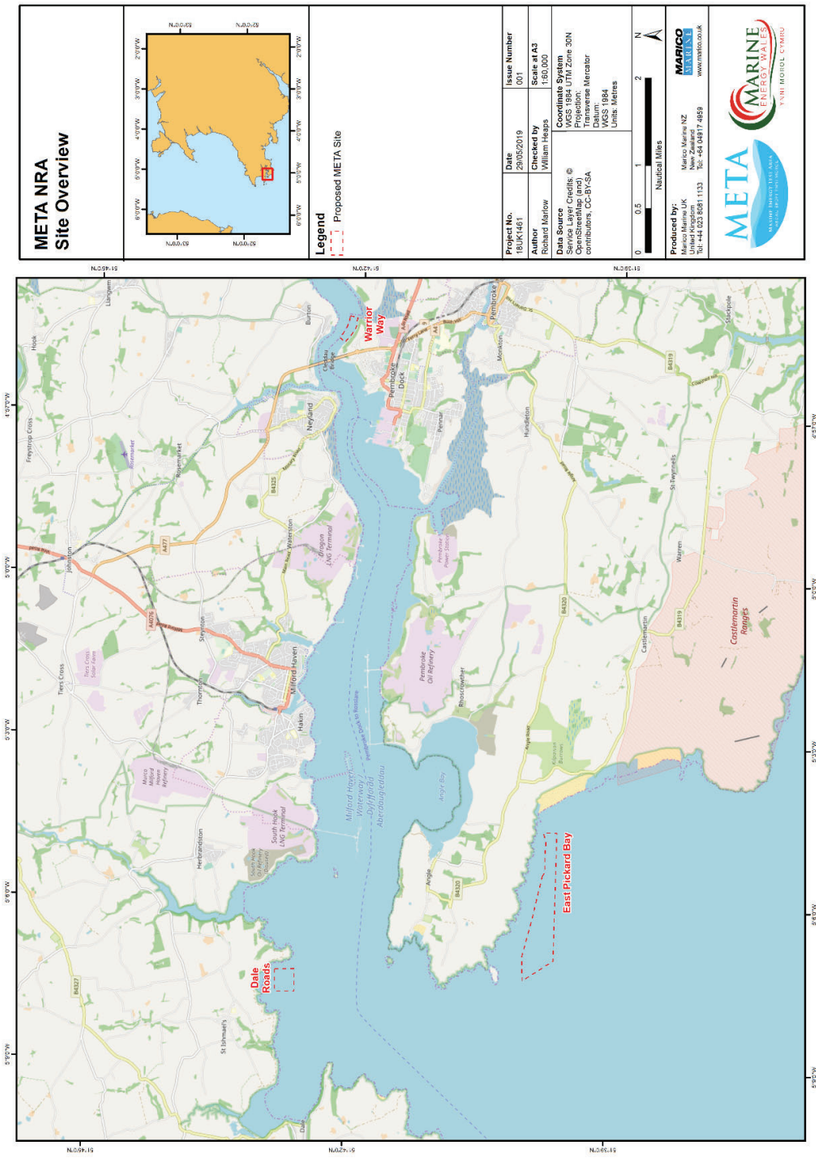

Figure 1: META Test Site Overview.

2.1 SCOPE AND METHODOLOGY

The scope of this assessment is to:

1) Describe the project sites;
2) Provide a description of the existing environment and activities in the study areas, including:
    a. Local ports and harbours;
    b. Met-Ocean conditions;
    c. Existing vessel management plans;
    d. Other uses of the area such as aquaculture, anchorages, military and renewable energy installations;
    e. Existing vessel traffic patterns, including frequency and types; and
    f. Existing risk profile for navigational incidents.
3) Determine likely future traffic profile;
4) Identify and assess impacts associated with the development to shipping and navigation, including:
    a. Traffic routeing;
    b. Collision risk;
    c. Contact risk;
    d. Communications, radar and positioning systems;
    e. Search and rescue; and
    f. Cumulative and in-combination effects;
5) Undertake an NRA that identifies navigational hazards during the installation and operation of the META sites. These hazards are assessed, and risk controls identified to reduce the risk to As Low as Reasonably Practicable (ALARP); and
6) Make recommendations as to the navigation safety of the project sites and identify any additional measures that should be implemented to further improve safety at the sites.

2.2 GUIDANCE

As stated in the introduction, this NRA draws on guidance given in the MCA's MGN 543 (M+F) which sets out the methodology for evaluating navigational safety around OREIs through traffic surveys. Further guidance is given in other publications as described in **Table 2-1**, and relevant parts of each guidance document has been followed while undertaking this NRA, as appropriate.

The NRA has been undertaken using the IMO approved Formal Safety Assessment Methodology (Described in **Annex A**).

Table 2-1: Guidance Documents.

Guidance	Key provisions
MGN 543 Guidance on UK Navigational Practice, Safety and Emergency Response Issues	This MGN highlights issues to be considered when assessing the impact on navigational safety and emergency response, caused by OREI developments. Including traffic surveys, stakeholder consultation, structure layout, collision avoidance, impacts on communications/ radar/ positioning systems and hydrography.
MGN 372 Guidance to Mariners Operating in the Vicinity of UK OREIs	Issues to be considered when planning and undertaking voyages near OREI developments off the UK coast.
International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures.	Guidance to national authorities on the marking of offshore structures.
International Maritime Organisation (IMO) (2018) Formal Safety Assessment.	Process for undertaking marine navigation risk assessments.
Royal Yachting Association (RYA) Position on Offshore Energy Developments	Outlines recreational boating concerns for offshore renewable energy developments.
HSE and MCA (2017) Regulatory expectations on moorings for floating wind and marine devices	Guidance document on mooring arrangements for OREIs.
MCA (2013) Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI)	Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of OREI.

2.3 MGN 543 COMPLIANCE TABLE

Table 2-2 acts as an aid for OREI developers when completing and submitting an NRA to the MCA to ensure all guidance has been considered and addressed. While it is not required that this assessment is undertaken in full compliance with the MGN, the table shows that all aspects of the MGN have been addressed within this assessment.

Table 2-2: MGN 543 Compliance.

Annex 1		Report Section
1	An up to date traffic survey of the area	**Section 4** – Consultation **Section 6** – Existing Vessel Traffic at the Test Sites **Section 9** – Potential Impacts to Navigation
2	OREI structures	**Section 9** – Potential Impacts to Navigation
3	Assessment of access to and navigation within, or close to, an OREI	**Section 9** – Potential Impacts to Navigation **Section 10.3** – Risk Control Options
Annex 2		**Report Section**
1	Effects of tides and tidal streams	**Section 5.1** – MetOcean Conditions **Section 9.3** – The Effects of Tides, Tidal Streams and Weather
2	Weather	**Section 5.1** – MetOcean Conditions **Section 9.3** – The Effects of Tides, Tidal Streams and Weather
3	Visual navigation and collision avoidance	**Section 9** – Potential Impacts to Navigation **Section 9.8 –** Impact on Search and Rescue and Emergency Response
4	Communications, radar and positioning systems	**Section 9.9** - Impact on Communications, Radar and Positioning Systems
5	Marine navigational marking	**Section 10.3.1.1** - Measures adopted as part of the META Project
Annex 3		**Report Section**
1	MCA Shipping Route Template	**Section 9.1** – Impact on Vessel Traffic Routeing
Annex 4		**Report Section**
1	Safety and mitigation measures	**Section 10.3** – Risk Control Options **Section 10.5** – Possible Additional Risk Controls
Annex 5		**Report Section**
1	Emergency response	**Section 9.8** – Impact on Search and Rescue and Emergency Response

3 MARINE ENERGY TEST AREA (META) PROJECT

3.1 OVERVIEW

Marine Energy Wales's (MEW) proposed Marine Energy Testing Area (the META Project) forms part of Pembroke Dock Marine, a £76 million project to develop a world class centre for marine energy development, fabrication, testing and deployment, in Pembrokeshire. The four pillars of the Pembrokeshire Dock Marine Project include:

- The META Project (being developed by MEW);
- Marine Energy Engineering Centre of Excellence (MEECE) (an Offshore Renewable Energy Catapult project);
- Pembroke Port managed and operated by Milford Haven Port Authority; and
- Pembrokeshire Demonstration Zone (PDZ) (being developed by WaveHub).

The META Project will support developer testing of marine energy component, sub-assembly, instrumentation and marine renewable devices including trialling installation, retrieval and decommissioning methodologies and operation and maintenance activities. These will be undertaken in a wide range of environmental conditions, thereby de-risking marine energy technology deployment. The META Project sites include sheltered marine environments as well as larger full-scale marine testing areas.

3.2 MARINE COMPONENTS OF THE PROJECT

The activities that will be supported at these sites are summarised below for each site. Full details are provided within Chapter 2: Project Description, of the META Environmental Statement (ES).

3.2.1 Warrior Way (Site 6)

Warrior Way is located within the Waterway adjacent to the Pembrokeshire Science and Technology Park, south east of Pembroke Ferry, and at the mouth of the Cosheston Pill. The site supports the greatest tidal resource in the Waterway (1.2 m/s) and has a depth of between 16-19 m. The Warrior Way site encompasses an area of 0.093 km^2.

Warrior Way will enable testing of:

- Scaled tidal devices,
- Micro tidal devices,
- Instruments, components and sub-assemblies;
- ROV or other monitoring equipment;

- Site preparation methodologies;
- Decommissioning methodologies; and
- Salvage methodologies.

3.2.2 Dale Roads (Site 7)

Dale Roads lies outside the Dale shelf anchorage within the Waterway to the west of Great Castle Head, and south of St Ishmael's. It supports depths of between 8 and 12 m and benefits from a significant wind and wave fetch from the south and southwest. The site encompasses an area of 0.195 km^2.

Dale Roads will enable testing of:

- Scaled wave energy converter (WEC) devices;
- Full-scale WEC devices; and
- Research and monitoring methodologies.

3.2.3 East Pickard Bay (Site 8)

The north-west side of East Pickard Bay overlaps with the southern boundary of the Waterway. It lies immediately south of Sheep Island and runs south-eastward parallel to the coast towards Freshwater West Bay.

The East Pickard Bay site is exposed to a good wave resource benefiting from a 200 km fetch from the prevailing wind direction and has a water depth of between 10 and 29 m. The East Pickard Bay site encompasses an area of 1.233 km^2.

The site also lies adjacent to a Ministry of Defence (MOD) Danger Area (Castlemartin Military Practice Area D113A).

East Pickard Bay will enable testing of:

- Full-scale WEC device testing;
- Scaled WEC device testing; and
- Component testing for floating offshore wind technology.

4 CONSULTATION

4.1 CONSULTEES

Consultation was carried out with key stakeholders to gain local knowledge and insight on navigation. This was predominantly achieved through a half-day stakeholder meeting held at Pembroke Dock on Wednesday 30 January 2019.

In addition, telephone consultation was undertaken with the MCA and Trinity House Lighthouse Services (THLS).

Further detailed consultation was undertaken during a visit to the offices of MHPA on the afternoon of 30 January 2019, with the chief aim of obtaining additional data and traffic information.

Table 4-1 and **Table 4-2** set out the list of stakeholders consulted including the list of workshop attendees. Where stakeholders were unable to attend the workshop, telephone and/or email consultation was undertaken where possible, as indicated within **Table 4-2**.

A summary of all consultation is given in **Table 4-1.**

Table 4-1: List of stakeholders consulted (workshop attendees).

Company
Marine Energy Wales
RPS
Marico
Port of Milford Haven
Dale Yacht Club
Valero
Pembroke Yacht Haven
Puma Energy
Milford Harbour Users Association (MHUA)
Warrior Cove Pembrokeshire Activity Centre & Pembrokeshire Performance Sailing Academy

Table 4-2: List of stakeholders consulted (workshop apologies).

Company
MHPA
Pembroke Haven Yacht Club
Irish Ferries (supplied email comment)
MCA (phone consultation)
THLS (phone consultation)
RNLI

The following organisations did not respond to the consultation invitation:

- Milford Haven Fisheries Group
- South Wales Sea Fisheries Committee
- Welsh Federation of Sea Anglers
- Pembrokeshire Cruiser Racing Club
- Lawrenny Yacht Club
- Neyland Yacht Club
- PYC – Gelliswick
- Williams Shipping
- Svitzer
- SMIT – Range Safety Boat
- South Hook LNG
- Dragon LNG

4.2 CONSULTATION SUMMARY

Table 4-3: Consulation Summary.

Date	Consultee and type of response	Issues raised
5 November 2018	RNLI, meeting and subsequent email correspondence	Floating infrastructure may attract kayakers/surfers etc to the area of deployments at East Pickard Bay thereby increasing the risk of interactions with the devices/buoys.
17 January 2019	Email from MCA summarising Scoping Response to NRW/MMO	Impact of proposed devices on the safety of navigation. In particular, allision/contact, changes to vessel routing and reduction in navigable space (and any resulting increase in the frequency of encounters), any constraints placed on recreational, commercial and fishing vessels operating in or transiting the area and access ports and harbours. The Environmental Statement should provide details on the following possible impacts on navigational issues for both commercial and recreational craft: Collision Risk Navigational Safety Visual intrusion and noise Risk Management and Emergency response Marking and lighting of site and information to mariners Effect on small craft navigational and communication equipment The risk to drifting recreational craft in adverse weather or tidal conditions The likely squeeze of small craft into the routes of larger commercial vessels. A NRA will need to be submitted in accordance with MGN 543 (and MGN 372). 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 and should be completed within 24 months prior to the Environmental Statement submission. Casualty information from the MAIB and RNLI would also be good data sources. The mooring arrangements for any floating turbines should be carried out in accordance with the MCA and HSE Guidance 'Regulatory expectations on moorings for floating wind and marine devices', which also include Third Party Verification. The marking of offshore wave and tidal energy installations will be based on recommendations of the IALA. Consideration will need to be given to the implications of the site size and location on SAR resources and Emergency Response Co-operation Plans (ERCOP).

Date	Consultee and type of response	Issues raised
		Particular attention should be paid to cabling routes and where appropriate burial depth. If cable protection is required, the MCA would be willing to accept a 5% reduction in surrounding depths referenced to Chart Datum. The cumulative and in combination effects require consideration, in particular regarding shipping routes.
22 January 2019	Telecon with MCA	MCA confirmed that radar data / visual data not required to inform the NRA, providing that robust alternatives are demonstrated in the form of wide consultation.
24 January 2019	Email from Irish Ferries	Effects on ferry schedule and services with the twice daily sailings from Pembroke Dock Ferry Terminal. Main issues: Restricted access to Pembroke Dock Ferry Terminal. The narrow Navigable Channel which the Ferry transits, and no other vessel movements permitted during her transit to the berth. Increased activity around Pembroke Dock waterway, which could incur slow passing of berths, causing delays. Delays to ferry service due weather and the impact any activity would have with this project.
24 January 2019	Email from THLS	Any existing aids to navigation in the META project areas should be maintained or fully risk assessed with the Harbour Authority before removal or relocation. This would then need to be consented by THLS. If any additional aids to navigation are considered, THLS will need to be consulted and can provide specific advice. THLS would stipulate any aids to navigation in their advice to NRW during the licencing process. META project areas will need some form of marking due to the recreational and other small vessels operating in the area. This would most probably be through a mix of lit/unlit cardinal and special marks. THLS will provide a firm direction following consultation with the Harbour Authority during the licencing process.
30 January 2019	Stakeholder (Navigation) Workshop	Warrior Way There is an activity centre at Warrior Way [the Pembrokeshire Performance Sailing Academy, offering dinghy sailing, power boat and shore-based courses], meaning there will be a lot of small vessel activity. Yacht racing occurs at Neyland and Pembroke Yacht Club at Hobbs Point – Wednesday nights and Sunday. Start line uses entire width of the Waterway at Hobbs Point [these

Date	Consultee and type of response	Issues raised
		races go downstream from the start line which is in line with Neyland marina entrance]. Cruiser racing predominately occurs in daylight hours, 12-20 boats maximum, of 29-35 foot Kids jumping/swimming across from Hobbs Point Jetty [unofficially] Concern that activities at Warrior Way may cause vessels to be pushed towards the shallows on the opposite side of the Waterway. Small craft training occurs at Warrior Way, and several children may use the slipway at any one time during the Spring/Summer. A dedicated safety boat recovers people (including children) from the water following practice capsize events. Concern that unattended small craft could drift into the Warrior Way area with the tidal flow. Some potting occurs within the Warrior Way area. Line fishing also occurs (predominately recreational). Potential conflicts are not insurmountable with careful planning and management.
30 January 2019	Stakeholder (Navigation) Workshop	Dale Roads Water sports occur at a lower level compared with Warrior Way. Diving occurs on the wrecks to the south of Great Castle Head. Occasional power boat training. Swimming is generally discouraged in the Waterway, and restricted to sheltered bays (e.g. Dale Bay, Sandy Haven) Some potting for whelks occurs in the vicinity, and there are lots of unmarked fishing buoys. 5/6 fisherman were understood to use the Dale area commercially, with the rocky reef habitats favoured (noting that these rocky reef areas have been excluded from the META sites), and a few take out recreational fisherman. 3-4 line fisherman operate from Dale Roads. Potential risk from breakout of META devices and associated drifting/sinking. Also potential risk of third party vessel breakout impacting a META device in this area. Small tankers anchor to the western end of the Dale Bay. There are similar, but more dispersed, vessel traffic levels to Warrior Way.
30 January 2019	Stakeholder (Navigation) Workshop	East Pickard Bay Commercial vessels and cruise ships are unlikely to use the site. Potting occurs along the coast, but the site is at the edge of the 10 m contour.

Date	Consultee and type of response	Issues raised
		Most traffic would likely be lobster fisherman, or the Navy transiting through the site to their training areas. Kayaking is sporadic, however there is potential for surfers to investigate the devices.
30 January 2019	Stakeholder (Navigation) Workshop	Other general points raised: The MHPA regularly patrol the waters May-September. Potential for reduced under keel clearance. It was noted that there is good management and relationships between recreational users and the port authority, with a designated officer. Activities are generally away from the Port and there is well-established interaction.
22 February 2019	Email from Pembrokeshire Performance Sailing Academy	Key points in relation to Warrior Way: AIS and RYA data sources are unreliable for the area. Many members of the public use the slipway seasonally at Warrior Way/Cleddau Reach to launch/recover craft (sailing dinghies, powerboats/sportboats, water ski/wakeboard users and Personal Watercraft). In addition, PPSA, Llanion Cove and other paddlesports and multi-activity users use the slipway throughout the year. The site boundaries encompass the slipway area and would compress access to the river east of the Cleddau Bridge. Request that if possible the boundaries be revised. Request consultation regarding scheduling of activities before a Notice to Mariners is published, due to the need to accommodate advance bookings. The area is used to train novice sailors and powerboat users. There may be times when boats drift into the META test area. The proposed site is also within the area used for introducing planned speed manoeuvres on powerboat courses.

5 OVERVIEW OF THE MARINE ENVIRONMENT

The test sites are situated within, or close to the entrance to, the Milford Haven Waterway. The Port of Milford Haven is a leading UK shipping gateway handling liquid bulk, break bulk, dry bulk and project cargoes. It is known as the UK's largest energy port and is capable of delivering 30% of the UK gas demand.

The Port currently serves: Valero Refinery and Valero Pembrokeshire Oil Terminal, Puma Energy, South Hook LNG and Dragon LNG. Cargoes are received from the North Sea, North and West Africa, the Middle East, Asia and Europe and processed materials are transported domestically and internationally. The Waterway is also home to Europe's largest gas-fired power station, Pembroke Power Station. Additionally, Milford Haven Docks are home to a fishing fleet, and Pembroke Dock facilitates a twice daily ferry service to Ireland, as well as general and project cargo facilities. Pembroke Dock is redeveloping to accommodate marine renewable energy support craft.

The Waterway also includes a number of smaller harbours and marinas and is popular with leisure mariners.

5.1 METOCEAN CONDITIONS

The natural estuary of Milford Haven provides deep water berths and most vessels have 24-hour tidal access.

A weather station exists at Milford Haven (51°42'N 005°03'W, height 32m Above MSL) where data has been continuously collected and analysed since at least 1980. The weather data is summarised in the UKHO Publication NP37 – Admiralty Sailing Directions – West Coasts of England and Wales Pilot, and therefore, available to mariners using the port.

In summary Milford Haven experiences prevailing south westerly winds, though winds from the north west and south east are not uncommon, with south easterly winds being more common in the mornings from March to June inclusive. NP137 (**Section 1.140**) gives more detail.

During the period 1980 to 2010, gale force winds were experienced on average 33 days per year, mainly in the period October to March inclusive, and predominantly from a west, to south westerly direction.

The same 30-year period saw fog recorded on 27 days per year, on average (more frequently in the March to July period).

As noted above the Waterway is very sheltered, especially from the prevailing south westerly winds. However, Dale Roads is exposed to swells and wind from the south, and East Pickard Bay, lying outside the headlands is very exposed to the prevailing south westerly weather conditions.

5.2 EXISTING VESSEL TRAFFIC MANAGEMENT

The Waterway is managed by the Port of Milford Haven, a Trust Port, which is responsible for pilotage and conservancy on the Waterway. Warrior Way and Dale Roads are within the Milford Haven Statutory Harbour Authority (SHA) and Competent Harbour Authority (CHA) areas managed by MHPA. Marine risks have been assessed and reviewed on an ongoing basis through procedures included in MHPA's Marine Management System. MHPA provides a VTS service actively monitoring the whole Waterway below the Cleddau Bridge.

East Pickard Bay is largely out-with of the SHA area, and therefore, the port authority has no statutory duty or powers to direct traffic within the majority of this proposed test area, which is in UK waters and thus the MCA is the responsible authority for safe navigation. However, the site is very close to the approaches to Milford Haven, and all commercial traffic passing close by, or through the proposed site, is likely to be bound to or from the port, and therefore subject to pilotage, and other existing port control measures such as passage planning requirements.

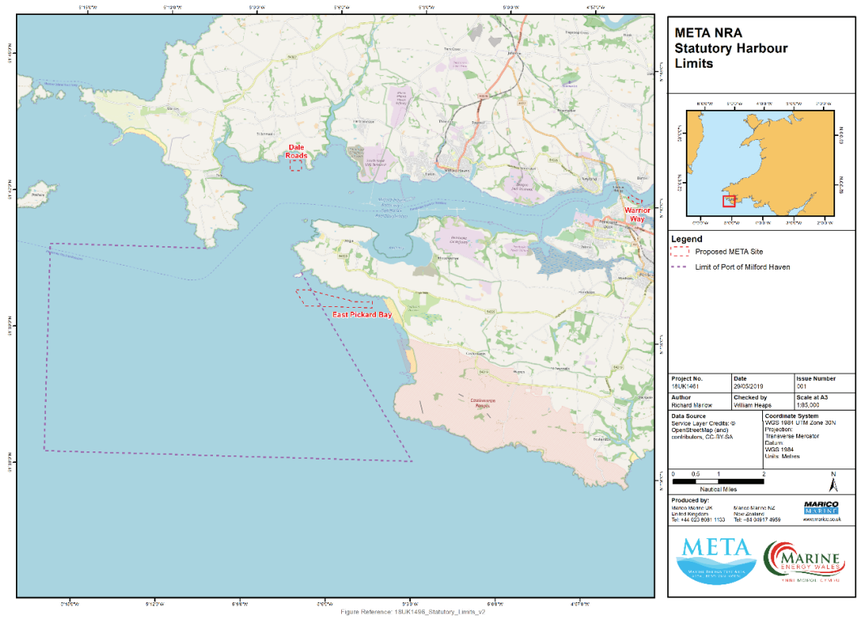

Figure 2: Statutory Harbour Authority Area.

5.3 SEARCH AND RESCUE

Royal National Lifeboat Institution (RNLI) lifeboats are stationed at Angle on the southern shore of the Waterway, south west of the town of Milford Haven. The Angle lifeboat is a Tamar class all weather lifeboat. The lifeboat is 16.3m LOA, has a crew of seven, and is capable of 25 knots having a range of 250 nm. In addition, two "D" class inshore lifeboats are based at the station.

Her Majesty's Coastguard (HMCG) helicopter assets are based at St Athan near Cardiff and Newquay in Cornwall.

Milford Haven Coastguard Operations Centre (CGOC) is the local coastguard base for the region and co-located with the MHPA offices and VTS centre. The 2015 implementation of the Future Coastguard Programme saw a restructuring of the CGOCs and implementation of a new IT system that enabled areas to be monitored and incidents responded to from any CGOC or from the National Maritime Operations Centre (NMOC), near Southampton. Therefore, whilst Milford Haven CGOC would likely manage an incident in the Waterway, it could be managed from elsewhere.

5.4 OTHER MARINE ACTIVITIES

The following marine activities have been identified as currently existing in the study area or may be relevant in the future.

5.4.1 Marine renewable energy installations

There are no existing marine renewable energy installations within the META test areas or wider Waterway however marine renewable energy development is being encouraged through the Pembroke Dock Marine project.

5.4.2 Subsea Cables

Numerous subsea cables are charted in the Waterway. There are currently none charted in, or close to, the proposed East Pickard Bay or Dales Road sites. One cable is charted (UKHO Chart 3275) close to the western boundary of Warrior Way crossing from bank to bank of the Waterway. A pipeline also crosses the Waterway between the site boundary and the Cleddau Bridge.

5.4.3 Anchorages

No formal anchorages exist in any of the sites. A regularly used anchorage named Dale Roads is managed by MHPA and vessels are directed to a charted area while awaiting orders. The designated anchorage is some 0.5 NM south of the proposed Dale Roads META project test site.

There are no restrictions on anchoring in any of the sites, and none are likely to be used by commercial vessels, but leisure vessels may choose to anchor in the shallower waters of Warrior Way and Dale Roads. It is not considered likely that any vessel would choose to anchor in East Pickard Bay, except in emergency.

5.4.4 Military Exercise Areas

There are no military exercise areas within the Waterway (no impact on Warrior Way or Dale Roads). A large and active range exists outside the entrance to the Waterway (Castlemartin Firing Range), immediately adjacent to the East Pickard Bay site. While the range is active, it is actively managed and protected by a range safety vessel.

5.4.5 Dredging Areas and Spoil Grounds

MHPA carries out maintenance dredging in several areas of the Waterway, chiefly in the main deep-water channel and approaches to the main hydrocarbon jetties. There is a licensed maintenance dredge area covering the principal berths in Pembroke Dock and their approaches (DML 1666, licence expires 08 March 2022)[1].

Two licensed disposal sites exist in the Milford Haven area – the principal site being outside the entrance to seaward (Milford Haven / St Anns Head), while a small area also exists closer to Pembroke Dock towards the Cleddau Bridge (LU 190 "Neyland [off Milford Haven]).

Dredging is managed by MHPA, while licensing of dredge areas and disposal sites are regulated by NRW through licensing / consents.

None of these activities are likely to directly impact on operations in any of the three sites under consideration.

[1] Source – NRW data portal

5.4.6 Leisure Areas

The Waterway as a whole is an important and well used area for all forms of water-based leisure, including activities falling under the traditional definition of navigation such as sailing and motorboat cruising. There are also a wide variety of other activities including paddle sports, sail training, swimming, diving and coasteering. Overall these are well regulated by MHPA in conjunction with the National Park Authority, and compliance with rules and regulations is enforced through the on-water presence of the MHPA water ranger, who is afloat throughout the year, but especially during the summer season.

Leisure and other uses of the Waterway are zoned, and clear information is given in the annual Tide Tables & Leisure User Guide[2]. See also **Figure 3**

It is noted that Warrior Way and Dale Roads have already been marked on the 2019 chart (below) in anticipation of their development.

East Pickard Bay is outside this zoning scheme, but stakeholder consultation confirmed that the Bay is much less intensively used by leisure vessels than the sites within the Waterway.

[2] See: https://www.mhpa.co.uk/uploads/2019%20documents/PoMH%20Tide%20Tables%202019%20for%20online.pdf

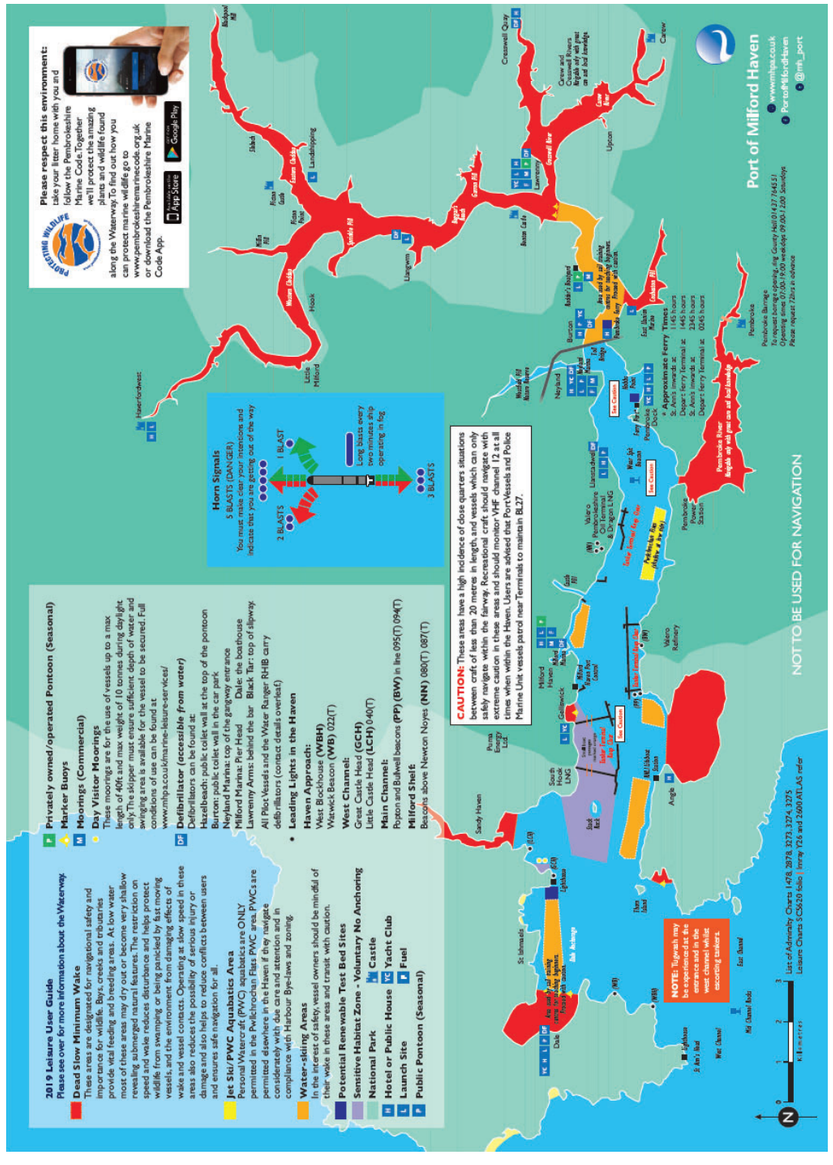

Figure 3: MHPA Leisure User Guide Chartlet.

6 EXISTING VESSEL TRAFFIC AT THE TEST SITES

6.1 DATA SOURCES

MCA's MGN 543 requires that *"An up to date, traffic survey of the area concerned should be undertaken within 12 months prior to submission of the Environmental Statement. This should include all the vessel types found in the area and total at least 28 days duration but also take account of seasonal variations in traffic patterns and fishing operations. (Note: AIS data alone will not constitute an appropriate traffic survey)."*

Therefore, the NRA should be based on the best available data that accounts for all marine users, not just those equipped with AIS. Typically, this is achieved through a radar and visual traffic survey from shore or from afloat. This approach is not considered proportionate for the META project, given the scale and location of the test sites within or in close proximity to the MHPA SHA area.

Following advice from the MCA it has been considered sufficient to obtain and analyse suitable AIS data and support the analysis of that data with wide stakeholder consultation to establish the status of non-AIS equipped traffic.

Recent AIS data was obtained for the whole Waterway covering the following winter and summer periods:

- 01 to 28 February 2018
- 01 to 28 August 2018

Additional data sources, over and above stakeholder consultation included:

- MHPA commercial traffic data;
- RYA Leisure user intensity mapping (via NRW web portal); and
- MHPA and MAIB incident data sets

6.1.1 AIS Derived Vessel Traffic Routes in Milford Haven

Figure 4 shows an overview of AIS reported vessel traffic within the Waterway during the summer months, while **Figure 5** gives a similar overview for the winter period.

Both plots clearly show that the intensity of traffic bound for the main commercial berths is consistent in both summer and winter, with the routes to the main hydrocarbon berths (South Hook LNG, Valero refinery on the south bank, and Valero Oil Terminal & Dragon LNG), Milford Haven Dock and Pembroke Dock being clearly highlighted in yellow / red on the density plots.

However, the summer plot also demonstrates that much more of the Waterway (i.e. in terms of area) is used by those vessels transmitting AIS data than is the case during the winter – particularly the margins of the Waterway including the approaches to Dale (Dale Roads site) and the reaches above the Cleddau Bridge (Warrior Way site). Also, to a lesser extent, and less relevant to this NRA, Angle Bay and the Pembroke River.

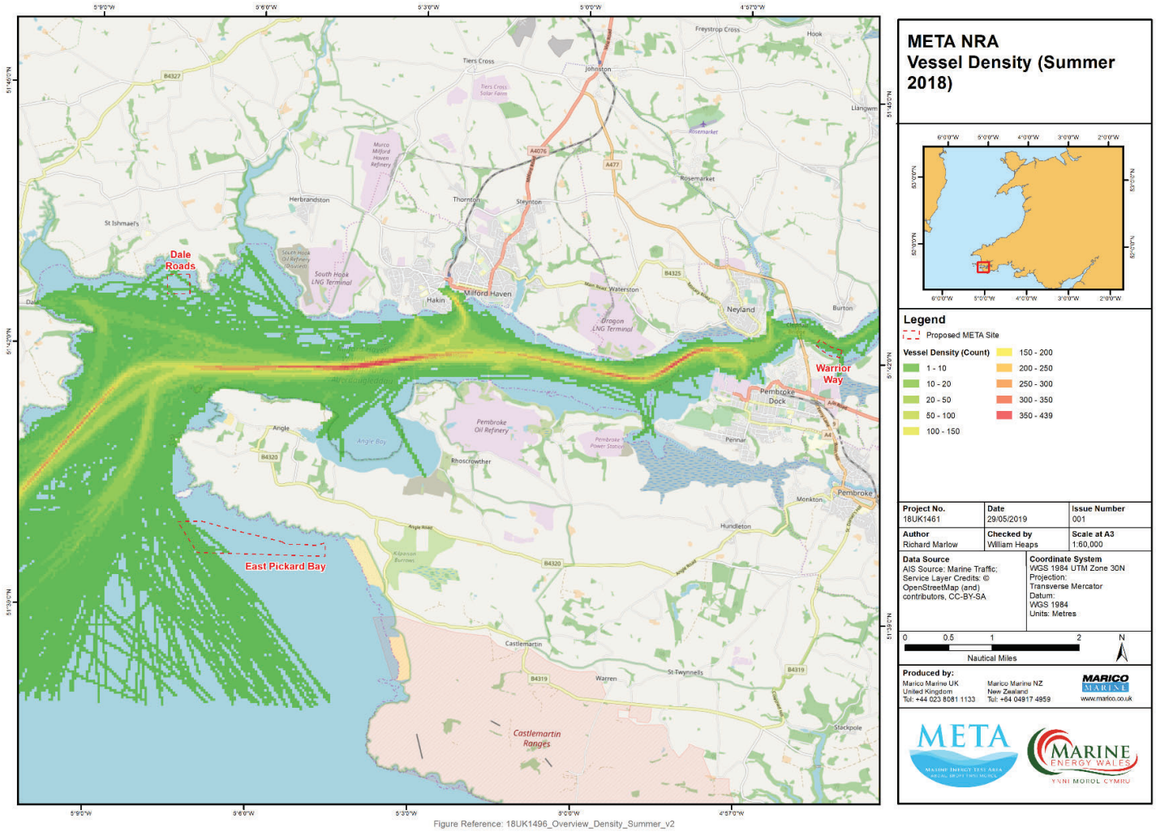

Figure Reference: 18UK1496_Overview_Density_Summer_v2

Figure 4: Vessel transit density Milford Haven Waterway (summer).

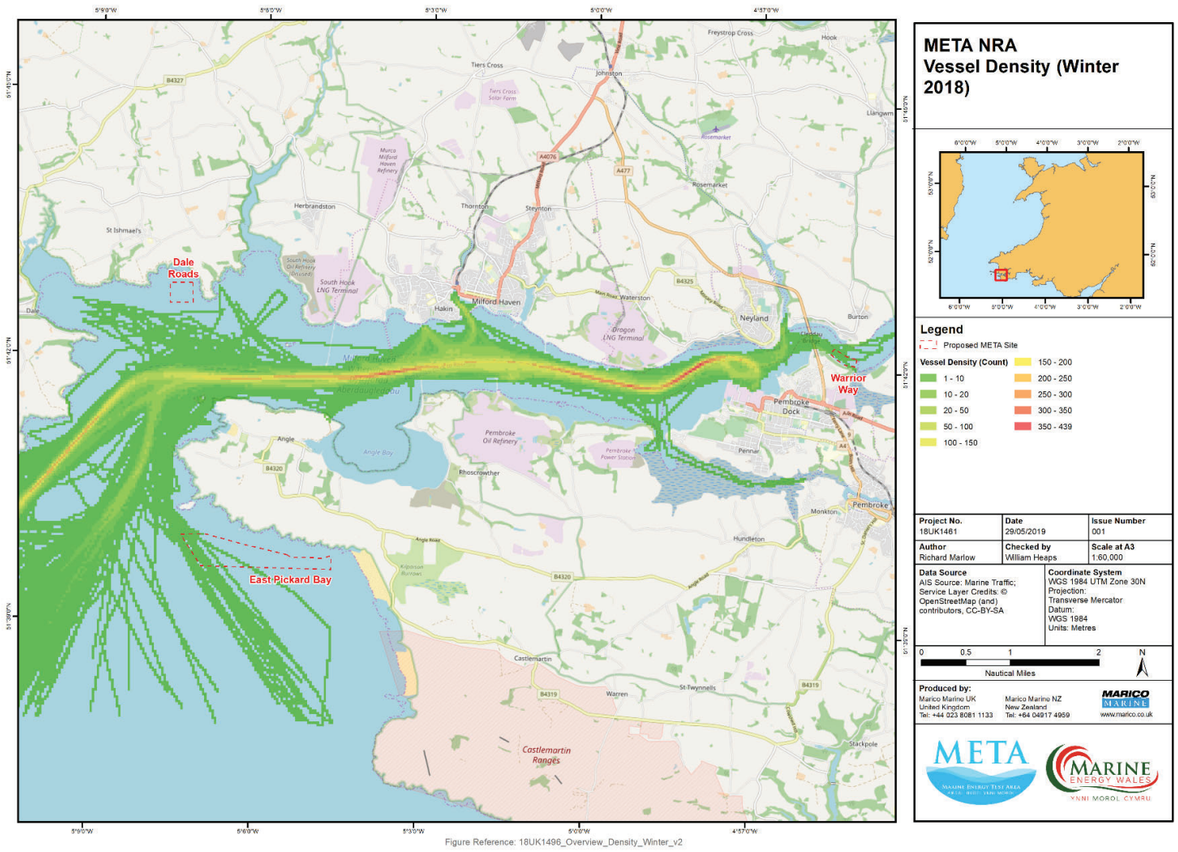

Figure Reference: 18UK1496_Overview_Density_Winter_v2

Figure 5: Vessel transit density Milford Haven Waterway (winter).

6.1.2 Other Traffic Data Sources

Recognising that AIS data cannot capture all vessel movements, and in order to verify AIS data sets additional data regarding commercial vessel traffic was obtained from MHPA covering a five-year period (including the periods covered by AIS data).

Furthermore, stakeholders (including the MHPA Water Ranger) were consulted to ensure an accurate picture of leisure vessel traffic was established, as it is known that few leisure vessels in Milford Haven are equipped with AIS transmitters (see discussion in **section 6.5**).

6.1.3 MHPA Data

Table 6-1, Figure 6 and Figure 7 below summarise vessels arriving at Milford Haven during the same Winter (February) and Summer (August) periods as illustrated in the AIS data.

These statistics have been extracted from the full vessel movement data records maintained by Milford Haven Port Control.

Arrivals are those vessels bound for any berth or anchorage within the Waterway from an external port / sea.

Note that the figures below represent arrivals only, so total vessel movements in each period are approximately double the numbers indicated when departures and movements are considered.

It should also be noted that Tug movements are NOT shown in these figures, as routine tug voyages are not recorded on the port data base. See **section 6.7** for further discussion.

A summary of principal arrivals is shown in **Table 6-1** below. There is no significant difference between winter and summer traffic levels, with the Irish ferry, along with small product and chemical tankers making up the majority of movements.

Table 6-1: Summary of vessel arrivals at Milford Haven.

Ship Type	Winter	Summer
Chemical Tanker		2
Chemical/Oil Products Tanker	40	39
Chemical/Products Tanker	25	34
Crew/Supply Vessel	2	
Crude Oil Tanker	6	3
Crude/Oil Products Tanker	6	5
Deck Cargo Pontoon, non-propelled	1	
Dredger	3	2
Ferry	54	55
Fishing Vessel	1	2
General Cargo Ship		3
IMO Chemical (Type 2) Tanker		1
IMO Chemical (Type 3) Tanker		4
LNG Tanker	1	1
LPG Tanker	8	14
Mooring Vessel		1
Oil Products Tanker	23	22
Passenger/Cruise	1	3
Patrol Vessel	2	1
Products Tanker	7	8
Sail Training Ship		1
Sailing Vessel		1
Training Ship		1
Trawler	10	8
Tug	4	1
VLCC	1	9
Work / Repair Vessel	1	

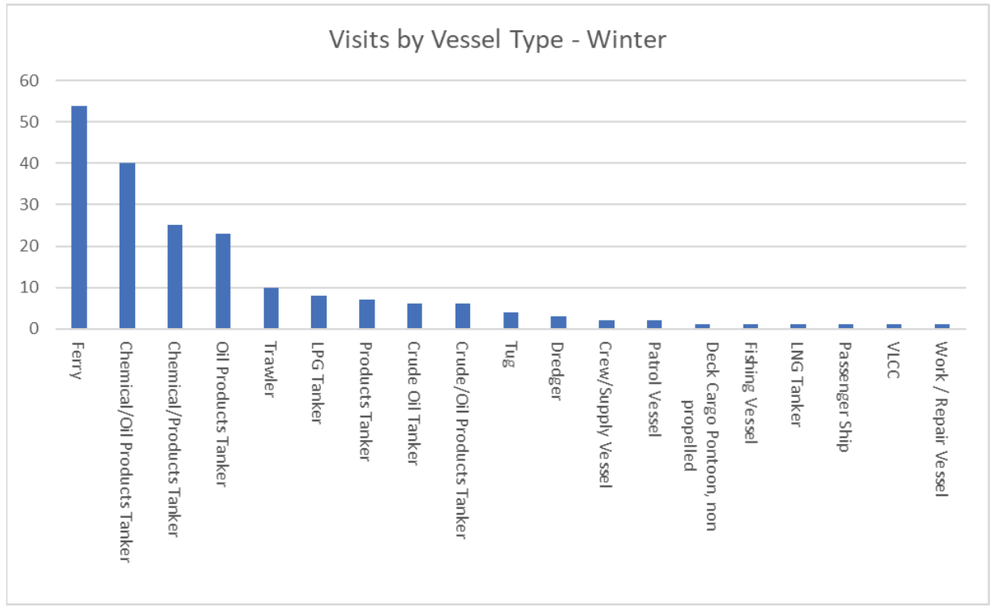

Figure 6: Vessel Arrivals Milford Haven (February 2018).

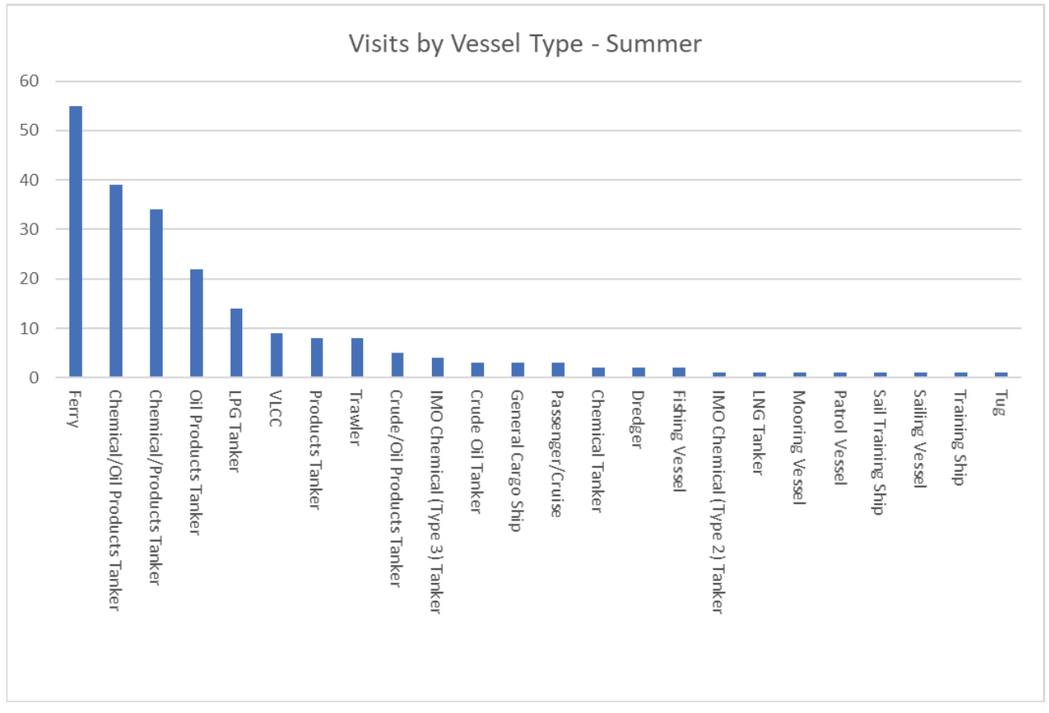

Figure 7: Vessel Arrivals Milford Haven (August 2018).

6.1.4 Stakeholder Information

See **section 4** for details of organisations consulted. Many of these stakeholders were able to give detailed information on local traffic patterns, which has been considered in the individual paragraphs below. It was particularly noted that leisure traffic is very seasonal in nature (predominantly summer months) while commercial traffic is relatively consistent throughout the year. Leisure stakeholders also confirmed that AIS is not reliable for detecting leisure vessels, as very few local leisure vessels have AIS fitted. They were however able to confirm that Warrior Way is intensively used by leisure vessels, and that Dale Roads is also a popular leisure area. East Pickard Bay is less intensively used, mainly being transited by leisure vessels on passage.

MHPA publishes a widely distributed and consulted annual Leisure User Guide[3] (and tide tables), in addition to directions and passage planning documents for commercial traffic.

The leisure guide includes a diagram (**Figure 3**) which identifies 3 specific areas where traffic density is high, and in which there is a high incidence of "close quarters situations". These areas are off South Hook LNG terminal, near War Spit Beacon and north of Dockyard Bank. None are close to the three test areas under review.

[3] https://www.mhpa.co.uk/uploads/2019%20documents/PoMH%20Tide%20Tables%202019%20for%20online.pdf

6.2 COMMERCIAL VESSELS (TANKER / GENERAL CARGO)

General commercial vessels can be sub-classified as Tankers (including LNG) and General Cargo. AIS tracks for these vessel classes are shown below for each test area.

It was stated during the stakeholder consultation (Valero representative) that the number of tanker movements may be significantly reduced during periods of facility maintenance shutdowns. However, there was no evidence that this was the case in the data sets analysed.

It can be seen in the figures below that vessels have been recorded on clear in- and outbound routes passing both Dale Roads and East Pickard Bay, and there is no evidence of interaction with either of these sites. In the case of Dale Roads, some tracks do approach closer to the site from the south, these being tracks of generally smaller vessels making use of the nominated anchorage in the southern part of Dale Roads while awaiting berths or orders.

No commercial vessel transits were recorded above the Cleddau Bridge and passing through the Warrior Way site.

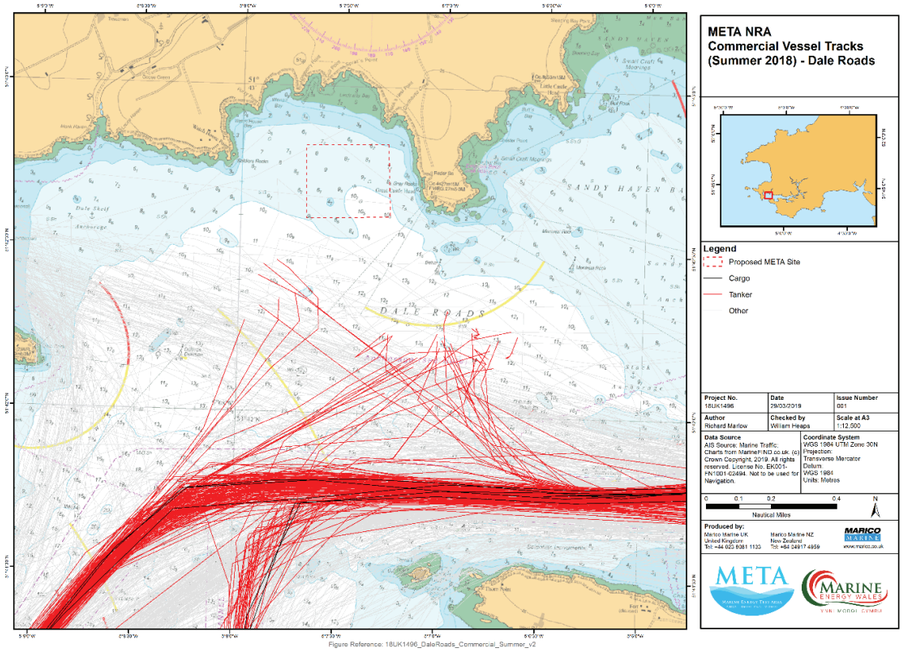

Figure Reference: 18UK1496_DaleRoads_Commercial_Summer_v2

Figure 8: Commercial Vessel Transits: Dale Roads (summer).

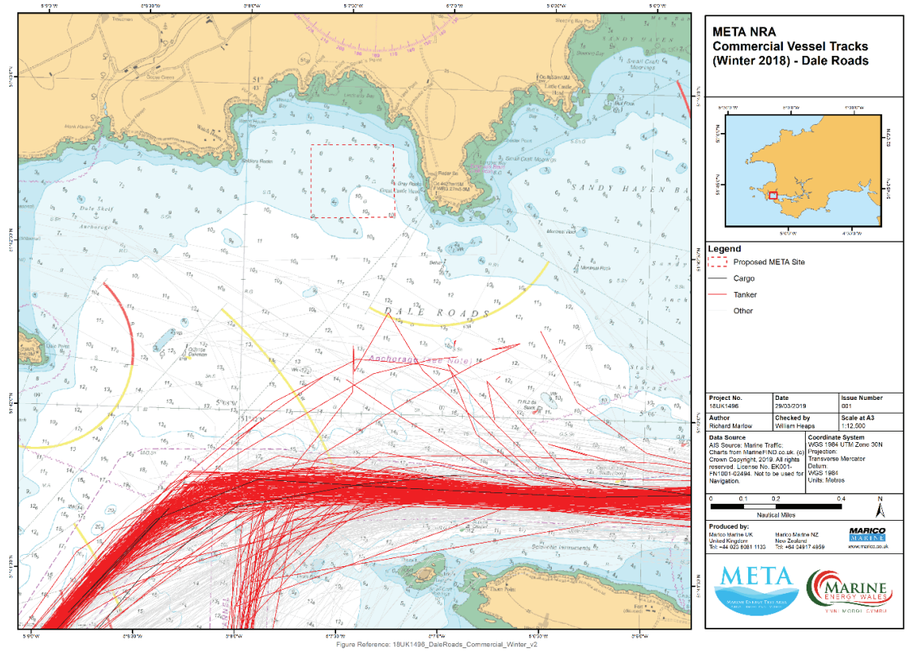

Figure Reference: 18UK1496_DaleRoads_Commercial_Winter_v2

Figure 9: Commercial Vessel Transits: Dale Roads (winter).

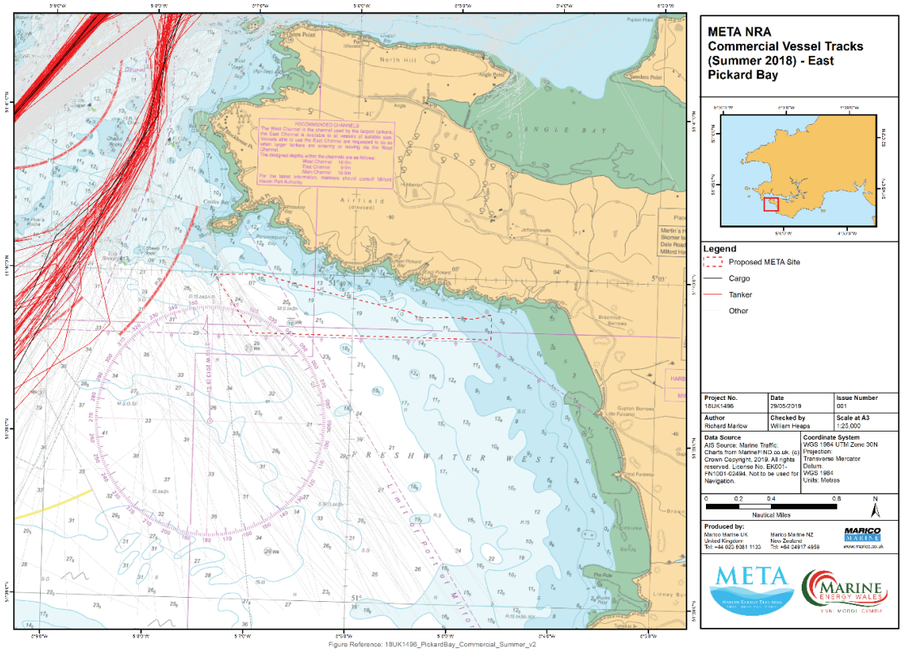

Figure 10: Commercial Vessel Transits: East Pickard Bay (summer).

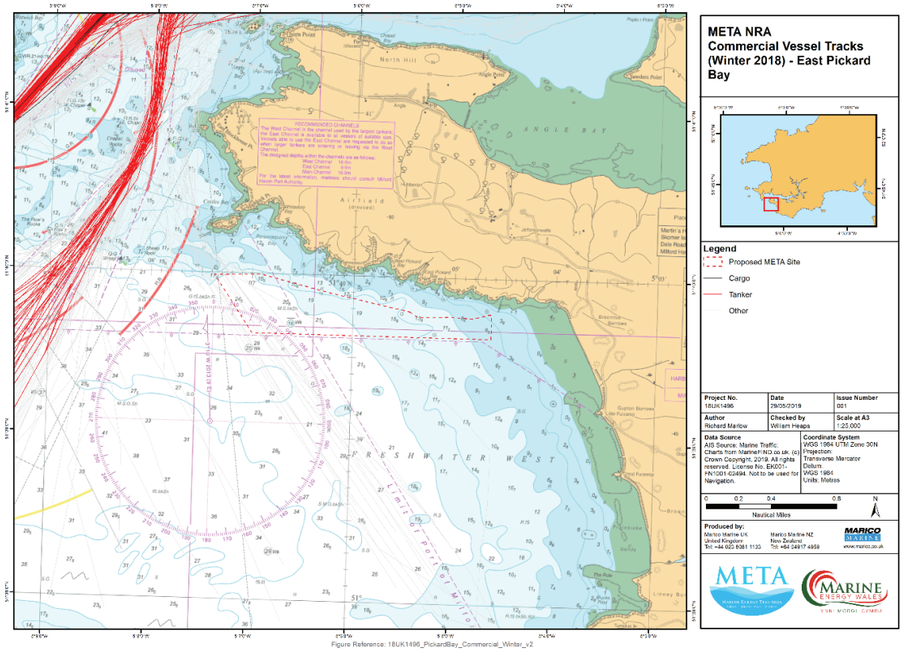

Figure 11 Commercial Vessel Transits: East Pickard Bay (winter).

6.3 PASSENGER VESSELS

Pembroke Dock is an important ferry port for Southern Irish Sea passenger and freight traffic. There are routinely two departures / arrivals per day (same vessel) on the normal timetable (around midday and midnight). This service makes up the majority of the tracks recorded on the Dale Roads and East Pickard Bay plots below and does not interact with either site (nor the upstream Warrior Way site).

Additional passenger ferry AIS tracks are recorded passing close by or through all three sites, notably during the summer. These are likely to be seasonal commercial services (for example RHIB sight-seeing trips), but even in summer few tracks are recorded passing through any of the test site areas.

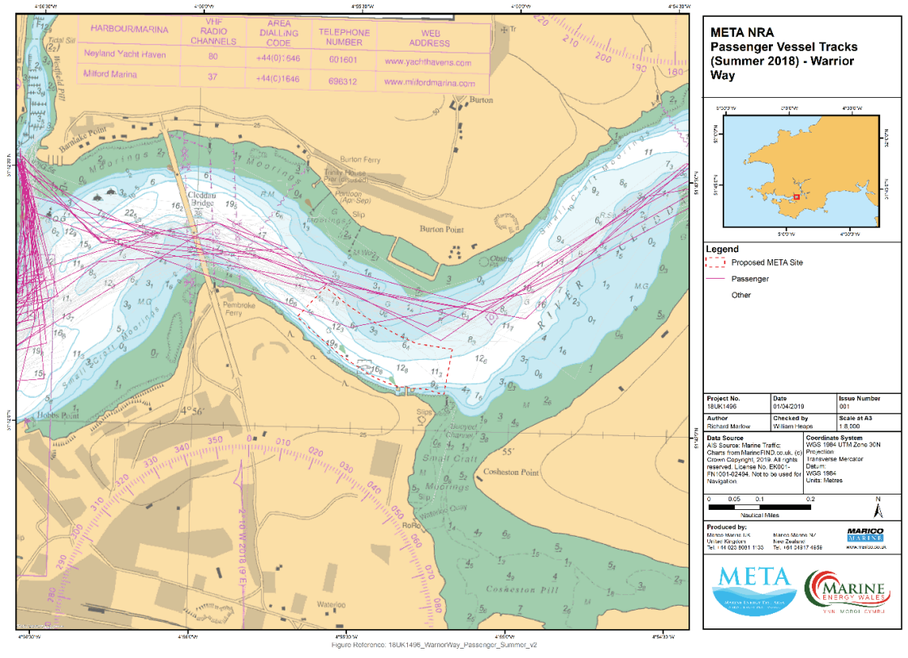

Figure 12: Passenger Vessel Transits: Warrior Way (summer).

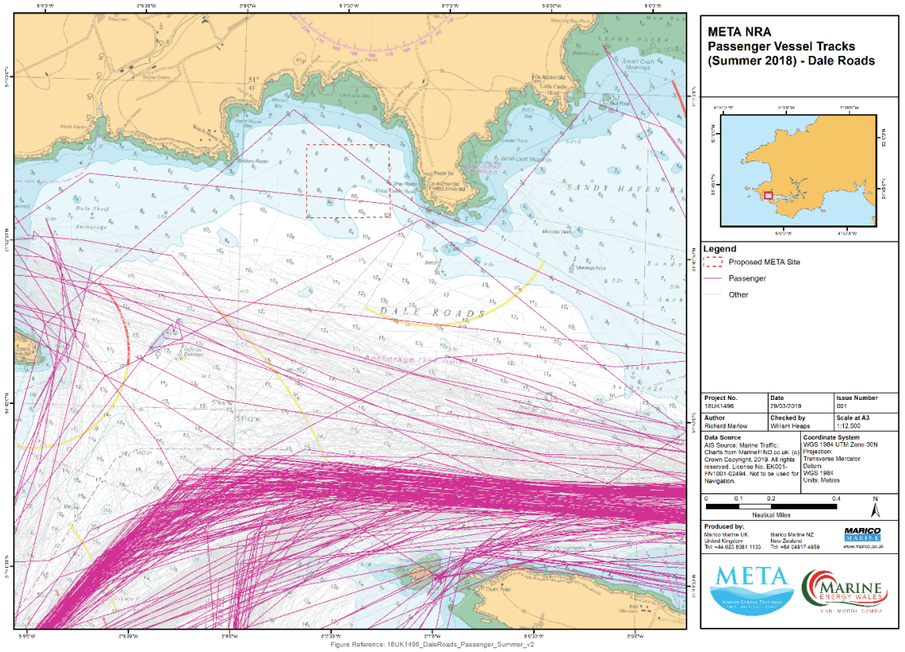

Figure Reference: 18UK1496_DaleRoads_Passenger_Summer_v2

Figure 13: Passenger Vessel Transits: Dale Roads (summer).

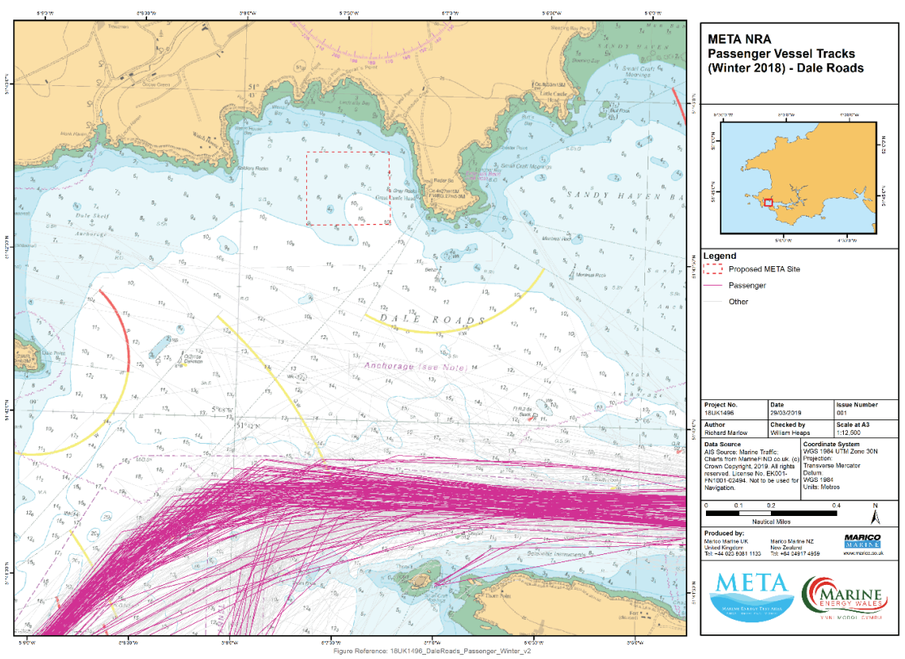

Figure Reference: 18UK1496_DaleRoads_Passenger_Winter_v2

Figure 14: Passenger Vessel Transits: Dale Roads (winter).

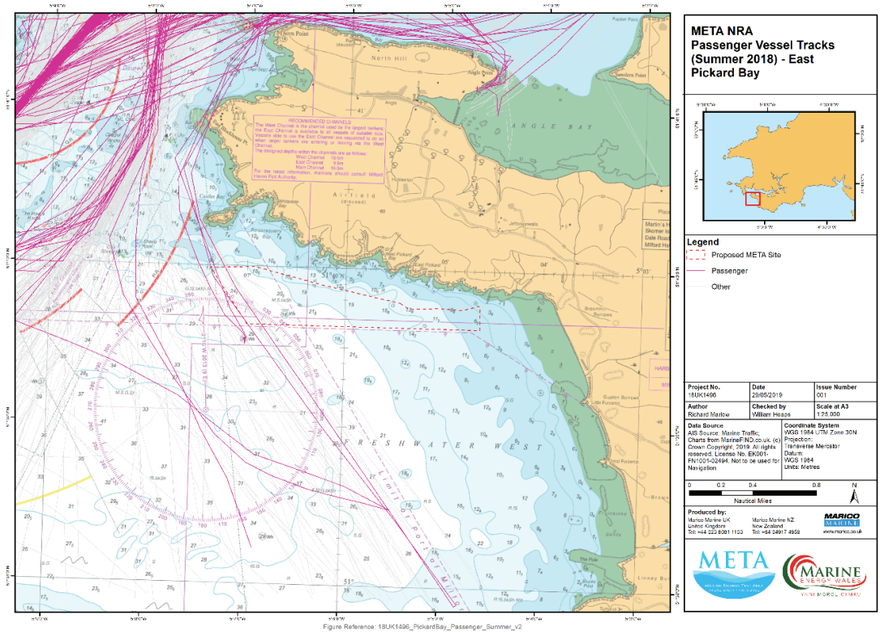

Figure Reference: 18UK1496_PickardBay_Passenger_Summer_v2

Figure 15: Passenger Vessel Transits: East Pickard Bay (summer).

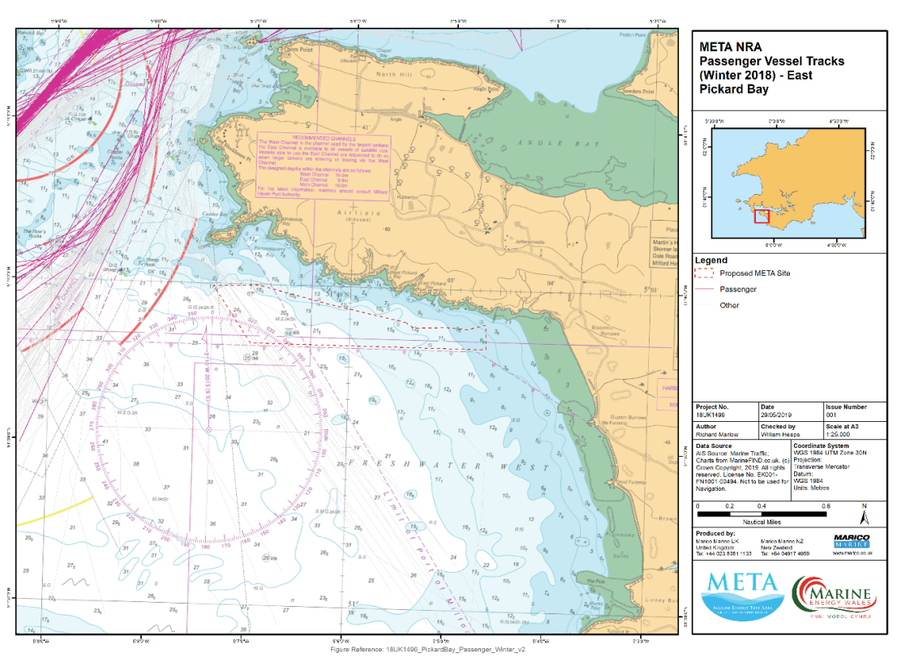

Figure Reference: 18UK1496_PickardBay_Passenger_Winter_v2

Figure 16: Passenger Vessel Transits: East Pickard Bay (winter).

6.4 FISHING VESSELS

Fishing vessel movements are minimal in the three test site areas based on AIS data. AIS tracks attributed to fishing vessels mainly show passages from Milford Haven Docks to sea through the Waterway, with no evidence of active fishing. This concurs with stakeholder feedback, although there may be some small-scale inshore commercial fishing and leisure angling (not captured by AIS) in the nearshore area north of the East Pickard Bay site boundary and/or in the wider vicinity.

Some potting may take place in all three areas, with stakeholders reporting buoys being encountered especially on channel margins and inshore areas.

Overall, fishing vessel traffic is not considered significant to this study.

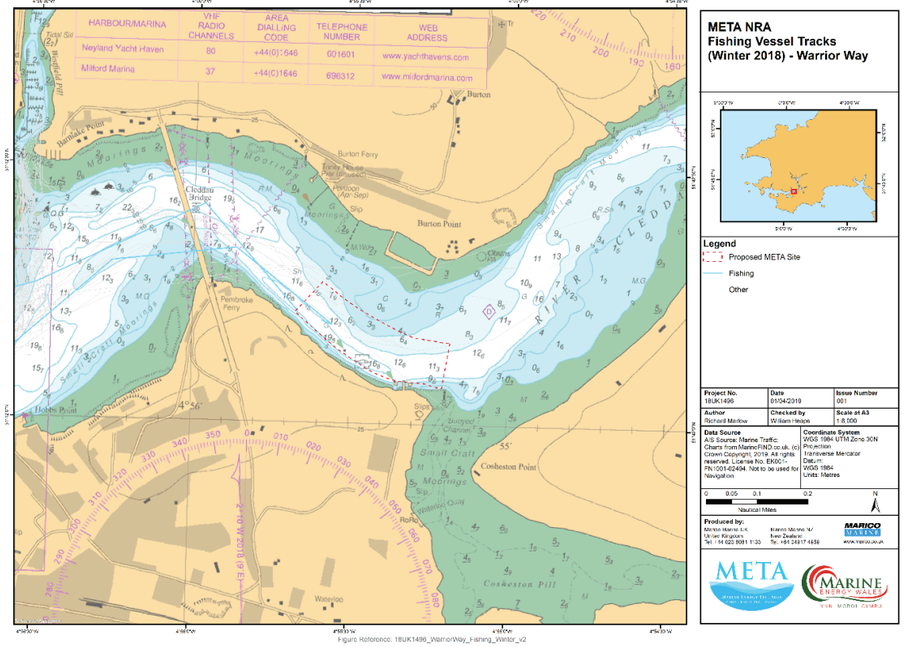

Figure Reference: 18UK1496_WarriorWay_Fishing_Winter_v2

Figure 17: Fishing Vessel Transits: Warrior Way (winter).

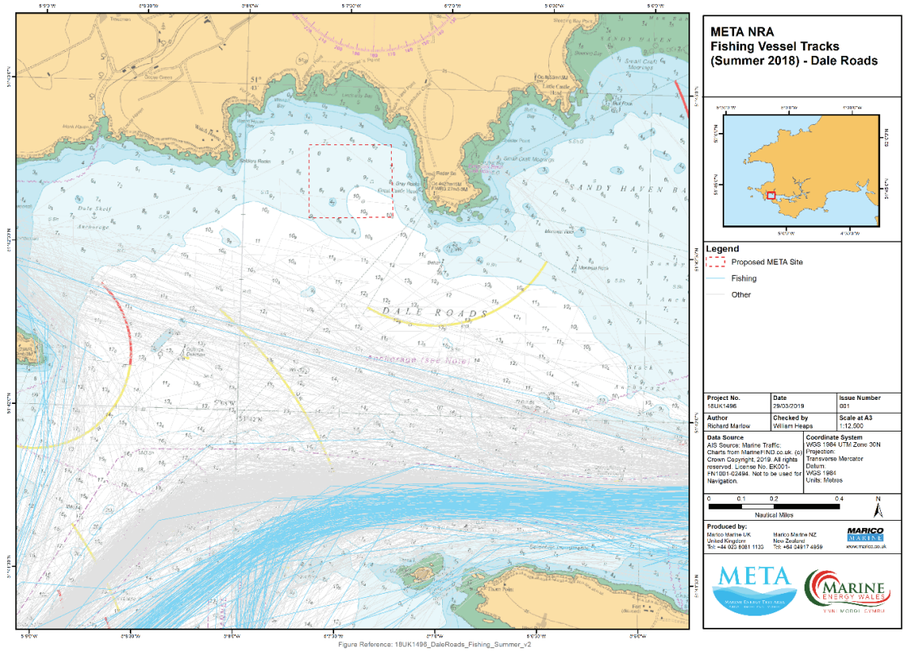

Figure Reference: 18UK1496_DaleRoads_Fishing_Summer_v2

Figure 18: Fishing Vessel Transits: Dale Roads (summer).

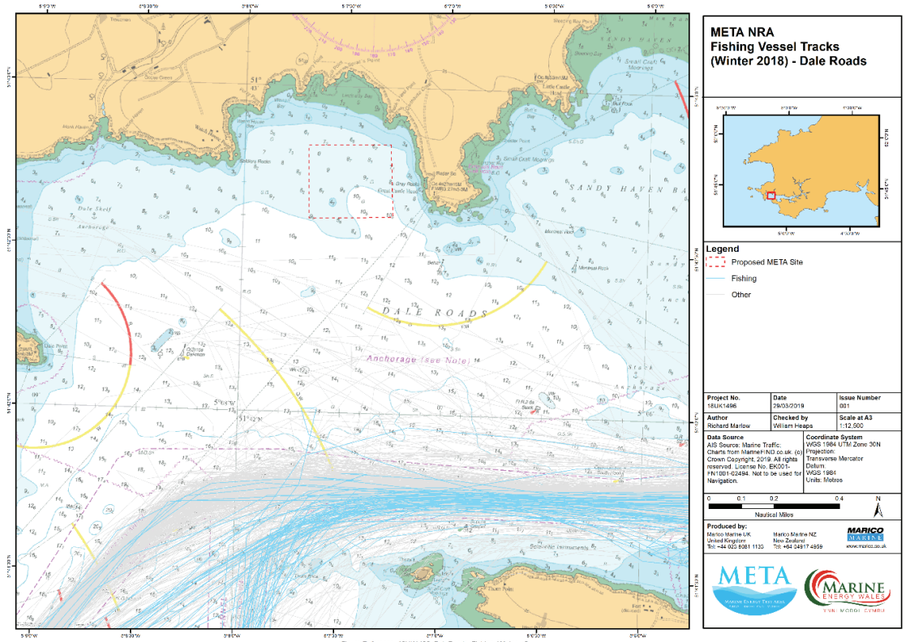

Figure Reference: 18UK1496_DaleRoads_Fishing_Winter_v2

Figure 19: Fishing Vessel Transits: Dale Roads (winter).

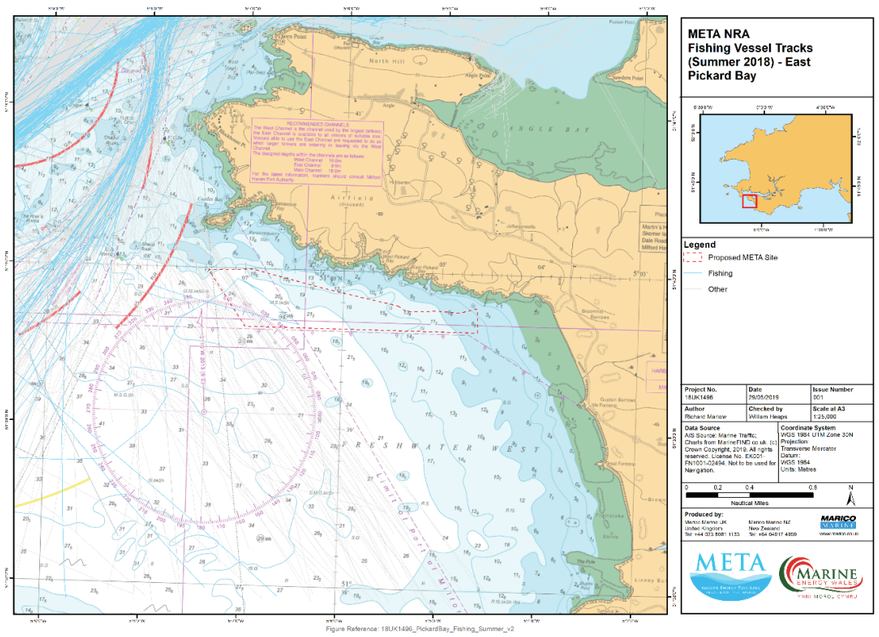

Figure Reference: 18UK1496_PickardBay_Fishing_Summer_v2

Figure 20: Fishing Vessel Transits: East Pickard Bay (summer).

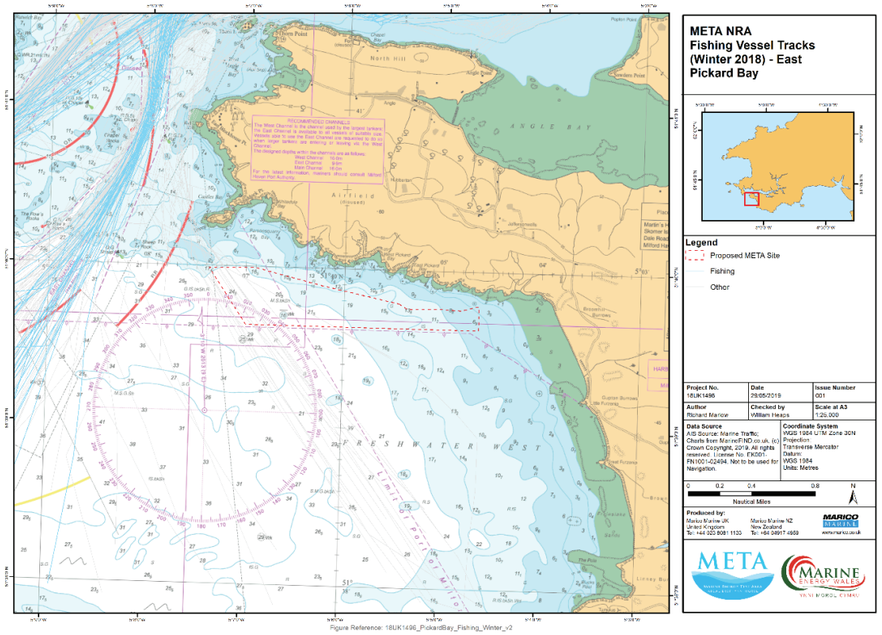

Figure Reference: 18UK1496_PickardBay_Fishing_Winter_v2

Figure 21: Fishing vessel transits: East Pickard Bay (winter).

6.5 RECREATIONAL CRAFT

Most leisure vessels in the Waterway are unlikely to transmit AIS data. Nevertheless, numerous tracks were recorded in the summer, mainly transiting between Neyland and the seaward end of the Waterway. Most of these are likely to be larger vessels, and probably semi-commercial in nature.

Warrior Way is the most intensively used of the three sites for leisure navigation, and in particular the area is frequently used for youth sail training and other adventurous water-based activity (including coasteering in the coastal zone which has been excluded from the site footprint). Many leisure navigators in small craft access the area from the slipways at Llanion cove at the south-eastern extremity of the proposed site footprint. Some stakeholders including the representative from Pembrokeshire Activity Centre and the Harbour Users Association expressed concern that the bank on the northern shore would force most larger leisure vessels into the proposed test site limits, despite the impression given by the AIS tracks shown in the figure below. There were no recorded leisure AIS tracks in the winter period for the Warrior Way site. It is noted that in practice only one device will be deployed at any given time, with a very much smaller footprint within the overall site boundary.

With respect to Dale Roads and East Pickard Bay, no leisure traffic equipped with AIS was recorded passing through either site in the winter months, and very few tracks were recorded passing through either area in the summer (though many tracks were recorded passing relatively close to the site boundaries). Stakeholder consultation again confirmed that AIS was under representing leisure traffic, especially in the summer, but that the density of traffic using Dale Roads and East Pickard Bay was much lower than Warrior Way. It was noted that the Dale Roads area is currently used occasionally for Power Boat training exercises.

Stakeholder consultation confirmed that leisure vessels on passage are likely to follow similar tracks to those indicated in the figures below. However, there is also intensive usage of the Waterway by local vessels, e.g. dinghy and small yacht cruising, racing (especially in the area near Hobbs Point), (youth) sail training, canoeing and other paddle sports, and support vessels for all of the above activities. While there is no numerical data available for these vessel tracks, stakeholders agreed that the RYA intensity data available from the Wales Marine Planning Portal (though based on AIS) broadly gives a realistic illustration of leisure vessel intensity in the Waterway. The RYA intensity data indicates very high leisure usage in Warrior Way with relatively less in Dale Roads and low intensity of use in East Pickard Bay. Overall, leisure vessel traffic is concentrated in the summer months, and very much reduced in the winter.

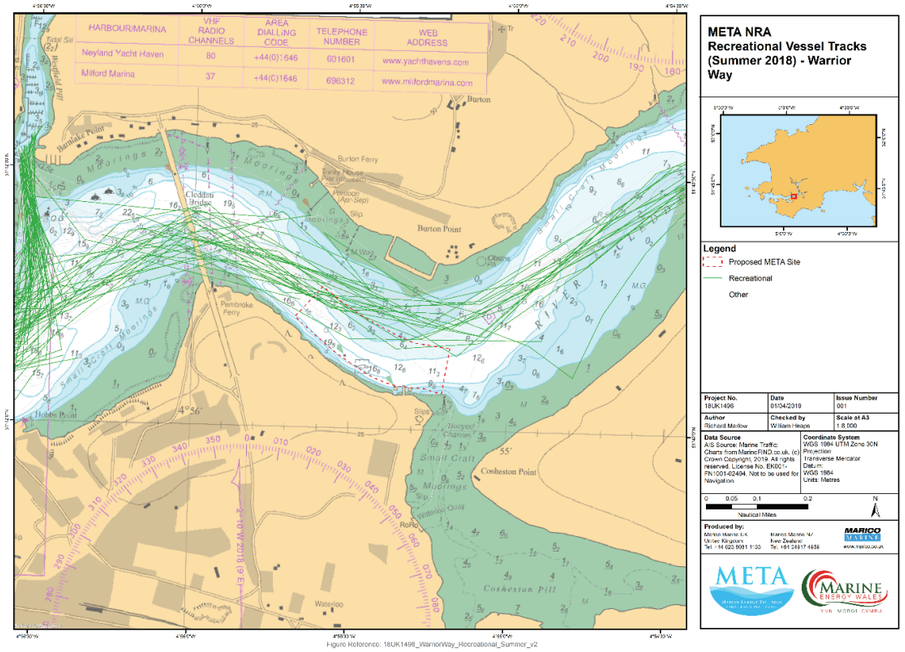

Figure Reference: 18UK1496_WarriorWay_Recreational_Summer_v2

Figure 22: Recreational Vessel Transits: Warrior Way (summer).

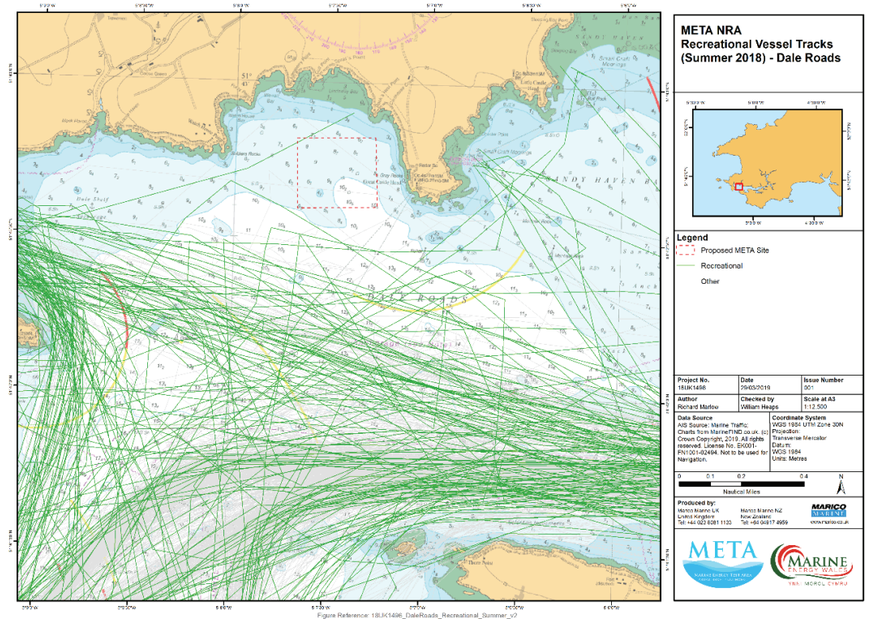

Figure Reference: 18UK1496_DaleRoads_Recreational_Summer_v2

Figure 23: Recreational Vessel Transits: Dale Roads (summer).

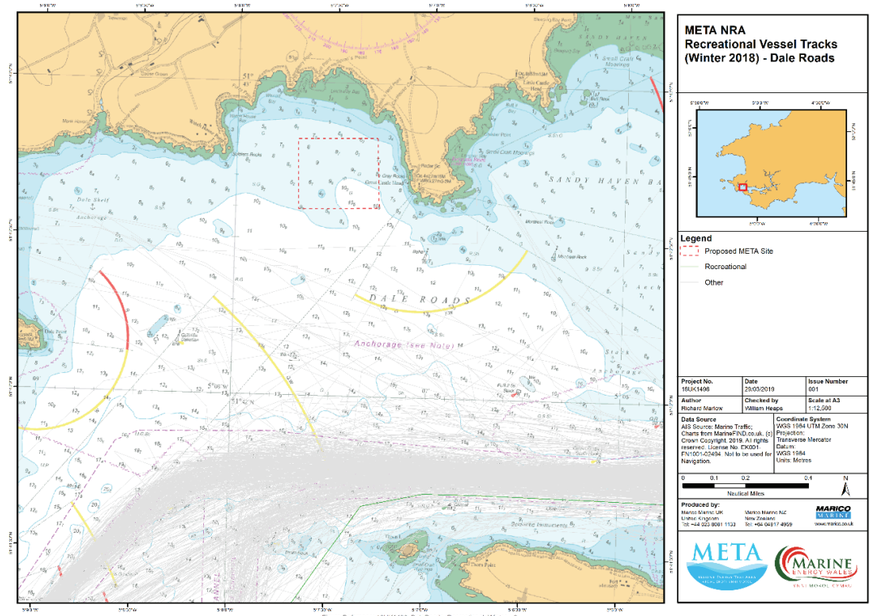

Figure Reference: 18UK1496_DaleRoads_Recreational_Winter_v2

Figure 24: Recreational Vessel Transits: Dale Roads (winter).

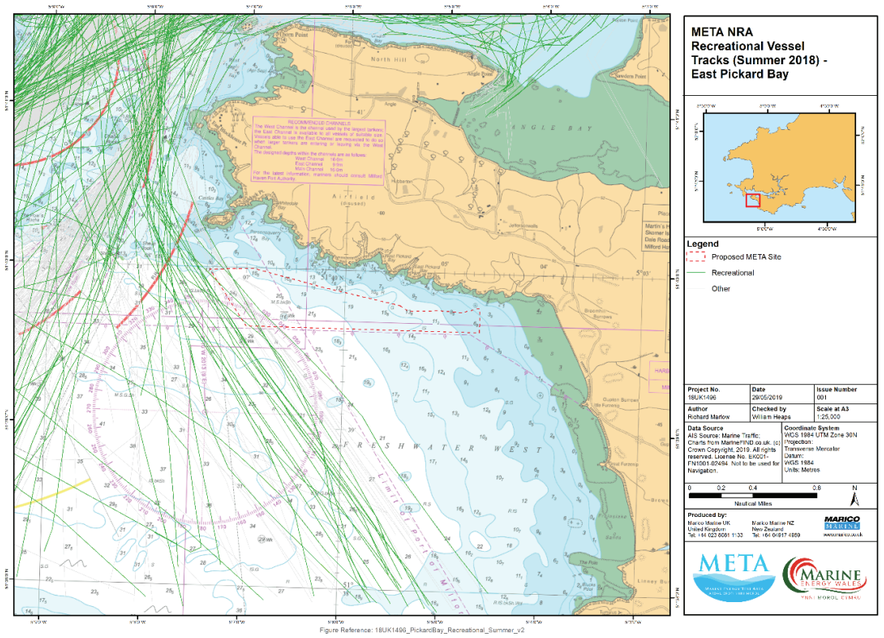

Figure Reference: 18UK1496_PickardBay_Recreational_Summer_v2

Figure 25: Recreational Vessel Transits: East Pickard Bay (summer).

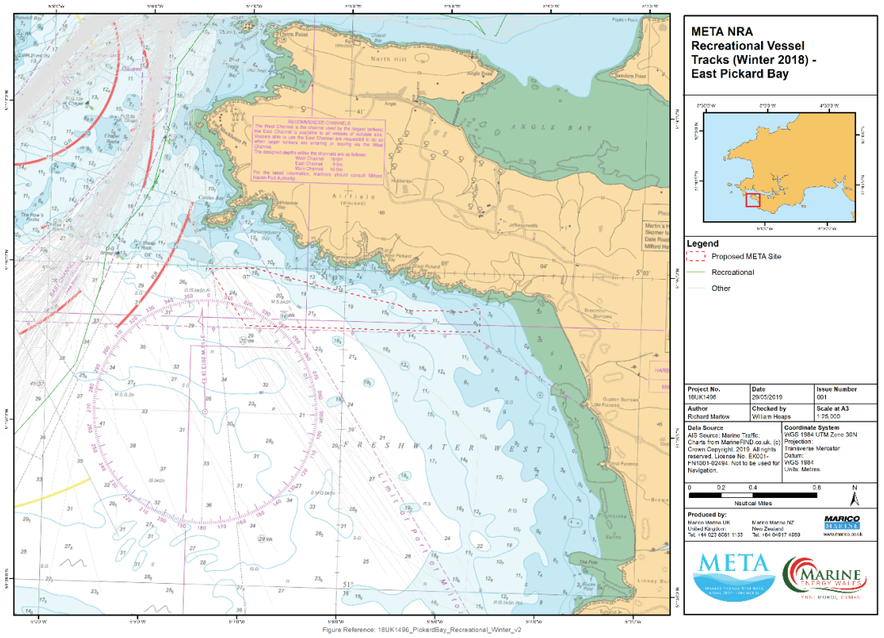

Figure Reference: 18UK1496_PickardBay_Recreational_Winter_v2

Figure 26: Recreational Vessel Transits: East Pickard Bay (winter).

6.6 HIGH SPEED CRAFT

Tracks of High-Speed craft were identified in both the summer and winter datasets and are generally passages which do not pass through the proposed test areas, though occasional tracks are recorded passing through both Warrior Way and East Pickard Bay in both seasons.

No tracks were recorded passing through the proposed Dale Roads site in either season.

High-Speed craft transmitting AIS data are likely to be commercial vessels. A number of other craft capable of high speeds such as RHIBs and motor cruisers will be considered as leisure vessels.

Stakeholder feedback confirmed that power boat training takes place in the Dale Roads (site 7) test site area on occasion and less frequently in the Warrior Way (site 6) test site area.

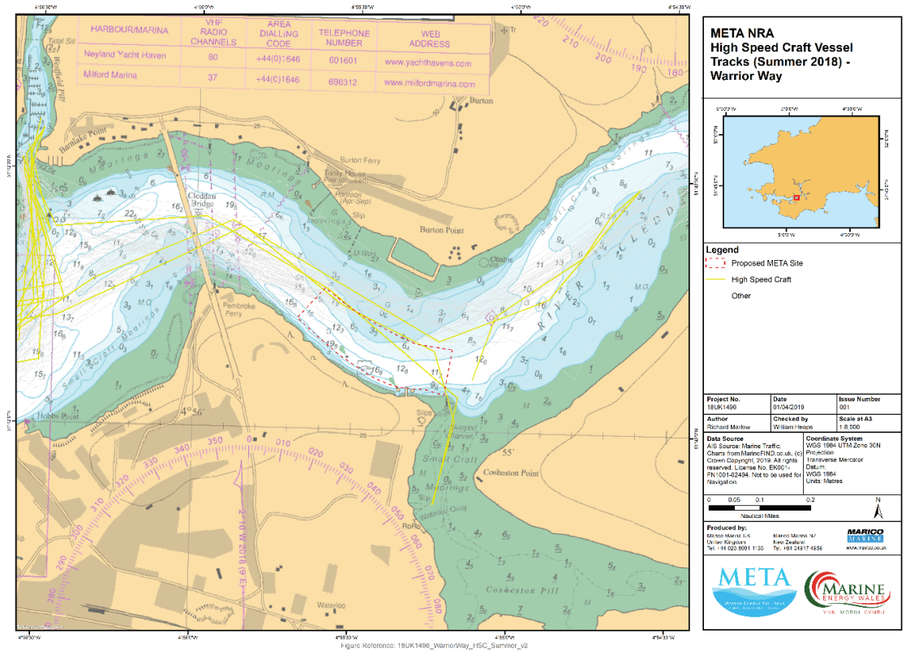

Figure Reference: 18UK1496_WarriorWay_HSC_Summer_v2

Figure 27: High Speed Craft Transits: Warrior Way (summer).

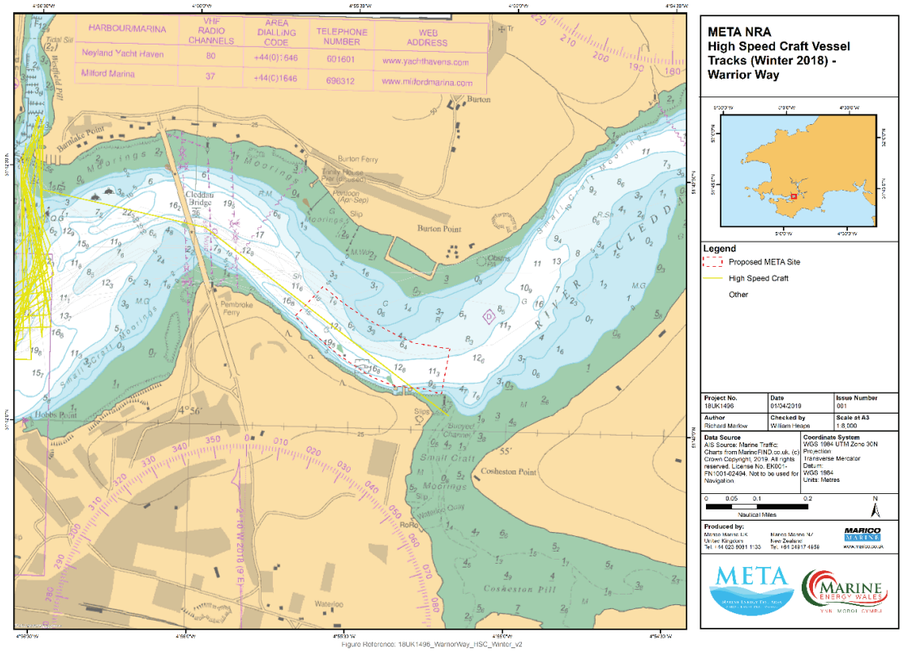

Figure 28: High Speed Craft Transits: Warrior Way (winter).

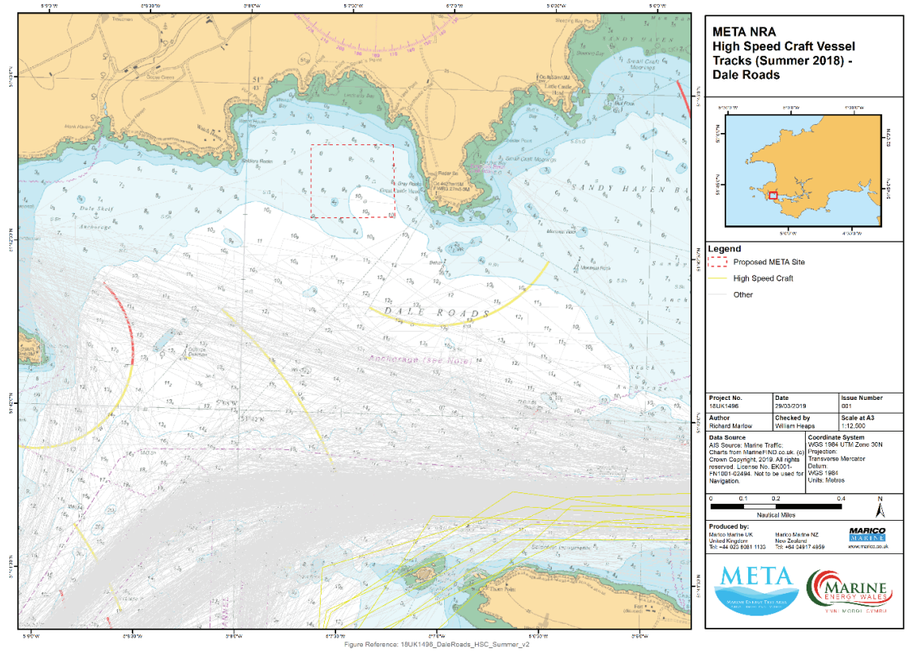

Figure 29: High Speed Craft Transits: Dale Roads (summer).

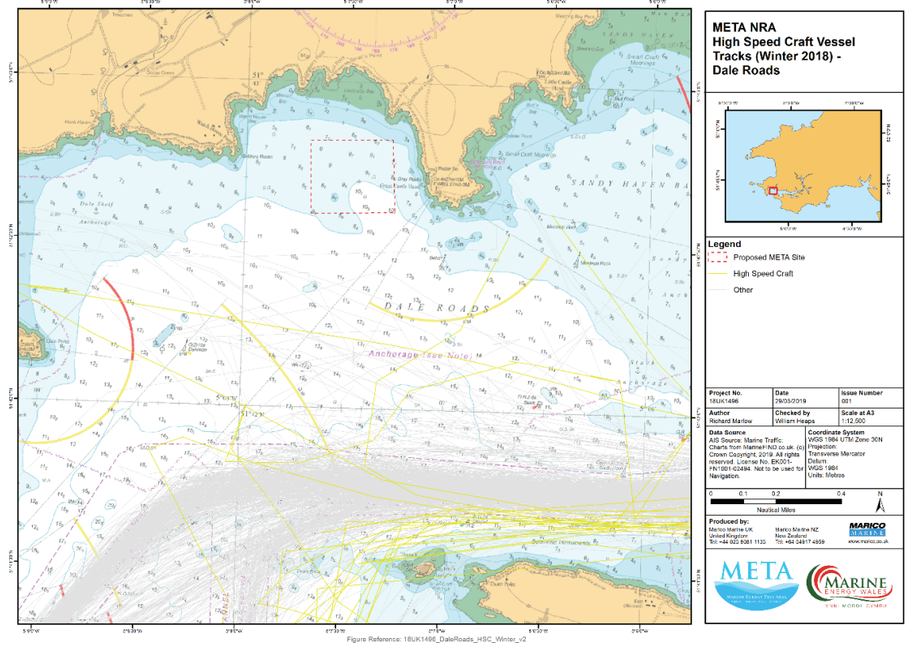

Figure 30: High Speed Craft Transits: Dale Roads (winter).

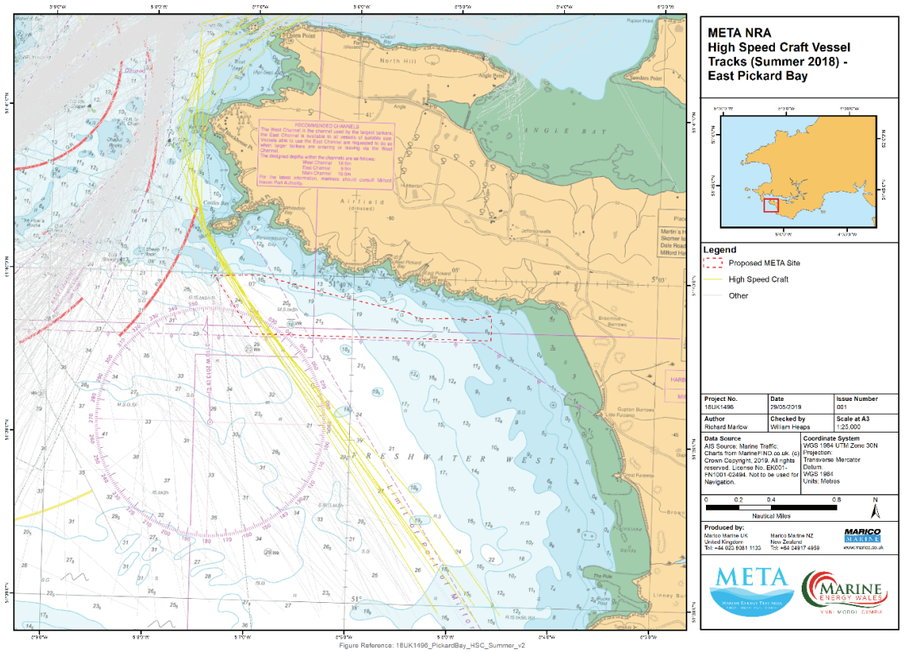

Figure Reference: 18UK1496_PickardBay_HSC_Summer_v2

Figure 31: High Speed Craft Transits: East Pickard Bay (summer).

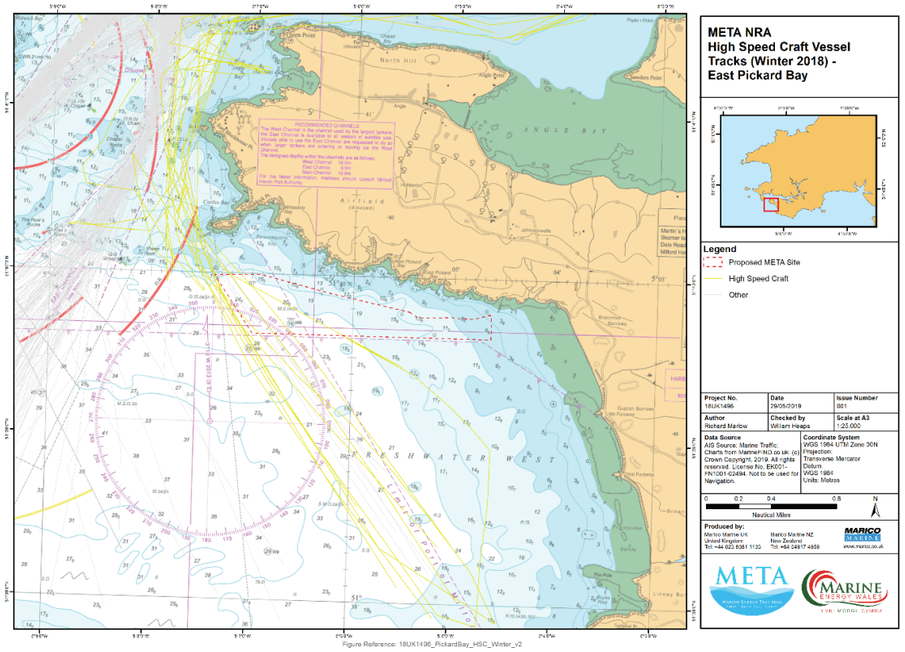

Figure Reference: 18UK1496_PickardBay_HSC_Winter_v2

Figure 32: High Speed Craft Transits: East Pickard Bay (winter).

6.7 TUGS AND OTHER SERVICE VESSELS

This class of vessel was rarely recorded in any of the test sites in either season.

Tracks were recorded passing Warrior Way to the north, and a significant number of tracks (representing ship towage tugs) were recorded passing well to the south of Dale Roads and to the west of East Pickard Bay. These patterns are not expected to change once the sites are established. However, once the sites are operational, this class of vessel will make frequent visits to all three areas to support deployment, maintenance and recovery of the test devices.

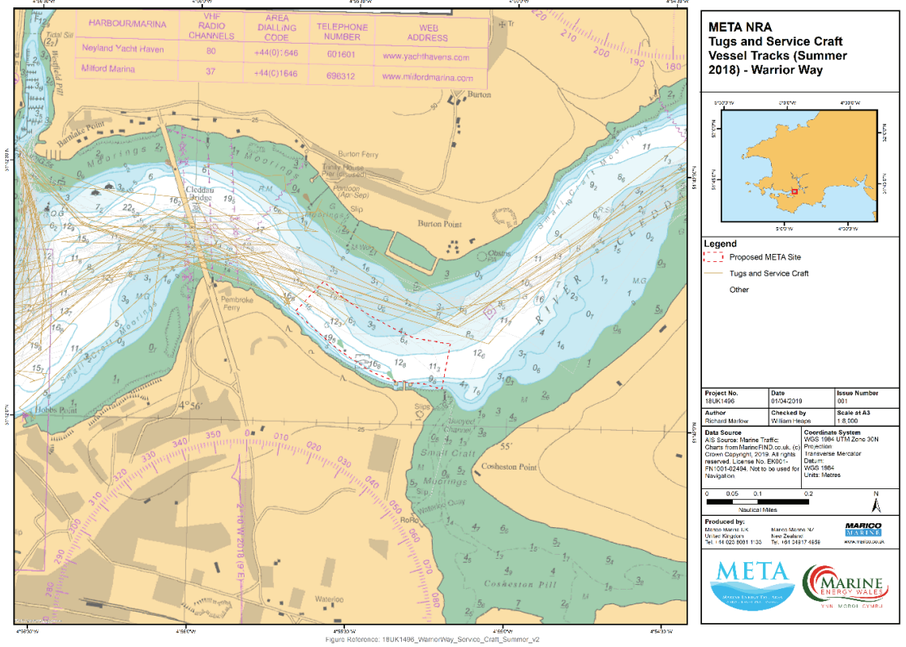

Figure Reference: 18UK1496_WarriorWay_Service_Craft_Summer_v2

Figure 33: Tug and Service Vessel Transits: Warrior Way (summer).

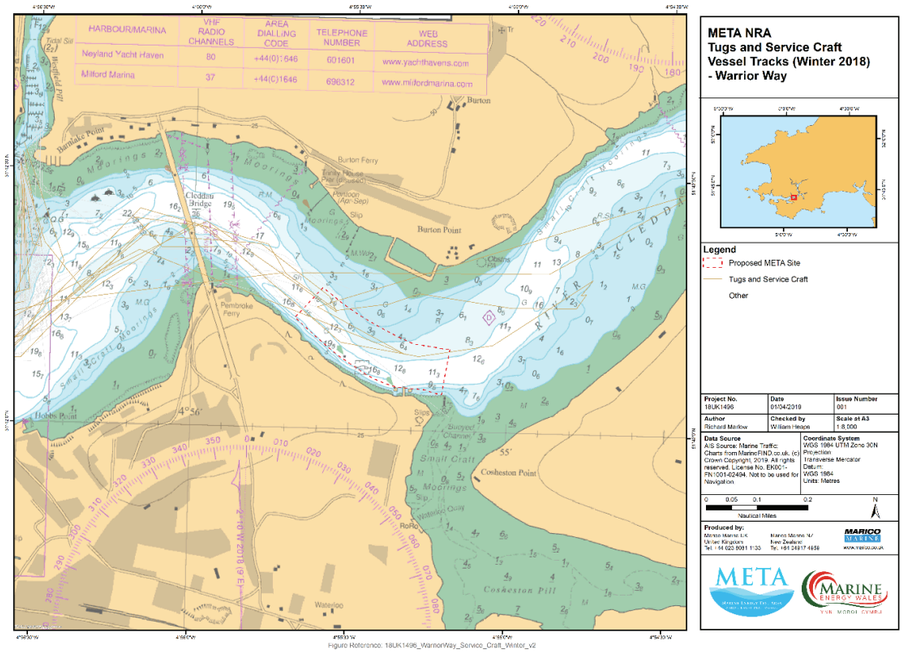

Figure Reference: 18UK1496_WarriorWay_Service_Craft_Winter_v2

Figure 34: Tug and Service Vessel Transits: Warrior Way (winter).

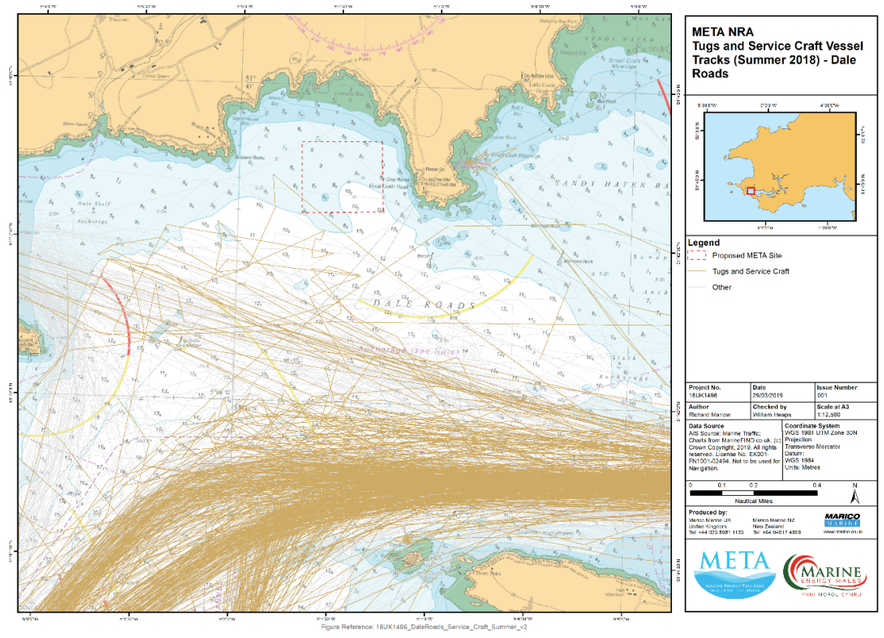

Figure Reference: 18UK1496_DaleRoads_Service_Craft_Summer_v2

Figure 35: Tug and Service Vessel Transits: Dale Roads (summer).

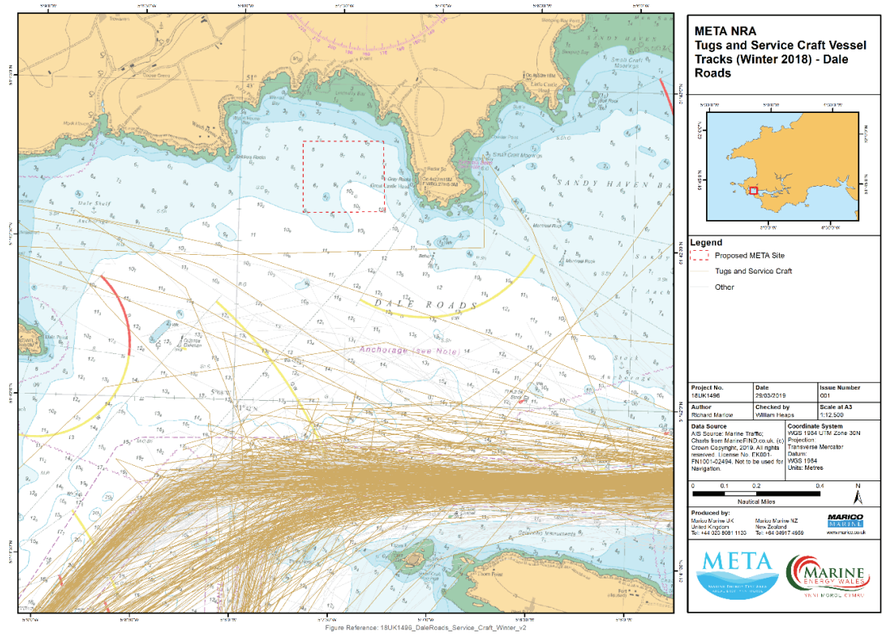

Figure Reference: 18UK1496_DaleRoads_Service_Craft_Winter_v2

Figure 36: Tug and Service Vessel Transits: Dale Roads (winter).

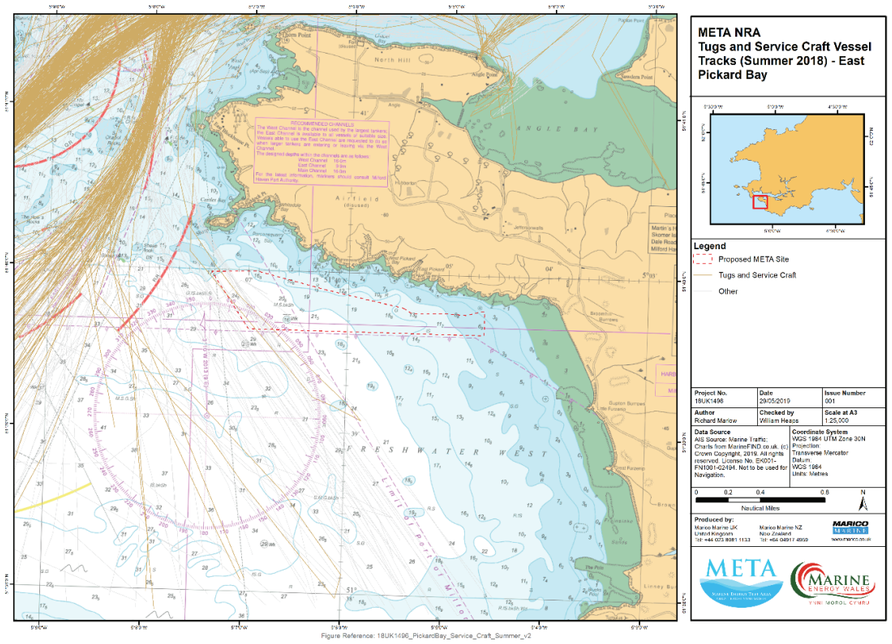

Figure 37: Tug and Service Vessel Transits: East Pickard Bay (summer).

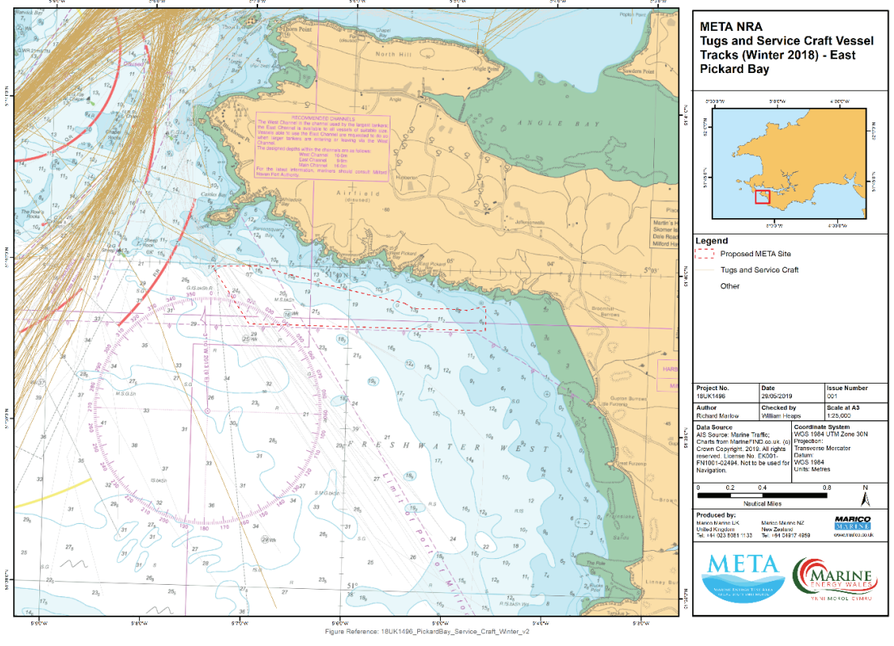

Figure 38: Tug and Service Vessel Transits: East Pickard Bay (winter).

7 HISTORICAL INCIDENTS

Analysis of historical incident data provides a secure basis for assessing likely future incident frequency. The principal sources of incident data for Milford Haven are the Marine Accident Investigation Branch (MAIB) and the Port Authority's own records. Both sources of data have been verified through the stakeholder consultation exercise.

7.1 MAIB REPORTABLE INCIDENTS

An analysis of MAIB incidents between 1997 and 2017 was conducted, with some 183 incidents being identified in the Milford Haven area as shown in **Figure 39** below.

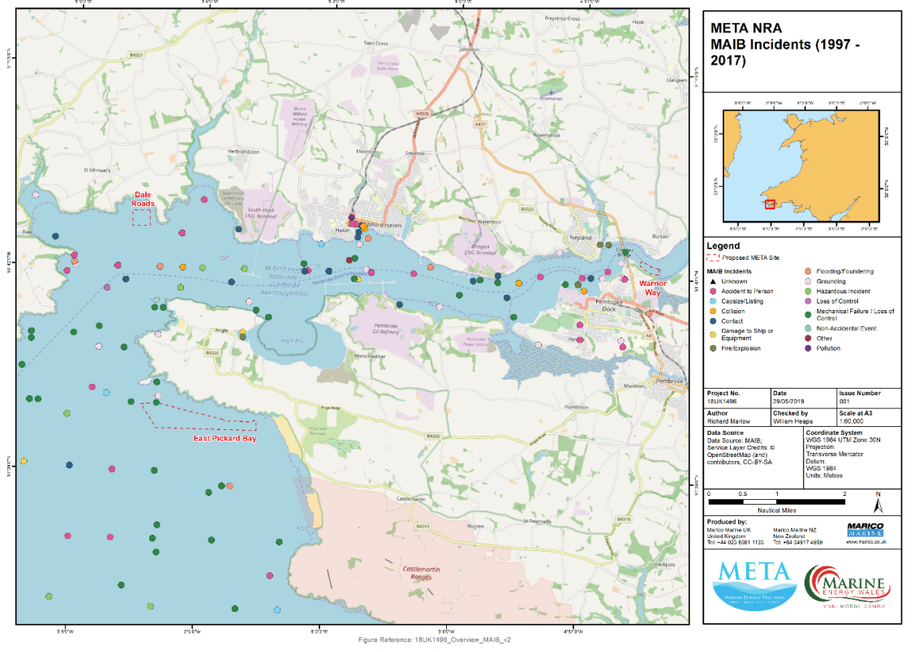

Figure 39: MAIB Incidents between 1997-2017.

During the period for which records are available (1 January 1997 to 1 September 2017 [last recorded incident]) the total number of incidents categorised by the primary event cause are as shown in **Figure 40**.

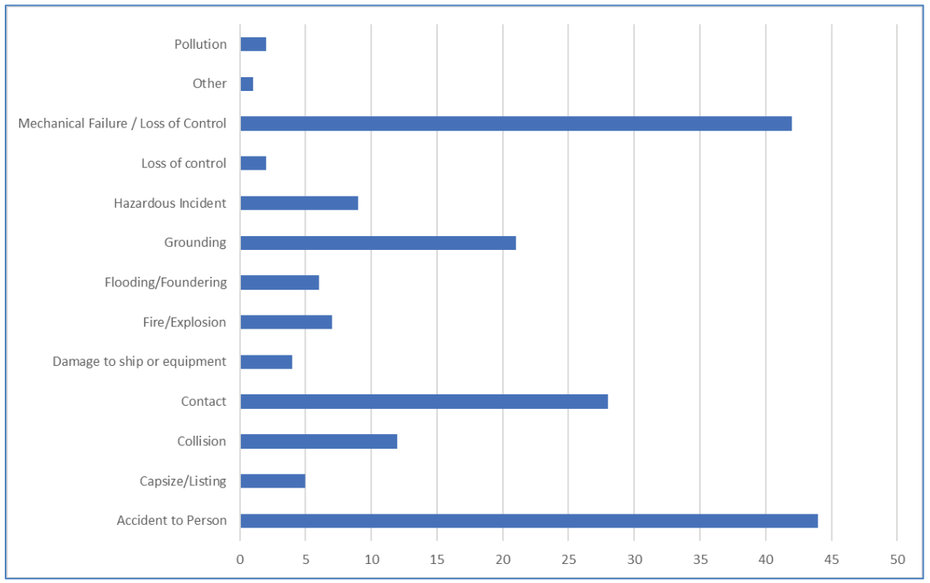

Figure 40: Primary Incident Cause.

Since new casualty reporting regulations were introduced in 2012[4], the MAIB has also categorised incident severity, and this data is illustrated for all incidents recorded since June 2012 in **Figure 41**.

A *marine casualty* is an event or sequence of events that occurred directly in connection with the operation of a ship, and resulted in:

- The death of, or serious injury to, a person;
- The loss of a person from a ship;
- The loss, presumed loss or abandonment of a ship;
- Material damage to a ship;
- The ship being unfit to proceed or requires flag state approval or a condition of class before it may proceed;
- At sea, a breakdown of the ship, requiring towage;
- The stranding or disabling of a ship, or the involvement of a ship in a collision; and
- Material damage to marine infrastructure external of a ship that could seriously endanger the safety of the ship, another ship or any individual.
- Pollution, caused by damage to a ship or ships.

[4] MGN 564, MAIB, October 2012

A *marine incident* means an event, or sequence of events, which occurred directly in connection with the operation of a ship, that do not meet the criteria to be classified as a marine casualty but that endangered or, if not corrected would endanger, the safety of the ship, its occupants or any other person or the environment (i.e. a near miss).

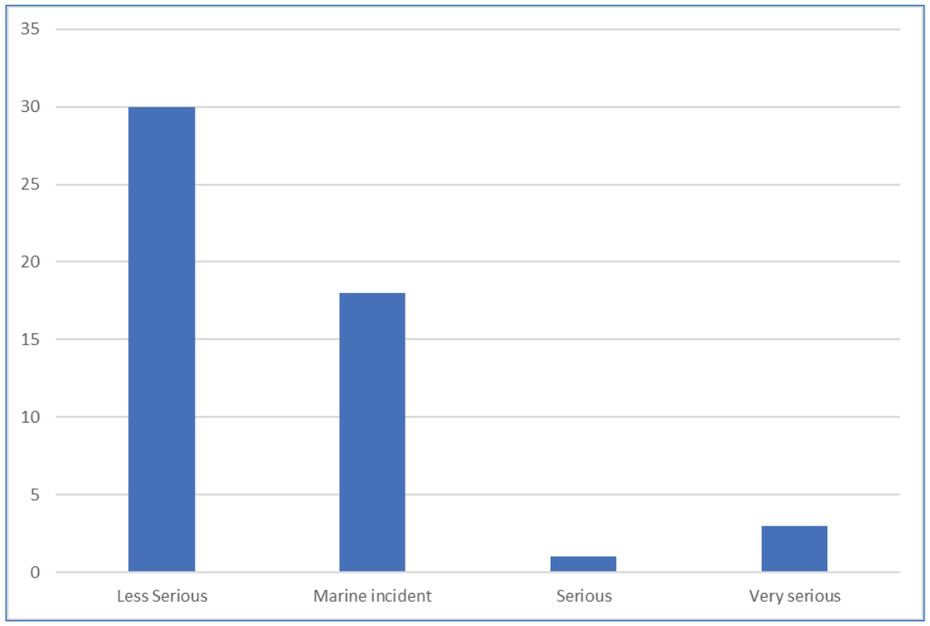

Figure 41: Incident Severity (Since June 2012).

Most of these statistics will relate to large commercial vessel movements and this is illustrated by the geographical spread of incidents shown in **Figure 39,** with many being concentrated in the deep-water channel and harbour approaches (many of the latter being mechanical failures reported by pilots).

The majority of incidents (since classification began) have been less serious or “marine incidents” (near misses). Incidents involving small vessels (only) especially leisure craft are unlikely to be represented in MAIB statistics due to lack of reporting. However, stakeholder consultation confirmed that incidents involving small craft rarely resulted in significant damage or injuries.

Only one incident in this period is within (on the boundary of) one of the proposed test sites. This was a mechanical failure report at the north western extremity of the East Pickard Bay site.

7.2 MILFORD HAVEN PORT AUTHORITY INCIDENTS

Incident data was received from MHPA covering the calendar years 2013 to 2018. Unfortunately, it proved difficult to extract precise locations of incidents, due to the way the data had been recorded, however useful analysis could be performed to inform assessment of how frequently certain hazards had occurred and thus inform the risk assessment process.

At a broad level, it can be seen (**Figure 42**) that the overall number of marine events (divided into incidents and near misses) have been increasing over the last six years, but the number of incidents has been increasing more slowly than the number of near misses. However, this is likely to reflect an industry wide campaign to capture more incident reports, and especially to encourage near miss reporting.

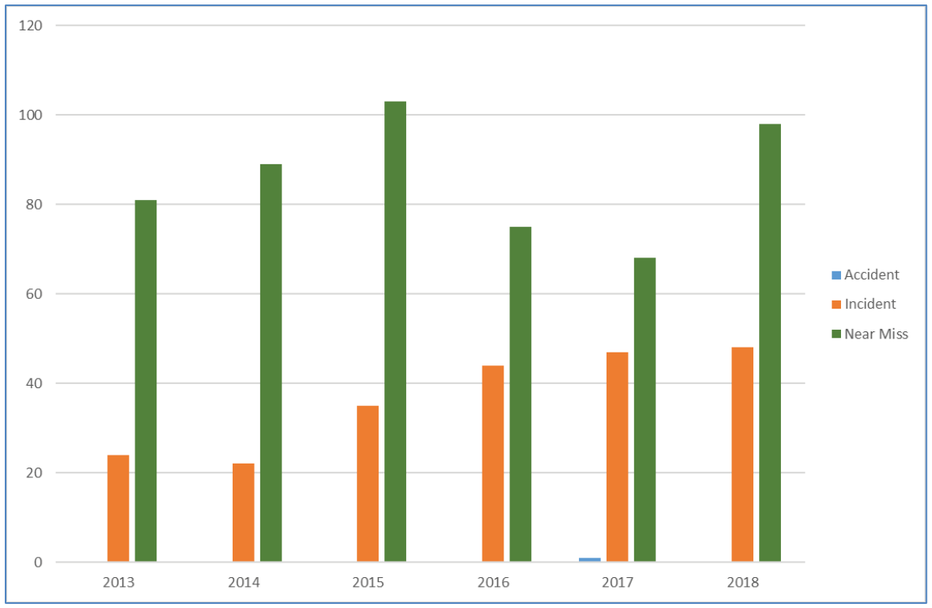

Figure 42: Incident and Near Miss Reports 2013-2018.

If the same data is reviewed on a seasonal basis (**Figure 43**) it is apparent that, in general, more incident and near miss reports are recorded in Q3 (approximating to summer) than Q1 (winter). This reflects the greater leisure traffic densities during the summer as discussed in **section 6** of this report.

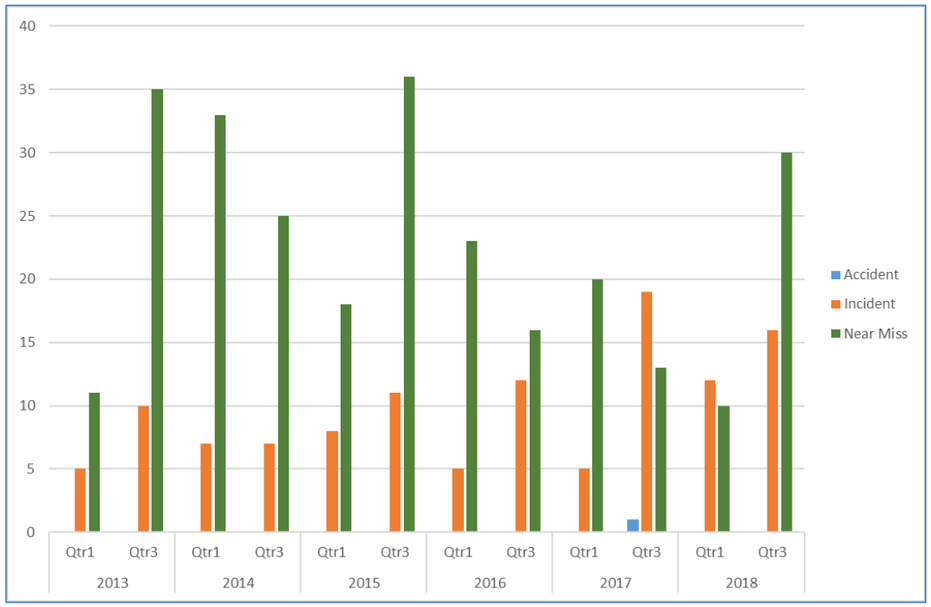

Figure 43: Incident Reports by Season.

Incidents for the most recent data (2018) were analysed by category, and **Figure 44** shows the number of incidents occurring by selected category (These categories broadly correspond to the hazards identified for META assessments in **Section 10.2.4**). It is noted that Engine / machinery failure should more correctly be considered a cause rather than a hazard, but could contribute to the other hazards developing).

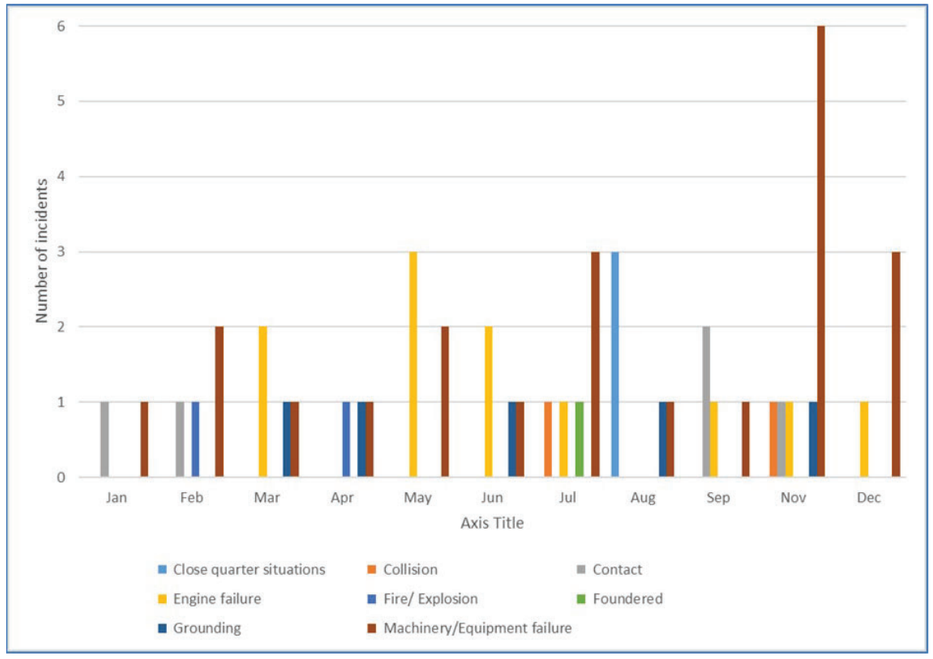

Figure 44: Incidents and Near Misses Reported 2018 (selected categories).

While detailed analysis of incident location was not possible, manual review of the data supplied corresponded with the evidence provided in the MAIB data.

8 FUTURE TRAFFIC PROFILE

8.1 MILFORD HAVEN COMMERCIAL TRAFFIC

While both Pembroke Port and MHPA are actively looking to increase business and therefore vessel traffic within the wider Waterway there are currently no firm commitments to new services, and with the exception of possible growth in marine renewable energy related traffic, it is not expected that traffic profiles will be dissimilar from those analysed in **Section 6** of this report.

8.2 FUTURE RENEWABLE ENERGY RELATED TRAFFIC

It is envisaged that the number of vessels servicing the META test sites (and other marine renewable energy installations) will increase the current traffic density. Such vessels may typically comprise small to medium work boats, occasional jack up barges, high speed crew transfer vessels and survey craft. All three test sites are in areas rarely visited by this vessel type at present.

The following tables indicate traffic levels for each META test site during both deployment and retrieval of devices and operations and maintenance for both the maximum and most likely scenarios. Increased traffic density will lead to a greater opportunity for navigation incidents, but the vessels will be subject to the existing port traffic management controls already in place in the Waterway.

8.2.1 Warrior Way Traffic Forecast

Table 8-1: Warrior Way Deployment and Retrieval.

Project Detail	Maximum Scenario	Most Likely Scenario
No. vessels	Up to 5	Up to 3
Frequency of deployment and retrieval operations in a 12-month period	Up to 20 test deployments and 20 retrieval operations in a 12-month period.	Up to 20 test deployments and 20 retrieval operations in a 12-month period.

Table 8-2: Warrior Way Operations and Maintenance.

Project Detail	Maximum Scenario	Most Likely Scenario
Frequency of O&M visits	Up to 104 vessel visits in a 12-month period	Up to 52 vessel visits in a 12-month period
No. of vessels	Up to 5	Up to 3

8.2.2 Dale Roads Traffic Forecast

Table 8-3: Dale Roads Deployment and Retrieval.

Project Detail	Maximum Scenario	Most Likely Scenario
No. of vessels	Up to 5	Up to 3
Frequency of deployment and retrieval operations in a 12-month period, per site	Up to 20 test deployments and 20 retrieval operations in a 12-month period.	Up to 20 test deployments and 20 retrieval operations in a 12-month period

Table 8-4: Dale Roads Operations and Maintenance.

Project Detail	Maximum Scenario	Most Likely Scenario
Frequency of O&M visits	Up to 104 vessel visits in a 12-month period	Up to 52 vessel visits in a 12-month period (weekly)
No. of vessels	Up to 5	Up to 3

8.2.3 East Pickard Bay Traffic Forecast

Table 8-5: East Pickard Bay Deployment and Retrieval.

Project Detail	Maximum Scenario	Most Likely Scenario
No. of vessels	Up to 5	Up to 3
Frequency of deployment and retrieval operations in a 12-month period	Up to 40 test deployments and 40 retrieval operations in a 12-month period.	Up to 20 test deployments and 20 retrieval operations in a 12-month period.

Table 8-6: East Pickard Bay Operations and Maintenance.

Project Detail	Maximum Scenario	Most Likely Scenario
Frequency of O&M visits	Up to 150 vessel visits in a 12-month period	Up to 104 vessel visits in a 12-month period
No. of vessels	Up to 5	Up to 3

9 POTENTIAL IMPACTS TO NAVIGATION

Based on consultation with stakeholders and a review of the traffic profile around the project sites, the following potential impacts were reviewed as recommended within MGN 543.

ID	Description
1	Impact on Vessel Traffic Routeing
2	Impact on Collision/Allision Risk
3	Effect of the Tides, Tidal Streams and Weather
4	Impact on Under Keel Clearance
5	Impact on Fishing Activity
6	Impact on Recreational Activity
7	Impact on Subsea Cables
8	Impact on Search and Rescue and Emergency Response
9	Impact on Communications, Radar and Positioning Systems
10	Cumulative and In-Combination Effects

9.1 IMPACT ON VESSEL TRAFFIC ROUTEING

The proposed sites will generate additional movements of vessels which are most likely to be in the "tugs and other service vessel" category. As it has been shown that this category of vessel does not regularly visit any of the proposed test areas, the result will be the development of new routes to each site, most likely directly from and to Pembroke Dock. Potential for conflict (i.e. collision) is likely to be managed by means of VTS traffic management, and the possibility of using the alternative approach channels in the approaches to Pembroke Dock at times when the principal channel is in use by larger commercial traffic. Neither Dale Roads, nor East Pickard Bay sites lie on any regularly used routes for any class of vessel considered and are therefore not expected to have any impact on vessel routing within the Waterway or approaches. The Warrior Way site boundaries encompass the deep-water channel to the east of the Cleddau Bridge, and several stakeholders expressed concern that vessels would be pushed to shallower water to the north. However, in practice, only a small part of the test area will be used at any one time, and it was accepted that this would have minimal impact on vessel routing.

9.2 IMPACT ON COLLISION/ALLISION RISK

The additional traffic predicted may increase the potential for vessel to vessel collision due to increased traffic density and the possibility of traffic diverting from currently preferred routes to avoid the test areas or devices. The presence of the test devices may also increase the potential for allision (i.e. with the test devices).

Note that this assessment has identified three hazards in this category: Collision, contact with floating object (i.e. floating META device) and contact with structure (i.e. fixed META device). However, existing port control measures will remain effective, including clear channel marking, proactive VTS / Harbour Authority traffic management and zoning of the Waterway. It is recommended that MHPA review minimum levels of competence and local knowledge for all commercial vessel masters using the SHA area, even if vessel sizes are small and masters may not require STCW certification (see **Section 10.5**).

9.3 THE EFFECTS OF TIDES, TIDAL STREAMS AND WEATHER

As each site will only host one (or up to two at East Pickard Bay) relatively small-scale test devices at any one time, no impact is expected on local tidal streams. Potential effects of tide and weather on deployed devices include the possibility that extreme conditions could cause a device under test to break away, and hence pose a hazard to navigation. As devices are designed for the deployment conditions, and will be well maintained, this is considered unlikely to occur.

9.4 IMPACT ON UNDER KEEL CLEARANCE

Devices to be deployed may include surface-piercing, at surface and sub-surface components. If the test devices are sub-surface there will be a potential for vessels to contact them if under keel clearance (UKC) is not sufficient. Such obstructions should be managed by appropriate control measures (temporary AtoNs such as navigational marker buoys, Notices to Mariners, proactive traffic management) to mitigate against impact due to insufficient UKC.

9.5 IMPACT ON FISHING ACTIVITY

There is no large-scale commercial fishing activity in any of the test areas at present. Small scale potting operations and recreational sea angling already co-exist with other users, and the deployment of devices in each area is unlikely to significantly impact on these activities assuming the fisherman are made aware of deployment locations through Notices to Mariners issued and sent directly to an email list of registered interested parties. There is a slightly increased risk that fishing gear could snag on the test devices while the fishing gear is being deployed or recovered.

9.6 IMPACT ON RECREATIONAL ACTIVITY

It has been established that leisure activities can be intensive in the Waterway, especially during the summer months, including vessels making passage and involved in specific activities such as racing, cruising, sight-seeing, training, etc.

The development of the test sites will both introduce a new obstruction hazard (the deployed devices) and lead to an increase in service traffic (service craft supporting the devices) in all three areas, which are considered in turn below.

See **sections 9.1 and 9.2** for a discussion on the potential impacts of increased traffic density.

9.6.1 Warrior Way

This site is intensively used for recreational purposes, both individuals in private vessels, and organised groups. In particular the area is regularly used for youth sail training and other activities, and therefore the vessels involved may be under the control of very inexperienced helmsmen. Regular exercises such as planned and controlled capsize drills are also regularly undertaken. There was concern raised at the stakeholder workshop that the extent of the Warrior Way test site boundary would significantly impact on these activities. However, it is noted that in practice only one device will be deployed at any one time, which will in effect be a “point” obstruction at one location within the wider test site boundary. Risk, and inconvenience to other users can be significantly reduced through the designed-in measures (see Section 10.3) such as clear promulgation of the device location (Notices to Mariners etc.), marking with AtoNs (buoys) and in the case of short period deployments of certain devices, provision of guard boats.

9.6.2 Dale Roads

While Dale Roads is less intensively used by leisure vessels than Warrior Way, stakeholder feedback indicated that the area is used especially in the summer, both for cruising / passage making and occasional yacht anchoring. However, device deployment will again be restricted to single “points” within the extents of the area and impacts can be mitigated by promulgation of information / marking.

9.6.3 East Pickard Bay

This site is the least intensively used by leisure vessels, with the majority recorded passing through or nearby being on passage. It was noted that the coastal area is sometimes used by kayakers who may be tempted to visit any deployed devices, which may put themselves at risk, but this was considered unlikely by stakeholders.

9.7 INTERACTION WITH SUBSEA CABLES

No existing subsea cables are considered to be relevant to any of the sites.

9.8 IMPACT ON SEARCH AND RESCUE AND EMERGENCY RESPONSE

Due to the small-scale nature of the devices to be deployed, there is not expected to be any impact on SAR and emergency response.

9.9 IMPACT ON COMMUNICATIONS, RADAR AND POSITIONING SYSTEMS

No impacts are anticipated.

9.10 CUMULATIVE AND IN-COMBINATION EFFECTS WITH OTHER ACTIVITIES

The META project is closely associated with the Pembroke Dock redevelopment project, which has been subject to a separate NRA, and the META Phase 1 projects which consist of five additional test sites within the Pembroke Dock area. The cumulative effect is, by design, an increase in traffic density as the Pembroke Dock development has been designed to accommodate the additional marine traffic which will be required to service the META devices, and potentially additional marine renewable developments in the future.

Other projects which may increase general traffic flow in the vicinity of the Waterway include the Greenlink interconnector cable which is proposed to make landfall at Freshwater West and the Wave Hub project. However, these will generate traffic in the existing shipping lanes within the Waterway and approaches and are not considered likely to have a significant impact in combination with the three META test areas.

The consequence is an increase in traffic levels above those already existing. This has been considered within the NRA through review of potential incident frequency – more traffic presents an increased opportunity for hazards to be realised. Control measures are discussed in Section 10.3.

The presence of wave devices or floating offshore wind components at East Pickard Bay (site 8) and other projects and plans in proximity to East Pickard Bay (site 8), including the Greenlink Interconnector and the Bombora Wave Energy project, may increase risk of gear/anchor snagging. The installation and presence of the Greenlink Interconnector cable may lead to an increased risk of gear/anchor snagging during installation and/or in the event of any cable exposure. The Bombora Wave Energy project, including deployment of the mWave device and installation of a surface-laid cable between the mWave device and the shore may lead to an increased risk of gear/anchor snagging.

As noted further above, anchoring / fishing activity is very infrequent in this area, and the designed-in measures (see Section 10.3) such as charting and Notices to Mariners will ensure this potential impact is controlled. These industry standard measures are also likely to apply to the Greenlink Interconnector project.

10 NAVIGATION RISK ASSESSMENT

10.1 INTRODUCTION AND METHODOLOGY

This NRA was commissioned to assess the impact on navigation potentially caused by the installation and operation and maintenance of the META project devices. The NRA is limited to identifying and quantifying any additional or increased navigational risk resulting from the project. It subsequently identifies possible mitigation measures where appropriate and makes recommendations.

The process starts with the identification of all potential hazards. It then assesses the likelihood (frequency) of a hazard causing an incident and considers the possible consequences of that incident. It does so in respect of two scenarios, namely the "most likely" and the "worst credible". The quantified values of frequency and consequence are then combined using a Marico risk algorithm to produce a risk score for each hazard. These are collated into a "Ranked Hazard List" from which the need for possible additional mitigation may be reviewed.

The hazards were scored using the collective experience of the project team and feedback provided by consultees, and drawing on traffic analysis, incident analysis and other available information to support the assessment. For a description of the risk assessment methodology, see **Annex A.**

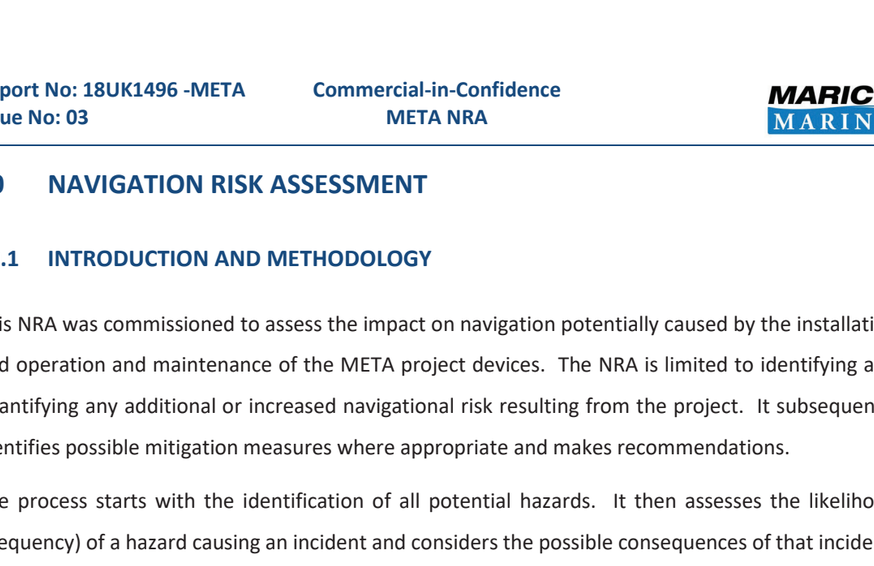

Figure 45: Marico Marine Risk Assessment Methodology.

10.2 HAZARD IDENTIFICATION

The following information sources were used in order to identify hazards:

- Existing MHPA Navigation Risk Assessments;
- Historical incident data (See **section 7**);
- Stakeholder consultation; and
- Assessor professional opinion and experience.

10.2.1 Existing MHPA Navigation Risk Assessments

The Port Authority shared a summary of their existing NRAs which have been undertaken and kept under review in compliance with the requirements of the Port Marine Safety Code (PMSC).

Figure 46 shows the top 10 hazards assessed by MHPA ranked by risk score (Higher score equates to greater risk).

Register Rank	Register Hazard Ref	Hazard Title	Category	Inherent Risk	Residual Risk
1	135	Large Vessel contacts berth/vessel after taking avoiding action	Contact Navigation	7.89	6.23
2	49	Contact Berthing LNG Carrier	Contact Berthing	6.1	6.1
3	123	LNG Carrier Fire	Fire\Explosion	6.24	5.97
4	95	Tanker grounding (non-VLCC) East Channel	Grounding	6.77	5.92
5	84	VLCC Grounding at Entrance	Grounding	5.96	5.77
6	78	Cruise ship and large vessel collision	Collision	5.94	5.77
7	64	LNG vessel in collision in port approach	Collision	5.91	5.67
8	98	Ferry grounds at the entrance	Grounding	7.2	5.67
9	35	Sinking of Pilot boat	Sinking/capsize	6.05	5.6
10	143	Large vessel grounds after taking avoiding action	Grounding	6.55	5.6

Figure 46: MHPA Top 10 Navigational Risks.

It can be seen that most of these risks are connected with the very large vessel movements within the Waterway, but they do identify the following hazard categories:

- Grounding;
- Collision;
- Contact;
- Fire / Explosion; and
- Sinking capsizing

All of the NRAs undertaken by MHPA (a total of 111 directly related to navigation) have been analysed and ranked by sum of total residual risk (**Figure 47**).

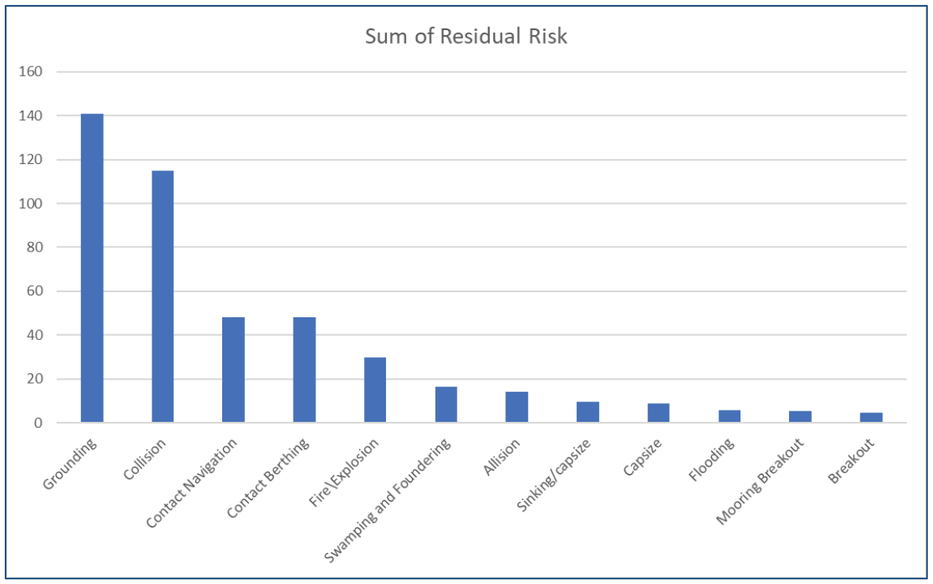

Figure 47: Hazards Categorised by Residual Risk.

The top risks assessed by this method are therefore very similar to those identified as the top 10 ranked risks.

10.2.2 Historical Incident Data

The incident data described in **Section 7** identifies similar hazard categories with Contact, Grounding and Collison being the top navigational hazards (excluding mechanical failure / loss of control which can be considered a cause).

10.2.3 Stakeholder Consultation

An additional hazard identified from stakeholder consultation is “device breakout” due to mooring failure of a device under test. Such an occurrence could lead to a free-floating device becoming a

hazard to navigation, though in all three locations it is likely to quickly fetch up on shore, due to the prevailing wind direction.

A further hazard identified from stakeholder consultation is potential for interaction between leisure users and the devices (e.g. kayakers who may be tempted to visit any deployed devices, which may put themselves at risk). This hazard is considered under the assessment of a leisure vessel contacting a floating object.

10.2.4 Hazard Categories to be used for this NRA

The following hazard types have been identified for assessment:

- **Collision** – two navigating vessels come into contact;
- **Contact with floating object** – a navigating vessel comes into contact with floating object (AtoN, flotsam, device);
- **Contact with fixed object** – a navigating vessel comes into contact with a fixed or stationary object (gravity base/pin pile device foundation);
- **Grounding** – a navigating vessel makes contact with the seabed; and
- **Device breakout** – a device becomes a hazard to navigation following mooring failure.

All of the above hazards will be present at all project stages, including device installation, operation and maintenance and decommissioning.

The following existing hazards were identified from review of existing MHPA NRAs, but not assessed for the META NRA as these hazards are not considered to be directly associated with the META test devices and are likely to be the result of external factors:

- **Fire / Explosion –** a fire or explosion occurs on a vessel in the assessment area**;**
- **Sinking / Capsizing (including Swamping / Foundering)** – a vessel sinks or capsizes in the assessment area during normal operations or as a result of external factors.

Vessel categories were defined as follows:

- **Commercial Shipping** – cargo and tankers that carry cargo (including ro-ro, container, bulk or liquid);
- **Passenger Vessels** – passenger ferries and cruise ships;
- **Recreational Vessels** – yachts and pleasure craft; and
- **Tugs and Service Craft** – workboats, fishing vessels on transit, tugs, pilot vessels and maintenance vessels. Small craft whose primary purpose is commercial (including the marine renewable energy service vessels).

10.3 RISK CONTROL OPTIONS

10.3.1.1 Measures adopted as part of the META Project

As part of the project design process, a number of designed-in measures have been proposed to reduce the potential for impacts on Shipping and Navigation (see Table 10-1). As there is a commitment to implementing these measures, they are considered inherently part of the design of the META project and have been considered in the assessment (i.e. the risk scores assume implementation of these measures).

Table 10-1: Designed-in measures adopted as part of the META project.

Measures adopted as part of the META project	Justification
Promulgation of information including Notices to Mariners issued before and during every deployment, advising on the location, timings and other relevant information. Information and notices will also be posted at onshore locations, this may include signage if appropriate/possible. **MEW plans to create a database of known users (including yacht clubs and local activity centres) to act as a mailing list for direct issue of Notices to Mariners.**	Notices to mariners will be issued on a specific device-deployment basis, and will be sent directly to an email list of registered interested parties to help ensure that as many interested parties as possible are aware of the presence of infrastructure and the need to avoid the area during the period of specific device deployments. Signage may help mitigate potential interactions between small craft navigators and device deployments.
Navigational marker buoys and/or other Aids to Navigation will be deployed, as directed by THLS, to demarcate testing activities.	MEW will liaise with THLS to ensure areas and devices are appropriately marked for navigational safety.
Marine charting (where appropriate).	Where appropriate (e.g. depending on the duration of the deployment), sites will be marked on nautical charts and publications, with suitable chart notes.
500 m Safety Zones may be applied for around any pin piling activities during the installation phase.	Safety Zones are established in the interests of safety to other mariners, in accordance with The Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007.
Advisory clearance distances are likely to be recommended around vessels undertaking installation, maintenance and decommissioning activities. The nature of the advisory clearance distances will be discussed and agreed with the MHPA on a case-by-case basis.	Advisory clearance distances are recommended in the interests of navigational safety.
MEW will consider the use of safety vessels/guard boats during short term deployments, subject to the results of the device-specific risk assessment and following discussion with the navigational authorities.	To ensure other traffic does not encroach on the test device.
Compliance with International Maritime Organisation Conventions including COLREGs and SOLAS.	To ensure that standard levels of navigation and vessel safety are adhered to by all project related vessels.
Operational Management Plan (including Emergency Response)	This will be developed and implemented for the installation and operation and maintenance phases of the META project, in consultation with the MHPA/MCA, to manage navigational risk. To include for emergency shut down of devices in the event of an emergency situation. It is recommended that the outcome of the NRA process feeds into the Plan. The Plan will include a requirement for device-specific risk assessments to be prepared in advance of each specific device deployment to ensure that any risks to leisure users are minimised to ALARP or lower.

The design of any Aids to Navigation (AtoN) deployment should be carefully assessed in conjunction with the port authority and approved by THLS before deployment.

Marking the full extents of the test sites with fixed permanent navigation aids has the merit that such areas are easily charted and delimited but may lead to confusion for mariners if the obstruction is only a point feature within this area, and not always in the same location (this observation particularly applies to Warrior Way). Conversely temporary AtoNs only deployed close to devices while actually present may be more meaningful to mariners on the water but could not be charted. Therefore it is proposed that the final marking will be agreed with MHPA and THLS, on a deployment specific basis, in advance of deployment.

10.3.1.2 Existing port control measures

As the META project test areas are predominantly located within a PMSC compliant SHA area, all of the identified hazards (with the exception of device breakout) have previously been risk assessed for the Waterway (although in the absence of the META test devices) and risk reduced to as low a level as reasonably practicable through the introduction of a range of appropriate risk controls. These controls will continue to apply during device installation and operation and maintenance and have been considered during this project specific assessment.

Such controls include, but are not limited to:

- Traffic Management Procedures (VTS / berth allocation);
- Lighting and marking of obstructions (AtoNs);
- Charting of sites and obstructions;
- Competence and training of marine personnel;
- Operational procedures;
- Regulations (e.g. Collision Regulations, local byelaws);
- Pilotage;
- Dredging and surveying of the harbour and approaches;
- Waterway management with identified zones for different activities; and
- Dissemination of information via Notices to Mariners, Website, Year book etc.

10.4 RISK ASSESSMENT

Full hazard logs are contained in **Annex B.**

The following tables in **Sections 10.4.1, 10.4.2 and 10.4.3** show the top ten risks assessed for each of the test areas. All hazards were assessed to be ALARP (yellow) or low (green) risk with the designed-in mitigation in place. Of those hazards assessed to have a risk in the ALARP range, none were specifically related to the area under assessment being utilised for device testing (the risks would remain within the areas assessed whether the test devices and associated navigational activities (i.e. device support vessels) were present, or not).

10.4.1 Warrior Way

Rank	Hazard Ref.	Affected Areas	Accident Category	Hazard Title	Consequence Descriptions		Risk Overall
					Most Likely (ML)	Worst Credible (WC)	
1	18	META Site: Warrior Way	Grounding	Grounding: Tugs/Service Craft	Not Stranded	Grounding leading to loss of structural integrity, and pollution.	3.88
2	17	META Site: Warrior Way	Grounding	Grounding: Commercial Vessel	Not Stranded	Grounding leading to loss of structural integrity, and pollution.	3.83
3	16	META Site: Warrior Way	Grounding	Grounding Recreational Vessel	e.g. moving out of channel for other traffic, and "touching bottom" (Not stranded).	Grounding leading to sinking or loss of stability	3.82
4	12	META Site: Warrior Way	Contact	Contact with Floating Object: Recreational Vessel	e.g. striking NavAid, possible crew injury.	Striking larger object (e.g. large flotsam) possible multiple injuries, and significant damage leading to sinking	3.65
5	1	META Site: Warrior Way	Collison	Collision: Tugs/Service Craft - Recreational Vessel	Glancing blow, both vessels continue on voyage	Leisure vessel sinks with loss of life	3.48
6	4	META Site: Warrior Way	Collison	Collision: Recreational Vessel - Passenger Vessel / Ferry	Glancing blow, minor damage to both vessels, multiple injuries on leisure vessel	Leisure vessel sinks with multiple loss of life	3.45
7	5	META Site: Warrior Way	Collison	Collision: Recreational Vessel - Commercial Vessel	Glancing blow, minor damage to both vessels, multiple injuries on leisure vessel	Leisure vessel sinks with multiple loss of life	3.45
8	6	META Site: Warrior Way	Collison	Collision: Commercial Vessel - Passenger Vessel / Ferry	Glancing blow, minor damage to both vessels	Multiple injuries on both vessels, major damage to one or both	3.31
9	15	META Site: Warrior Way	Grounding	Grounding: Passenger Vessel / Ferry	P: Moderate - multiple minor injuries	Large ferry grounds: multiple injuries during event, major business disruption	3.22
10	10	META Site: Warrior Way	Contact	Contact with Fixed structure: Tugs/Service Craft	e.g. minor collision with device structure	Serious collision, or anchor fouling leads to capsize. P: Major	2.96

10.4.2 Dale Roads

Rank	Hazard Ref.	Affected Areas	Accident Category	Hazard Title	Consequence Descriptions		Risk Overall
					Most Likely (ML)	Worst Credible (WC)	
1	17	META Site: Dale Roads	Grounding	Grounding: Commercial Vessel	Not Stranded	Grounding leading to loss of structural integrity, and pollution.	3.83
2	4	META Site: Dale Roads	Collison	Collision: Recreational Vessel - Passenger Vessel / Ferry	Glancing blow, minor damage to both vessels, multiple injuries on leisure vessel	Leisure vessel sinks with multiple loss of life	3.72
3	5	META Site: Dale Roads	Collison	Collision: Recreational Vessel - Commercial Vessel	Glancing blow, minor damage to both vessels, multiple injuries on leisure vessel	Leisure vessel sinks with multiple loss of life	3.72
4	18	META Site: Dale Roads	Grounding	Grounding: Tugs/Service Craft	Not Stranded	Grounding leading to loss of structural integrity, and pollution.	3.48
5	6	META Site: Dale Roads	Collison	Collision: Commercial Vessel - Passenger Vessel / Ferry	Glancing blow, minor damage to both vessels	Multiple injuries on both vessels, major damage to one or both	3.31
6	15	META Site: Dale Roads	Grounding	Grounding: Passenger Vessel / Ferry	Moderate - multiple minor injuries	Large ferry grounds: multiple injuries during event, major business disruption	3.22
7	1	META Site: Dale Roads	Collison	Collision: Tugs/Service Craft - Recreational Vessel	Glancing blow, both vessels continue on voyage	Leisure vessel sinks with loss of life	3.08
8	3	META Site: Dale Roads	Collison	Collision: Tugs/Service Craft - Passenger Vessel / Ferry	Glancing blow, minor damage to both vessels	Multiple injuries on a large passenger vessel, loss of life if small passenger vessel	2.89
9	12	META Site: Dale Roads	Contact	Contact with Floating Object: Recreational Vessel	e.g. striking NavAid, possible crew injury.	Striking larger object (e.g. large flotsam) possible multiple injuries, and significant damage leading to sinking	2.83
10	2	META Site: Dale Roads	Collison	Collision: Tugs/Service Craft - Commercial Vessel	Glancing blow, minor damage to both vessels	Multiple injuries, smaller craft sinks	2.81

10.4.3 East Pickard Bay

Rank	Hazard Ref.	Affected Areas	Accident Category	Hazard Title	Consequence Descriptions		Risk Overall
					Most Likely (ML)	Worst Credible (WC)	
1	6	META Site: East Pickard Bay	Collison	Collision: Commercial Vessel - Passenger Vessel / Ferry	Glancing blow, minor damage to both vessels	Multiple injuries on both vessels, major damage to one or both	4.43
2	17	META Site: East Pickard Bay	Grounding	Grounding: Commercial Vessel	Not Stranded	Grounding leading to loss of structural integrity, and pollution.	4.13
3	5	META Site: East Pickard Bay	Collison	Collision: Recreational Vessel - Commercial Vessel	Glancing blow, minor damage to both vessels, multiple injuries on leisure vessel	Leisure vessel sinks with multiple loss of life	4.12
4	18	META Site: East Pickard Bay	Grounding	Grounding: Tugs/Service Craft	Not Stranded	Grounding leading to loss of structural integrity, and pollution.	3.88
5	4	META Site: East Pickard Bay	Collison	Collision: Recreational Vessel - Passenger Vessel / Ferry	Glancing blow, minor damage to both vessels, multiple injuries on leisure vessel	Leisure vessel sinks with multiple loss of life	3.72
6	15	META Site: East Pickard Bay	Grounding	Grounding: Passenger Vessel / Ferry	P: Moderate - multiple minor injuries	Large ferry grounds: multiple injuries during event, major business disruption	3.5
7	3	META Site: East Pickard Bay	Collison	Collision: Tugs/Service Craft - Passenger Vessel / Ferry	Glancing blow, minor damage to both vessels	Multiple injuries on a large passenger vessel, loss of life if small passenger vessel	3.18
8	2	META Site: East Pickard Bay	Collison	Collision: Tugs/Service Craft - Commercial Vessel	Glancing blow, minor damage to both vessels	Multiple injuries, smaller craft sinks	3.1
9	12	META Site: East Pickard Bay	Contact	Contact with Floating Object: Recreational Vessel	e.g. striking NavAid, possible crew injury.	Striking larger object (e.g. large flotsam) possible multiple injuries, and significant damage leading to sinking	2.83
10	1	META Site: East Pickard Bay	Collison	Collision: Tugs/Service Craft - Recreational Vessel	Glancing blow, both vessels continue on voyage	Leisure vessel sinks with loss of life	2.72

10.5 POSSIBLE ADDITIONAL RISK CONTROLS

While all risks have been assessed as ALARP or Low (and therefore acceptable) with the designed-in measures and existing port risk control measures in place, further additional risk controls identified during the assessment are listed below. It is recommended that consideration be given to introducing these controls (in consultation with relevant authorities) to maintain assessed risk levels or reduce them further.

Table 10-2: Possible Additional Risk Controls.

ID	Name	Description
1.	Waterway management	Consider introducing specific routes or rules for specific classes of vessels once operational stage is reached to ensure traffic segregation (if traffic density makes this appropriate).
2.	Enhanced Stakeholder Engagement	Stakeholder engagement is already well established and managed by the MHPA. Consider forming stakeholder groups for each test area to keep users informed of deployments, and ensure risks are regularly reviewed.
3.	Seafarer Competence	It is recommended that MHPA review minimum levels of competence and local knowledge for all commercial vessel masters using the SHA area, even if vessel sizes are small and masters may not require STCW certification.

11 SUMMARY

In summary, all hazards assessed in this NRA have been scored as ALARP or Low. The operation of the test areas (including installation and decommissioning of devices) either individually or in combination with each other is not expected to increase the risk associated with any of the identified navigation hazards to an unacceptable level, assuming the designed-in measures are implemented, and all existing port risk controls are maintained.

There is an opportunity to reduce risk still further, and additional risk controls have been proposed. Ensuring all navigators and Waterway users are fully aware of the META operations is fundamental to maintaining an acceptable level of risk.

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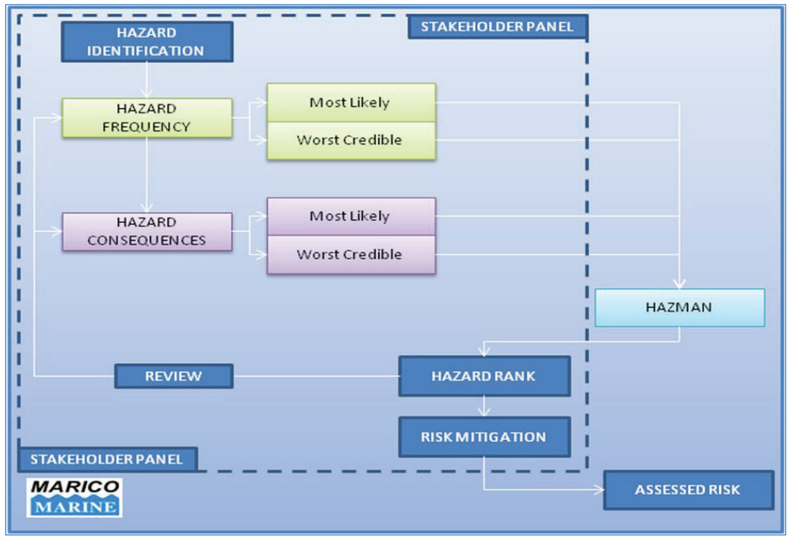
Annex A NRA Methodology

Methodology

This NRA was commissioned to assess the impact on navigation potentially caused by the installation and operation and maintenance of the META project devices. The NRA is limited to identifying and quantifying any additional or increased navigational risk resulting from the project. It subsequently identifies possible mitigation measures where appropriate and makes recommendations.

The process starts with the identification of all potential hazards. It then assesses the likelihood (frequency) of a hazard causing an incident and considers the possible consequences of that incident. It does so in respect of two scenarios, namely the "most likely" and the "worst credible". The quantified values of frequency and consequence are then combined using the Marico HAZMAN software to produce a Risk Score for each hazard. These are collated into a "Ranked Hazard List" from which the need for possible additional mitigation may be reviewed.

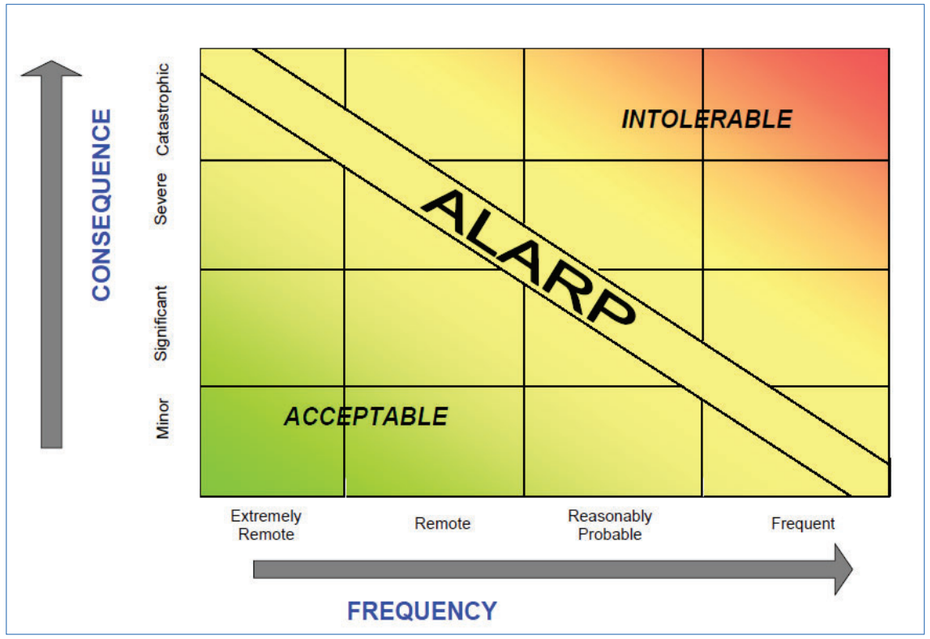


Marico Marine Risk Assessment Methodology.

Criteria for Navigational Risk Assessment

Risk is the product of a combination of consequence of an event and the frequency with which it might be expected to occur. In order to determine navigational risk a Formal Safety Assessment (FSA) approach to risk management is used. International Maritime Organisation (IMO) Guidelines define a hazard as "something with the potential to cause harm, loss or injury", the realisation of which results in an accident. The potential for a hazard to be realised can be combined with an estimated or known

consequence of outcome. This combination is termed "risk". Risk is therefore a measure of the frequency and consequence of a particular hazard.



General risk matrix.

The consequence and frequency of occurrence of a hazard is combined using a risk matrix which enables hazards to be ranked and a risk score assigned. The resulting scale can be divided into three general categories:

- Acceptable;
- As Low as Reasonably Practicable (ALARP); and
- Intolerable.

At the low end of the scale, frequency is extremely remote and consequence minor, and as such the risk can be said to be "acceptable", whilst at the high end of the matrix, where hazards are defined as frequent and the consequence catastrophic, then risk is termed "intolerable". Every effort should be made to mitigate all risks such that they lie in the "acceptable" range. Where this is not possible, they should be reduced to the level where further reduction is not practicable. This region, at the centre of the matrix is described as the ALARP region. It is possible that some risks will lie in the "intolerable" region, but can be mitigated by measures, which reduce their risk score and move them into the ALARP region, where they can be tolerated, albeit efforts should continue to be made when opportunity presents itself to further reduce their risk score.

The FSA methodology used in this NRA, determines where to prioritise risk control options for the navigational aspects of a project site. It is recommended that the outcome of this risk assessment process feeds into the META project Operational Management Plan which will be developed in consultation with the MHPA / MCA to manage navigational risk. In the case of Milford Haven, the overarching marine safety management system is the responsibility of the Harbour Authority (MHPA).

Hazard Identification

Hazard identification is the first and fundamental step in the risk assessment process. It was undertaken for this project by three Marico Marine specialists using the results of the analysis and feedback from local stakeholders.

Risk Matrix Criteria

As indicated earlier, frequency of occurrence and likely consequence were both assessed for the "most likely" and "worst credible" scenario. Frequencies were assessed according to the levels set out below.

Frequency criteria.

Scale	Description	Definition	Operational Interpretation
F5	Frequent	An event occurring in the range once a week to once an operating year.	One or more times in 1 year
F4	Likely	An event occurring in the range once a year to once every 10 operating years.	One or more times in 10 years 1 - 9 years
F3	Possible	An event occurring in the range once every 10 operating years to once in 100 operating years.	One or more times in 100 years 10 – 99 years
F2	Unlikely	An event occurring in the range less than once in 100 operating years.	One or more times in 1,000 years 100 – 999 years
F1	Remote	Considered to occur less than once in 1,000 operating years (e.g. it may have occurred at a similar site, elsewhere in the world).	Less than once in 1,000 years >1,000 years

Using the assessed notional frequency for the "most likely" and "worst credible" scenarios for each hazard, the probable consequences associated with each were assessed in terms of damage to:

- People – Personal injury, fatality etc.;
- Property – Project and third party;
- Environment – Oil pollution etc.; and
- Business – Reputation, financial loss, public relations etc.

The magnitude of each was then assessed using the consequence categories given below. These have been set such that the consequences in respect of property, environment and business have similar monetary outcomes.

Consequence categories and criteria.

Cat.	People	Property	Environment	Business
C1	**Negligible** Possible very minor injury (e.g. bruising)	**Negligible** Costs <£10k	**Negligible** No effect of note. Tier1 may be declared but criteria not necessarily met. Costs <£10k	**Negligible** Costs <£10k
C2	**Minor** (single minor injury)	**Minor** Minor damage Costs £10k – £100k	**Minor** Tier 1 – Tier 2 criteria reached. Small operational (oil) spill with little effect on environmental amenity Costs £10K–£100k	**Minor** Bad local publicity and/or short-term loss of revenue Costs £10k – £100k
C3	**Moderate** Multiple minor or single major injury	**Moderate** Moderate damage Costs £100k - £1M	**Moderate** Tier 2 spill criteria reached but capable of being limited to immediate area within site Costs £100k -£1M	**Moderate** Bad widespread publicity Temporary suspension of operations or prolonged restrictions to project Costs £100k - £1M
C4	**Major** Multiple major injuries or single fatality	**Major** Major damage Costs £1M -£10M	**Major** Tier 3 criteria reached with pollution requiring national support. Chemical spillage or small gas release Costs £1M - £10M	**Major** National publicity, Temporary closure or prolonged restrictions on project operations Costs £1M -£10M
C5	**Catastrophic** Multiple fatalities	**Catastrophic** Catastrophic damage Costs >£10M	**Catastrophic** Tier 3 oil spill criteria reached. International support required. Widespread shoreline contamination. Serious chemical or gas release. Significant threat to environmental amenity. Costs >£10M	**Catastrophic** International media publicity. Project site closes. Operations and revenue seriously disrupted for more than two days. Ensuing loss of revenue. Costs >£10M

Hazard Data Review Process

Frequency and consequence data were assessed for each hazard drawing initially on the knowledge and expertise of the Marico Marine specialists. This was subsequently influenced by the views and experience of stakeholders, as well as historic incident data where available. It should be noted that the hazards were scored on the basis of the "status quo" i.e. with all existing mitigation measures taken into consideration. The outcome of this process was then checked for consistency against the assessments made in previous and similar risk assessments.

Having decided in respect of each hazard which frequency and consequence criteria are appropriate for the four consequence categories in both the “most likely” and “worst credible” scenarios, eight risk scores were obtained using the following matrix.

Risk factor matrix used for hazard assessment.

Consequences	Cat 5	5	6	7	8	10
	Cat 4	4	5	6	7	9
	Cat 3	3	3	4	6	8
	Cat 2	1	2	2	3	6
	Cat 1	0	0	0	0	0
	Frequency	**>1,000 years**	**100-1,000 years**	**10-100 years**	**1 to 10 years**	**Yearly**

Where:

Risk Number	*Risk*
0 to 1.9	*Negligible*
2 to 3.9	*Low Risk*
4 to 6.9	*As Low as Reasonably Practical*
7 to 8.9	*Significant Risk*
9 to 10.0	*High Risk*

It should be noted that occasionally, a “most likely” scenario will generate a higher risk score than the equivalent “worst credible” scenario; this is due to the increased frequency often associated with a “most likely” event. For example, in the case of a large number of small contact events, the total damage might be of greater significance than a single heavy contact at a much lesser frequency.

Hazard Ranking

The risk scores obtained from the above process were then analysed further to obtain four indices for each hazard as follows:

- The average risk score of the four categories in the “most likely” set;
- The average risk score of the four categories in the “worst credible” set;
- The maximum risk score of the four categories in the “most likely” set; and
- The maximum risk score of the four categories in the “worst credible” set.

These scores were then combined in Marico Marine’s hazard management software “HAZMAN” to produce a single numeric value representing each of the four indices. The hazard list was then sorted

in order of the aggregate of the four indices to produce a “Ranked Hazard List” with the highest risk hazards prioritised at the top.

Mitigation

Mitigation measures that could be employed to reduce the likelihood or consequence of the hazards occurring are then identified.

Annex B Navigation Risk Assessments – Hazard Logs

Warrior Way

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
1	META Site: Warrior Way	Collison	Collision: Tugs/Service Craft - Recreational Vessel	A tug or service craft collides with a recreational vessel of any type	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, both vessels continue on voyage P: Minor single injury P: Minor E: Negligible S: Negligible	Leisure vessel sinks with loss of life P: Major P: Moderate E: Moderate S: Moderate	2	2	1	1	4	4	3	3	3	2	3.48
2	META Site: Warrior Way	Collison	Collision: Tugs/Service Craft - Commercial Vessel	A tug or service craft collides with a commercial vessel	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels P: Minor single injury P: Minor E: Minor S: Minor	Multiple injuries, smaller craft sinks P: Major P: Major E: Moderate S: Moderate	2	2	2	2	1	4	4	3	3	1	2.63
3	META Site: Warrior Way	Collison	Collision: Tugs/Service Craft - Passenger Vessel / Ferry	A tug or service craft collides with a passenger vessel (any type carrying paying passengers)	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels P: Minor single injury P: Minor E: Minor S: Minor	Multiple injuries on a large passenger vessel, loss of life if small passenger vessel P: Major P: Major E: Moderate S: Major	2	2	2	2	1	4	4	3	4	1	2.71
4	META Site: Warrior Way	Collison	Collision: Recreational Vessel - Passenger Vessel / Ferry	Any type of recreational vessel collides with a passenger vessel (any type carrying paying passengers)	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels, multiple injuries on leisure vessel P: Moderate - multiple minor injuries P: Minor E: Minor S: Minor	Leisure vessel sinks with multiple loss of life P: Catastrophic P: Major E: Moderate S: Major	3	2	2	2	1	5	4	3	4	1	3.45

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
5	META Site: Warrior Way	Collison	Collision: Recreational Vessel - Commercial Vessel	Any type of recreational vessel collides with a commercial vessel	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels, multiple injuries on leisure vessel P: Moderate - multiple minor injuries P: Minor E: Minor S: Minor	Leisure vessel sinks with multiple loss of life P: Catastrophic P: Major E: Moderate S: Major	3	2	2	2	1	5	4	3	4	1	3.45
6	META Site: Warrior Way	Collison	Collision: Commercial Vessel - Passenger Vessel / Ferry	A commercial vessel collides with a passenger vessel (any type carrying paying passengers)	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels P: Moderate - multiple minor injuries P: Moderate E: Minor S: Moderate	Multiple injuries on both vessels, major damage to one or both P: Major P: Major E: Moderate S: Major	3	3	2	3	1	4	4	3	4	1	3.31
7	META Site: Warrior Way	Contact	Contact with Fixed Structure: Passenger Vessel / Ferry	A passenger vessel makes contact with a fixed structure. (e.g. gravity foundation)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. minor collision with device structure P: Negligible P: Minor E: Negligible S: Minor	Serious collision leads to capsize. P: Major P: Moderate E: Minor S: Moderate	1	2	1	2	1	4	3	2	3	1	2.28
8	META Site: Warrior Way	Contact	Contact with Fixed Structure: Recreational Vessel	A recreational vessel makes contact with a fixed structure. (e.g. gravity foundation) Includes kayakers or similar making unauthorised visit.	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. minor collision with device structure P: Negligible P: Minor E: Negligible S: Minor	Serious collision leads to capsize. P: Major P: Moderate E: Minor S: Moderate	2	1	1	1	3	4	3	2	3	2	2.83

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
9	META Site: Warrior Way	Contact	Contact with Fixed structure: Commercial Vessel	A commercial vessel makes contact with a fixed structure. (e.g. gravity foundation)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. minor collision with device structure P: Negligible P: Minor E: Negligible S: Minor	Serious collision leads to capsize. P: Major P: Moderate E: Minor S: Moderate	1	2	1	2	1	3	3	2	3	1	1.91
10	META Site: Warrior Way	Contact	Contact with Fixed structure: Tugs/Service Craft	A tug / service craft makes contact with a fixed structure. (e.g. gravity foundation)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure, Failure to follow procedures (device maintenance)	e.g. minor collision with device structure P: Negligible P: Minor E: Negligible S: Minor	Serious collision leads to capsize. P: Major P: Moderate E: Minor S: Moderate	1	2	1	2	4	3	3	2	3	2	2.96
11	META Site: Warrior Way	Contact	Contact with Floating Object: Passenger Vessel / Ferry	A passenger vessel makes contact with a floating object. (e.g. debris, navigation aid, test device)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. striking NavAid P: Negligible P: Minor E: Negligible S: Minor	Striking larger object (e.g. large flotsam) possible multiple injuries P: Major P: Moderate E: Minor S: Moderate	1	2	1	2	2	4	3	2	3	1	2.42
12	META Site: Warrior Way	Contact	Contact with Floating Object: Recreational Vessel	A recreational vessel makes contact with a floating object. (e.g. debris, navigation aid, test device) Includes kayakers or similar making unauthorised visit.	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. striking NavAid, possible crew injury. P: Minor P: Negligible E: Negligible S: Negligible	Striking larger object (e.g. large flotsam) possible multiple injuries, and significant damage leading to sinking P: Major P: Moderate E: Minor S: Moderate	2	1	1	1	4	4	3	2	3	3	3.65
13	META Site: Warrior Way	Contact	Contact with Floating Object: Commercial Vessel	A commercial vessel makes contact with a floating object. (e.g. debris, navigation aid, test device)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. striking NavAid P: Negligible P: Minor E: Negligible S: Minor	Striking larger object (e.g. large flotsam) possible injuries P: Moderate P: Moderate E: Minor S: Moderate	1	2	1	2	1	3	3	2	3	1	1.91

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
14	META Site: Warrior Way	Contact	Contact with Floating Object: Tugs/Service Craft	A tug / service craft makes contact with a floating object. (e.g. debris, navigation aid, test device)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure, Failure to follow procedures (device maintenance)	e.g. striking NavAid P: Negligible P: Minor E: Negligible S: Minor	Striking larger object (e.g. large flotsam) possible injuries P: Moderate P: Moderate E: Minor S: Moderate	1	2	1	2	3	3	3	2	3	2	2.56
15	META Site: Warrior Way	Grounding	Grounding: Passenger Vessel / Ferry	Any type of passenger ferry grounds (including stranding over more than one tide)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Machinery or equipment failure, Traffic density or position of devices causes unplanned course alteration, Inadequate chart / hydrographic information.	P: Moderate - multiple minor injuries P: Minor E: Minor S: Moderate	Large ferry grounds: multiple injuries during event, major business disruption P: Major P: Major E: Moderate S: Major	3	2	2	3	1	4	4	3	4	1	3.22
16	META Site: Warrior Way	Grounding	Grounding Recreational Vessel	Any type of recreational vessel grounds (including stranding over more than one tide)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Machinery or equipment failure, Traffic density or position of devices causes unplanned course alteration, Inadequate chart / hydrographic information.	e.g. moving out of channel for other traffic, and "touching bottom" (Not stranded). P: Minor single injury P: Minor E: Minor S: Minor	Grounding leading to sinking or loss of stability P: Major P: Moderate E: Minor S: Moderate	2	2	2	2	4	4	3	2	3	2	3.82
17	META Site: Warrior Way	Grounding	Grounding: Commercial Vessel	Any type of commercial vessel grounds (including stranding over more than one tide)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Machinery or equipment failure, Traffic density or position of devices causes unplanned course alteration, Inadequate chart / hydrographic information.	Not Stranded P: Minor single injury P: Moderate E: Moderate S: Moderate	Grounding leading to loss of structural integrity, and pollution. P: Major P: Catastrophic E: Catastrophic S: Catastrophic	2	3	3	3	1	4	5	5	5	1	3.83

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
18	META Site: Warrior Way	Grounding	Grounding: Tugs/Service Craft	Any tug or service craft grounds (including stranding over more than one tide)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Machinery or equipment failure, Traffic density or position of devices causes unplanned course alteration, Inadequate chart / hydrographic information.	Not Stranded P: Minor single injury P: Moderate E: Minor S: Minor	Grounding leading to loss of structural integrity, and pollution. P: Major P: Major E: Major S: Major	2	3	2	2	3	4	4	4	4	1	3.88
19	META Site: Warrior Way	Breakout	Breakout of a test device	Test device breaks free and presents a hazard to other shipping	Adverse weather, Equipment (mooring system) failure, Failure to follow procedures (device maintenance), Deliberate act (sabotage), Following Collison (hit by a vessel)	Device washes ashore nearby P: Negligible P: Minor E: Negligible S: Negligible	Device drifts into shipping area and is struck by a small vessel P: Moderate - multiple minor injuries P: Moderate E: Moderate S: Moderate	1	2	1	1	2	3	3	3	3	1	2.01

Dale Roads

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
1	META Site: Dale Roads	Collison	Collision: Tugs/Service Craft - Recreational Vessel	A tug or service craft collides with a recreational vessel of any type	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, both vessels continue on voyage P: Minor single injury P: Minor E: Negligible S: Negligible	Leisure vessel sinks with loss of life P: Major P: Moderate E: Moderate S: Moderate	2	2	1	1	3	4	3	3	3	2	3.08
2	META Site: Dale Roads	Collison	Collision: Tugs/Service Craft - Commercial Vessel	A tug or service craft collides with a commercial vessel	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels P: Minor single injury P: Minor E: Minor S: Minor	Multiple injuries, smaller craft sinks P: Major P: Major E: Moderate S: Moderate	2	2	2	2	2	4	4	3	3	1	2.81
3	META Site: Dale Roads	Collison	Collision: Tugs/Service Craft - Passenger Vessel / Ferry	A tug or service craft collides with a passenger vessel (any type carrying paying passengers)	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels P: Minor single injury P: Minor E: Minor S: Minor	Multiple injuries on a large passenger vessel, loss of life if small passenger vessel P: Major P: Major E: Moderate S: Major	2	2	2	2	2	4	4	3	4	1	2.89
4	META Site: Dale Roads	Collison	Collision: Recreational Vessel - Passenger Vessel / Ferry	Any type of recreational vessel collides with a passenger vessel (any type carrying paying passengers)	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels, multiple injuries on leisure vessel P: Moderate - multiple minor injuries P: Minor E: Minor S: Minor	Leisure vessel sinks with multiple loss of life P: Catastrophic P: Major E: Moderate S: Major	3	2	2	2	2	5	4	3	4	1	3.72

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
5	META Site: Dale Roads	Collison	Collision: Recreational Vessel - Commercial Vessel	Any type of recreational vessel collides with a commercial vessel	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels, multiple injuries on leisure vessel P: Moderate - multiple minor injuries P: Minor E: Minor S: Minor	Leisure vessel sinks with multiple loss of life P: Catastrophic P: Major E: Moderate S: Major	3	2	2	2	2	5	4	3	4	1	3.72
6	META Site: Dale Roads	Collison	Collision: Commercial Vessel - Passenger Vessel / Ferry	A commercial vessel collides with a passenger vessel (any type carrying paying passengers)	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels P: Moderate - multiple minor injuries P: Moderate E: Minor S: Moderate	Multiple injuries on both vessels, major damage to one or both P: Major P: Major E: Moderate S: Major	3	3	2	3	1	4	4	3	4	1	3.31
7	META Site: Dale Roads	Contact	Contact with Fixed Structure: Passenger Vessel / Ferry	A passenger vessel makes contact with a fixed structure. (e.g. gravity foundation)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. minor collision with device structure P: Negligible P: Minor E: Negligible S: Minor	Serious collision leads to capsize. P: Major P: Moderate E: Minor S: Moderate	1	2	1	2	2	4	3	2	3	1	2.42
8	META Site: Dale Roads	Contact	Contact with Fixed Structure: Recreational Vessel	A recreational vessel makes contact with a fixed structure. (e.g. gravity foundation) Includes kayakers or similar making unauthorised visit.	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. minor collision with device structure P: Negligible P: Minor E: Negligible S: Minor	Serious collision leads to capsize. P: Major P: Moderate E: Minor S: Moderate	2	1	1	1	2	4	3	2	3	1	2.3

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
9	META Site: Dale Roads	Contact	Contact with Fixed structure: Commercial Vessel	A commercial vessel makes contact with a fixed structure. (e.g. gravity foundation)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. minor collision with device structure P: Negligible P: Minor E: Negligible S: Minor	Serious collision leads to capsize. P: Major P: Moderate E: Minor S: Moderate	1	2	1	2	1	3	3	2	3	1	1.91
10	META Site: Dale Roads	Contact	Contact with Fixed structure: Tugs/Service Craft	A tug / service craft makes contact with a fixed structure. (e.g. gravity foundation)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure, Failure to follow procedures (device maintenance)	e.g. minor collision with device structure P: Negligible P: Minor E: Negligible S: Minor	Serious collision leads to capsize. P: Major P: Moderate E: Minor S: Moderate	1	2	1	2	3	3	3	2	3	1	2.26
11	META Site: Dale Roads	Contact	Contact with Floating Object: Passenger Vessel / Ferry	A passenger vessel makes contact with a floating object. (e.g. debris, navigation aid, test device)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. striking NavAid P: Negligible P: Minor E: Negligible S: Minor	Striking larger object (e.g. large flotsam) possible multiple injuries P: Major P: Moderate E: Minor S: Moderate	1	2	1	2	2	4	3	2	3	1	2.42
12	META Site: Dale Roads	Contact	Contact with Floating Object: Recreational Vessel	A recreational vessel makes contact with a floating object. (e.g. debris, navigation aid, test device) Includes kayakers or similar making unauthorised visit.	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. striking NavAid, possible crew injury. P: Minor P: Negligible E: Negligible S: Negligible	Striking larger object (e.g. large flotsam) possible multiple injuries, and significant damage leading to sinking P: Major P: Moderate E: Minor S: Moderate	2	1	1	1	3	4	3	2	3	2	2.83
13	META Site: Dale Roads	Contact	Contact with Floating Object: Commercial Vessel	A commercial vessel makes contact with a floating object. (e.g. debris, navigation aid, test device)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. striking NavAid P: Negligible P: Minor E: Negligible S: Minor	Striking larger object (e.g. large flotsam) possible injuries P: Moderate P: Moderate E: Minor S: Moderate	1	2	1	2	2	3	3	2	3	1	2.04

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
14	META Site: Dale Roads	Contact	Contact with Floating Object: Tugs/Service Craft	A tug / service craft makes contact with a floating object. (e.g. debris, navigation aid, test device)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure, Failure to follow procedures (device maintenance)	e.g. striking NavAid P: Negligible P: Minor E: Negligible S: Minor	Striking larger object (e.g. large flotsam) possible injuries P: Moderate P: Moderate E: Minor S: Moderate	1	2	1	2	3	3	3	2	3	2	2.56
15	META Site: Dale Roads	Grounding	Grounding: Passenger Vessel / Ferry	Any type of passenger ferry grounds (including stranding over more than one tide)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Machinery or equipment failure, Traffic density or position of devices causes unplanned course alteration, Inadequate chart / hydrographic information.	P: Moderate - multiple minor injuries P: Minor E: Minor S: Moderate	Large ferry grounds: multiple injuries during event, major business disruption P: Major P: Major E: Moderate S: Major	3	2	2	3	1	4	4	3	4	1	3.22
16	META Site: Dale Roads	Grounding	Grounding Recreational Vessel	Any type of recreational vessel grounds (including stranding over more than one tide)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Machinery or equipment failure, Traffic density or position of devices causes unplanned course alteration, Inadequate chart / hydrographic information.	e.g. moving out of channel for other traffic, and "touching bottom" (Not stranded). P: Minor single injury P: Minor E: Minor S: Minor	Grounding leading to sinking or loss of stability P: Major P: Moderate E: Minor S: Moderate	2	2	2	2	1	4	3	2	3	1	2.47
17	META Site: Dale Roads	Grounding	Grounding: Commercial Vessel	Any type of commercial vessel grounds (including stranding over more than one tide)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Machinery or equipment failure, Traffic density or position of devices causes unplanned course alteration, Inadequate chart / hydrographic information.	Not Stranded P: Minor single injury P: Moderate E: Moderate S: Moderate	Grounding leading to loss of structural integrity, and pollution. P: Major P: Catastrophic E: Catastrophic S: Catastrophic	2	3	3	3	1	4	5	5	5	1	3.83

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
18	META Site: Dale Roads	Grounding	Grounding: Tugs/Service Craft	Any tug or service craft grounds (including stranding over more than one tide)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Machinery or equipment failure, Traffic density or position of devices causes unplanned course alteration, Inadequate chart / hydrographic information.	Not Stranded P: Minor single injury P: Moderate E: Minor S: Minor	Grounding leading to loss of structural integrity, and pollution. P: Major P: Major E: Major S: Major	2	3	2	2	2	4	4	4	4	1	3.48
19	META Site: Dale Roads	Breakout	Breakout of a test device	Test device breaks free and presents a hazard to other shipping	Adverse weather, Equipment (mooring system) failure, Failure to follow procedures (device maintenance), Deliberate act (sabotage), Following Collison (hit by a vessel)	Device washes ashore nearby P: Negligible P: Minor E: Negligible S: Negligible	Device drifts into shipping area and is struck by a small vessel P: Moderate - multiple minor injuries P: Moderate E: Moderate S: Moderate	1	2	1	1	2	3	3	3	3	1	2.01

East Pickard Bay

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
1	META Site: East Pickard Bay	Collison	Collision: Tugs/Service Craft - Recreational Vessel	A tug or service craft collides with a recreational vessel of any type	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, both vessels continue on voyage P: Minor single injury P: Minor E: Negligible S: Negligible	Leisure vessel sinks with loss of life P: Major P: Moderate E: Moderate S: Moderate	2	2	1	1	3	4	3	3	3	1	2.72
2	META Site: East Pickard Bay	Collison	Collision: Tugs/Service Craft - Commercial Vessel	A tug or service craft collides with a commercial vessel	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels P: Minor single injury P: Minor E: Minor S: Minor	Multiple injuries, smaller craft sinks P: Major P: Major E: Moderate S: Moderate	2	2	2	2	3	4	4	3	3	1	3.1
3	META Site: East Pickard Bay	Collison	Collision: Tugs/Service Craft - Passenger Vessel / Ferry	A tug or service craft collides with a passenger vessel (any type carrying paying passengers)	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels P: Minor single injury P: Minor E: Minor S: Minor	Multiple injuries on a large passenger vessel, loss of life if small passenger vessel P: Major P: Major E: Moderate S: Major	2	2	2	2	3	4	4	3	4	1	3.18
4	META Site: East Pickard Bay	Collison	Collision: Recreational Vessel - Passenger Vessel / Ferry	Any type of recreational vessel collides with a passenger vessel (any type carrying paying passengers)	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels, multiple injuries on leisure vessel P: Moderate - multiple minor injuries P: Minor E: Minor S: Minor	Leisure vessel sinks with multiple loss of life P: Catastrophic P: Major E: Moderate S: Major	3	2	2	2	2	5	4	3	4	1	3.72

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
5	META Site: East Pickard Bay	Collison	Collision: Recreational Vessel - Commercial Vessel	Any type of recreational vessel collides with a commercial vessel	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels, multiple injuries on leisure vessel P: Moderate - multiple minor injuries P: Minor E: Minor S: Minor	Leisure vessel sinks with multiple loss of life P: Catastrophic P: Major E: Moderate S: Major	3	2	2	2	3	5	4	3	4	1	4.12
6	META Site: East Pickard Bay	Collison	Collision: Commercial Vessel - Passenger Vessel / Ferry	A commercial vessel collides with a passenger vessel (any type carrying paying passengers)	Poor seamanship, Failure to comply with regulations, Poor visibility / weather, One vessel suddenly alters course to avoid test device or area, Traffic density, Machinery or equipment failure	Glancing blow, minor damage to both vessels P: Moderate - multiple minor injuries P: Moderate E: Minor S: Moderate	Multiple injuries on both vessels, major damage to one or both P: Major P: Major E: Moderate S: Major	3	3	2	3	3	4	4	3	4	2	4.43
7	META Site: East Pickard Bay	Contact	Contact with Fixed Structure: Passenger Vessel / Ferry	A passenger vessel makes contact with a fixed structure. (e.g. gravity foundation)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. minor collision with device structure P: Negligible P: Minor E: Negligible S: Minor	Serious collision, or anchor fouling leads to capsize. P: Major P: Moderate E: Minor S: Moderate	1	1	1	1	1	4	4	3	4	1	1.96
8	META Site: East Pickard Bay	Contact	Contact with Fixed Structure: Recreational Vessel	A recreational vessel makes contact with a fixed structure. (e.g. gravity foundation) Includes kayakers or similar making unauthorised visit.	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. minor collision with device structure P: Negligible P: Minor E: Negligible S: Minor	Serious collision, or anchor fouling leads to capsize. P: Major P: Moderate E: Minor S: Moderate	2	1	1	1	1	4	3	3	3	1	2.28

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
9	META Site: East Pickard Bay	Contact	Contact with Fixed structure: Commercial Vessel	A commercial vessel makes contact with a fixed structure. (e.g. gravity foundation)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. minor collision with device structure P: Negligible P: Minor E: Negligible S: Minor	Serious collision, or anchor fouling leads to capsize. P: Major P: Moderate E: Minor S: Moderate	2	2	1	1	1	4	4	3	3	1	2.45
10	META Site: East Pickard Bay	Contact	Contact with Fixed structure: Tugs/Service Craft	A tug / service craft makes contact with a fixed structure. (e.g. gravity foundation)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure, Failure to follow procedures (device maintenance)	e.g. minor collision with device structure P: Negligible P: Minor E: Negligible S: Minor	Serious collision, or anchor fouling leads to capsize. P: Major P: Moderate E: Minor S: Moderate	2	2	1	1	2	4	3	3	3	1	2.5
11	META Site: East Pickard Bay	Contact	Contact with Floating Object: Passenger Vessel / Ferry	A passenger vessel makes contact with a floating object. (e.g. debris, navigation aid, test device)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. striking NavAid P: Negligible P: Minor E: Negligible S: Minor	Striking larger object (e.g. large flotsam) possible multiple injuries P: Major P: Moderate E: Minor S: Moderate	1	2	1	2	3	4	3	2	3	1	2.64
12	META Site: East Pickard Bay	Contact	Contact with Floating Object: Recreational Vessel	A recreational vessel makes contact with a floating object. (e.g. debris, navigation aid, test device) Includes kayakers or similar making unauthorised visit.	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. striking NavAid, possible crew injury. P: Minor P: Negligible E: Negligible S: Negligible	Striking larger object (e.g. large flotsam) possible multiple injuries, and significant damage leading to sinking P: Major P: Moderate E: Minor S: Moderate	2	1	1	1	3	4	3	2	3	2	2.83

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
13	META Site: East Pickard Bay	Contact	Contact with Floating Object: Commercial Vessel	A commercial vessel makes contact with a floating object. (e.g. debris, navigation aid, test device)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure.	e.g. striking NavAid P: Negligible P: Minor E: Negligible S: Minor	Striking larger object (e.g. large flotsam) possible injuries P: Moderate P: Moderate E: Minor S: Moderate	1	2	1	2	3	3	3	2	3	2	2.56
14	META Site: East Pickard Bay	Contact	Contact with Floating Object: Tugs/Service Craft	A tug / service craft makes contact with a floating object. (e.g. debris, navigation aid, test device)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Obstruction (e.g. test device) not charted or promulgated, Machinery or equipment failure, Failure to follow procedures (device maintenance)	e.g. striking NavAid P: Negligible P: Minor E: Negligible S: Minor	Striking larger object (e.g. large flotsam) possible injuries P: Moderate P: Moderate E: Minor S: Moderate	1	2	1	2	3	3	3	2	3	2	2.56
15	META Site: East Pickard Bay	Grounding	Grounding: Passenger Vessel / Ferry	Any type of passenger ferry grounds (including stranding over more than one tide)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Machinery or equipment failure, Traffic density or position of devices causes unplanned course alteration, Inadequate chart / hydrographic information.	P: Moderate - multiple minor injuries P: Minor E: Minor S: Moderate	Large ferry grounds: multiple injuries during event, major business disruption P: Major P: Major E: Moderate S: Major	3	2	2	3	2	4	4	3	4	1	3.5
16	META Site: East Pickard Bay	Grounding	Grounding: Recreational Vessel	Any type of recreational vessel grounds (including stranding over more than one tide)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Machinery or equipment failure, Traffic density or position of devices causes unplanned course alteration, Inadequate chart / hydrographic information.	e.g. moving out of channel for other traffic, and "touching bottom" (Not stranded). P: Minor single injury P: Minor E: Minor S: Minor	Grounding leading to sinking or loss of stability P: Major P: Moderate E: Minor S: Moderate	2	2	2	2	2	4	3	2	3	1	2.65

Hazard ID	Area	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Overall Risk
								People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
17	META Site: East Pickard Bay	Grounding	Grounding: Commercial Vessel	Any type of commercial vessel grounds (including stranding over more than one tide)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Machinery or equipment failure, Traffic density or position of devices causes unplanned course alteration, Inadequate chart / hydrographic information.	Not Stranded P: Minor single injury P: Moderate E: Moderate S: Moderate	Grounding leading to loss of structural integrity, and pollution. P: Major P: Catastrophic E: Catastrophic S: Catastrophic	2	3	3	3	2	4	5	5	5	1	4.13
18	META Site: East Pickard Bay	Grounding	Grounding: Tugs/Service Craft	Any tug or service craft grounds (including stranding over more than one tide)	Poor seamanship, Poor visibility, AtoN out of position / unlit, Machinery or equipment failure, Traffic density or position of devices causes unplanned course alteration, Inadequate chart / hydrographic information.	Not Stranded P: Minor single injury P: Moderate E: Minor S: Minor	Grounding leading to loss of structural integrity, and pollution. P: Major P: Major E: Major S: Major	2	3	2	2	3	4	4	4	4	1	3.88
19	META Site East Pickard Bay	Breakout	Breakout of a test device	Test device breaks free and presents a hazard to other shipping	Adverse weather, Equipment (mooring system) failure, Failure to follow procedures (device maintenance), Deliberate act (sabotage), Following Collison (hit by a vessel)	Device washes ashore nearby P: Negligible P: Minor E: Negligible S: Negligible	Device drifts into shipping area and is struck by a small vessel P: Moderate - multiple minor injuries P: Moderate E: Moderate S: Moderate	1	2	1	1	2	3	3	3	3	1	2.01