

Appendix B – Navigation Safety and Risk Assessment



ORCADES MARINE
Management Consultants Ltd

Navigation Safety and Risk Assessment



Flex Marine Power

Document Number OP 427.01

This report is issued to:

Company	Flex Marine Power Ltd
Address	91 Clober Road
	Glasgow
	G62 7LS
Contact Name	Mark Spybey
Position	
Telephone	[Redacted]
Email	mark.spybey@flexmarinepower.com

This report was issued by:

Company	Orcades Marine Management Consultants Ltd.
Address	Unit 3, Warness Park
	Hatston Pier Road, Kirkwall
	KW15 1ZL
Contact Name	David Thomson
Position	Managing Director
Telephone	+44 (0) 1856 874884
Email	david.thomson@orcademarine.co.uk

Prepared by	Checked by	Authorised by	Date
David Thomson	Alexandra Thomson	David Thomson	08.02.2024
Revision Number	Issue Date	Revision Details	Distribution List Index Number
0.1	08.02.2024	Issued	Internal
1.0	14.02.2024	Review by FMPPA	1,2,3

Distribution List Key

Company	Responsible Person	Distribution List Index Number
Flex Marine	Thomas Campbell	1
Flex Marine	Mark Spybey	2
Flex Marine	David Mummery	3

Table of Contents

1	Project Summary	6
1.1	Background.....	6
2	Risk Claim	6
3	Description of the Marine Environment	7
4	Description of the OREI Development and how it changes the Marine Environment	10
4.1	Under Keel Clearance.....	11
5	Analysis of the Marine Traffic	14
6	Status of the Hazard and Risk Register	17
7	Navigation Risk Assessment	17
7.1	Base Case.....	17
7.2	Future Case.....	17
7.3	Base Case with OREI Device Installed	17
7.4	Future Case with OREI Device Installed.....	18
7.5	Future Options	18
7.6	Summary of other Navigation Safety Risks from Hazard Log & Controls.....	18
8	Search and Rescue Overview and Assessment	18
9	Emergency Response Overview and Assessment	18
10	Status of Risk Control Log	18
11	Major Hazards Summary	19
12	Statement of Limitations	20
13	Through Life Safety Management	20
14	Annex – Risk Register	21
15	Annex – Traffic Survey Data	22
16	Annex – Tables of Coordinates	32
17	Annex Extract from Wave Study (Wark Consulting 2022)	33
18	Annex – References	33

Figure 1 Sound of Islay Admiralty Chart	8
Figure 2 Revised location of turbine within red sector of Carraig Mhor Light	9
Figure 3 Relative location of turbine and position of Virtual AtoN - AIS signal	10
Figure 4 Profile of installation at MLWS slack water.....	11
Figure 5 Profile of installation when tidal flow is a maximum strength.....	12
Figure 6 Graph showing variations in water depth over the tidal turbine over a 28 day period	13
Figure 7 AIS tracks of all vessels - July-November 2022	16
Figure 8 Passenger Vessels - July-November 2022	23
Figure 9 Search and Rescue - July-November 2022	24
Figure 10 Cargo - July-November 2022	25
Figure 11 Tugs - July-November 2024	26
Figure 12 Special Craft - July-November 2022	27
Figure 13 Recreational Craft - July-November 2022	28
Figure 14 Fishing vessels - July--November 2022.....	29
Figure 15 Vessel type not declared July-November	30
Figure 16 Vessel type uncategorised – July-November 2022	31
Figure 17 Predicted Extreme Wave Conditions: 1in 100-year return period.	33

Please note that charts included in this document are © Crown Copyright and/or database rights. Reproduced by permission of The Keeper of Public Records and the UK Hydrographic Office (www.GOV.uk/UKHO).

Table of Abbreviations

ALS	Accidental Limit State
BP	Bollard Pull
CD	Chart Datum
CHA	Competent Harbour Authority
DHSE Rep	Designated Health and Safety Representative
DSA	Dynamic Systems Analysis
EMEC	European Marine Energy Centre
ERP	Emergency Response Plan
ETA	Estimated time of arrival
HAT	Highest Astronomical Tide
HIRA	Hazard Identification and Risk Assessment
HSE	Health and Safety Executive
IMO	International Maritime Organisation
ISM	International Safety Management Code
KN	Kilo Newtons
KW	Kilo Watt
LAT	Lowest Astronomical Tide
LOLER	Lifting Operations and Lifting Equipment Regulations 1998
MAIB	Marine Accident Investigation Branch
MBL	Minimum Breaking Load
MCA	Maritime and Coastguard Agency
MHWN	Mean High Water Neaps
MLWN	Mean Low water Neaps
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MWS	Marine Warranty Surveyor
MRCC	Maritime Rescue Coordination Centre
m/s	Metres per second
NRA	Navigation Risk Assessment
OMMC	Orcades Marine Management Consultants Ltd
OREI	Offshore Renewable Energy Installation
PTW	Permit to Work
PPE	Personal Protective Equipment
RA	Risk Assessment
RHIB	Rigid Hull Inflatable Boat
RIDDOR	Reporting Injuries & Diseases & Dangerous Occurrences Regulations 1995
ROV	Remotely Operated Vehicle
SWL	Safe Working Load
TSS	Traffic Separation Scheme
ULS	Ultimate Limit State
WEC	Wave Energy Converter
WLL	Working Load Limit

1 Project Summary

Flex Marine Power Ltd (FMP) are a tidal technology developer based in Scotland (www.flexmarinepower.com). FMP, in association with the Islay Energy Trust, propose to install a single SwimmerTurbine™, rated up to 70kW, in the Sound of Islay, Scotland, with the power being transmitted to Islay for private connection. The anticipated date of installation of the SwimmerTurbine™ and its associated mooring system is Q3, 2024. The operational period is anticipated to last approximately 5 years. Thereafter, all equipment will be completely removed from site. This document follows the guidance contained in MGN 654 Safety of Navigation: Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response.

1.1 Background

This document is an updated version of NRA OP416 Revision 0.1 issued on the 17th of November 2021. This revision has been undertaken due to a change in location and marking as was described in the previous document. Following extensive consultation with the Northern Lighthouse Board (NLB), Caledonian Macbrayne (CalMac), the Maritime and Coastguard Agency (MCA), the Royal Yachting Association (RYA) and the Scottish Fishermen's Federation (SFF) the position of the SwimmerTurbine™ has been moved further to the west, and lowered in the water column to give greater under keel clearance. The turbine will be marked by a Virtual Aid to Navigation in the form of AIS signal indicating a virtual east cardinal buoy, therefore there will be no physical surface obstruction to vessels navigating in the vicinity of the device .

The location of the device has been carefully considered, initial site searches included the area north of Port Askaig however this area is under Option with Crown Estate Scotland for a different tidal development. The proposed site has been chosen due to several factors; a) utilising the significant tidal flow resource, b) utilising an area of seabed that is suitable for mooring c) choosing a site with a depth that enables the turbine to function as per its design d) ensuring the turbine is located outwith the main navigation channel.

2 Risk Claim

A proportionate approach has been taken to assess the risks and preserve the safety of navigation, and the Navigation Risk Assessment has been undertaken based on qualitative techniques and "expert judgement".

Traffic analysis has been undertaken over a five-month period in 2022 to cover changes in seasonal vessel traffic from July to November. The area in question is an area of relatively low traffic density with the regular ferry traffic being the dominant feature. For vessels which transmit AIS data it can be seen quite clearly that the device is situated well away from the regular routes that vessels take when transiting the Sound of Islay. The compulsory carriage requirements for AIS are covered in the SOLAS V regulations under which compulsory carriage of AIS is limited to "all ships of 300 gross tonnage and upwards engaged on international voyages and cargo ships of 500 gross tonnage and upwards not engaged on international voyages and passenger ships irrespective of size".

The developer has carried out local stakeholder engagement with local fishermen and the RNLI and is progressing the development in association with the local organisation, the Islay Energy Trust. To capture other traffic which may not be carrying AIS transmitters and may be transiting or operating in the area the developer has consulted with the RYA and fisherman's association. Furthermore, and to achieve the level of marine navigational safety required, extensive consultation has taken place with the NLB, RYA, MCA and CalMac (the local ferry operator) and improvements to the safety of navigation have been made as a result of their feedback, primarily by moving the original location of the device

further to the west away from the routes of vessels in transit, marking the location of the device with “virtual” buoyage so that no surface obstruction exists and lowering the device in the water column to provide a greater under keel clearance. The Virtual Aid to Navigation will indicate the presence of an East Cardinal buoy on AIS receivers marking the location of the OREI.

The depth of the device fluctuates according to the height of tide and strength of the tidal stream, however the machine is never less than a minimum depth of 4.6 metres. The minimum depth only occurs for a short period twice each lunar month. Most commercial vessels under 500 GT and leisure vessels will have a draft less than 3.5 metres and would not be at risk of contact with the device in the infrequent situation that the OREI is at its minimum depth.

The qualitative risk assessment has been undertaken where the initial risks are assessed as low, and with further mitigations are assessed as “As Low As Reasonably Practicable” (ALARP). This development is assessed to be a “Low Risk Small Scale Development”.

3 Description of the Marine Environment

The Islay Sound is a narrow channel between the islands of Islay and Jura, on Scotland’s west coast and is used by mariners to avoid the open sea route to the west of Islay. Transit through the sound is limited by a rocky bank extending 2.5’nm in the northern entrance which has the least depth of 9.1m. It has strong tidal streams. The tidal stream generally follows in the direction of the channel. The rates at spring tides in the sound are in the order of 5kn as indicated on Admiralty Chart 2481.

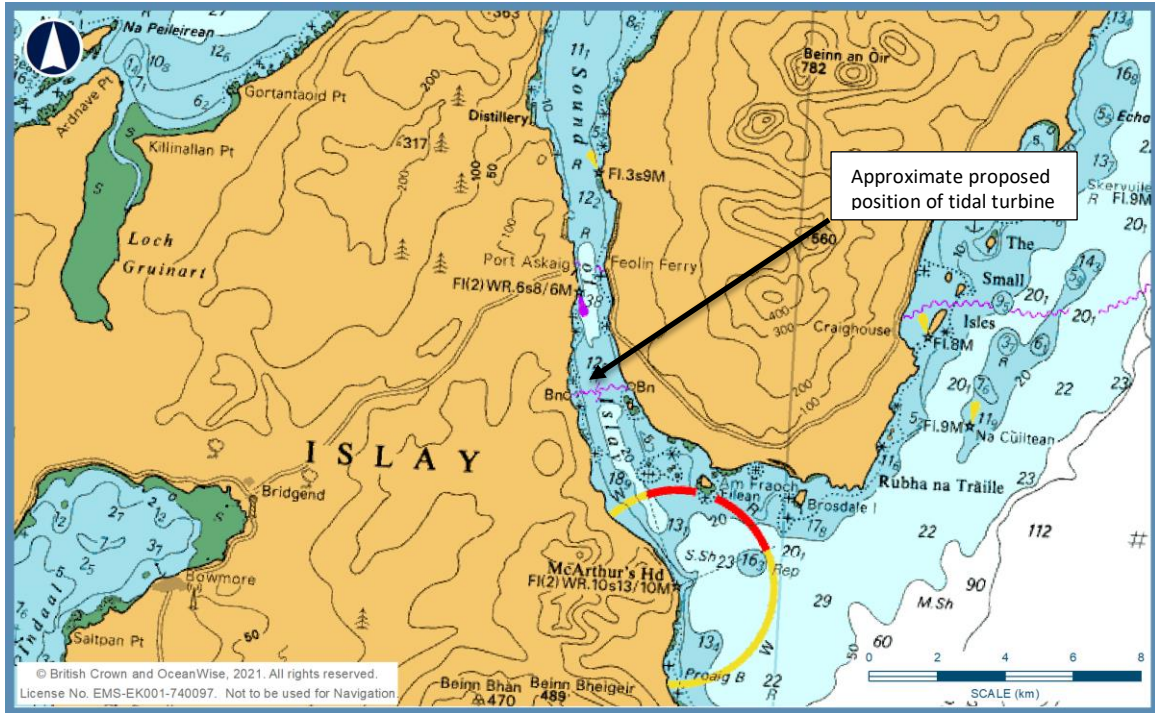


Figure 1 Sound of Islay Admiralty Chart – Not to be used for Navigation -scale is approximate.

0382 Port Askaig is a Secondary Non-Harmonic port
The tide type is Semi-Diurnal.

HAT	2.5 m
MHWS	2.2 m
MHWN	1.6 m
MSL	1.33 m
MLWN	1.1 m
MLWS	0.5 m
LAT	0.1 m

Admiralty Tide Tables / Admiralty TotalTideRecords tidal height data for Port Askaig indicate a mean range of 0.5m for neaps and 1.7m for springs. The height of tide in the sound is greatly affected by the wind and barometric pressure with certain conditions having the potential to raise the level by up to 1m.

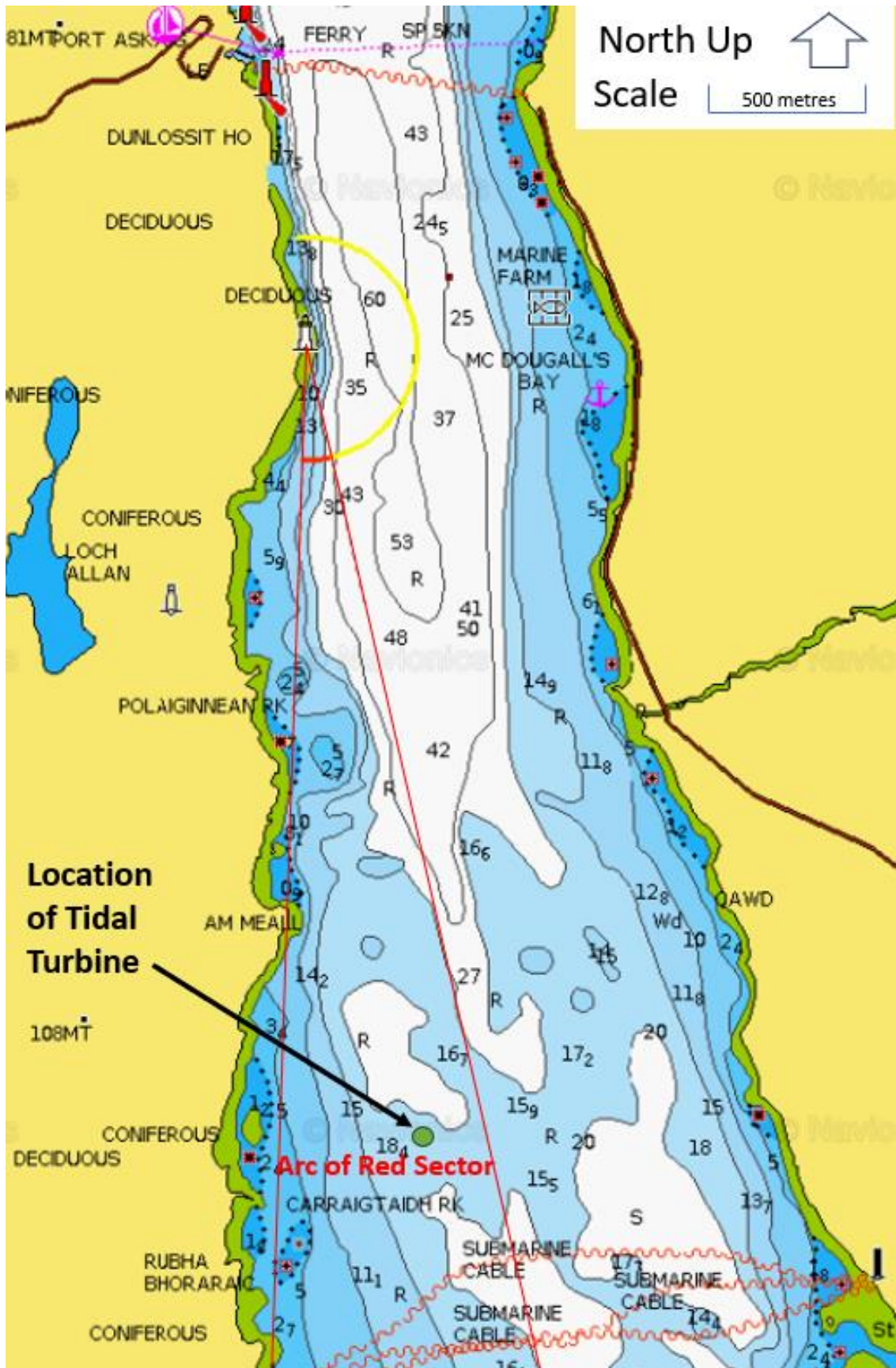


Figure 2 Revised location of turbine within red sector of Carraig Mhor Light– Not to be used for Navigation – scale is approximate.

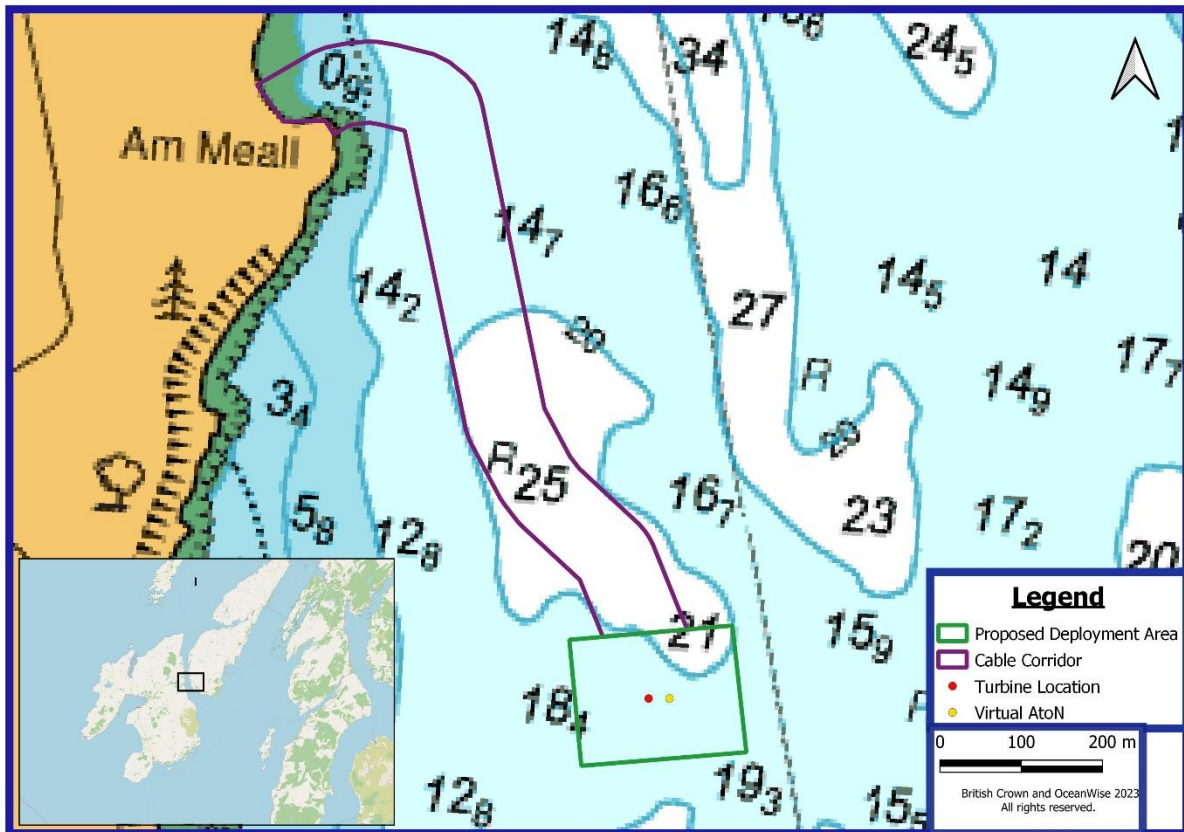


Figure 3 Relative location of turbine and position of Virtual AtoN - AIS signal – Not to be used for Navigation – scale is approximate.

4 Description of the OREI Development and how it changes the Marine Environment

The device is a submerged bladed turbine held in position by a clump weight and tether.

The armoured power cable runs down the tether to the seabed and then along the seabed to the shore substation. The device rotates around its anchor in response to the change of direction and speed of the tidal flow in an elliptical fashion. The footprint of the ellipse at its longest axis is approximately 45 metres in line with the tidal flow and on its shortest axis is approximately 35 metres.

The OREI device will be installed by a multicat type vessel and a RHIB operating from Port Askaig. The additional risk to navigating traffic is minimal on the passage to and from the site of the intended deployment location. During the operating phase additional traffic is expected to be a weekly transit by RHIB from Port Askaig to the device.

The device will create only very limited changes to the marine environment. The proposed area of deployment is situated ~150m to the west of the typical passage for vessels passing through the sound or bound for the ports within the Sound of Islay.

The device is intended to be decommissioned and completely removed from the site after an operating for a maximum period of 5 years.

4.1 Under Keel Clearance

The device is never less than 4.6m below the water surface at any time. The wave regime in the location is typified by short wavelength small waves (see Annex 17) and deep drafted vessels will not be prone to significant pitching and therefore have a negligible plunge depth. Applying a safety factor allowance of 30%, vessels of up to 3.5 m dynamic draught would not be at risk of contact with the device in the highly unlikely scenario where the vessel is precisely over the device at Mean Low Water Springs occurring for short periods twice per lunar month, and during slack water.

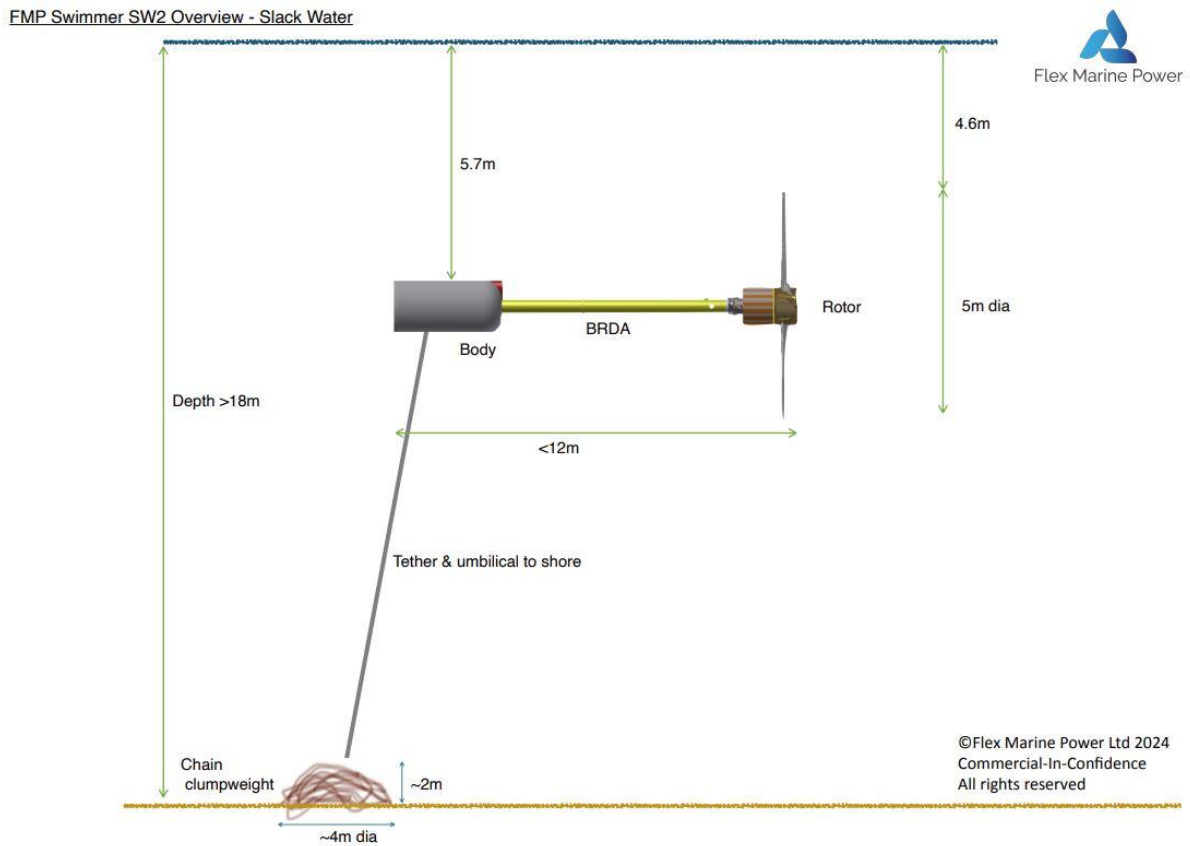


Figure 4 Profile of installation at MLWS slack water.

During the diurnal tidal cycle, the depth of the device fluctuates from a minimum depth of 4.6 metres at slack water Mean Low Water Springs (see Figure 4), getting progressively deeper as the tidal flow increases and the tide height increases.

FMP Swimmer SW2 Overview - Maximum Tidal Flow

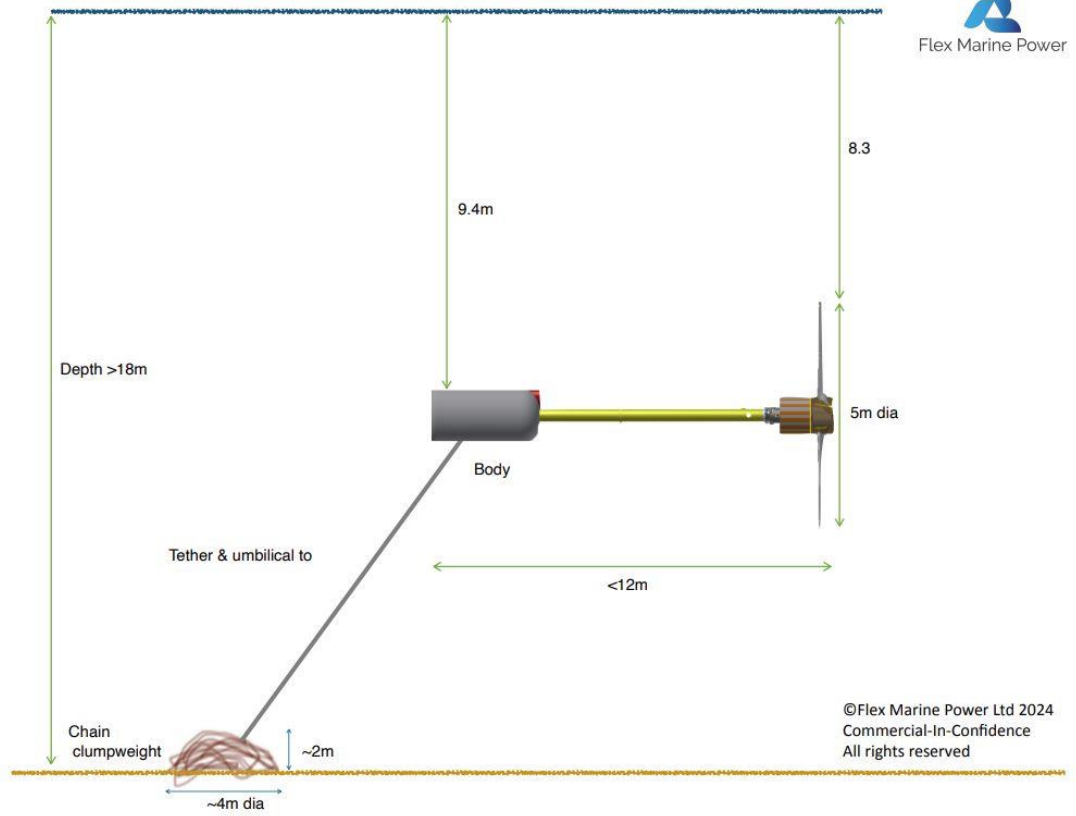


Figure 5 Profile of installation when tidal flow is a maximum strength.

When the tide is running at maximum flow the depth of water to the tip of the turbine blade is in the region of 8.3 metres. The turbine blades are constructed of light composite material.

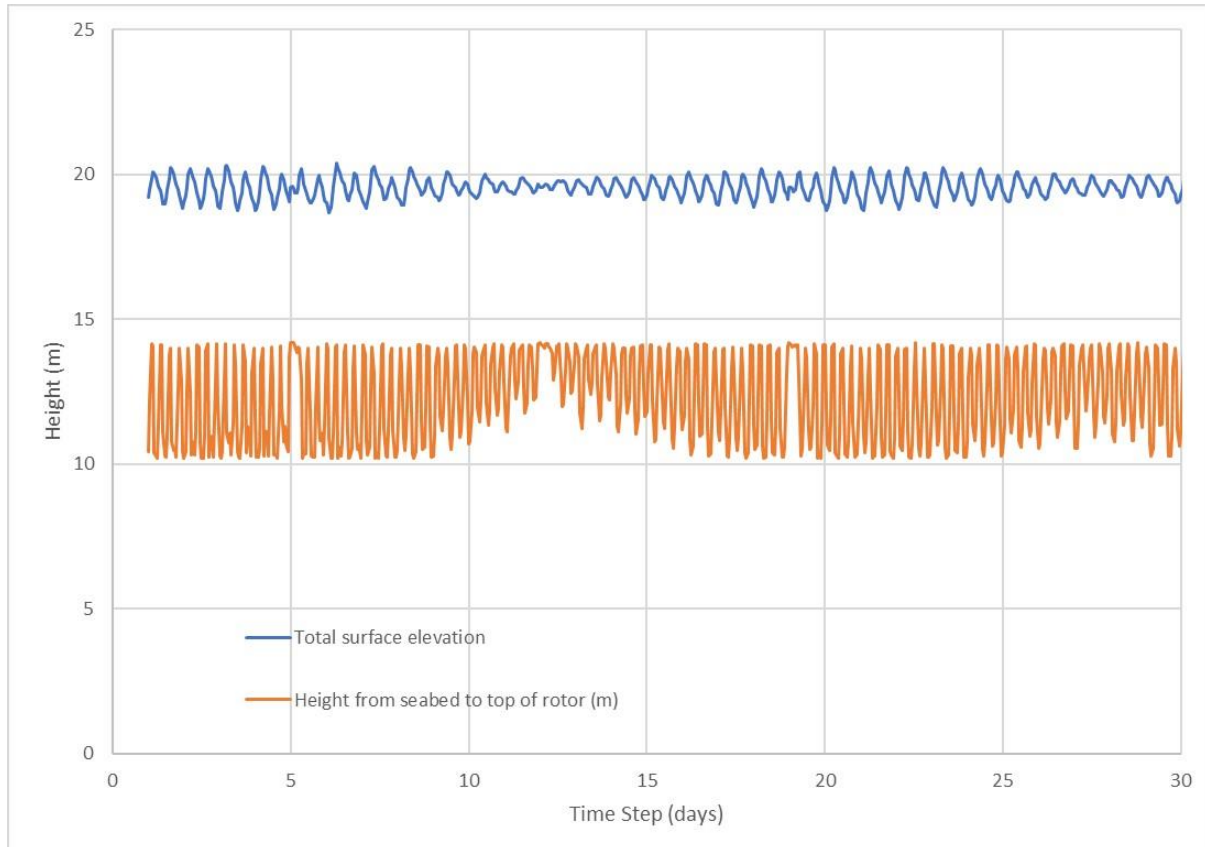


Figure 6 Graph showing variations in water depth over the tidal turbine over a 28-day period.

NB: The variation in the turbine height above the seabed shown in Figure 6 is directly related to the speed of the tidal current flowing at any time. When the tide is running the machine drops in height. The blue line represents the changes in height of the tide between low and high water.

5 Analysis of the Marine Traffic

Compulsory carriage of AIS is required on all ships of 300 gross tonnage and upwards engaged on international voyages and cargo ships of 500 gross tonnage and upwards not engaged on international voyages and passenger ships irrespective of size. In addition, whilst there is no requirement most commercial vessels and many leisure vessels under these tonnages now carry AIS transmitters.

AIS records of vessels in the Sound of Islay have been gathered for a 5-month period from July 2022 to November 2022. The AIS vessel tracks are shown on chart extracts of the study area in Annex 15 of this document.

The vessel plots are categorized into type as follows:

- Passenger
- Search and Rescue
- Cargo
- Tugs
- Special craft
- Recreational craft
- Fishing vessels
- Vessels not declared.
- Vessels uncategorised

This data was compared with an analysis for the area presented in 2013 and found to be similar, thereby allowing a reasonable assumption that traffic densities and types have not changed over the intervening period and are not likely to change within the duration of the deployment period. The exception to this assumption is the possible build out of a tidal development north of Port Askaig which may produce a small increase in traffic transiting the Sound of Islay.

The AIS data was further examined to show traffic in the winter against the summer and a two-week period was sampled from the 1st-14th July 2022 and from 16th-30th November 2022. The results are shown in Figure 7 and Figure 8.

There is significant drop in traffic during the winter months from the lack of recreational craft during winter period although commercial traffic shows a slight rise in numbers.

The most frequent use of the channel is ferry traffic running to Port Askaig, and this accounts for much of the vessel traffic through the study area.

AIS tracks - Summer (first two weeks in July 2022)		
Vessel Category	Total number of tracks in area	Number of individual vessels
Passenger	59	3
Search and Rescue	5	1
Cargo	13	10
Tugs	2	2
Special craft	2	2
Recreational craft	46	43
Fishing vessels	4	3
Vessels not declared.	0	0
Vessels uncategorised	0	0
Total	131	64

Figure 7 AIS traffic by vessel type - summer.

AIS tracks – Winter (last two weeks in November 2022)		
Vessel Category	Total number of tracks in area	Number of individual vessels
Passenger	32	3
Search and Rescue	3	1
Cargo	22	15
Tugs	2	2
Special craft	7	7
Recreational craft	0	0
Fishing vessels	11	6
Vessels not declared.	0	0
Vessels uncategorised	1	1
Total	78	35

Figure 8 AIS traffic by vessel type - winter.

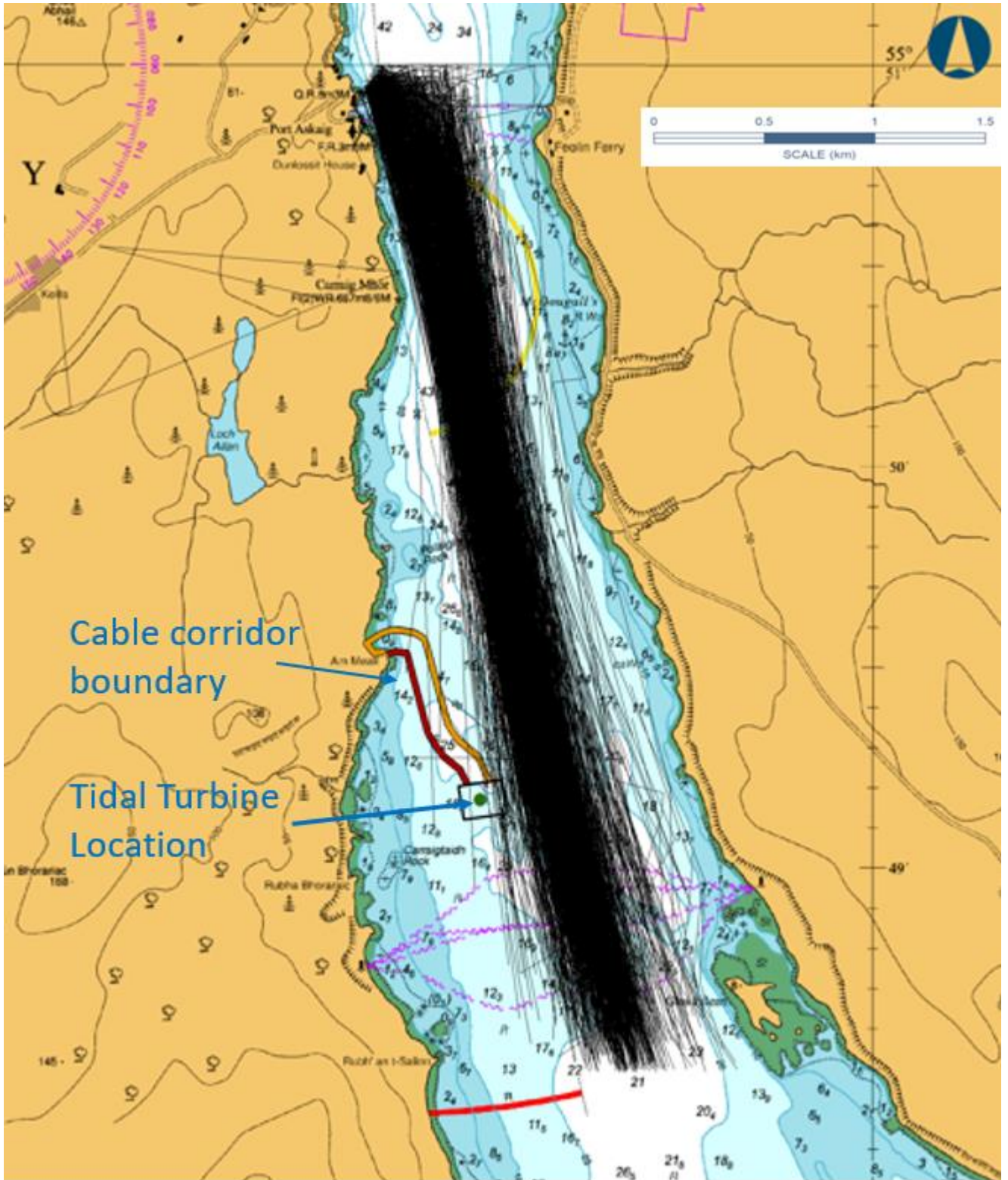


Figure 9 AIS tracks of all vessels - July-November 2022- Not to be used for Navigation – scale is approximate.

6 Status of the Hazard and Risk Register

The Hazard Risk Register will be kept as an active document amended and updated with any new hazards or changes to existing hazards to ensure that the risks remain low. The mitigations and controls will be put in place and maintained by Flex Marine Power.

A graphical representation hazard matrix is below; the ALARP level being considered a score of 9 or below.

Descriptive Word	CONSEQUENCE				
	Minor	Significant	Moderate	Major	Catasrophic
Hazard Severity	1	2	3	4	5
Actual/Potential Illness or Injury	Single First Aid	Medical attention or multiple first	LTI or multiple medical attention	Single Fatality	Multiple fatality
Environmental	Limited harm to the environment	Limited harm to the environment	Potential harm to employees and environment	Potential harm to employees and environment	Harms public, employees, and environment. Widespread concern of companies operations.
Cost of loss	<10,000	>10,000	>50,000	>250,000	>1m
LIKELIHOOD					
Very Unlikely	1	2	3	4	5
Unlikely	2	4	6	8	10
Possible	3	6	9	12	15
Quite Likely	4	8	12	16	20
Certain or very likely	5	10	15	20	25

The full risk register is found in Annex 14.

7 Navigation Risk Assessment

7.1 Base Case

The current risks to navigation are identified from charts and navigational publications. Vessels transiting or calling at ports in the sound should be well aware of the conditions within it. The routes followed by the vast majority of vessel traffic runs parallel and to the east of the OREI site. The majority of vessels transiting are CalMac ferries on the regular routes.

7.2 Future Case

There is no indication that there are any planned, significant changes to the level and types of traffic currently experienced. Neither is it envisaged that there will be any changes to the vessel types or size. Vessel draughts are constrained by the limiting depths in the northern area of the sound.

7.3 Base Case with OREI Device Installed

Within the expected operation period of the OREI the impact to the navigational risk is minimal.

There is a slight increase in risk of collision associated with the use of Port Askaig as a base for project vessels. This, however, is mitigated through design and operational procedural controls.

Similarly, there is a slight increase in the risk of accidental collision or entanglement with the device by exceptionally deep drafted fishing or leisure vessels on passage off the normal lines of navigation.

7.4 Future Case with OREI Device Installed

The OREI device is to be installed for a limited period. There are no expected significant changes expected in the period of deployment from that of the Base Case with the OREI in position.

7.5 Future Options

Should the OREI remain in service beyond the currently expected end date of May 2027, then a further projection of traffic densities may be necessary to maintain the risk register.

7.6 Summary of other Navigation Safety Risks from Hazard Log & Controls.

The main risks are those associated with a collision with project vessels and or OREI components with 3rd party vessels. This would most likely result in asset damage and may result in injury or fatality. As described in the risk matrix the mitigations for these are by procedural controls limiting proximity of vessels e.g., verification of vessel suitability, crew training, visibility of device, promulgation of hazard information.

8 Search and Rescue Overview and Assessment

The site falls within the coverage the UK Maritime Search and Rescue operational area administered by the Clyde Maritime Rescue Co-ordination Centre (MRCC) based at Greenock.

MRCC – It is not expected that the presence of the OREI will cause any difficulty to SAR Operations planning at the MRCC or additional capacity requirements.

Helicopter operations – The OREI does not present a risk to SAR helicopter operations as it is below the surface.

Port Askaig Lifeboat – The OREI does not present a risk to the operation of the RNLI Severn Class lifeboat. There is sufficient under keel clearance at all states of the tide there is also mitigated by the promulgation of notices to mariners and the Virtual Aid to Navigation marking the presence of the OREI.

It is considered that the installation does not present an unacceptable risk to SAR activities above the background risks of operating in the close inshore area of Islay Sound.

9 Emergency Response Overview and Assessment

An Emergency Response Plan (ERP) will be prepared by Flex Marine Power or their contractors for each of the operational phases to provide a clear command and control structure and communications plan together with clear definitions of roles and responsibilities. This will cover all unplanned events including major accidents, evacuation escape and rescue and casualty evacuation.

10 Status of Risk Control Log

10.1 Marking and lighting

There are no physical surface markers or lighting indicating the presence of the OREI tidal device. However, an AIS signal will be virtually transmitted which appears to emanate in the position 55 49.17' North 006 05.71' West which is approximately 25 metres east from the anchor position of the OREI. On vessels with AIS receivers the signal will appear as an East Cardinal Mark. A virtual aid to navigation can be described as digital information, broadcast from an Automatic Identification System (AIS) station, to place an aid to navigation that does not physically exist in the water. Virtual aids to navigation are visible on the AIS Minimum Keyboard and Display (MKD), or as a symbol on appropriate display system.

10.2 Monitoring

Outputs from the SwimmerTurbine™ will be monitored in real time using cloud-based communications. Cloud technology enables full control to be passed to a trained local operator, or offsite centralised operator, as and when required. Using an inertial/GPS system, the movement of the device will be monitored, and an alert will be triggered if the system moves outside of the predefined operational area. The following device specific monitoring will be undertaken by FMP:

- The control system will have a shock sensor for the purpose of giving indication if an object strikes the device.
- Pitch and roll movements are monitored and accelerometers are used to identify any movement. An inertial/GPS will record location.
- Cameras at the shoreside box will allow site monitoring by remote access when people are not present.
- Following a collision detection by the sensors, part of the response would be immediate review of operational and performance parameters (which can be assessed remotely). If these were considered sufficiently adverse, the device would be shut down.

10.3 Other risk controls

- Flex Marine Power and chartered vessels safety management systems will be adhered to.
- Competent personnel will be employed.
- Method statements and procedures will be adhered to.
- Contractors' personnel and chartered vessels will be audited.
- Notice to Mariners will be issued and also included in the Kingfisher Bulletin.

11 Major Hazards Summary

An analysis of risks during installation, operation, and decommissioning phases of the OREI were considered and risks identified as tolerable or as low as reasonably practical after application of prevention measures and additional controls.

- Project vessels in transit to/from the site.
- Installation, maintenance, and decommissioning in unfavourable weather conditions.
- Project vessels on DP or a mooring system.
- Project vessels working in close proximity to the tether.
- Fishing gear/abandoned fishing gear potentially in the area.
- Uncertified equipment
- Deep drafted 3rd party vessel negligence.
- Device not visible
- Components floating free due to failure of connections during operations.
- 3rd party vessel NUC
- 3rd party vessel manoeuvring to avoid the device, its tether and anchoring system.
- Navigation near to device
- Vessels navigating over the device, its tether, and its anchoring system.
- Vessels anchoring near to site.
- Vessels on DP when carrying out maintenance on the bottom joint or cable.
- Entanglement of tether in propeller of project vessels
- Leisure vessels (sailing yachts) navigation in close proximity

12 Statement of Limitations

This Navigation Safety and Risk assessment is only valid on the basis of the following assumptions:

- There are no significant changes to the specifications, layout, and location of the OREI device as given in this document.
- The risk register is continuously maintained and updated throughout the lifetime of the project.
- The risk mitigations are applied in their entirety.

13 Through Life Safety Management

The risks identified and mitigations required to keep the risks As Low As Reasonably Practicable will be managed by the Flex Marine Power through their project safety management system which will maintain and update the Hazard Risk Register as appropriate.

14 Annex – Risk Register

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Task Risk Assessment Reference Number				FMPA NRA												
2	Work Activity Being Assessed				Navigation Risk Assessment												
3	Revision Number				1												
4	Last Review Date				02.02.2024												
5	Current Review Date																
6	Reviewed by																
7																	
8	Hazards				Persons at Risk	Hazard Effect Description			Initial Risk Rating			Mitigating Actions			Residual Risk Rating		
9									Likelihood	Impact	Risk Rating				Likelihood	Impact	Risk Rating
10	Project vessels transiting to and from site				Project personnel	Collision with other vessels			3	3	9	Safety management system, competent personal, method statements and procedures. Notice to Mariners.			2	3	6
11																	
12																	
13	Installation, maintenance, and decommissioning in unfavourable weather conditions				Project personnel	Man overboard, injury.			4	4	16	Safety management system, competent personal, method statements and procedures with weather limitations for safe operation.			2	4	8
14																	
15																	
16																	
17	Project vessels on DP or on moorings				Project personnel	Contact with cables or snagging			3	2	6	Safety management system, competent personal, method statements and procedures			2	2	4
18																	
19																	
20																	
21	Project vessels working in close proximity to tether				Project personnel	Man overboard, injury.			3	4	12	Safety management system, competent personal, method statements and procedures with weather limitations for safe operation			2	4	8
22																	
23																	
24																	
25	Fishing gear in use or abandoned in area				Fishermen, and project personnel	Entanglement, injury.			4	3	12	Safety management system, contingency planning. Notice to Mariners. Kingfisher bulletin.			4	2	8
26																	
27																	
28																	
29	Uncertified equipment				Project personnel	Equipment breaking under load, injury, fatality			4	4	16	Safety management system, competent personal, method statements and procedures. Vessel and equipment auditing.			2	4	8
30																	
31																	
32																	
33	Deep drafted 3rd party vessel incompetence				Third party personnel	Allision with OREI			3	2	6	Marked by virtual AIS east cardinal buoy, limited damage (if any) can be caused to vessel. OREI buoyant and blades constructed of composite lightweight material. Notice to Mariners.			2	2	4
34																	
35																	
36																	
37	Device not visible				Third party personnel	Allision with OREI			3	2	6	Marked by virtual AIS east cardinal buoy. The safe underkeel clearance is 3.5 metres. Notice to Mariners.			2	2	4
38																	
39																	
40																	
41	Components breaking adrift				Third party personnel	Collision			3	2	6	Third party verification. Remote monitoring. OREI buoyant and blades constructed of composite lightweight material. Contingency planning.			2	2	4
42																	
43																	
44																	
45	3rd Party vessel NUC (not under command)				Third party personnel	Allision with OREI			3	2	6	The safe underkeel clearance is 3.5 metres. OREI buoyant and blades constructed of composite lightweight material. Remote monitoring.			2	2	4
46																	
47																	
48																	
49	3rd party vessel manoeuvring to avoid other vessel or OREI				Third party personnel	Collision or Allision			3	4	12	Marked by virtual east cardinal buoy but no surface obstruction. Notice to Mariners			2	4	8
50																	
51																	
52																	
53	Navigation near device				Third party personnel	Avoiding OREI causes collision with other vessel			3	4	12	Marked by virtual east cardinal buoy but no surface obstruction. Notice to Mariners			2	4	8
54																	
55																	
56																	
57	Navigation over device				Third party personnel	Allision			3	2	6	The safe underkeel clearance is 3.5 metres. OREI buoyant and blades constructed of composite lightweight material. Remote monitoring.			2	2	4
58																	
59																	
60																	
61	Vessels anchoring near site				Third party personnel	Anchor snagging causing heeling and foundering of smaller vessels			3	4	12	Strong tidal stream in vicinity not suitable for routine anchoring along most of route. Notice to Mariners			2	4	8
62																	
63																	
64																	
65	Project vessels working with cable				Project personnel	Equipment breaking under load, entanglement injury, fatality			3	4	12	Safety management system, competent personal, method statements and procedures. Vessel and equipment auditing.			2	4	8
66																	
67																	
68																	
69	Entanglement of tether with project or third party vessels				Third party personnel	Equipment breaking under load, entanglement injury, fatality			3	4	9	The safe underkeel clearance is 3.5 metres of blades, tether is taut. Contingency planning and remote monitoring.			2	4	8
70																	
71																	
72																	
73	Sailing vessels navigating in close proximity				Third party personnel	Allision			2	3	6	The safe underkeel clearance is 3.5 metres of blades, tether is taut.			2	2	4
74																	
75																	
76																	

15 Annex – Traffic Survey Data

The following AIS data covers a full 5 months from July 2022 to November 2022 inclusive. AIS tracks are categorised by the following vessel types:

- Passenger
- Search and Rescue
- Cargo
- Tugs
- Special craft
- Recreational craft
- Fishing vessels
- Vessels not declared.
- Vessels uncategorised

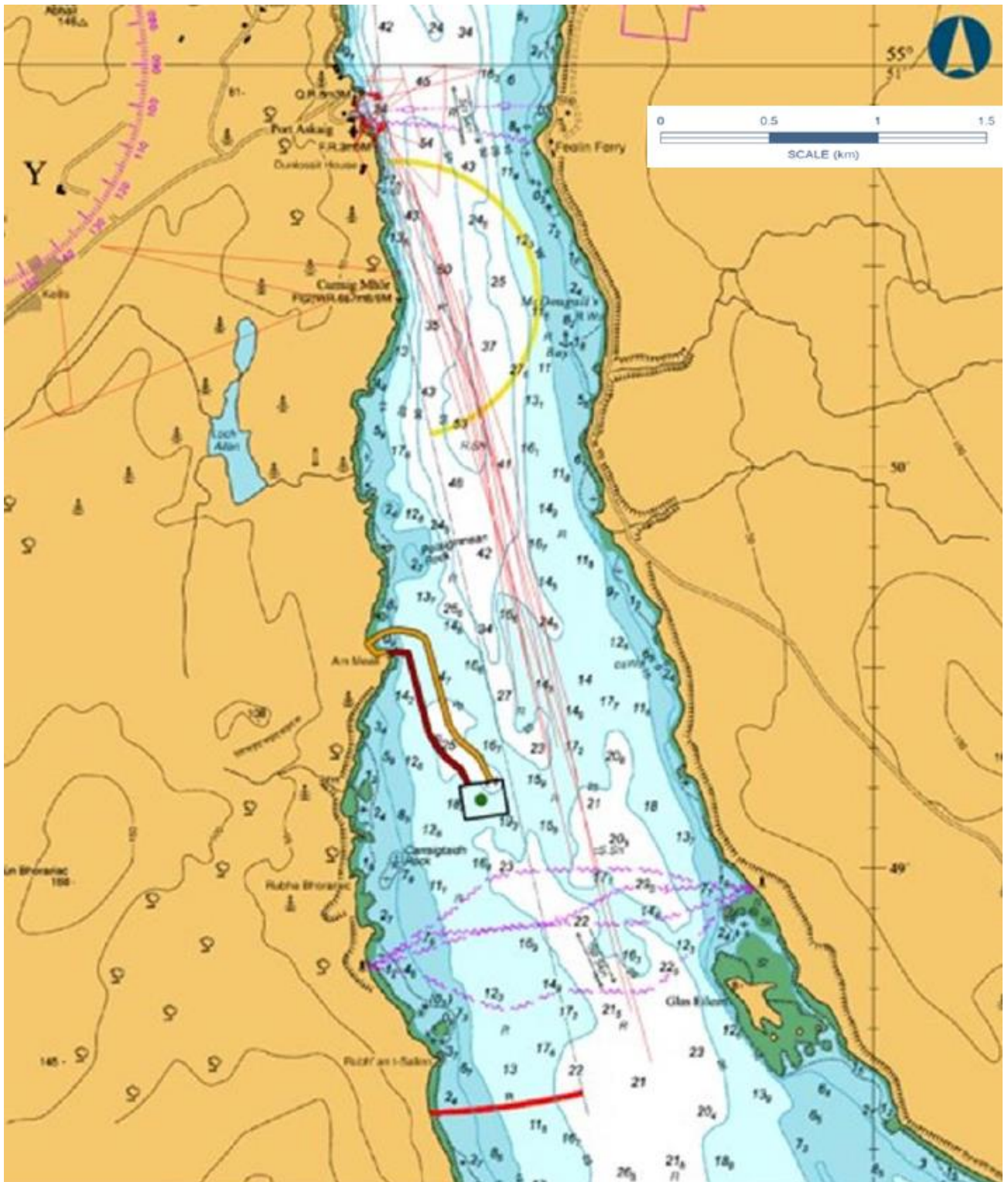


Figure 11 Search and Rescue - July-November 2022– Not to be used for Navigation- scale is approximate.

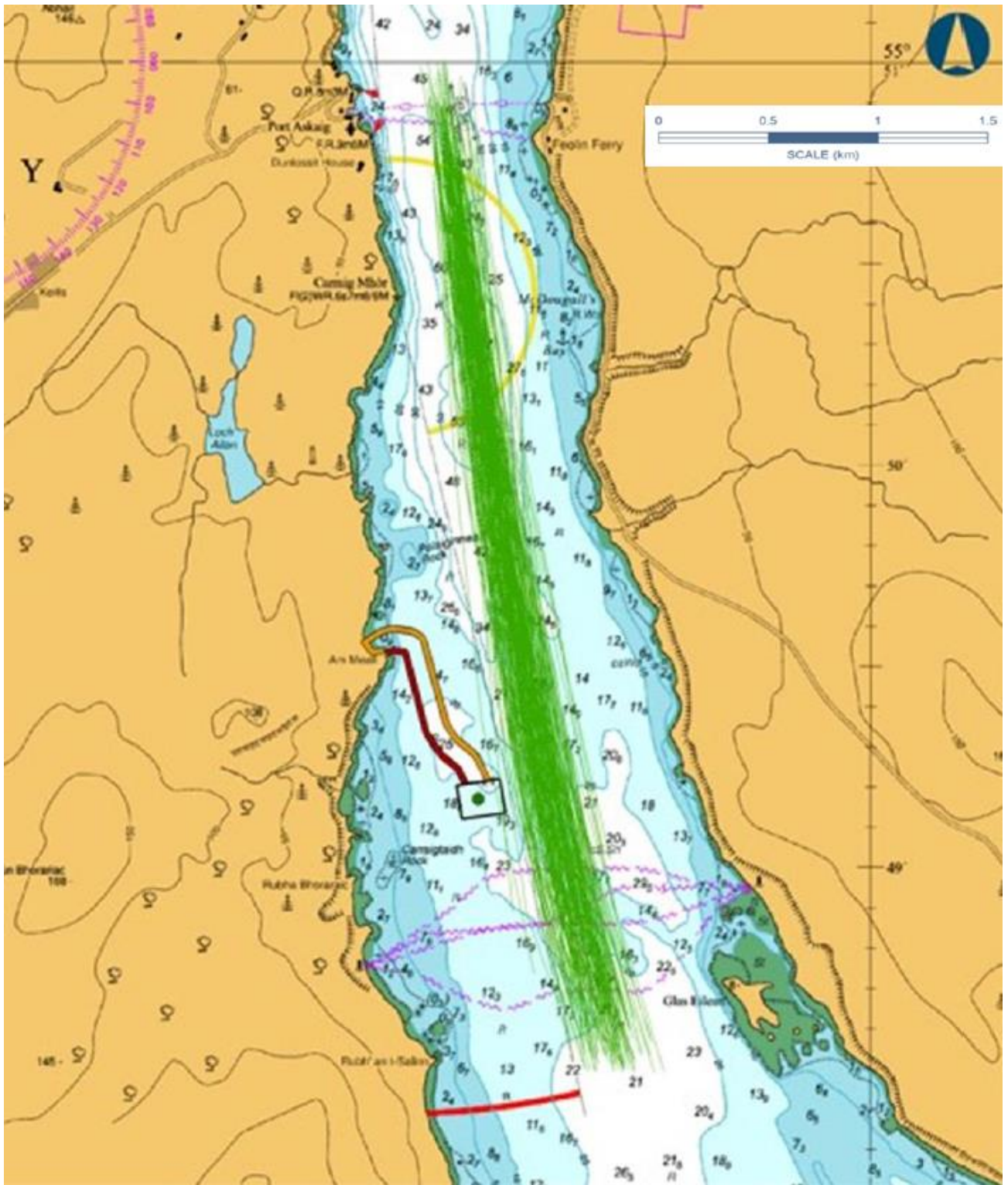


Figure 12 Cargo - July-November 2022– Not to be used for Navigation – scale is approximate.

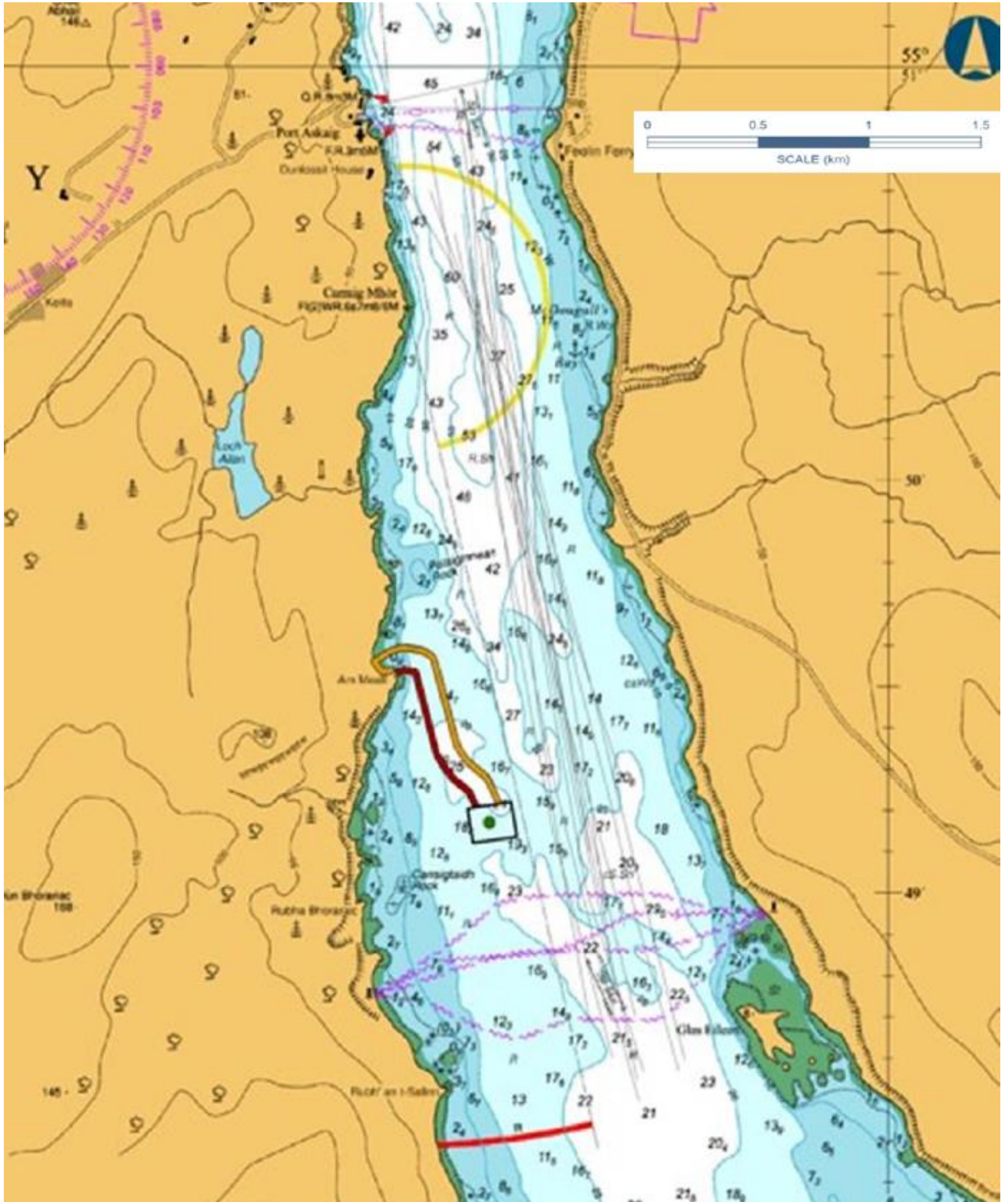


Figure 13 Tugs - July-November 2024– Not to be used for Navigation – scale is approximate.

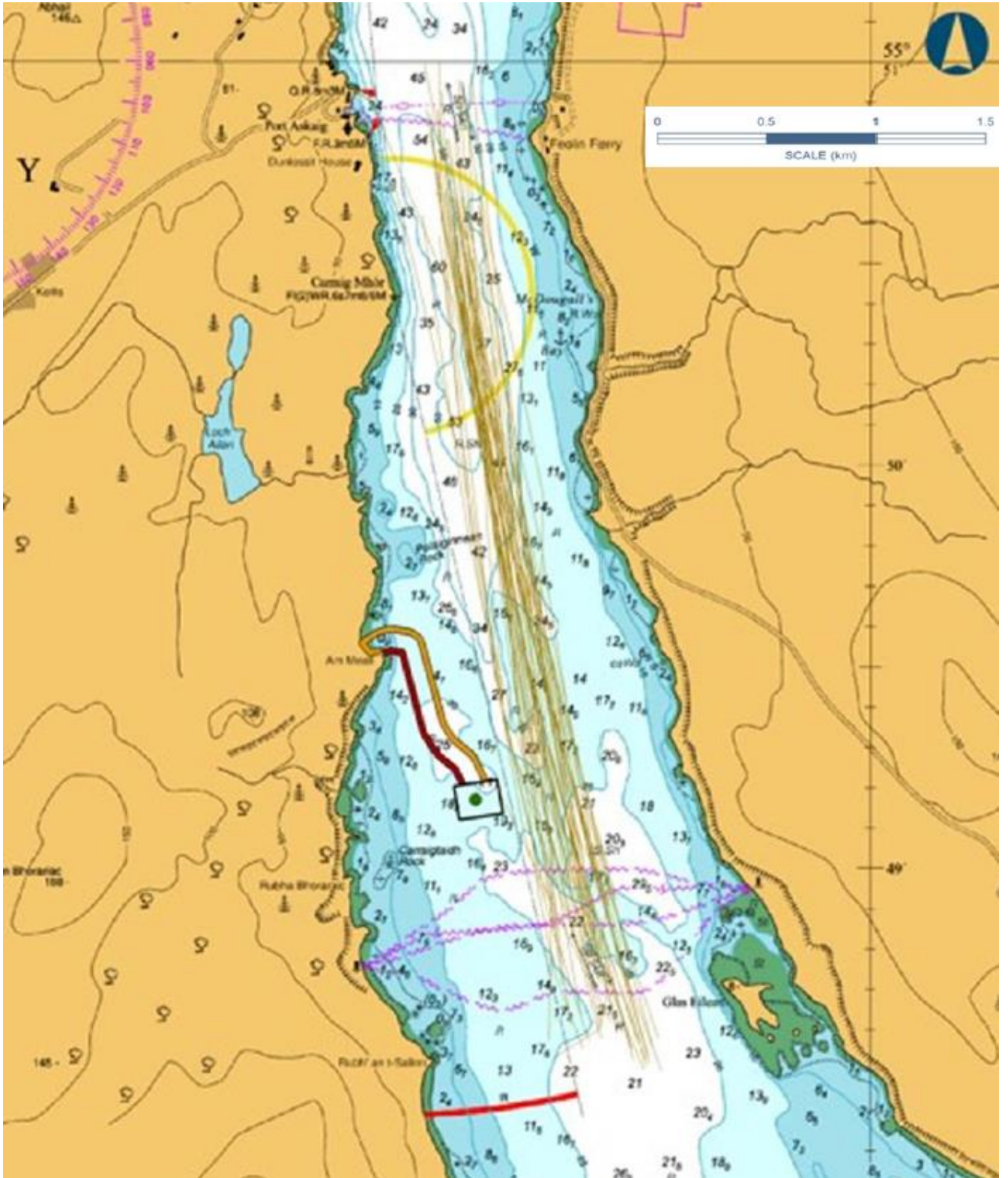


Figure 14 Special Craft - July-November 2022– Not to be used for Navigation – scale is approximate.

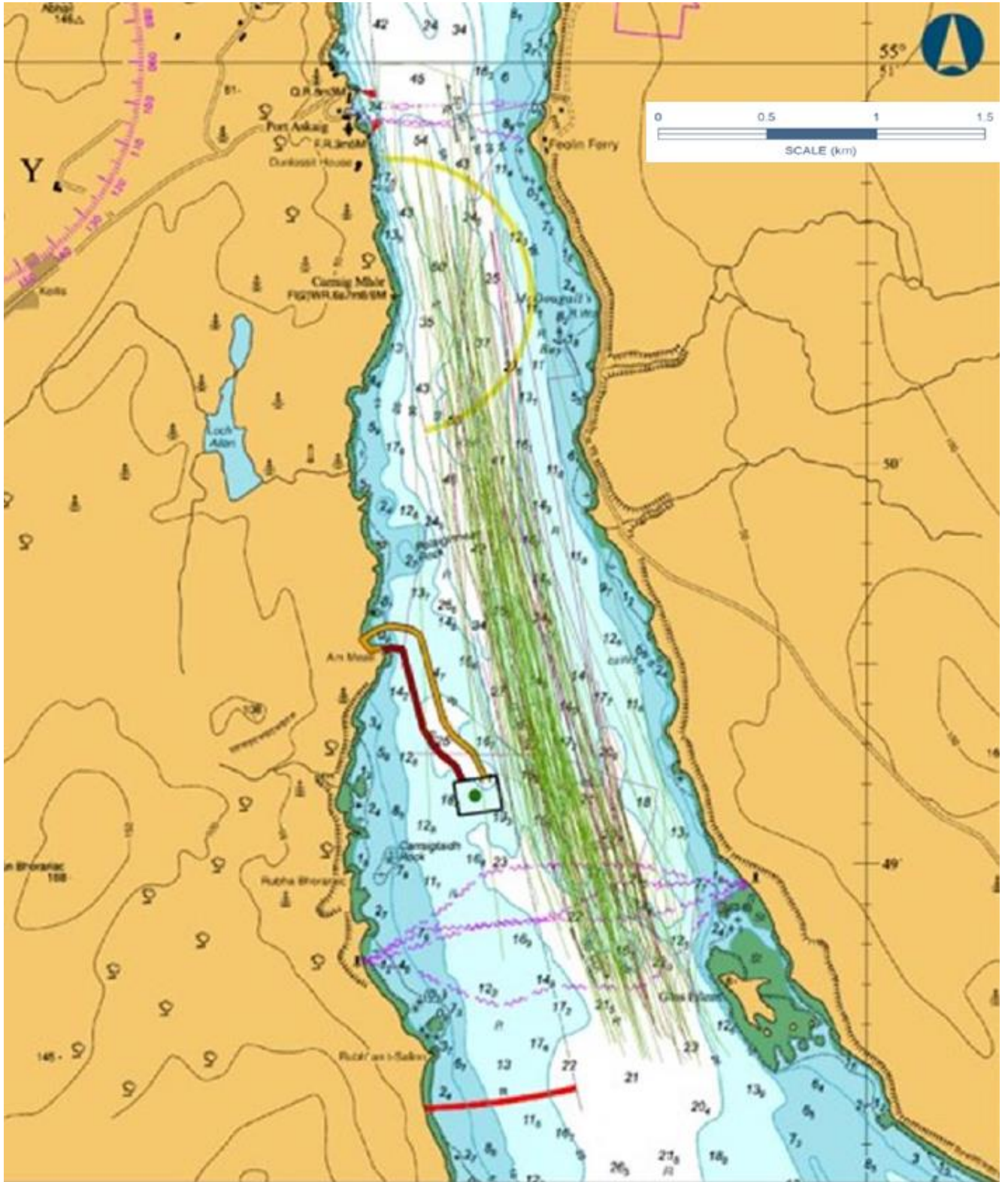


Figure 15 Recreational Craft - July-November 2022– Not to be used for Navigation – scale is approximate.

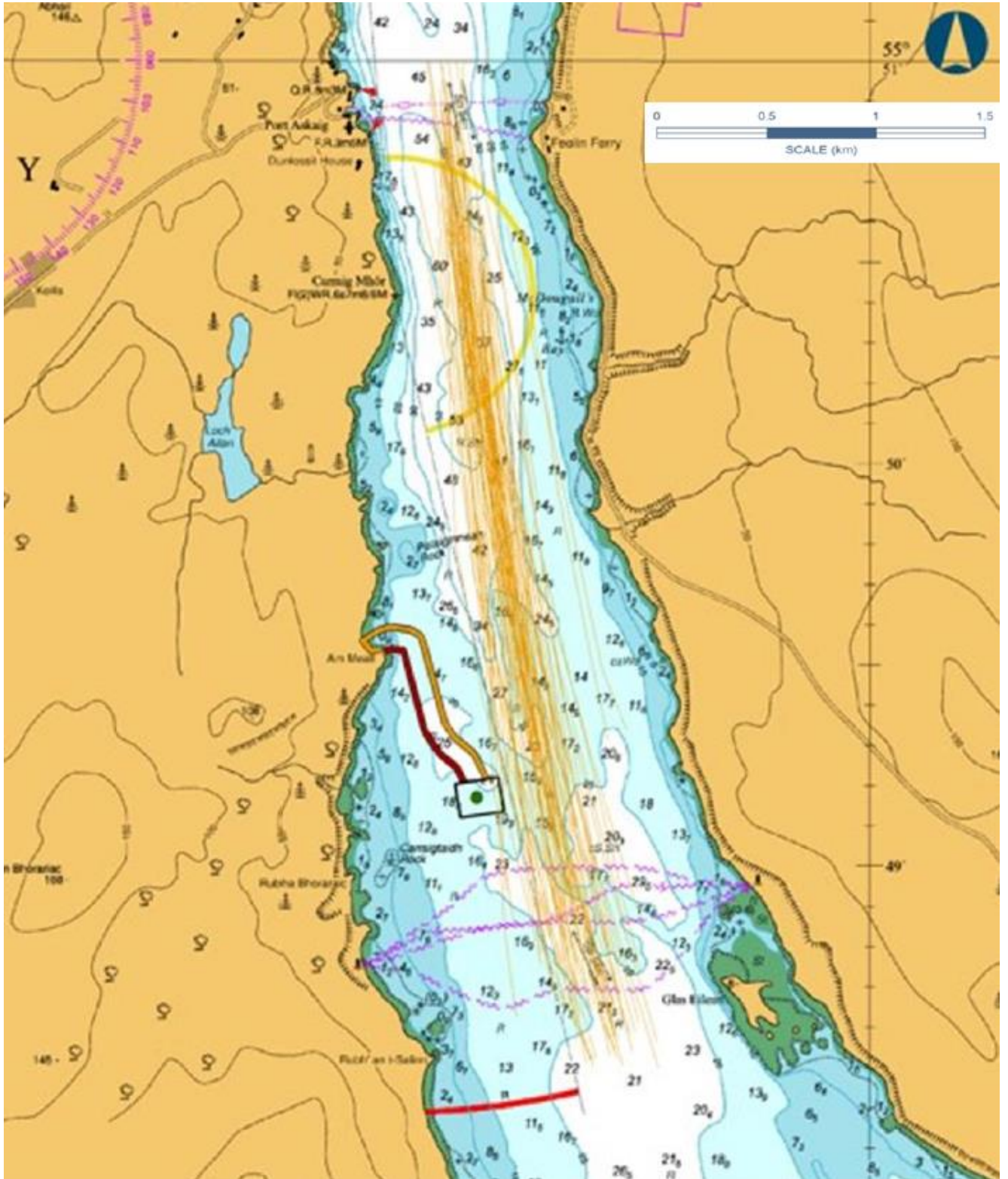


Figure 16 Fishing vessels - July–November 2022– Not to be used for Navigation – scale is approximate.

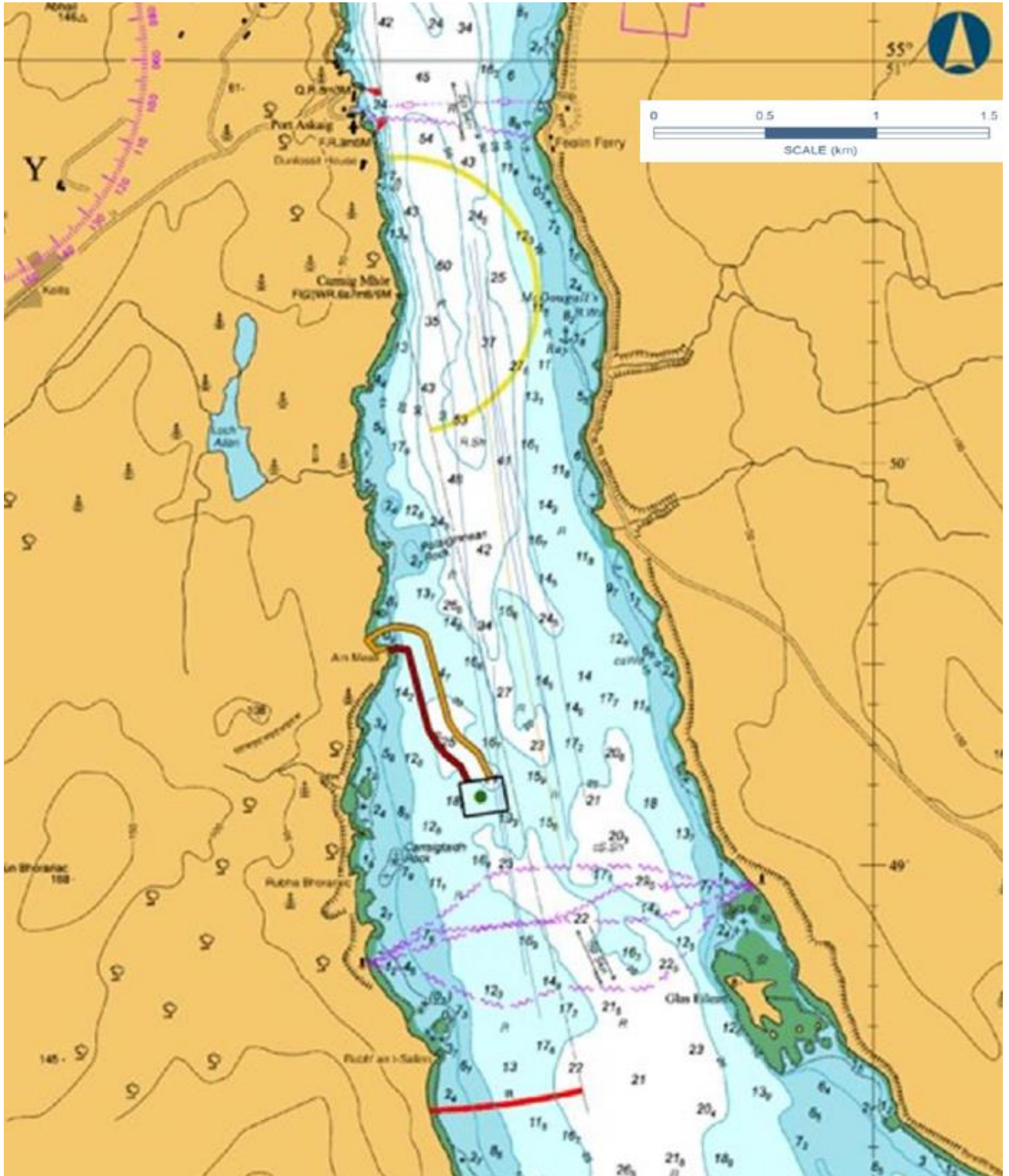


Figure 17 Vessel type not declared July-November– Not to be used for Navigation – scale is approximate.

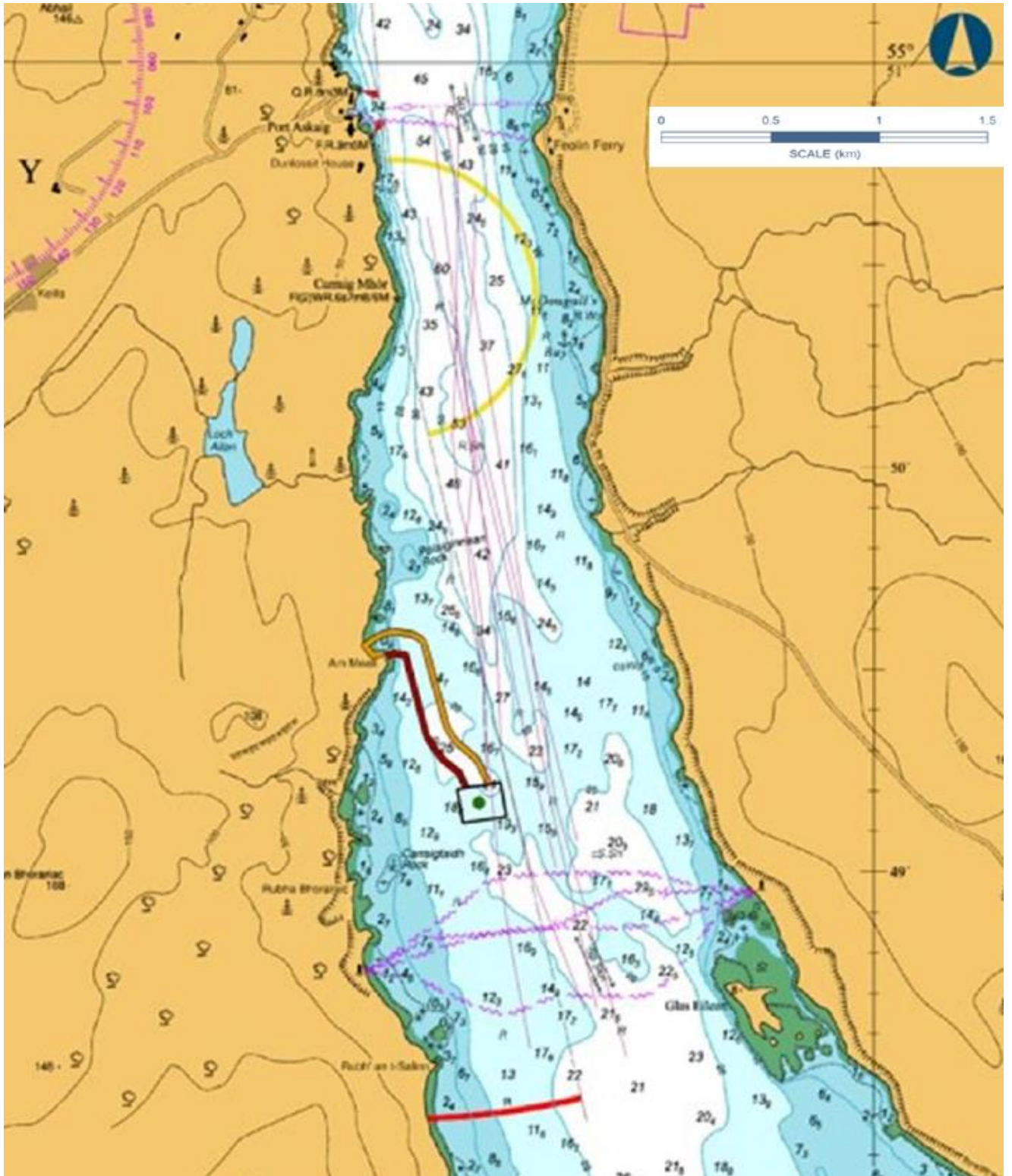


Figure 18 Vessel type uncatagorised – July-November 2022– Not to be used for Navigation – scale is approximate.

16 Annex – Tables of Coordinates

Coord	Main Turbine Anchor
Latitude	55.81948132
Longitude	-6.095615587

Co-ordinates of cable corridor				
Western Extents. Point No:	Latitude		Longitude	
1	55	49.53086	-6	6.14484
2	55	49.53678	-6	6.12963
3	55	49.5382	-6	6.11979
4	55	49.53946	-6	6.10528
5	55	49.53566	-6	6.06378
6	55	49.33931	-6	5.97048
7	55	49.33232	-6	5.96518
8	55	49.29257	-6	5.92129
9	55	49.27854	-6	5.89891
10	55	49.24478	-6	5.8261
11	55	49.20794	-6	5.79498
Eastern Extents. Point No:	Latitude		Longitude	
1	55	49.53886	-6	6.16237
2	55	49.53511	-6	6.2072
3	55	49.55922	-6	6.24164
4	55	49.58401	-6	6.17626
5	55	49.58774	-6	6.16172
6	55	49.59128	-6	6.13671
7	55	49.59329	-6	6.11349
8	55	49.5934	-6	6.10095
9	55	49.58747	-6	6.035
10	55	49.58285	-6	6.01606
11	55	49.57469	-6	5.99557
12	55	49.56901	-6	5.98519
13	55	49.56202	-6	5.97832
14	55	49.35705	-6	5.87984
15	55	49.32618	-6	5.84637
16	55	49.31854	-6	5.83464
17	55	49.28414	-6	5.76047
18	55	49.27984	-6	5.75305
19	55	49.2763	-6	5.74819
20	55	49.27133	-6	5.74277
21	55	49.21617	-6	5.69608

17 Annex - Extract from Wave Study (Wark Consulting 2022)

Offshore Wind / Wave Direction Deg	Hs (m)	Hmax (m)	Tp (sec)	Tm01 (sec)	Peak Wave Direction Deg TN	Mean Wave Direction Deg TN
0	0.52	1.04	4.8	3.9	0.0	2.5
30	0.47	0.93	4.4	3.7	0.0	7.6
60	0.36	0.72	4.0	3.3	0.0	40.4
90	0.47	0.94	4.1	3.4	135.0	127.8
120	0.61	1.21	4.7	3.9	135.0	139.2
150	0.60	1.19	4.9	4.1	141.8	143.6
180	0.47	0.92	5.0	4.2	145.2	148.2
210	0.28	0.56	5.1	4.2	145.2	160.3
240	0.18	0.36	4.4	3.7	192.3	208.1
270	0.17	0.33	4.9	4.0	220.3	268.6
300	0.17	0.33	5.3	4.4	345.7	322.1
330	0.21	0.40	6.2	5.2	0.8	355.7

Figure 19 Predicted Extreme Wave Conditions: 1in 100-year return period.

18 Annex – References

No.	Title	Document no.	Rev.
1	Sound of Islay Updated Wave Study – Wark Consulting 28 January 2022	WECC/2022/01/28	1
2	MGN 654 Safety of Navigation: Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response.	MGN 654 Annex 3	
3	Methodology for Assessing Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI)	April 2021	