Llywodraeth Cymru
Welsh Government

Sector Locational Guidance: Enabling Evidence for Sustainable Development

Tidal Stream Energy

December 2021

Context for Sectoral Locational Guidance

The Welsh Government, as the marine planning authority, has produced this tidal stream energy Sector Locational Guidance (SLG), implementing Welsh National Marine Plan (WNMP) sector supporting policy **ELC_03b (low carbon energy (supporting) tidal stream)**, which encourages a collaborative approach to understanding opportunities for the sustainable development of the sector.

This document represents an ongoing process. It builds on initial work undertaken by Atkins, Venn Associates and Pembrokeshire Coastal Forum, carried out in collaboration with industry representatives, regulators, and environmental specialists, through a series of stakeholder engagement events.

This version of the SLG describes the resources relevant to the sector's future prospects, how it may interact spatially with other sectors and also wider social and ecological considerations.

It is intended this SLG will support the sustainable development of the sector, informing identification of future opportunities. It will do this by helping guide the industry in their planning for future development (including through signposting to areas of potential consenting complexities), and through promoting engagement and dialogue within and between sectors.

Over time, SLG will feed into marine planning, including the potential identification of Strategic Resource Areas to safeguard areas of tidal stream resource. The Welsh Government is committed to engaging with stakeholders to further develop this SLG.

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Cover Image supplied by Visit Wales

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ACRONYMS AND ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
AIS	Automatic Identification System
AONB	Areas of Outstanding Natural Beauty
CSAG	Consenting Strategic Advisory Group
EIA	Environmental Impact Assessment
ESO	Electricity System Operator
EU	European Union
GW	Gigawatt
HV	High Voltage
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
iVMS	Inshore Vessel Monitoring System
LA	Local Authority
LSOA	Lower layer Super Output Area
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zone
MEECE	Marine Energy Engineering Centre of Excellence
META	Marine Energy Test Area
MEW	Marine Energy Wales
MoD	Ministry of Defence
MRESF	Marine Renewable Energy Strategic Framework
MW	Megawatt
NRW	Natural Resources Wales
ORJIP	Offshore Renewables Joint Industry Programme
OSPAR	Oslo/Paris Convention (for the Protection of the Marine Environment of the North-East Atlantic)
O&G	Oil and Gas
O&M	Operation and Maintenance
RA	Resource Area
RSA	Recreational Sea Angling
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SEACAMS	Sustainable Expansion of the Applied Coastal and Marine Sectors
SLG	Sector Locational Guidance
SMMNR	Sustainable Management of Marine Natural Resources
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TCE	The Crown Estate
UK	United Kingdom
WIMD	Welsh Index of Multiple Deprivation
WMPP	Welsh Marine Planning Portal
WNMP	Welsh National Marine Plan
WPD	Western Power Distribution

1. Introduction

For the purpose of this SLG, the following definition of tidal stream energy should be used:

Definition

Tidal stream technologies specifically utilise the flow of water generated by tidal currents. Suitable locations for the deployment of tidal stream energy generators are currently limited by the technology to areas of strong tidal currents (minimum peak spring current of 1.5 m/s).

Section 3.1 outlines the different types of tidal stream technology currently in development and operation in Welsh waters.

1.1 Purpose of Sector Locational Guidance

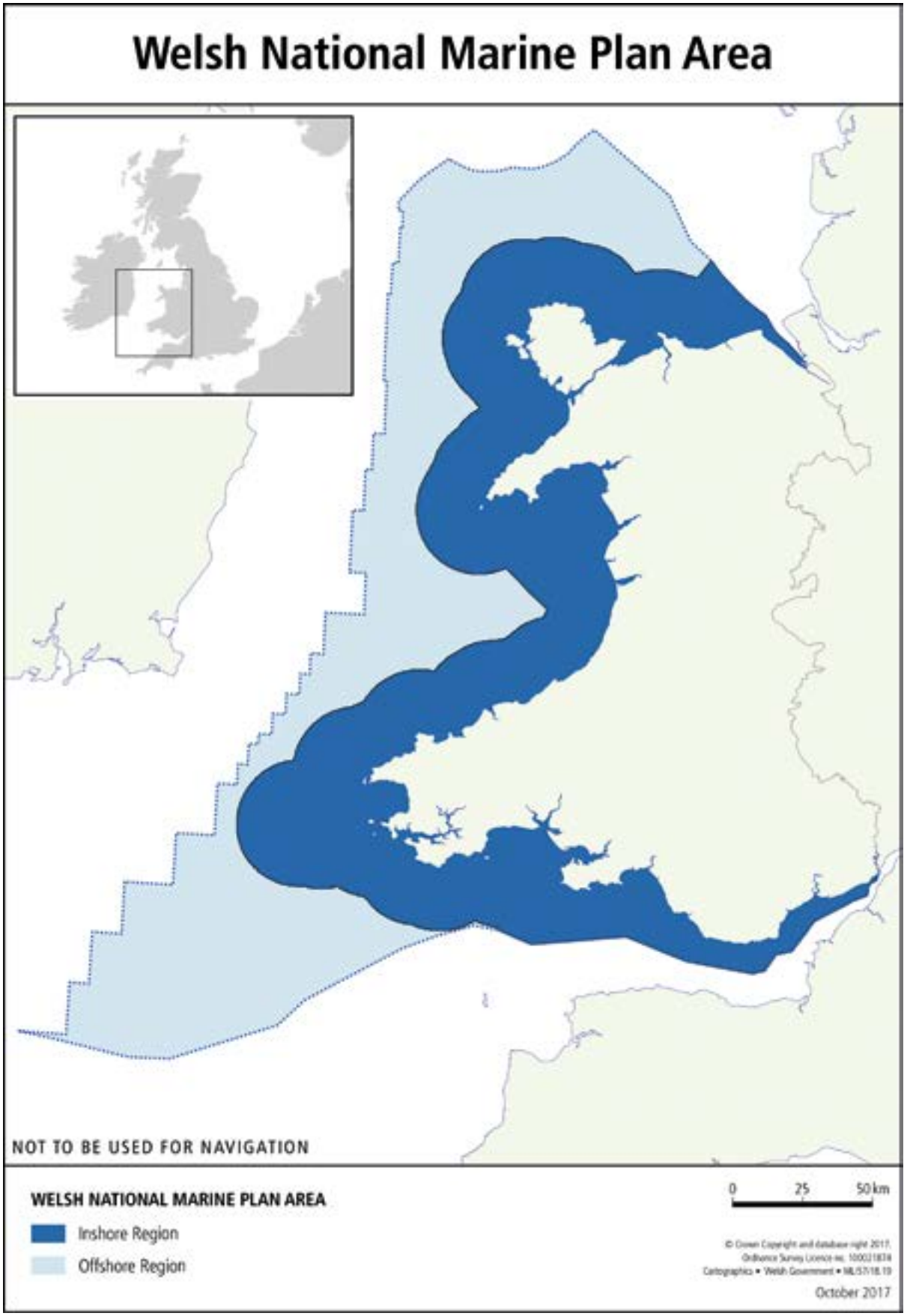
The purpose of this document is to **support characterisation of areas in Wales where there is good potential for tidal stream energy projects to prosper**. Bringing together technical and environmental knowledge with information on key social, cultural and economic issues and using this to understand future potential opportunities can support and enable the sustainable development of the sector. This SLG provides a relevant evidence base for tidal stream energy developers interested in operating in Welsh waters[1], highlighting key considerations and issues that may need to be addressed during project development and licensing processes. It will also inform the ongoing marine planning process. In order to support potential coexistence of multiple uses, the guidance also considers where opportunities may exist for the co-location of tidal stream technologies with other marine activities where potentially beneficial and practical.

The evidence landscape around tidal stream energy continues to develop, and considerations identified in this SLG may change over time. Knowledge gained from the deployment and monitoring of tidal stream energy technologies will also be key to further understanding. With time, this guidance may be developed to provide more specific signposting towards areas considered to be of higher potential for development.

This guidance has been developed in accordance with the Sustainable Development Principle and the five ways of working as set out within the Well-being of Future Generations Act. It is also informed by the Sustainable Management of Marine Natural Resources (SMMNR) principles of the Environment (Wales) Act, and the direction provided by the United Kingdom (UK) Marine Policy Statement to provide a proactive and spatially planned approach to the management of the marine area.

1 Tidal lagoons (tidal range technologies) are not included in this locational guidance.

Figure 1.1: WNMP Area



Source: WNMP, 2019

1.2 Marine planning policy context

In April 2019, Welsh Ministers declared a climate emergency. To address this, the Welsh Government has committed to achieving a carbon neutral public sector by 2030 and to make a decisive shift away from fossil fuels (Welsh Government, 2019). Welsh Government has committed to reaching net zero by 2050 and has also set ambitious targets for the generation of renewable energy including for Wales to generate 70% of its electricity consumption from renewable energy sources by 2030[2]. Welsh Government has specific targets for local ownership of renewable energy developments which include[3]:

- 1 gigawatt (GW) of renewable electricity and heat capacity in Wales is to be locally owned by 2030; and
- all new renewable energy projects from 2020 onwards are to have at least an element of local ownership.

The Welsh Government published the first **Welsh National Marine Plan (WMNP)**[4] in November 2019 to support the sustainable development of Welsh seas (Figure 1.1). The plan sets out Welsh Government's vision for the Welsh inshore and offshore regions and incorporated the Welsh Government's aim of supporting the development of marine renewable energy in Welsh waters (Figure 1.2).

2 Oral Statement on "Energy" delivered by the Cabinet Secretary for Environment and Rural Affairs to the National Assembly for Wales on 26 September 2017.

3 Welsh Government Policy statement: Local ownership of energy generation in Wales – benefitting Wales today and for future generations (Welsh Government, 2020).

4 Refer to WNMP: Vision, Objectives and Policies for additional information. **gov.wales/sites/default/files/publications/2019-12/welsh-national-marine-plan-vision-objectives-policies-quick-reference.pdf**

Figure 1.2: WNMP sector objective and supporting policies

WNMP Sector Objective: Energy – Low Carbon

1. To contribute significantly to the decarbonisation of our economy and to our prosperity by increasing the amount of marine renewable energy generated; and

2. To develop Wales as an exemplar of marine renewable energy technology by developing the essential skill base, infrastructure and technical knowledge to support the development of the industry over the next 20 years.

WNMP Sector Specific Supporting Policies

- ELC_03 a: Proposals for tidal stream energy generation will be supported where they contribute to the objectives of this plan. Proposals should comply with the relevant general policies and sector safeguarding policies of this plan and any other relevant considerations.
- ELC_03 b: In order to understand future opportunities for tidal stream energy development, relevant public authorities and the sector are encouraged, in liaison with other interested parties, to collaborate to understand opportunities for the sustainable use of tidal stream energy resources including identification of:
  - natural resources that provide potential opportunity for future use;
  - evidence to de-risk consenting for the sector; and
  - opportunities to define and, once in place, further develop and refine Strategic Resource Areas for tidal stream energy resource safeguarding;

  in order to support the sustainable development of the sector through marine planning.
  Relevant public authorities should make appropriate evidence available to support planning and decision making in order to support the sustainable development of the sector through marine planning, where it is appropriate to do so.

Source: WNMP, 2019

1.3 Sector Locational Guidance context and use

This SLG brings together information and data from a variety of sources to provide a preliminary evidence base for those involved in sectoral planning and developing location options for tidal stream energy projects. The SLG does not rule in or out specific areas for development; instead, it seeks to highlight environmental considerations, existing uses and associated infrastructure, sector interactions and social considerations. In doing so, the SLG provides a spatial understanding of potential sustainable development opportunities and challenges.

In considering this SLG, the following points should be noted:

- Understanding the range and interrelationships of a wide range of aspects important to the sector is a complex process. This guidance necessarily provides a high-level assessment of interactions using available evidence and incorporating stakeholder feedback.
- The presence of an area with a large number of constraints does not prohibit development. Rather, mapping such information highlights that an area already hosts multiple activities, contains important marine features or is subject to other constraints that might make development more challenging (e.g., take longer, reduce options, or increase costs). As set out in the WNMP, developers are advised to engage regulators and stakeholders early in project development to identify data needs, scope of assessments, ways of avoiding impacts that would need mitigating and whether mitigation measures may be viable.
- The SLG covers existing activities and looks forward. However, there may be activities that are not reasonably foreseeable at this time. Evolution in the use of marine resources and the speed at which technology changes will have a bearing on the options for sustainable use of Welsh waters.
- Maps have been created with accessible data and show the spatial distribution of activities at the time of publication. The absence of data may appear to indicate areas with few or no constraints which may be misleading. Such areas should always be investigated thoroughly as part of any optioneering process.
- Data used in this SLG is based on information available at the time of publication. As more data becomes available, this will need to be taken into consideration.
- The outputs of this SLG do not substitute the requirement for detailed project level assessment.
- This SLG is advisory and has no status in the decision-making process. It should be read alongside the WNMP and supporting Implementation Guidance[5].

5 gov.wales/welsh-national-marine-plan-implementation-guidance

2. Approach

2.1 Review and integration of existing work

The existing evidence base for future potential tidal stream energy resources has been reviewed and is reflected in this SLG. Sources used for the work are identified in Appendix A. Key sources include:

- SMMNR project reports (ABPmer, 2021 forthcoming). Elements of the SMMNR data have been incorporated into this SLG (see Sections 7 and 10 for further details)[6].
- Marine Renewable Energy Strategic Framework (MRESF) (Welsh Government, RPS 2007-2010).
- A review of the potential for co-existence of certain sectors in the WNMP Area (Cefas, 2020).

2.2 Stakeholder engagement

Effective and collaborative stakeholder engagement, creating cross-sector dialogue reflecting activities and interests across Wales, has been fundamental to the development of this SLG. This includes those operating within the tidal stream energy sector but also connects with representatives of wider marine interests in Wales and other maritime activities.

2.3 Sectoral interactions assessment

Sectoral Interactions Matrices have been used elsewhere in the UK as a means of capturing stakeholders' views on the nature of interactions between marine-related activities and interests in the early stages of marine planning for specific areas. This has been adapted for the SLG process to demonstrate the perceptions of interactions between the focal sector (tidal stream energy) and other marine sectors in Wales and provides a high-level assessment and a starting point for more detailed and in-depth studies in particular Resource Areas (RAs).

Sector interactions are used to inform the constraints analysis, and to better understand potential opportunities in the context of WNMP **policy ECON_02 (coexistence)** coupled with WNMP **sector supporting policies**.

Sectoral interactions assessment differs from the constraints analysis. Constraints analysis considers interactions in a way that may actively enable or preclude different activities from taking place as part of a decision-making process. Sectoral interactions assessment takes a more fundamental view of whether activities are perceived as being compatible with each other and helps contextualise spatial constraints analysis.

The following definitions are used for the sectoral interaction assessments:

- **Interactions:** where the proximity of two or more activities causes them to have an effect on each other. Interactions can be positive, neutral, or negative. They can also be likely, possible or unlikely. The assessment of interactions involves an element of judgement: two, or more, assessments of the same interaction may not reach the same conclusion about its outcome.
- **Co-existence:** Where multiple developments, activities or uses can exist alongside or close to each other in the same place and/or at the same time.
- **Co-location:** A subset of coexistence where multiple developments (often structures), activities or uses are located in the same place by sharing the same footprint or area in the marine environment. 'Footprint' can include both the physical location of a development or activity e.g., a built structure, and a wider area associated with the development or activity e.g., a surrounding safety zone. It could involve designing projects to accommodate multiple uses of marine space.

The approach to sectoral interactions used in the Cefas review of the potential for co-existence of different sectors in the WNMP area[7] has been adapted for this SLG. A range of marine activities have been assessed against the tidal stream energy sector and it has been identified where interactions and the potential for co-existence and/or co-location might be likely, possible or unlikely (See Section 9 for further details).

2.4 Constraints analysis

Constraints mapping has been undertaken to support the implementation of WNMP **general policies** (protecting socio-economic or environmental considerations) as well as safeguarding other sectors' interests (**policies SAF_01a and b**).
Sector-sector interactions have been considered to inform the constraints analyses and to better understand potential opportunities as a contribution to policy **ECON_02 (coexistence)** coupled with the relevant **sector supporting policies**.

Constraints analysis mapping is a process of mapping and interpreting spatial evidence to understand, for a particular activity or development, the spatial considerations which may influence the prospects of a proposal in a particular area. As a first step to understanding these spatial considerations, a list of key potential constraints to tidal stream energy development was identified drawing upon previous work undertaken for MRESF, alongside expert judgement. The distribution of these potential constraints was mapped to a 1 km^2 hexagonal grid, the same as that used for the SMMNR project, and the number of potential constraints was summed and is shown in Figure 10.21. The legend to Figure 10.21 lists the mapped potential spatial constraints.

Taken further, constraints analysis could develop a more refined understanding of spatial considerations to show differences in the relative constraints across areas. There is the potential to weight the relative importance of constraints in relation to the sector, and to combine multiple constraint layers to better understand their implications for development of the sector. Constraints mapping can be a useful tool to inform sectoral strategic planning but any such mapping exercise should clearly present the level of confidence and caution that should be applied in interpreting the resultant maps.

Developers will have different approaches, priorities, and risk appetites in relation to projects and will typically undertake their own constraints analysis in the project development process. The analysis presented here is intended to provide an accessible and focussed evidence base, and an early/high level indication of potential risks/issues to consider in the site selection process. It could also contribute to supporting the implementation of the WMNP's **general policies**, such as protecting socio-economic or environmental considerations (**ECON_01**), considering co-existence opportunities (**ECON_02**), and safeguarding other sector interests (**SAF_01a and b**).

Analysis of potential constraints to development has drawn on existing data, which has been supplemented with information gathered through stakeholder engagement and in discussion with Natural Resources Wales (NRW). The assessment of constraints relating to the different forms of tidal stream energy considered in this SLG is based on information gathered during the MRESF project and highlights those aspects where interactions between the itemised elements may be considered as a significant constraint. Elements given a high score (a score of 4 or 5) would likely cause delay and could possibly stop a tidal stream energy project from progressing.

7 Cefas, 2020. Mengo, E., Mynott, F. and Muench, A. A review of the potential for co-existence of different sectors in the Welsh Marine Plan Area. **gov.wales/review-potential-co-existence-different-sectors-welsh-marine-plan-area**

At the site selection stage, environmental designations are typically used by developers as an indication of the potential sensitivity and consenting risk associated with an area. Although site boundaries provide a limited indication of features and locations of mobile species, additional important considerations may lie beyond the boundaries but still need to be taken into account.

Environmental sensitivities are more nuanced than some of the physical characteristics or constraints associated with other marine users. The scoring approach used in SMMNR has attempted to reflect the spatial occurrence, conservation importance, and potential for impact pathways for different features. SMMNR outputs have been included in the constraints analysis. Further detail on the assessment of environmental sensitivities and the interpretation of the scoring outputs can be found in the SMMNR reports[8].

For the majority of constraints, both from other marine users, activities and ecological sensitivities, there are opportunities to either manage the interaction, microsite around key sensitivities, or apply appropriate mitigation. These options can only be properly explored at project level, so such areas should not be excluded prematurely at the site selection or marine planning stage but recognised as areas with particular characteristics which require consideration. Nevertheless, it is also recognised that there are some consenting risks that require better understanding before they can be resolved. If the risks are considered significant enough it may be appropriate, sensible, and more cost-effective to exclude the site at an early stage of any site selection process.

8 Sustainable management of marine natural resources **gov.wales/sustainable-management-marine-natural-resources**

3. Tidal stream energy resource

3.1 Resource Areas

Tidal stream resource is the key driver for site selection. The available tidal stream energy is based on areas of flows in excess of 1.5 m/s (Figure 3.1). The RAs were defined using the parameters set out in Table 3.1, and also include resource further offshore.

The tidal stream RAs[9] are defined in the WMNP (Figure 3.2), as informed by a study commissioned by Welsh Government in 2011 (MRSEF, 2011). There are four tidal stream RAs; these are considered separately within this SLG in Sections 10.1 – 10.4.

Table 3.1: Tidal stream energy technical parameters

Energy Type	Device Type Group	Device Type Sub-Group	Distance from shoreline	Water Depth	Energy Requirement
Tidal	Stream	Rotating turbine	< 100 m – 5 km	Generally, 20 – 60 m with some > 100 m	Min > 5 knots or 2 – 2.5 m/s spring peak velocity (some potentially 1.5 m/s)
		Hydroplanes, hydrofoils and sails	Coastal (especially estuaries) with potential for some devices offshore	Shallow coast or potentially offshore	2 m/s tidal velocity
		Single Blade	–	–	–
		Venturi Effect	Often rivers, estuarine, narrow straits	2 m (rivers) 10 – 60 m (marine)	2 m/s tidal velocity

(Source: MRESF, 2011)

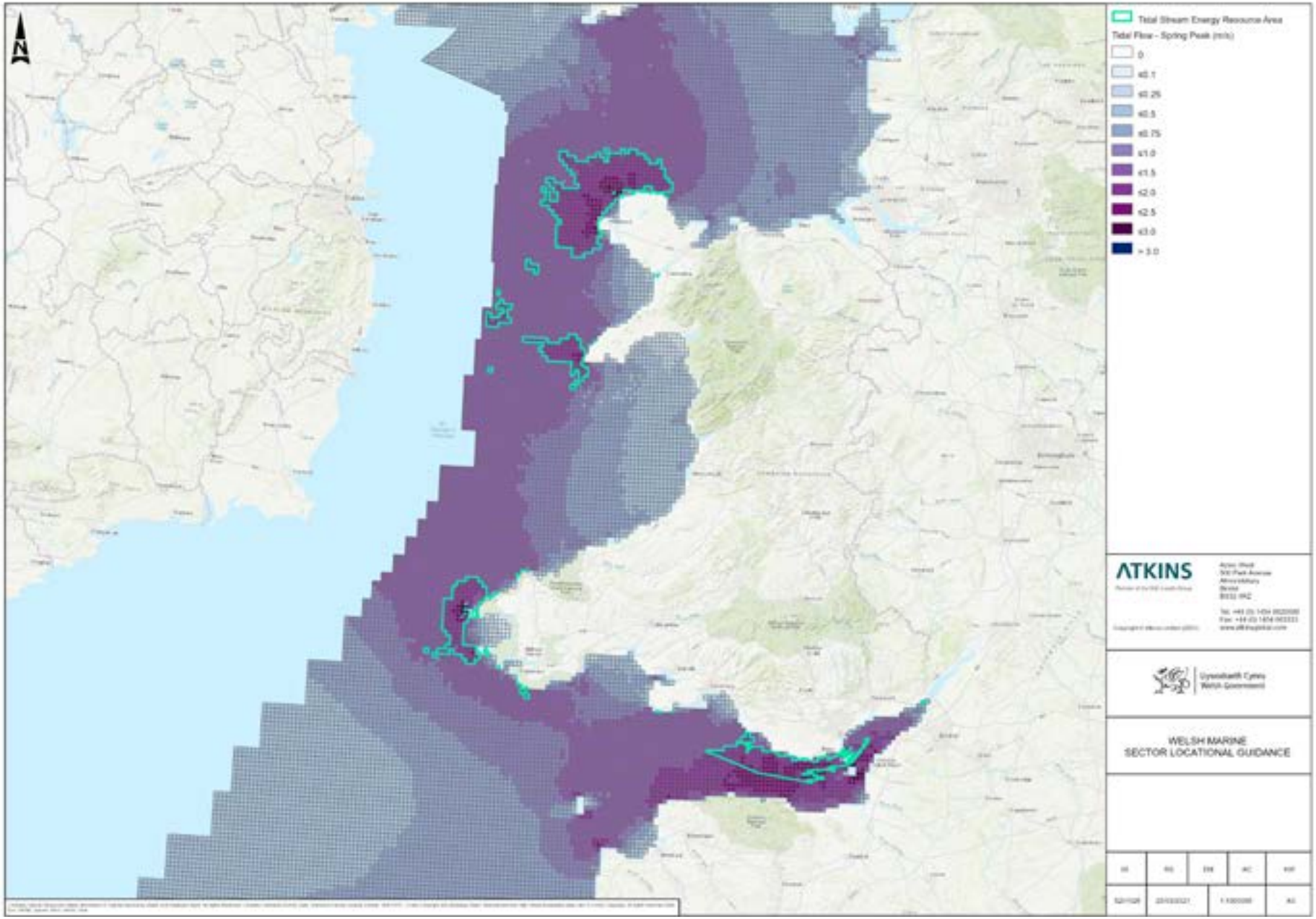
Tidal stream current speed is typically used as an early indication of resource at a site. The energy over a full tidal cycle is the important metric to assess the viability of a site but this needs to be determined through site surveys.

Hydrodynamic models that cover Welsh waters have been developed by both Bangor University and Swansea University. These can predict the tidal stream resource but rely on measurement data for validation.

Resource surveys using Acoustic Doppler Current Profiler (ADCP) deployments have been undertaken in most of the RAs. Seabed surveys are important to inform the engineering design of a project and geophysical surveys have also been undertaken by academia in most of the RAs. Where surveys have been carried out, and data is publicly available, this has been highlighted in the relevant RA section below.

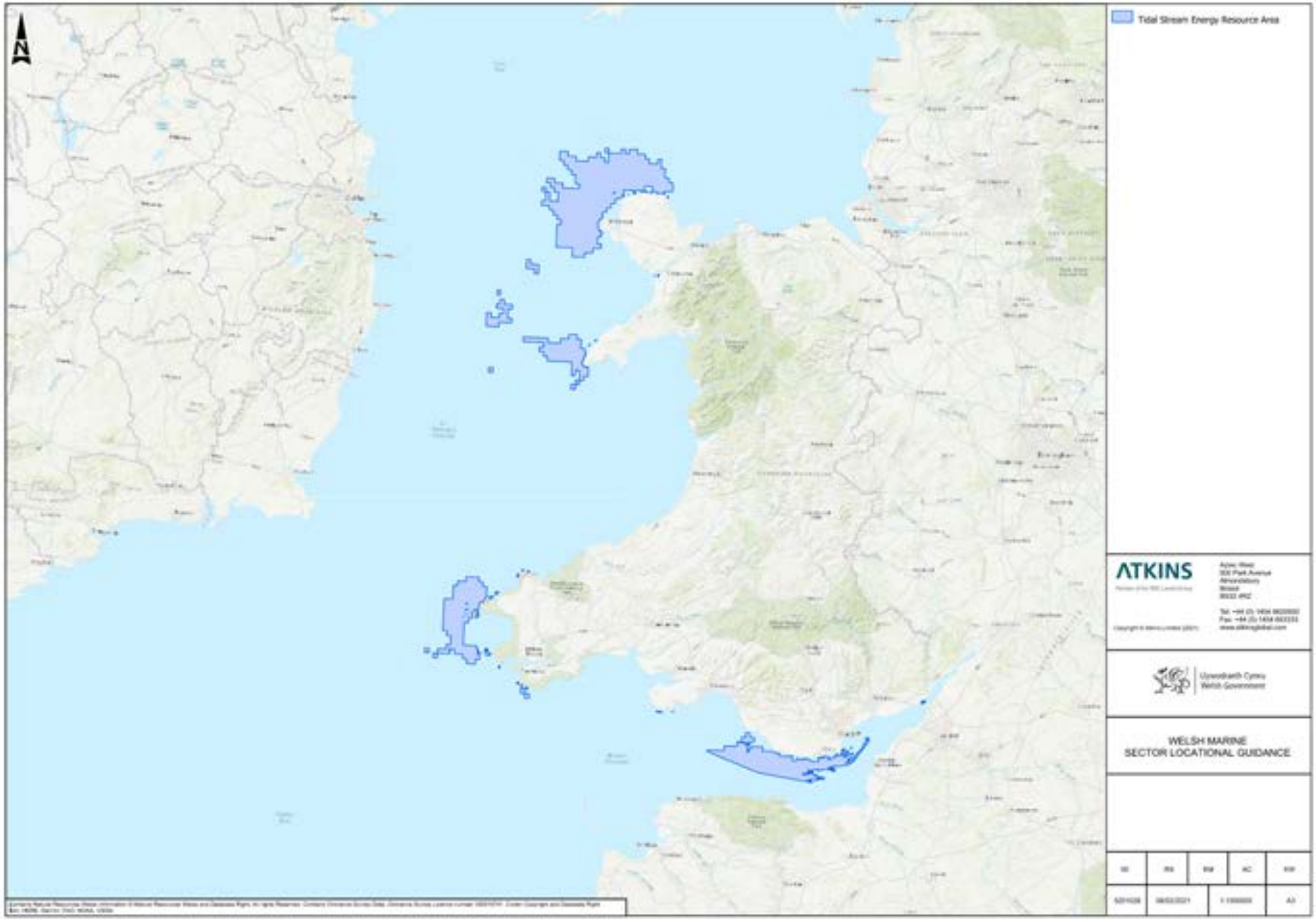
9 RAs are broad areas that describe the distribution of a resource that either has the potential to be used or is in use.

Figure 3.1: Tidal stream potential (flow) with RAs in Wales



Source: Renewables Atlas, 2020

Figure 3.2: Tidal stream energy RAs around Wales



Source: Lle, 2021

4. Current activity & future development

Tidal stream energy generation is an emerging industry in Welsh waters. The WNMP has identified that there is a substantial tidal stream energy resource at several locations in Welsh inshore waters (see Figure 3.1 and Figure 3.2), mainly where water flows are restricted, such as within narrow channels and around coastal headlands where the constriction of flow accelerates the tidal current (Roche *et al*., 2016). A number of supportive factors have been identified, placing Wales in a competitive position with regard to developing the tidal stream energy sector. This includes proximity of energy resources to population centres, existing energy industry capability, existing port facilities and associated supply-chains (Halcrow, 2012), as well as existing high voltage grid infrastructure.

Welsh Government prioritised €100 million of European Union (EU) structural funds (2014-2020) for marine energy in Wales (MEW, 2020a) with the strategic objective to increase the number of wave and tidal energy devices being tested in Welsh waters and off the Welsh coast, including multi-device array deployments, helping to establishing Wales as a centre for marine energy innovation and production including tidal stream energy technology.

4.1 Tidal stream energy technology

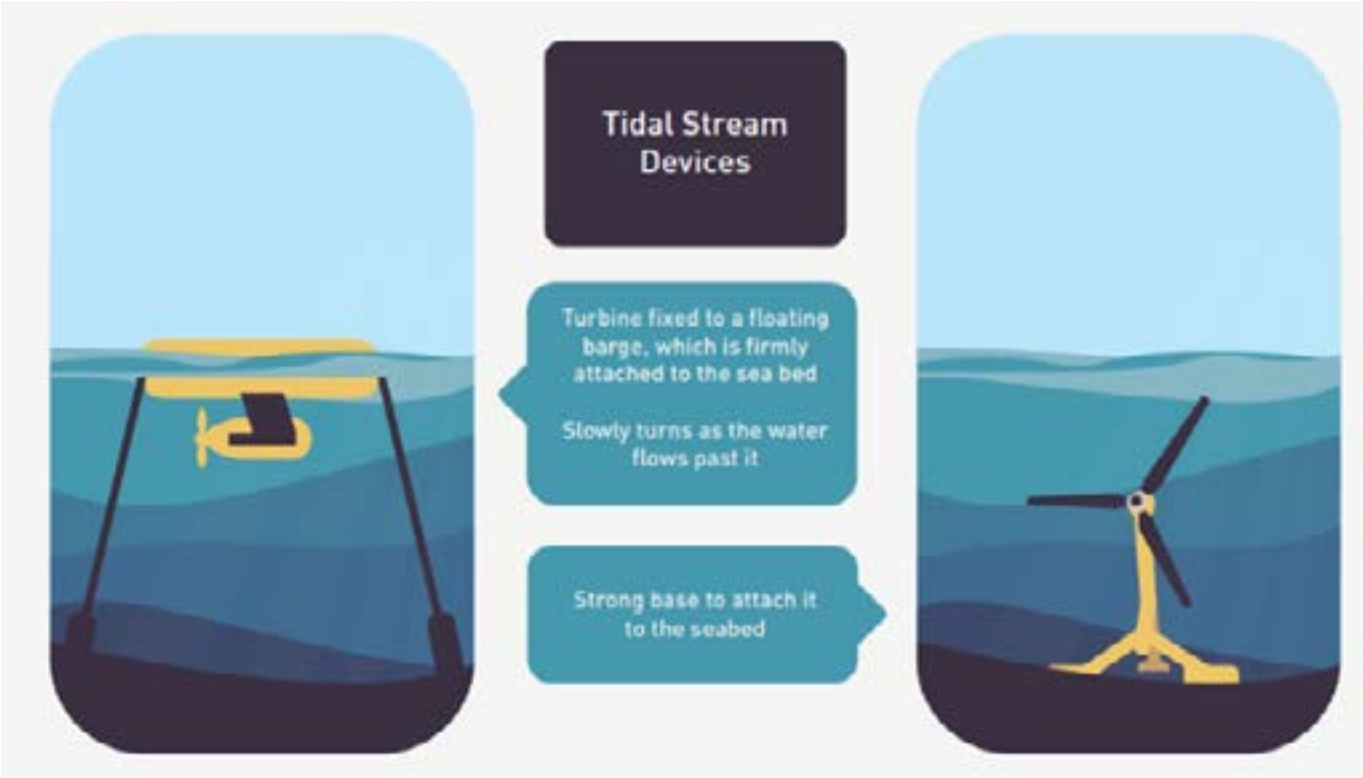
There are a number of different types of tidal stream devices at various stages of proof of concept and testing (see Figure 4.1). The European Marine Energy Centre describes six main types of devices:

- horizontal axis turbine;
- vertical axis turbine;
- oscillating hydrofoil;
- enclosed tips (venturi);
- archimedes screw; and
- tidal kite.

Devices can either be seabed mounted (e.g., Nova Innovation), mid-water (e.g., Minesto Deep Green tidal kite) or surface emergent (e.g., Orbital Marine Power). No single design has proven more effective/deployable to date and it is, therefore, not possible to determine which, if any, of the current designs might dominate a future tidal stream energy market, or if a range of devices may be commercially viable.

For this SLG, tidal stream technologies have been divided into three categories: surface, mid-water and seabed mounted.

Figure 4.1: Tidal stream devices



Source: Marine Energy Wales

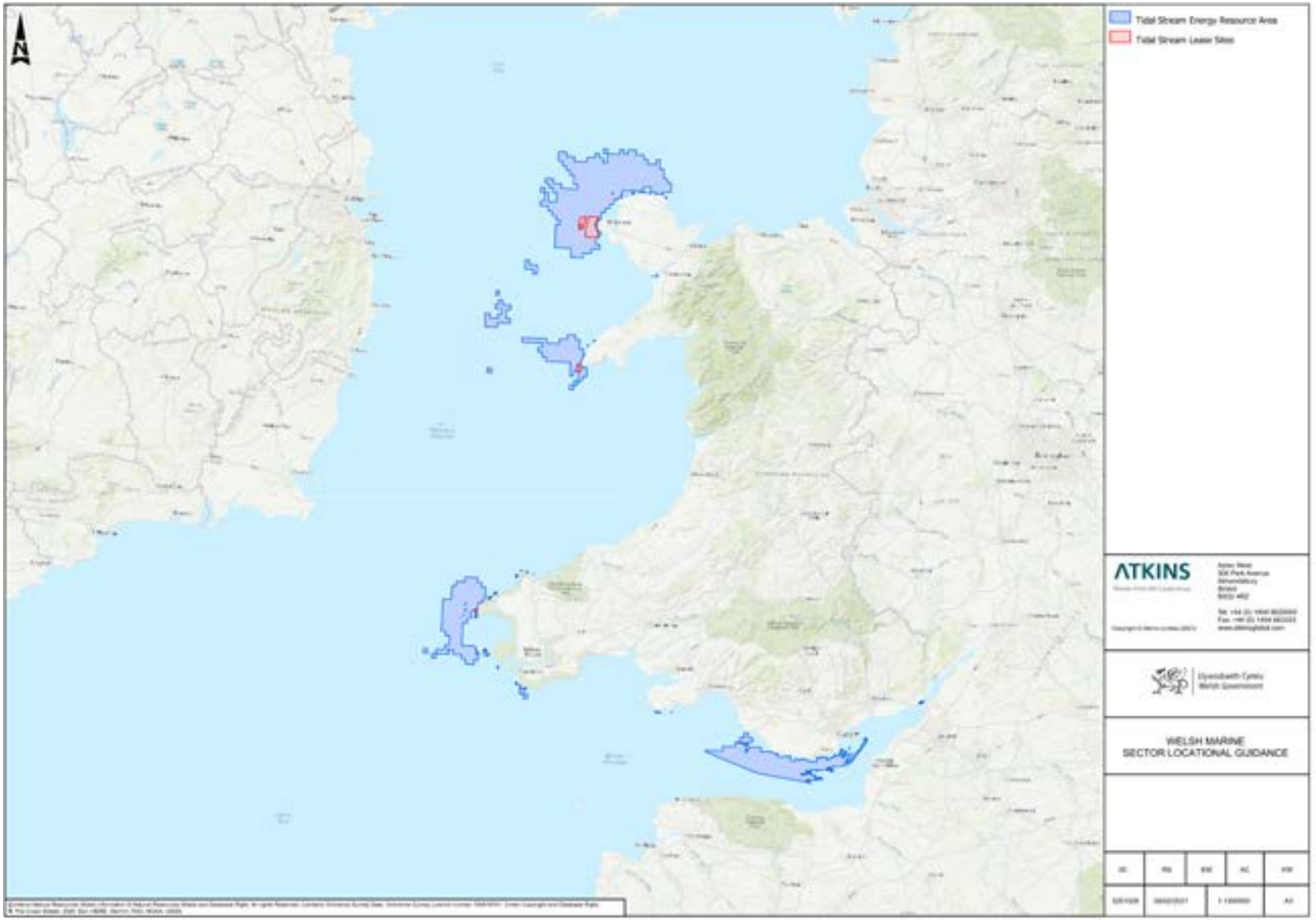
4.2 Projects in Welsh waters

A total of 16 marine renewable energy developers are actively progressing projects in Wales, with seabed lease agreements in place for over 532 megawatts (MW) of marine energy sites (MEW, 2020). Figure 4.2 shows the existing tidal energy lease areas in relation to the tidal stream RAs.

Since 2015 a number of tidal stream 'test' devices have been deployed in Welsh waters such as in Holyhead Deep, North Wales (Minesto UK Ltd), and in Ramsey Sound, Pembrokeshire (Tidal Energy Ltd). Phase 2 of the Marine Energy Test Area (META) in the Milford Haven waterway secured consent in early 2021 that will enable further test deployments. The Ramsey Sound site is also being repurposed for further testing of tidal energy devices (Cambrian Offshore Ltd).

In 2019, Menter Môn submitted a marine licence application for the installation and commercial demonstration of multiple arrays of tidal stream energy devices up to an installed capacity of 240 MW in the West Anglesey Tidal Demonstration Zone (Morlais Demonstration Zone, off Anglesey, North Wales). There are also tidal array projects under development with Agreements for Lease at Bardsey Island off the Llŷn peninsula (Nova Innovation).

Figure 4.2: Existing tidal energy lease areas



Source: TCE, 2021

4.3 Economic contribution

It is clear that coastal and peripheral regions of Wales are already experiencing benefits from emerging wave and tidal energy industries. Figures for 2020 indicate that tidal stream energy developers, including the Morlais Tidal Demonstration Zone, have contributed a total of £51.7 million of direct investment to the Welsh economy. This represents an increase of £22.3 million since 2017 and of £5 million since 2019 (MEW 2020). Combined with the figures for tidal range facilities (£8.6 million), wave energy (£29 million) and publicly funded Welsh research projects, the total investment to date in marine energy in Wales amounts to £123.7 million. Figures reported in previous research suggest that every £10 million of investment in marine energy resources could be associated with total Gross Value Added effects in Wales of around £2.5 million (an extra 25%), including direct, supply chain and related household effects (Fanning *et al*, 2014).

Around £46 million has been invested in North Wales to take advantage of its significant tidal stream energy resource (£32.5 million on Anglesey and £13.5 million in Gwynedd). Developments in these areas have taken advantage of local skills, services and infrastructure, providing additional direct and indirect economic benefits (MEW, 2019)[10].

Ancillary activities that support renewable energy generation include the construction (and maintenance) of marine energy installations, decommissioning of structures, and transmission of electricity to the distribution system, along with engineering/design services to design or improve devices. Survey and monitoring activities before, during, and after construction – for both engineering and environmental purposes – will also be required.

As a young industry, there is less social science research on which to draw in order to consider the social and cultural implications of developments and their associated local communities. Changes as a result of employment opportunities from tidal stream energy developments would be expected to be reflected in nearby coastal communities. The industry can contribute to the stability and cohesion of those communities by offering direct employment opportunities but also by providing a focus for investment in local infrastructure, providing wider social benefits e.g., upgrading roads or broadband roll-out. Making use of established marine-related skills found in the locale and extended supply chain e.g., boat building/maintenance or boat handling, also contributes to the stability and resilience of the local economy. As a result, development of this sector may reduce outward migration of the local population, maintaining traditions, language, and cultural heritage in support of WNMP **policies SOC_02 (well-being of coastal communities)** and **SOC_04 (Welsh language and culture)**. It may also attract inward migration and further investment into the community to support a growing industry, workforce and their families (e.g., house building/sales, shops and services) in support of **policy ECON_01 (sustainable economic growth)**.

Supply chain companies across Wales are actively engaging in the marine energy sector and several clusters are forming, primarily in regions close to project development. As a result, much supply chain activity is focused in peripheral, coastal regions, many of which would benefit from economic regeneration. Of the companies who have built or are currently building devices in Wales, MEW research indicates that at least 50% of their supply chain to date has come from within Wales (MEW, 2020). The potential benefits to be realised, therefore, include jobs supported both within and beyond the immediate supply chain environment.

10 Direct economic impacts are the result of money initially spent in the region by these industries, including money towards salaries, raw materials, supplies and operating expenses. Indirect economic impacts of these industries would include increased spending in the area, indirectly benefiting other local businesses, including hospitality and leisure businesses.

Many companies with relevant experience and expertise have been able to diversify into supporting tidal stream energy projects in Wales, with supply chain companies across Wales actively engaging in the tidal energy sector (MEW, 2020). In addition, recent research has found that Wales is well placed to capitalise on this expanding market (and the wider marine renewables sector) with considerable pre-existing marine expertise (e.g., fabrication, Operation and Maintenance (O&M), anchors etc.), high-capacity electricity connection and embedded energy industry knowledge through oil and gas (O&G) developments (ORE Catapult, 2020). It is expected that the region can capture up to 52% of project development spend through local companies providing surveying, engineering design and other development services.

4.4 Business support

There is a range of specific support for the tidal stream energy sector in Wales, as set out below.

4.4.1 Welsh Government

There is strong political support for the development of marine energy in Wales and Welsh Government supports a number of sector specific initiatives including:

- Marine Energy Wales (MEW) – see below.
- A Consenting Strategic Advisory Group (CSAG) and Science & Evidence Group for wave and tidal stream energy.
- The Offshore Renewables Joint Industry Programme (ORJIP) for Ocean Energy.

Welsh Government also provides business support available to companies operating in the marine energy sector or looking to diversify:

- **Welsh Government's Industrial Transformation Team** – provides support to companies looking to establish new operations in Wales by providing business advice and outlining potential financial assistance available.
- **Stakeholder groups** – Welsh Government supports MEW as well as coordinating a number of other stakeholder groups relevant to tidal stream energy including the CSAG.
- **SMARTCymru** – supports businesses in Wales to develop, implement and commercialise new products, processes, and services.
- **Welsh Government Energy Service** – supports community organisations in Wales to develop renewable energy projects that will lower carbon emissions and provide cost savings, income generation and wider community benefits. Launched in October 2018, the service provides financial and technical support to help community groups develop their own renewable energy schemes.
- **Business Wales** – provides a range of general business advice and support, including focussed support through the Accelerated Growth Programme.
- **Development Bank of Wales** – set up by Welsh Government to support the economy of Wales by making it easier for businesses to get the finance needed to start up, strengthen and grow.

4.4.2 Marine Energy Wales

MEW[11] acts as a focal point for supporting the marine energy sector in Wales. It hosts a working group that brings together technology developers, the supply chain, academia, and the public sector to tackle issues collaboratively and help support the growth of the sector. MEW provides direct support to companies looking to develop projects in Welsh waters through highlighting sources of information and signposting to other support available.

11 Marine Energy Wales **www.marineenergywales.co.uk**

4.4.3 Marine Energy Engineering Centre of Excellence

ORE Catapult's MEECE[12] delivers research, development, and demonstration activities to support innovation in the Welsh supply chain, accelerating the commercialisation of the wave, tidal and offshore wind sectors by reducing the cost of energy.

4.4.4 Marine Energy Test Area

META is a series of pre-consented test sites in the Milford Haven waterway that can be used by technology developers to test components, installation approaches, and full-scale devices ahead of deployment into array projects.

4.4.5 Sustainable Expansion of the Applied Coastal and Marine Sectors 2

SEACAMS2 is a research programme managed by Swansea and Bangor Universities that provides environmental focussed research and development support to companies developing marine energy projects in Wales.

4.4.6 The Anglesey Enterprise Zone and the Energy Island Programme

The Anglesey Enterprise Zone and the Energy Island Programme have been set up to bring high skilled jobs to North Wales through major energy investments (MEW, 2020), to replace those that were lost with the closure of the Wylfa facility.

4.4.7 Menter Môn

Menter Môn, as a not-for-profit social enterprise company, has leased and is managing a 35 km^2 area of seabed near Holy Island, off the west coast of Anglesey. It is seeking the necessary consents to develop and operate a tidal stream demonstration zone at Morlais, offering tidal stream energy enterprise/operators the opportunity to deploy their technology and bring social and economic opportunities to the area.

4.5 Future development scenario

Growth of the tidal energy sector has slowed over recent years due to the lack of a viable revenue support mechanism to enable the sector to progress to commercial developments. Financial support through the European Regional Development Fund has enabled progress to continue to be made in Wales. However, this momentum may be at risk unless a viable revenue support mechanism is put in place to support the next step. Consideration is being given to ring fencing part of the Contract for Difference for tidal energy, however this has not yet been confirmed (UK Energy Minister, 2020). If this does happen, initial development over the next 5 years will likely be focussed on the existing lease locations – Morlais, Holyhead Deep and Bardsey Sound with demonstration arrays of up to 10 MW. Individual device testing and broader research will take place at META and Ramsey Sound.

There is significant potential for larger scale development in RAs in the future, provided potential adverse effects on environmental receptors can be suitably managed and/or adaptive management can be used to enable careful deployment and monitoring of effects. The MRESF study estimated tidal stream energy projects totalling up to 500 MW could potentially be developed within the existing tidal stream RAs in Welsh waters. Areas of lower flow speeds could also be viable in the future as the technology develops, which would increase this potential.

The key to unlocking future, commercial growth is the presence of a clear and demonstrable route to market – that devices can make the 'jump' from testing to commercial deployment. This requires a funding mechanism, pipeline of work (for both financial backers and supply chain to have confidence to invest), and an evidence base to demonstrate that regulator and stakeholder concerns such as environmental considerations can be addressed. The latter can only realistically be achieved through the deployment and monitoring of devices in the water

12 The Marine Energy Engineering Centre of Excellence **www.meece.org.uk**

in real world situations. As evidence develops, issues can be better understood and retired to allow focus on any key remaining issues. WNMP **policy SCI_01 (risk-based decision making)** states that opportunities to apply adaptive management should be considered where appropriate. These can be used to manage uncertainty around impacts in conjunction with thresholds of acceptable adverse effects and associated monitoring programmes.

As a result of the emerging nature of the tidal stream energy sector, there are a large number of opportunities to strengthen the evidence base and further refine the RA. In line with WNMP **policy ELC_03b (low carbon energy (supporting) tidal stream)**, the sector is encouraged to collaborate with regulators, other developers, other sectors, and interested parties to understand opportunities for future tidal stream activity.

4.5.1 Co-location

Co-location is often seen by technology developers as introducing unnecessary risk to demonstration projects. However, some project developers see co-location as an opportunity to increase the economic potential of projects by sharing infrastructure and operational resources, and to maximise the environmental benefits. WNMP **policy ECON_02 (coexistence)** recognises the potential for optimum use of space and resources by promoting consideration of opportunities for coexistence between and within sectors.

Co-location of different generation assets sharing electrical infrastructure could significantly improve the financial viability of projects. In the future this could see seabed mounted tidal stream technology co-locating with midwater or floating tidal stream, as well as tidal stream co-locating with other sectors such as wave energy, or with floating wind devices in lower flow areas. Technology advances are likely to see offshore hubs become more commonplace, potentially co-located with storage assets, electrolysers for hydrogen production, or underwater data centres, as has been trialled by Microsoft. The first step towards colocation and greater cooperation between developers would be the sharing of some key infrastructure, such as grid connection points/landfalls for cables (see Section 5.1). Such a move could also reduce environmental impacts and some stakeholder concerns.

Co-location with aquaculture is unlikely in the near term but there is interest in co-locating marine renewables with seaweed farming and fish farming further offshore.

4.5.2 Supply chain

It is expected that supply chain activity will be focused around the ports closest to the RAs such as Pembroke Port and Holyhead Port. The recent Swansea Bay City Deal funding announcement for the Pembroke Dock Marine project, once in a position to break ground, will kick-start significant infrastructure upgrades at Pembroke Port, and further establish the region as a hub for offshore renewables.

Floating wind development in the Celtic Sea is expected to grow significantly over the next 10 years with up to 120 GW of potential identified in recent reports (ORE Catapult, 2020). This will require significant growth in the supply chain in the region, as well as upgrades to grid and port infrastructure. The tidal stream sector could benefit from synergies in supply chain and infrastructure developments, with floating wind accelerating the development of these key areas in advance of tidal stream energy deployment needs, thereby reducing potential cost and programme burdens for these projects.

Supply chain companies located in the different geographic regions relevant to the tidal stream RAs are highlighted in Section 10.

4.5.3 Employment

Employment associated with the tidal stream energy sector will continue to be concentrated in distinct regions and will grow primarily from existing areas where there is strong absorptive capacity, especially the offshore wind, O&G, steel, and maritime sectors.

In the UK, it is expected that tidal energy jobs could grow to approximately 4,000 by 2030, giving a total of almost 14,500 jobs supported by the sector by 2040 (ORE Catapult, 2018). With the focus on tidal stream development in Wales, a significant proportion of this new job creation can realistically be expected in the regions close to the RA's. There are some challenges in recruitment associated with the expansion of the tidal stream energy sector including the availability of skilled workers in the locality of planned developments and uncertainty around future staff requirements for O&M activities. However, there are a number of opportunities for the tidal stream energy sector to encourage positive social and economic outcomes for local coastal communities through training programmes, apprenticeships, and the attraction of skilled workers into the local area. As a result, there is potential for the expansion of the tidal stream energy sector to support Welsh Government's objectives around creating employment, tackling poverty, and opportunities for coastal communities, under WNMP **policies ECON_01 (sustainable economic growth)**, and **SOC_02 (well-being of coastal communities)**.

4.5.4 Consenting

An important issue for the sector in the future will be around the consenting of array-scale projects. The move to commercial scale projects will require further collaborative work between government, the regulator, key stakeholders, and industry to address areas of uncertainty and increase confidence related to management of environmental impacts. As set out in section 4.4, a framework for addressing these issues is already in place with the establishment of the CSAG that brings together key stakeholders in Wales, and links to ORJIP for Ocean Energy, ensuring positive and enabling steps are being taken at several levels.

The scale of a proposed tidal stream energy development will influence the regulatory regime under which the permissions are required. It should also be recognised that in many cases there will be ancillary structures onshore, associated with offshore renewable energy generation, that will require planning permission.

Under the provisions of the Wales Act 2017, energy generation projects up to 350 MW (excluding wind energy) in Welsh waters are to be consented by Welsh Ministers, with those above 350 MW consented by the Secretary of State. Since 1 April 2019, Welsh Ministers are responsible for determining applications for a project of between 1 MW and 350 MW under Section 36 of the Electricity Act 1989.

Table 4.1 outlines the consents and licences which may be required for tidal stream energy developments. In all cases a marine licence will be required. The Marine Licence Determination infographic in Figure 4.3 outlines the legislation which governs the marine licensing process in Wales. For more information on this process, see Welsh Government's marine renewable consenting infographic[13].

13 **gov.wales/sites/default/files/publications/2020-11/marine-renewable-consenting-infographic.pdf**

Tidal stream energy projects will largely follow the typical consenting process for any development in the marine environment in Welsh waters (see Figure 4.3). However, wider supporting elements may also be required including:

- Environmental Impact Assessment (EIA) – under the EIA Regulations (2020) and the Marine Works (EIA) (Amendment) Regulations 2017[14].
- Habitat Regulations Assessment – under the Conservation of Habitats and Species Amendment (EU Exit) Regulations (2019).
- Water Framework Directive Assessment – under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.
- Navigational Risk Assessment – compliant to the Maritime and Coastguard Agency's Marine Guidance Note 543.

If permission is granted, licence conditions may stipulate a range of post-consent management and monitoring to confirm the assumptions made in the EIA and to ensure no significant adverse impacts are occurring post-consent. Monitoring can help develop additional understanding of actual impacts in inform future consenting.

Table 4.1: Consents and licences required for tidal stream developments[15]

Regulator/Authority	Consent/Authorisation
NRW acting on behalf of Welsh Ministers	Marine Licence: • For the deposit of substances or objects in the sea. Other licensable activities include construction activities, dredging and removals.
Local Authority (LA)	Planning Permission where there is an intertidal aspect for any onshore facilities.
Welsh Ministers	A Development of National Significance consent or Transport and Works Act Order (for harbour works).
Secretary of State (handled by the Planning Inspectorate)	A Development Consent Order for Nationally Significant Infrastructure Projects.
TCE (or other landowner)	Grants foreshore/seabed rights for a range of activities up to 12 nm. Awards sovereign rights to generate electricity from wind, waves and tides (Energy Act 2004) for the continental shelf beyond 12 nm.

(adapted and simplified from WG[16])

14 Offshore renewable energy projects are likely to fall within Schedule A2 and require an EIA where any part of the development is likely to have significant effects on the environment.

15 Note this is not an exhaustive list. Each development should consult with regulatory sources to confirm which consents/licences are required for their specific project. **www.naturalresources.wales/permits-and-permissions/marine-licensing/?lang=en**

16 Welsh Government. (2021). Marine Renewable Consenting Process Flowchart **gov.wales/sites/default/files/publications/2020-11/marine-renewable-consenting-infographic.pdf**

NRW has produced guidance notes of relevance to tidal stream energy developments, including topics covering:

- marine vertebrate conservation legislation[17];
- marine ecology datasets[18];
- benthic habitat assessment[19];
- marine physical processes[20]; and
- marine mammal site characterisation requirements at wave and tidal stream energy sites in Wales[21].

NRW also provide guidance on:

- scoping an EIA[22],
- Water Framework Directive assessment[23],
- Habitats Regulation Assessment[24],
- the Marine Noise Registry[25], and
- use of adaptive management approaches in consenting[26].

For more information on the consenting process for low carbon energy developments in Wales see NRW's marine renewables webpage[27] and flow chart[28] on the process for EIA applications. For additional information on preparing an application for development consent, see the relevant sections of the **WNMP Implementation Guidance[29]**. More information and evidence to support development preparation and consenting can be found on the Welsh Government's Marine Planning Portal[30].

17 www.cdn.naturalresources.wales/media/691896/gn003-marine-vertebrate-conservation-legislation-in-wales.pdf

18 www.cdn.naturalresources.wales/guidance-and-advice/business-sectors/marine/marine-ecology-datasets-for-marine-developments/?lang=en

19 www.cdn.naturalresources.wales/media/691900/gn030-guidance-note-final-2-mar2019.pdf

20 www.cdn.cyfoethnaturiol.cymru/media/692263/marine-physical-processes-guidance-to-inform-environmental-impact-assessment-eia.pdf

21 www.cdn.naturalresources.wales/media/686187/eng-report-082-guidance-marine-mammal-site-characterisation-for-wave-and-tidal-energy-sites.pdf

22 www.cdn.naturalresources.wales/media/684594/gn13-scoping-an-environmental-impact-assessment-for-marine-developments.pdf

23 www.naturalresources.wales/permits-and-permissions/marine-licensing/marine-licensing-and-the-water-framework-directive/?lang=en

24 www.naturalresources.wales/permits-and-permissions/marine-licensing/marine-licence-habitats-regulations-assessment/?lang=en

25 www.naturalresources.wales/permits-and-permissions/marine-licensing/marine-noise-registry/?lang=en

26 www.naturalresources.wales/permits-and-permissions/marine-licensing/applying-for-a-marine-licence-for-projects-using-adaptive-management-or-project-phasing/?lang=en

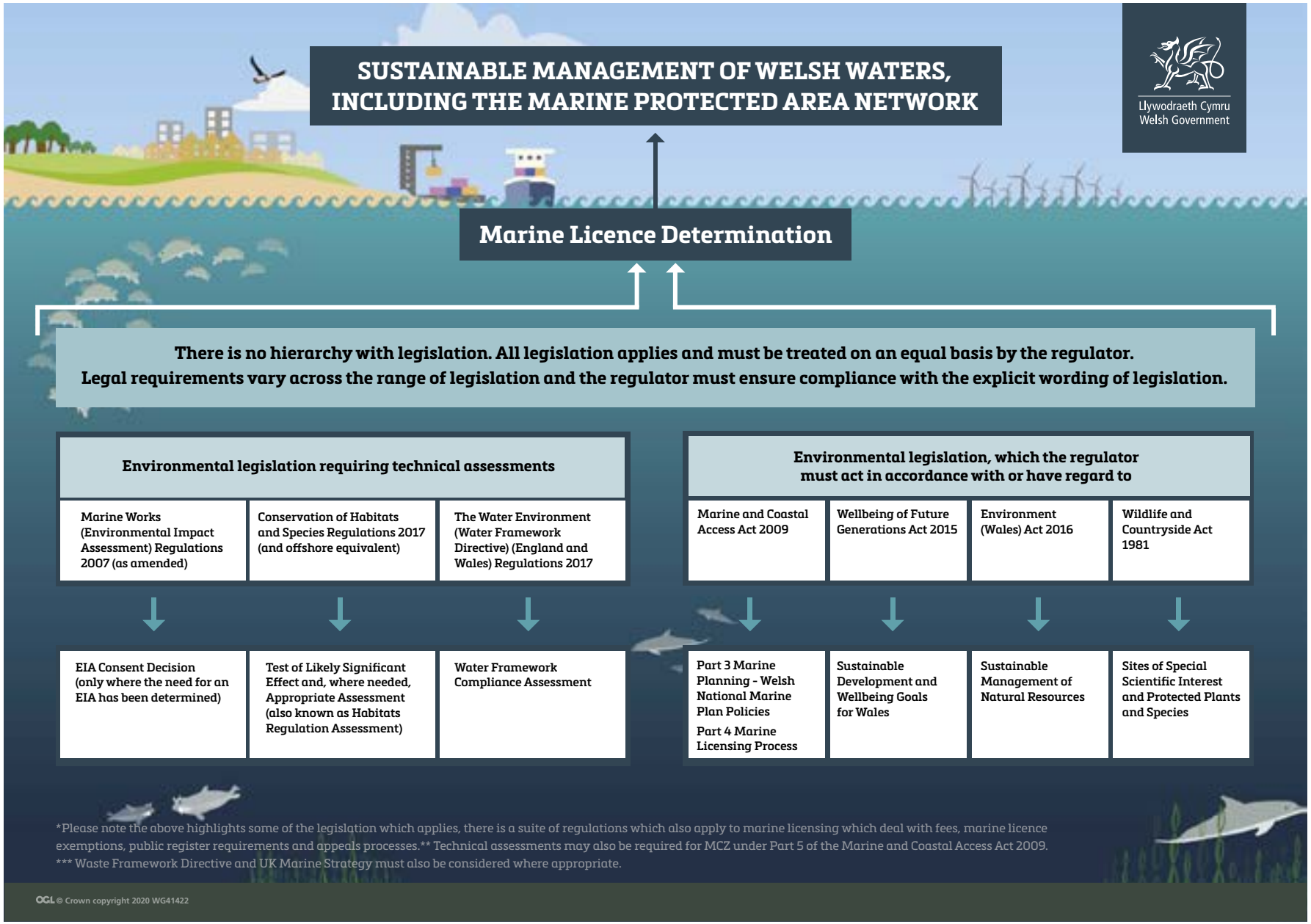
27 www.naturalresources.wales/guidance-and-advice/business-sectors/marine/marine-renewable-energy-developments/?lang=en

28 www.cdn.cyfoethnaturiol.cymru/media/688033/marine-licensing-band-3-application-process-flowchart.pdf

29 Welsh National Marine Plan: implementation guidance gov.wales/welsh-national-marine-plan-implementation-guidance

30 www.lle.gov.wales/apps/marineportal/#lat=52.5145&lon=-3.9111&z=8&tgt=false

Figure 4.3: Overview of marine licensing process in Welsh Waters



Source: Welsh Government, 2020

5. Infrastructure

Figure 5.1: Coastal and offshore infrastructure in relation to tidal stream RAs

Source: National Grid, 2021 and Oceanwise, 2021

5.1 Grid

Access to the grid is often raised as a constraint to tidal stream energy development in Wales and more widely in the UK. Grid connection has been a deciding factor in some cases with regards to the location of developments. Figure 5.1 shows the coastal and offshore grid infrastructure in Wales.

An ORE Catapult study carried out for Welsh Government in 2020 assessed existing grid capacity in Wales, and upgrades required to accommodate future growth of offshore renewables over the next 20 years. The study primarily focussed on the growth of offshore wind (fixed and floating) but did also consider potential tidal stream development, particularly at Morlais.

The study assumed that landfall for projects would either come into Anglesey or Pembrokeshire and considered a number of scenarios based on the likelihood of projects going forward.

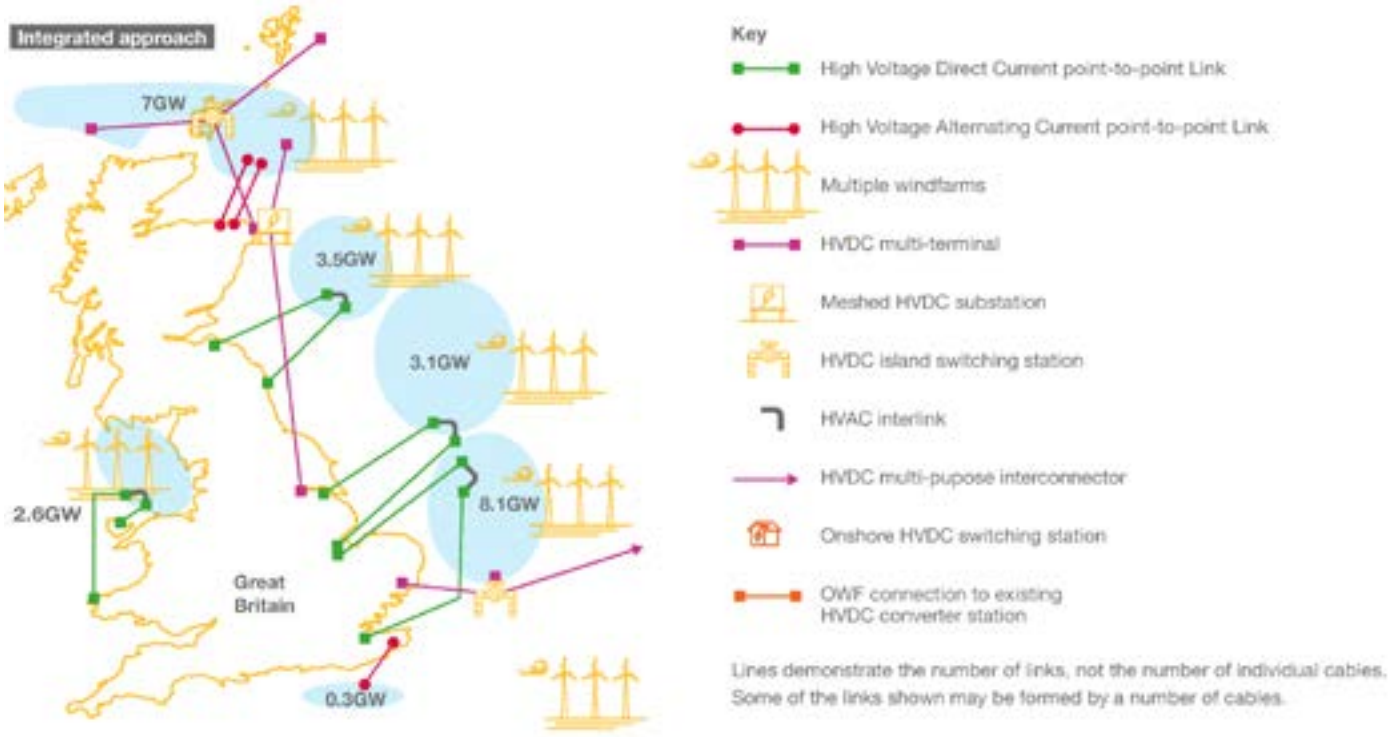
Due to the scale of the projects being considered, the focus of the study was on the transmission system. Community scale tidal stream projects would be anticipated to connect to the lower voltage distribution grid which would require project specific assessments (National Grid, 2020).

A significant amount of work is being undertaken by National Grid Electricity System Operator (ESO) to plan for the upgrades required to support the expected growth of offshore wind around the UK. In Wales, the future scenarios being considered are 3.7 GW of offshore generation by 2030 and 15.4 GW by 2050. (National Grid ESO, Future Energy Scenarios, July 2020). The scenarios have not specifically identified potential contributions from wave and tidal projects, likely due to the scale of offshore wind development envisaged.

Rather than a project-by-project approach that only considers point to point offshore network connections and individual project optimisation and transmission (HVAC or HVDC) decisions, the future upgrades are being looked at strategically considering a range of connection options including multi terminal/meshed HVDC and HVAC options, and considering whole system optimisation and transmission technology decisions.

A high-level representation of what the electricity system could look like in 2050 is shown in Figure 5.2.

Figure 5.2: High level representation of what the electricity system could look like in 2050



Source: National Grid, 2020

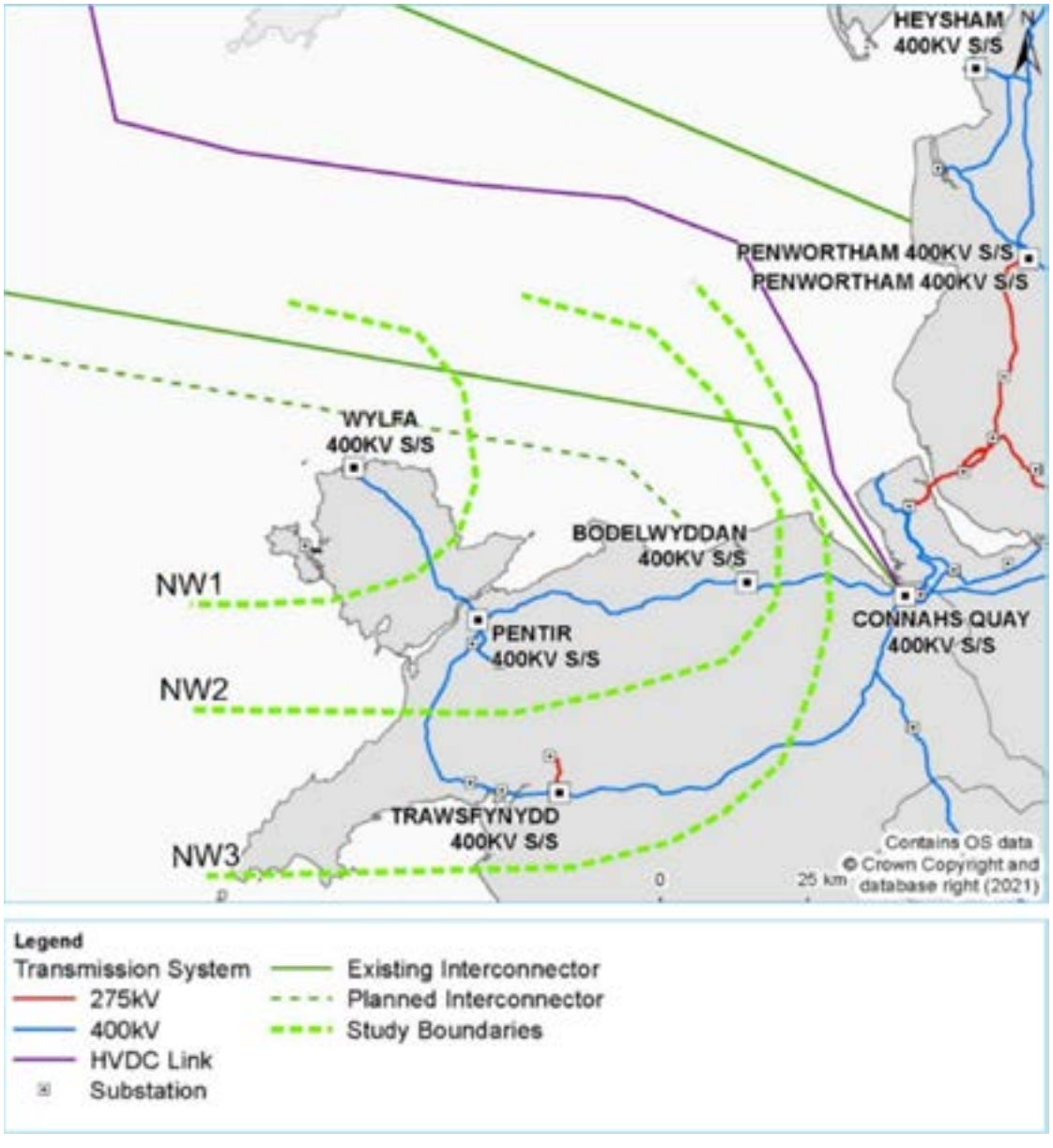
Whilst the future scenarios do not currently include potential development of floating wind in the Celtic Sea, this will undoubtedly be factored into further strategic upgrades to the electricity system in south Wales. The scale of offshore wind in both north Wales and in the Celtic Sea, and the associated upgrades to the electricity system, suggests that development of large-scale wave and tidal stream projects could also be easily accommodated.

5.1.1 North Wales

The transmission system in North Wales consists of a double circuit 400 kV line from Connah's Quay out to Pentir and then onto Wylfa nuclear on Anglesey. A second 400 kV double circuit also extends across North Wales from Connah's Quay to Trawsfynydd which is interconnected to Pentir to form a ring around North Wales. This part is only by way of a single circuit and constitutes a key bottleneck. This part of the grid is characterised by a high penetration from offshore wind projects and various other generators which include the pumped hydro at Dinorwig. Figure 5.3 shows the existing North Wales energy transmission system.

There is currently approximately 3.5 GW of generation connected within the North Wales region with an additional 2.7 GW of generation and a 750 MW interconnector already contracted to connect in the North Wales region. This includes Morlais, with a contracted capacity of 180 MW due connect at Penrhos utilising a 132 kV line from Wylfa that used to service the old aluminium plant.

Figure 5.3: North Wales transmission system



Source: TCE, 2019

Welsh Government's MRESF study estimated 120 MW of potential tidal stream capacity off the west coast of Anglesey, and a further 100 MW off the north coast of Anglesey. The ORE Catapult study considered the capacity already contracted for Morlais to be adequate to support large scale tidal projects that might connect into the grid in North Wales over the coming years.

Smaller community scale tidal projects would be anticipated to connect to the lower voltage distribution grid which would be a challenge in North Wales. Connections of any magnitude would likely trigger reinforcements to release capacity. With the new nuclear site at Wylfa now not being progressed, there could be an opportunity for a new connection there which may not need reinforcements.

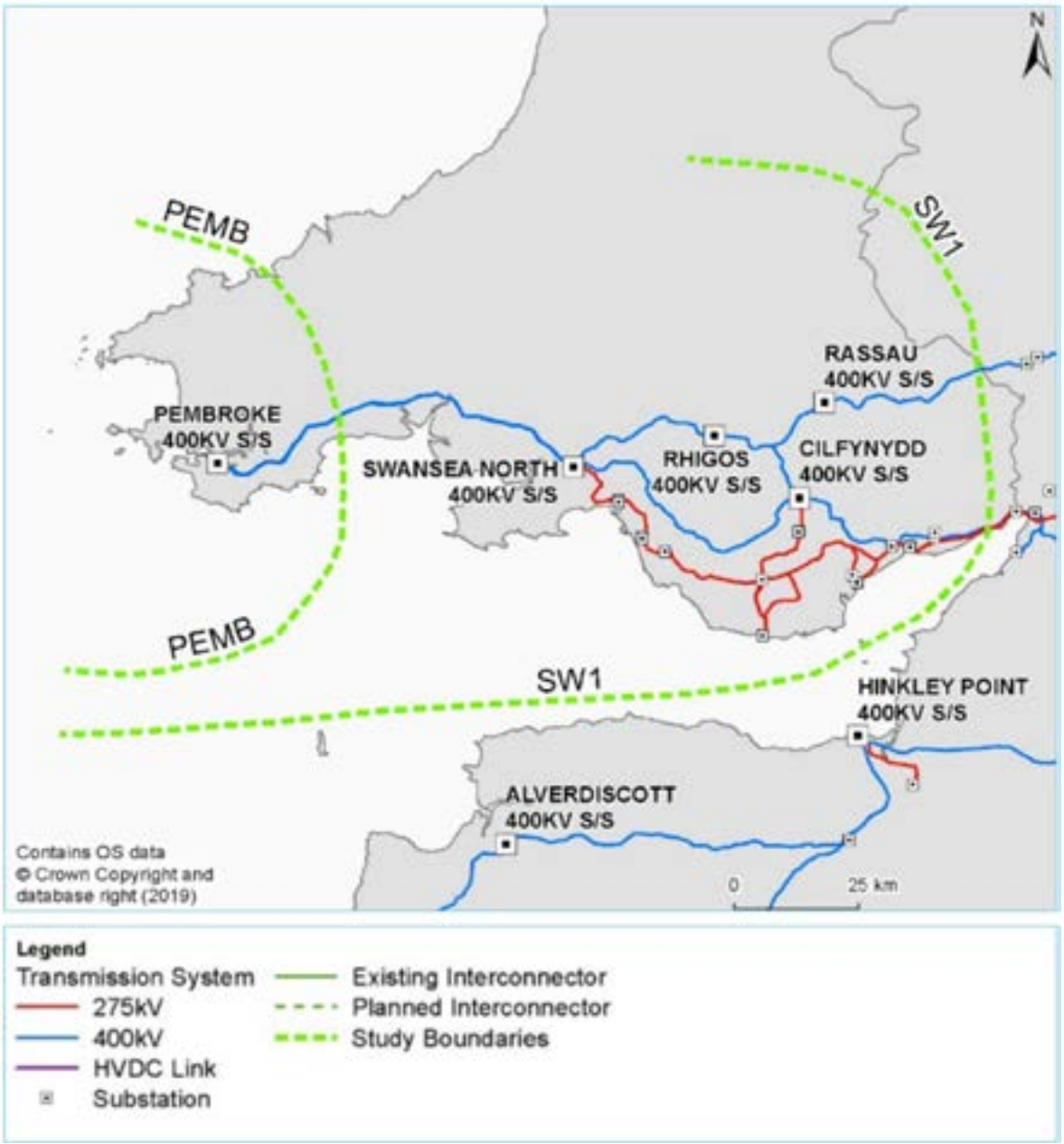
5.1.2 South Wales

The grid in South Wales consists of a 400 kV ring from Pembroke to Walham, and from there to Melksham. There is a meshed 275 kV network that connects to this 400 kV ring at Swansea North, Cilfynydd and Melksham. The meshed 275 kV network connects numerous current and contracted generators of various technology types including tidal, coal, gas and solar. Figure 5.4 shows the existing South Wales energy transmission system.

The distribution network in this region is owned and operated by Western Power Distribution (WPD) South Wales and feeds the large demand centres of Swansea and Cardiff along with the surrounding industry. There are also substantial volumes of generation connected or contracted to connect to WPD South Wales.

Pembroke substation is ideally located close to the Celtic Sea and offers a distinct opportunity for future floating offshore wind and/or tidal stream energy connections to South Wales. It currently connects the Pembroke Power station to the grid and is due to connect to the Greenlink interconnector, tying the Great Britain transmission system to Ireland.

Figure 5.4: South Wales transmission system



Source: TCE, 2019

The ORE Catapult study identified approximately 5.6 GW of generation connected within the South Wales region, and an additional 2.7 GW of generation and a 526 MW interconnector contracted to connect. There appears to be up to 3 GW capacity across the system so any additional connection would likely require reinforcements.

The ORE Catapult study identified a potential additional 7 GW of offshore wind capacity requiring connection into either North Wales or Pembrokeshire between 2030 and 2040 should potential projects be developed. In Pembrokeshire the MRESF study identified a potential 70 MW of tidal stream development, and potential 170 MW in the Bristol Channel.

Hydrogen hubs being developed on Anglesey and in Pembrokeshire could present a potential alternative to grid connection for tidal projects, but the economic viability of this option would need to be considered.

5.2 Ports

Whilst supporting the development of grid capacity is important to enable the delivery of tidal stream energy projects, port developments also need to consider how they can develop to maximise sectoral opportunities in the future. Accommodating large-scale technological components on laydown areas, either for construction before deployment or on their retrieval from operational areas for servicing or decommissioning, requires areas of hardstanding on land. Sufficient depth of water alongside quays or in approach channels may also be required to enable vessels to use ports in close proximity to RAs. The location of the main ports significant to the tidal stream sector in Wales are shown in Figure 8.9 showing harbour areas and shipping routes.

Given the lead-in time that can be required to secure planning permission for new quay areas or consents to undertake capital dredging, ports need to use the 2020s to plan ahead for tidal-stream energy business in the following decades. Projects like the Morlais tidal array demonstration zone enable costs of consenting and required infrastructure to be addressed upfront, providing the opportunities to share infrastructure with other projects and potentially reducing the costs faced by technology developers and their supply chain.

Pembroke Port is another example of a Welsh port with proven experience in supporting the tidal stream sector, having worked in partnership with Tidal Energy Ltd to accommodate the fabrication and deployment of the DeltaStream prototype onsite at the port. A planning application has been submitted by the Port of Milford Haven in 2020 seeking approval to develop the port into a Marine Renewable Energy Hub. Floating devices or devices that can be towed to site may not require such significant water depths.

Welsh ports that benefit from investment and revenue from the offshore wind sector in the coming years, will potentially have the necessary infrastructure, workforce and supply chain to support the tidal stream energy sector. However, if Welsh ports are not actively involved in offshore wind developments, the capacity and capital required to support future commercial tidal stream energy will need to be driven by another source.

Welsh Government is working to develop a wider understanding of supply chains for marine renewable energy sectors and have commissioned a project looking at supply chain links for the offshore wind sector. The outputs from this work are due to be published in 2021.

6. Social considerations

The tidal stream energy sector has the potential to positively contribute to the achievement of WNMP **social policies** and objectives, promoting resilient, prosperous, and equitable coastal communities. Sectoral developments can offer employment opportunities for coastal communities, helping to protect and create employment at all skill levels and tackle poverty through supporting deprived communities, in line with WNMP **policy ECON_01 (sustainable economic growth)**. The sector can also contribute to the promotion and facilitation of the use of Welsh language and culture, in line with **policy SOC_04 (Welsh language and culture)**. This could be through simple actions such as providing Welsh language signage, information, and educational resources. The tidal stream energy sector can also support the development of local industries and supply chain links within a development area, bringing job opportunities and supporting local economies and the well-being of coastal communities in support of **policy SOC_02 (well-being of coastal communities)**.

Whilst the location of new development will primarily be driven by the available tidal stream resource and grid connectivity, social considerations are important for developers establishing themselves in a region, engaging with the local supply chain and local communities. Coastal communities living within 5 km of the coast account for an estimated 60% of the total population of Wales (NRW, 2020). Regional analysis shows that the characteristics of these coastal communities varies, but many parts of the Welsh coast have an ageing population, sometimes as a result of inward migration by retirees. Other areas have fragmented communities spread geographically along the coast and its hinterland. The more densely populated city regions such as Swansea and Cardiff have significant areas of deprivation but younger populations as a result of being hubs for academic institutions.

Social aspects considered for this guidance include the following elements:

- population density;
- demographics;
- area deprivation;
- Welsh speaking (%);
- local workforce/skill set;
- cultural identity; and
- business support.

A large proportion of social information is considered by LA area. Therefore, the information presented for each RA may vary slightly depending on the LA boundaries in relation to the RA.

The Welsh language, Welsh culture and heritage are integral elements of the social fabric of communities and are central to many people's sense of identity. The 2011 Census showed that across Wales approximately 20% of the population speak Welsh, whilst in some areas this is substantially higher and Welsh is the first language.

Figure 6.1 shows the distribution of Welsh speakers around Wales. The Welsh Language (Wales) Measure 2011 made Welsh an official language in Wales and, along with its associated Regulations introduced in 2014, created a new legislative framework for the Welsh language to ensure it must be treated no less favourably than English. For larger developments this includes assessment of the impact on the Welsh language as part of the planning process.

Government support has attracted a number of technology developers to base themselves in Wales. Tidal resources are evident around the Welsh coastline and overlap with the spheres of influence of centres of socio-economic activity and supporting infrastructure, such as Bangor, St. David's and Cardiff, which have hinterlands that extend away from the coast. Such areas in turn may support supply chain interests, potential markets and securing a workforce with the necessary skills.

Figure 6.2 uses information on travel time to five key identified centres of population across Wales as an indicator of the extent of their spheres of influence. Those in closest proximity to the RAs may provide useful support but the likely impact of the sector will extend far beyond these localities.

The developing tidal stream energy sector could result in potential new employment opportunities for local populations; however, feedback from stakeholder engagement suggests that the remote nature of the RAs has meant that developers have sometimes found it challenging to attract suitably qualified staff for some specialisms. Anecdotal evidence also suggests that the dispersed nature of rural communities has sometimes meant that younger recruits from outside those communities have struggled to settle if they have relocated for economic opportunities.

Feedback from stakeholders suggests that developers are aware of the 'push' and 'pull' factors relating to social policy, but these are not currently amongst the prime considerations for the siting of new developments. At the moment, the presence of the necessary viable resource understandably dictates the interest in an area for tidal stream energy projects. However, it is acknowledged that access to a local supply chain, in which desired and required skill sets are present, plays an important role in decision-making. Travel time to/from these hinterland areas can also be an important factor in the development of business opportunities.

It is also acknowledged that investment and development in a peripheral coastal area may be a catalyst for stemming outward migration of the local population in search of work or study elsewhere. In turn, this bolsters and reinforces aspects of Welsh language and cultural identity.

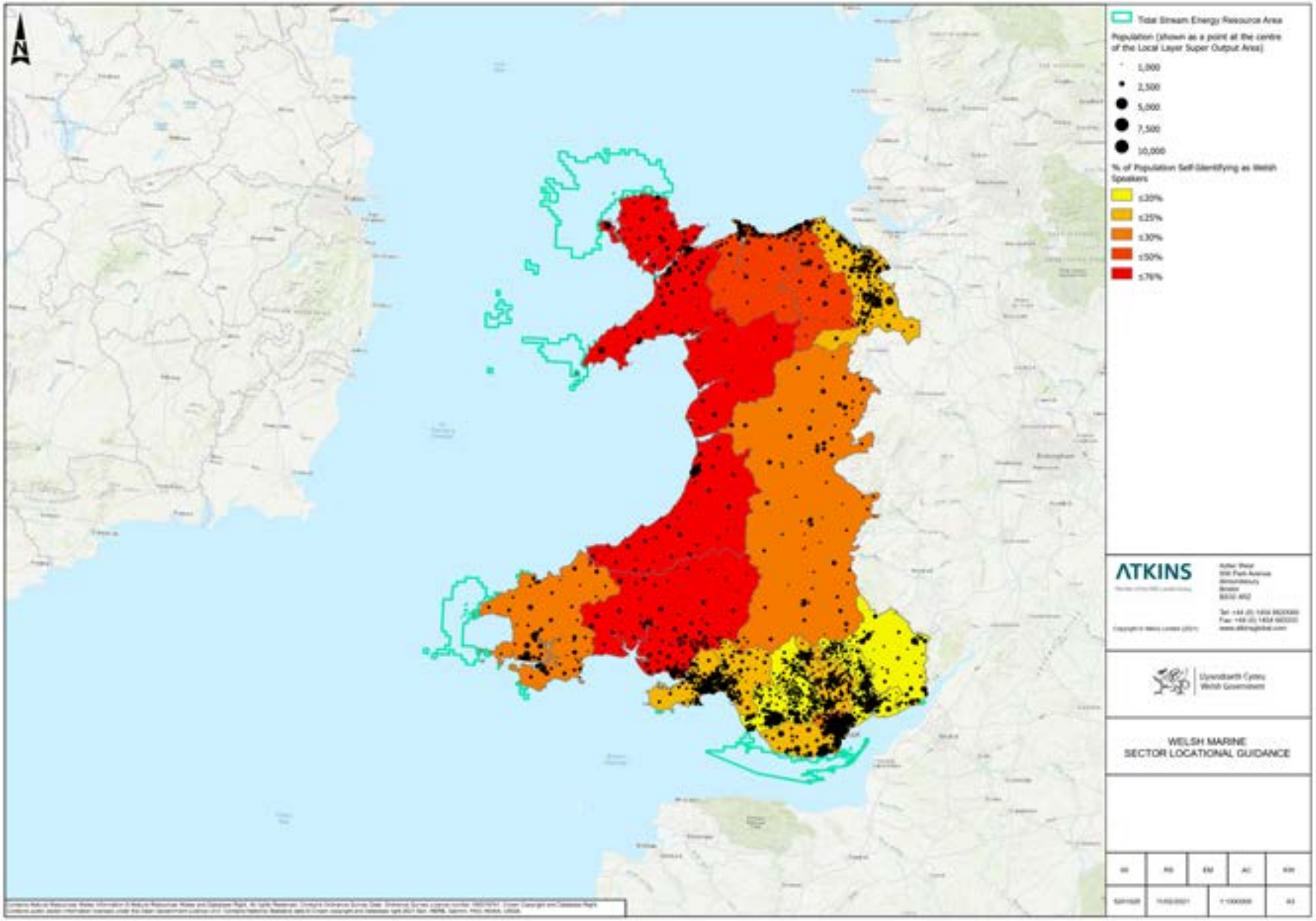
Support from the local community is an important factor in the success of a project. To date, there has been positive support for marine energy projects in Wales, with developers citing community support having a positive impact in helping them establish in the area. Welsh Government also has specific targets for local ownership of renewable energy developments, including:

- 1 GW of renewable electricity and heat capacity in Wales is to be locally owned by 2030; and
- all new renewable energy projects from 2020 onwards are to have at least an element of local ownership[31].

It is unlikely that social constraints will have a significant influence on determining the location of development. However, Menter Môn's involvement in the Morlais tidal array initiative demonstrates that social enterprise may have a facilitating role to play in the development of offshore renewable energy. If successful, it could promote a model that other areas may subsequently adopt.

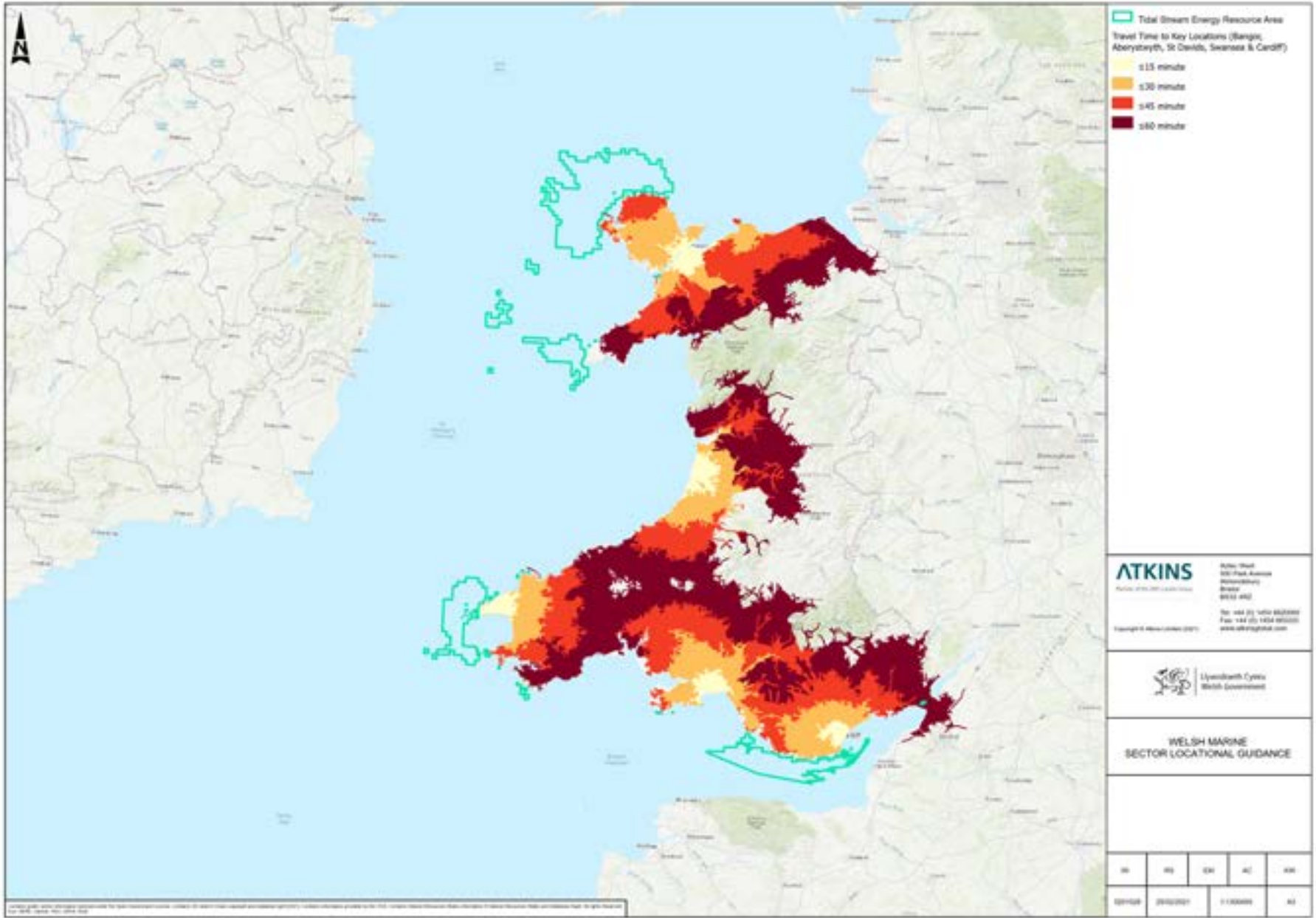
31 Welsh Government Policy statement: Local ownership of energy generation in Wales - benefitting Wales today and for future generations **gov.wales/local-ownership-energy-generation-wales-policy-statement** and Oral Statement on "Energy" delivered by the Cabinet Secretary for Environment and Rural Affairs to the National Assembly for Wales on 26 September 2017 **www.assembly.wales/en/bus-home/pages/rop.aspx?meetingid=4644&assembly=5&c=Record%20of%20Proceedings#C494225**

Figure 6.1: Population size and % of people identifying as Welsh speaking



Source: WIMD, 2019 and Stats Wales, 2021

Figure 6.2: Travel time to key locations (Bangor, Aberystwyth, St. David's, Swansea and Cardiff)



Source: Atkins, 2021

7. Environmental considerations

The tidal stream energy sector has the potential to contribute to the Welsh Government's climate and renewable energy objectives in support of a clean, healthy, and resilient environment. Sectoral developments can align with WNMP **policy SOC_10 (minimising climate change)** through avoiding or minimising the emission of greenhouse gases and, in doing so, contribute to the decarbonisation of the energy system in Wales.

New renewable energy developments have the potential to change the dynamics of the use of an area through the establishment of safety or exclusion zones and/or the restriction of certain activities within the vicinity of the development site. Where this may be the case, there are good opportunities to gather evidence and information to understand how further development could deliver tangible environmental benefits. This is supported by WNMP **policy ELC_03b (low carbon energy (supporting) tidal stream)** in relation to understanding future opportunities for the sector.

Tidal stream energy developments also offer the potential to deliver a degree of additional environmental benefit through the incorporation of restoration or enhancement measures in line with WNMP **policy ENV_01 (resilient marine ecosystems)**. This could include even small details such as consideration of alternatives for substrates introduced into the marine environment to provide a more colonisable or valuable habitat to local species. As part of priorities identified through the Marine Area Statement, NRW are working to develop understanding of opportunities for restoration and enhancement of the marine and coastal environment around Wales. Current work is focussed on identifying spatial opportunities and associated benefits from restoring saltmarsh and intertidal mudflats, seagrass beds, native oyster (*Ostrea edulis*) habitat, horse mussel (*Modiolus modiolus*) beds and honeycomb worm (*Sabellaria alveolata*) reef. The outputs from this initial work including areas of potential opportunity are due to be published in 2021.

Tidal stream energy devices, depending upon the type and location, may have a range of adverse environmental impacts. These could include, for example, changes to seafloor habitat through the introduction of new structures and the introduction of underwater noise during construction activity. In the preparation of a development proposal, any identified impacts will need to be addressed in line with the relevant **environmental policies** of the WNMP.

Development can impact on marine biodiversity, some of which is given legal protection either because they are a feature of a site designated for their protection or because they are a species of conservation importance protected wherever they are located. Figure 7.1 shows the location of MPAs in Welsh waters and Figure 7.2 shows coastal and marine environmental designations in relation to the tidal stream RAs. Understanding and managing potential impacts on protected sites or species will be an important factor in project planning. Developments will need to demonstrate compliance with relevant national and international regulations and legislation with regard to protected sites and designated features as well as ensuring compatibility with established management measures. Mitigation measures may also need to be secured to ensure the integrity of protected species and sites are maintained.

The presence of a protected site or species does not preclude the possibility of development within an area; however, in such a situation, additional consideration of impacts and management measures would be required. Depending on the specific sensitivities of the protected feature and the type of activity proposed, there is potential for development activity to co-exist alongside ecological considerations. The WNMP supports a proportionate, sensitive, and evidence-based approach to the siting of developments and the use of detailed management measures to ensure sustainable development of the marine area whilst not compromising the necessary and appropriate protection of marine species and habitats.

Adverse impacts can potentially be avoided through careful planning early in the project development process, and through timing of construction, as well as micro-siting within the project area to avoid specific features where necessary. Detailed assessment and extensive engagement with stakeholders would be required as part of the consenting process, and potential impacts need careful consideration within a designation. This is likely to lead to longer consenting times and increased consenting risk in designated areas with sensitive environmental features. It may also lead to the need for increased environmental monitoring and mitigation which would increase project costs.

Further information on development impacts and requirements relating to MPAs and protected species can be found on NRW's protected sites webpages[32], which provide information and advice about protected areas of land and sea; marine development guidance pages[33], where advice on assessment can be found; and marine licensing pages[34] which contain information and advice on the marine licensing process and formal requirements of assessment.

In addition to designated sites and species, WNMP **policy ENV_07 (fish species and habitats)** includes consideration of impacts on important feeding, breeding (including spawning and nursery) and migration areas or habitats for key fish and shellfish species of commercial or ecological importance.

There is still some uncertainty around potential collision risk for birds with surface-level or shallow submerged energy devices. Seabirds are, therefore, likely to be more of a constraint for surface-level or mid-water tidal stream energy devices due to the potential interaction of these technologies with diving seabird species. There is also uncertainty remaining around potential impacts on marine mammals including collision risk and barrier effects. Work is being progressed to develop the evidence base through monitoring of demonstration scale projects. However, whilst there is still uncertainty, it is likely projects will come under increased scrutiny in the consenting process in areas considered important for diving bird species and marine mammals. This will likely extend consenting timescales and may require environmental monitoring and potentially mitigation during construction and operation.

Through the European Maritime and Fisheries Fund SMMNR project,[35] Welsh Government has begun a process of mapping to understand the distribution of important environmental features which are likely to be a particular consideration for consenting. The project focussed on aquaculture, tidal stream energy, and wave energy sectors and considered the relative consenting constraints associated with four ecological 'Broad Interest Features': marine mammals, fish, benthic habitats, and birds.

32 www.naturalresources.wales/guidance-and-advice/environmental-topics/wildlife-and-biodiversity/protected-areas-of-land-and-seas/?lang=en

33 www.naturalresources.wales/guidance-and-advice/business-sectors/marine/?lang=en

34 www.naturalresources.wales/permits-and-permissions/marine-licensing/?lang=en

35 gov.wales/sustainable-management-marine-natural-resources

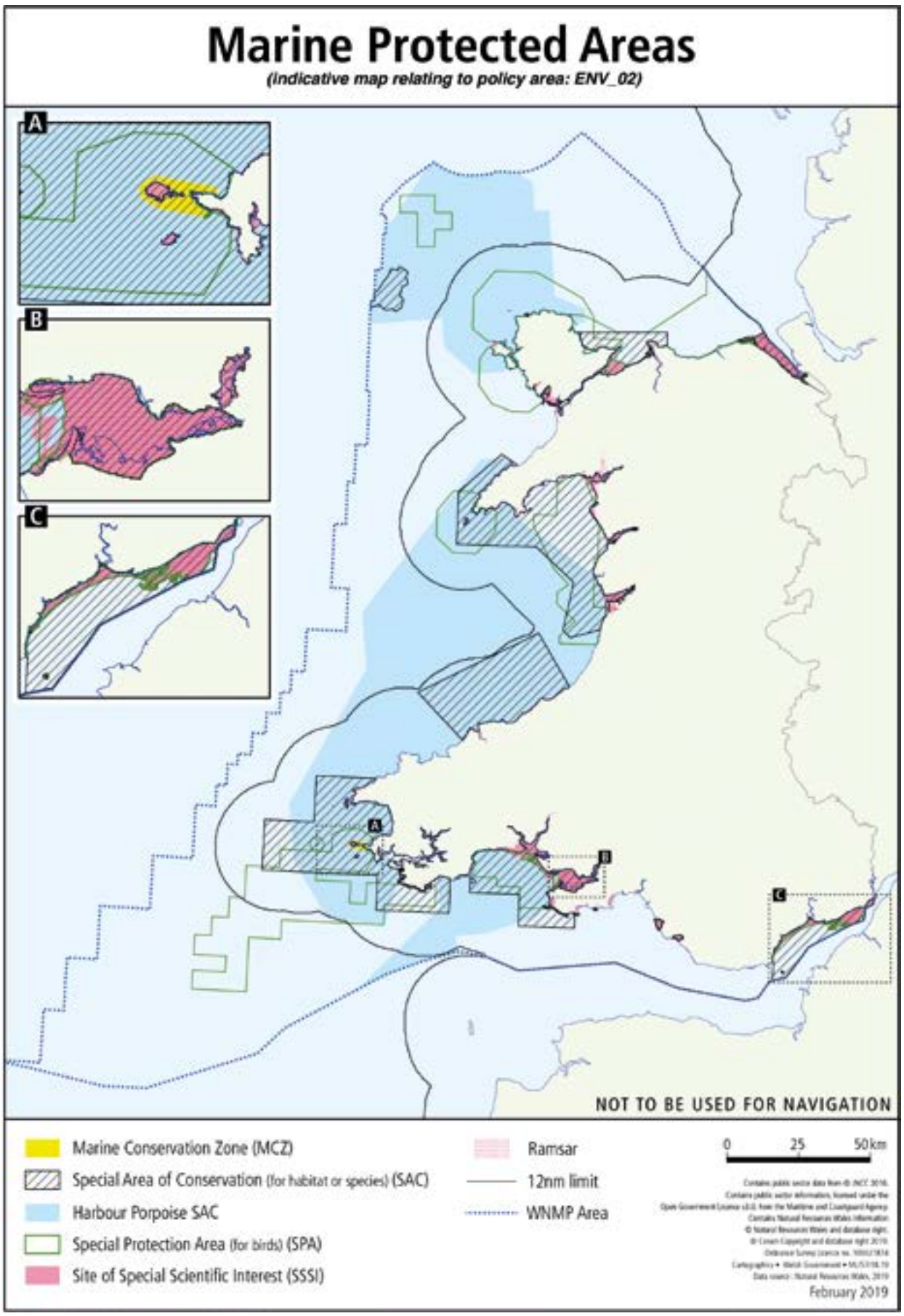
The SMMNR outputs represent the start of an iterative process of spatial analysis and mapping to support sustainable sectoral development and further marine planning. As such they should be interpreted and applied carefully. The SMMNR outputs are reliant upon and reflect the available data at the time of production. It should be noted that there is limited availability of data in some areas, especially offshore, and confidence in some data may be lower. Figure 7.3 and Figure 7.4 are indicative of survey coverage for seabirds and habitats respectively, in relation to the tidal stream RAs. Future iterations of the SMMNR work can be updated both to develop the underlying models and to incorporate new evidence. Ongoing data collection and analysis is warranted, especially where evidence gaps have been identified.

Maps of the estimated relative constraints for the tidal stream energy sector are shown below in relation to marine mammals (Figure 7.5), fish (Figure 7.6, Figure 7.7 and Figure 7.8), benthic habitats (Figure 7.9, Figure 7.10 and Figure 7.11) and birds (Figure 7.12, Figure 7.13 and Figure 7.14). For further details on methodology, assumptions and results, users should refer to the SMMNR project outputs, in particular the SMMNR Ecological Constraints and Opportunities report (ABPmer, 2020). In addition, Appendix A provides further information on data limitations.

The evidence presented within this SLG is to help users understand some of the ecological considerations relevant to tidal stream energy development in Welsh seas. None of the material may be relied upon as being fully up to date or definitive in nature; it is a tool based upon a number of assumptions set out in the SMMNR work, which can be used at an early stage of sectoral planning. The resolution of the mapped constraints reflects that of the underlying data and the level of spatial resolution may be of limited relevance or value for small scale project planning purposes.

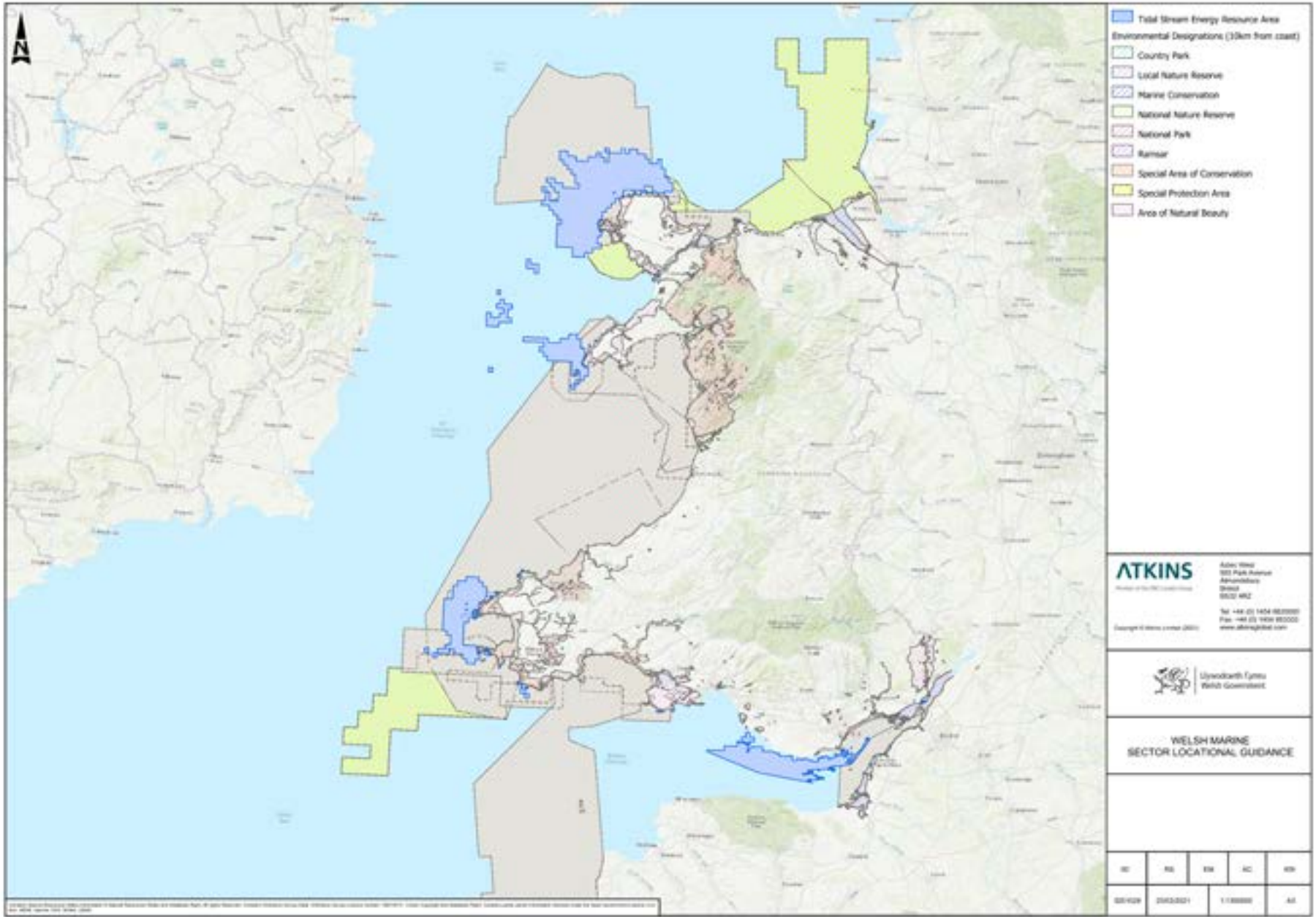
Further, careful consideration should be given to data limitations and gaps. High level ecological mapping such as this may imply there are no or few constraints in some areas. This should be interpreted as no **known** or few **known** relative constraints related to a particular sector. Therefore, while the constraints maps provide a tool for users to explore and better understand potential ecological considerations, they do not obviate the need for users to consult the source datasets and other relevant evidence or gather additional evidence where necessary.

Figure 7.1: MPAs



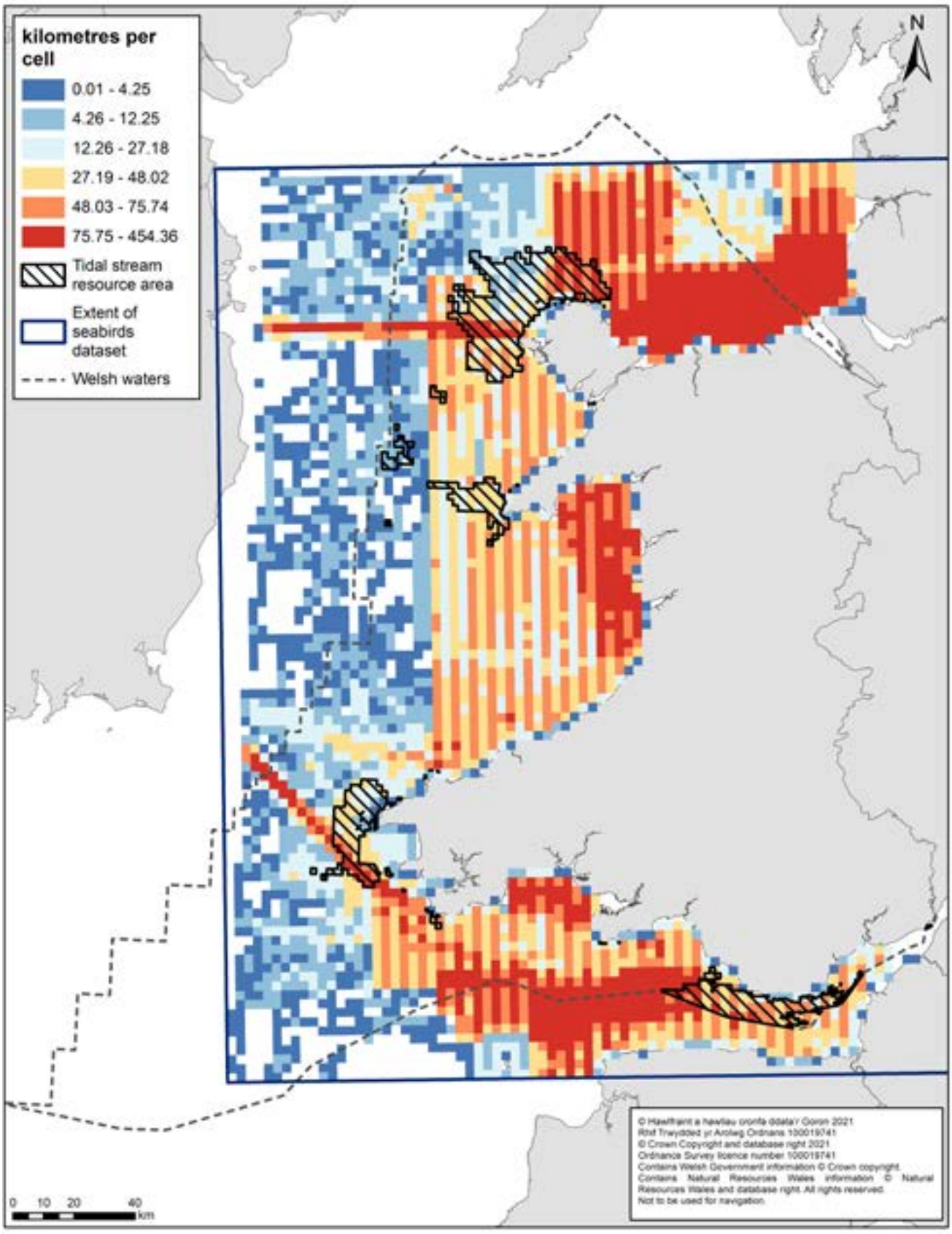
Source: WNMP, 2019

Figure 7.2: Environmental designations in relation to tidal stream RAs



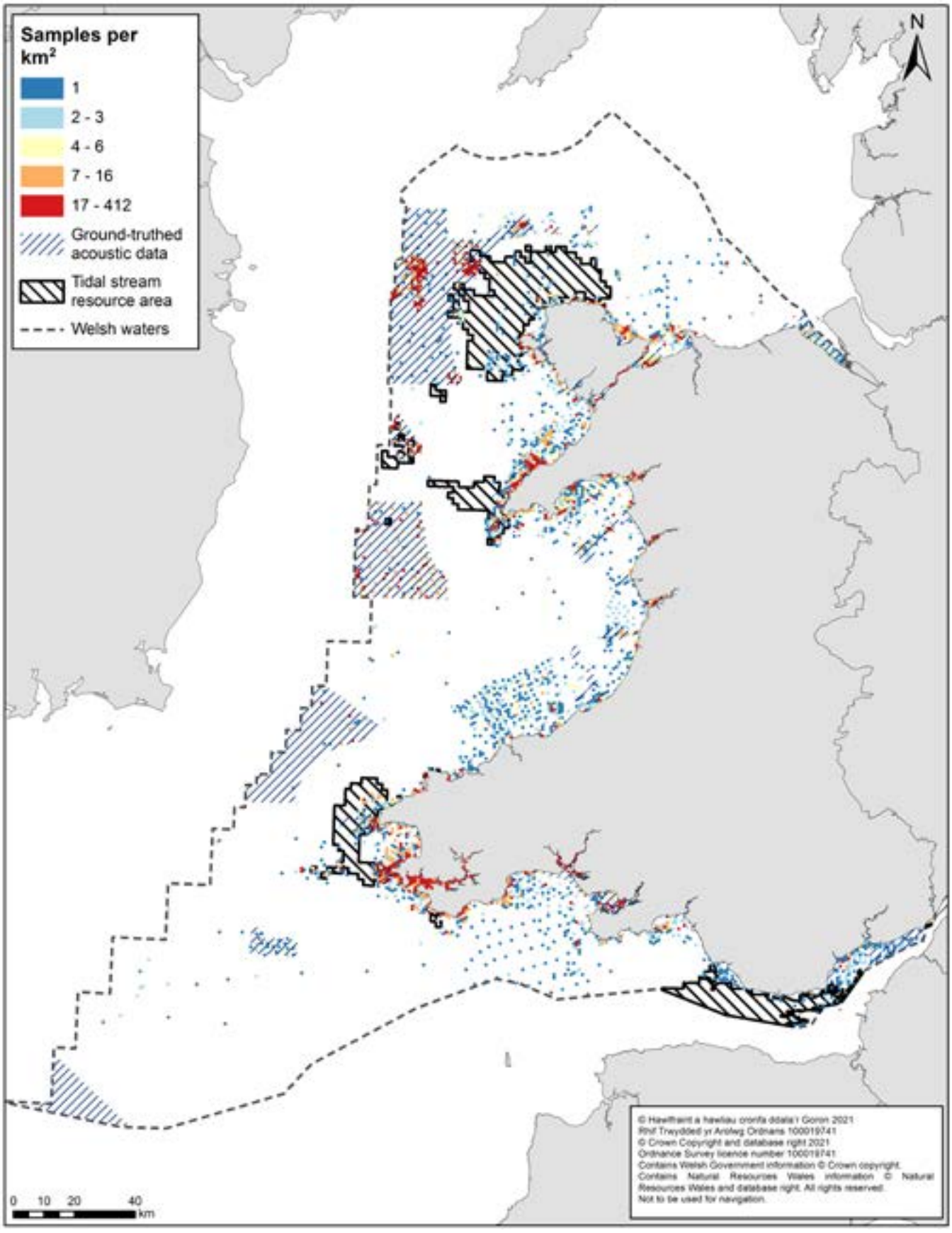
Source: Lle, 2020

Figure 7.3: Survey coverage from seabirds at sea data



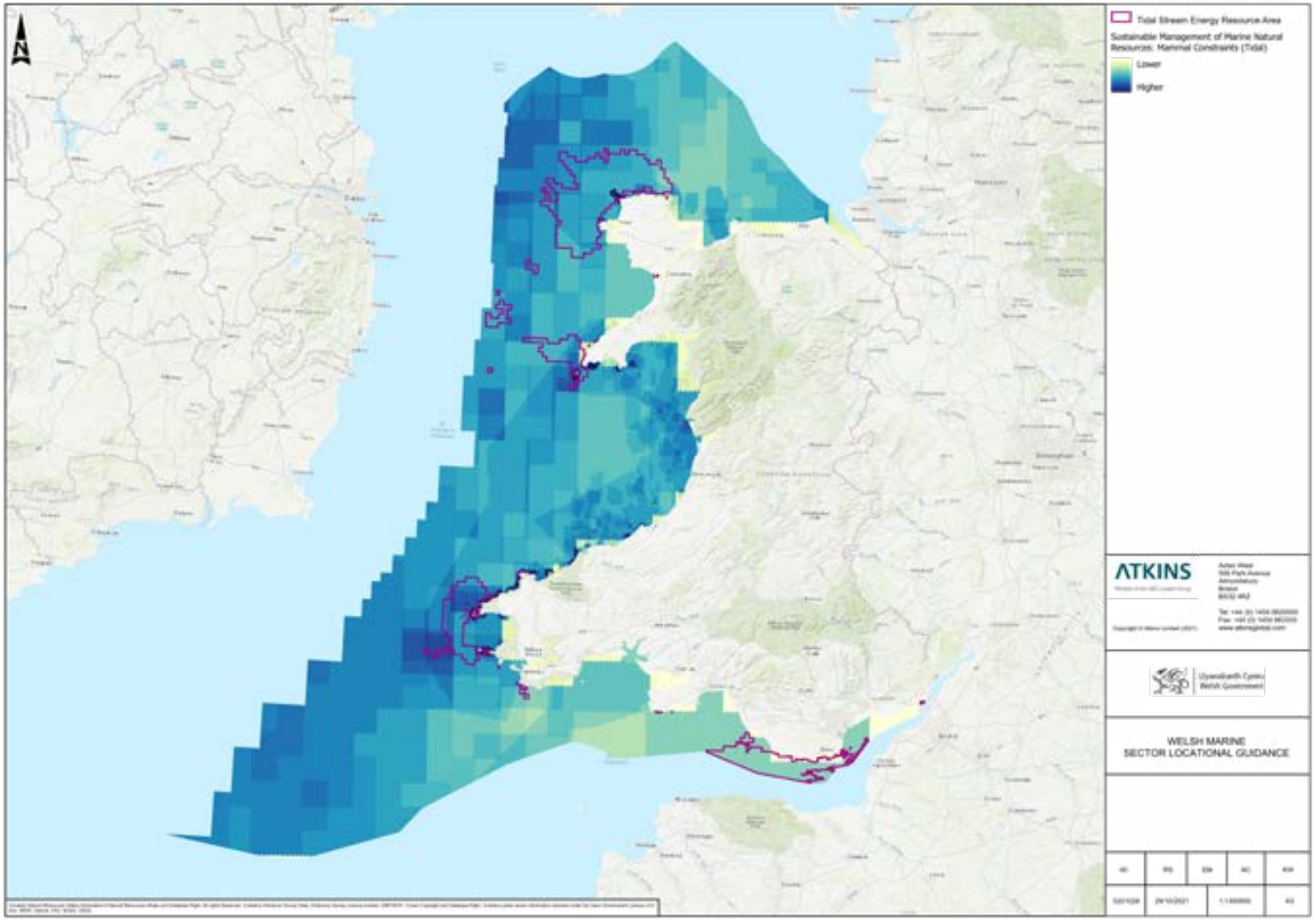
Source: SMMNR, 2021

Figure 7.4: Survey coverage from Marine Recorder data and ground-truthed acoustic data from the JNCC combined map



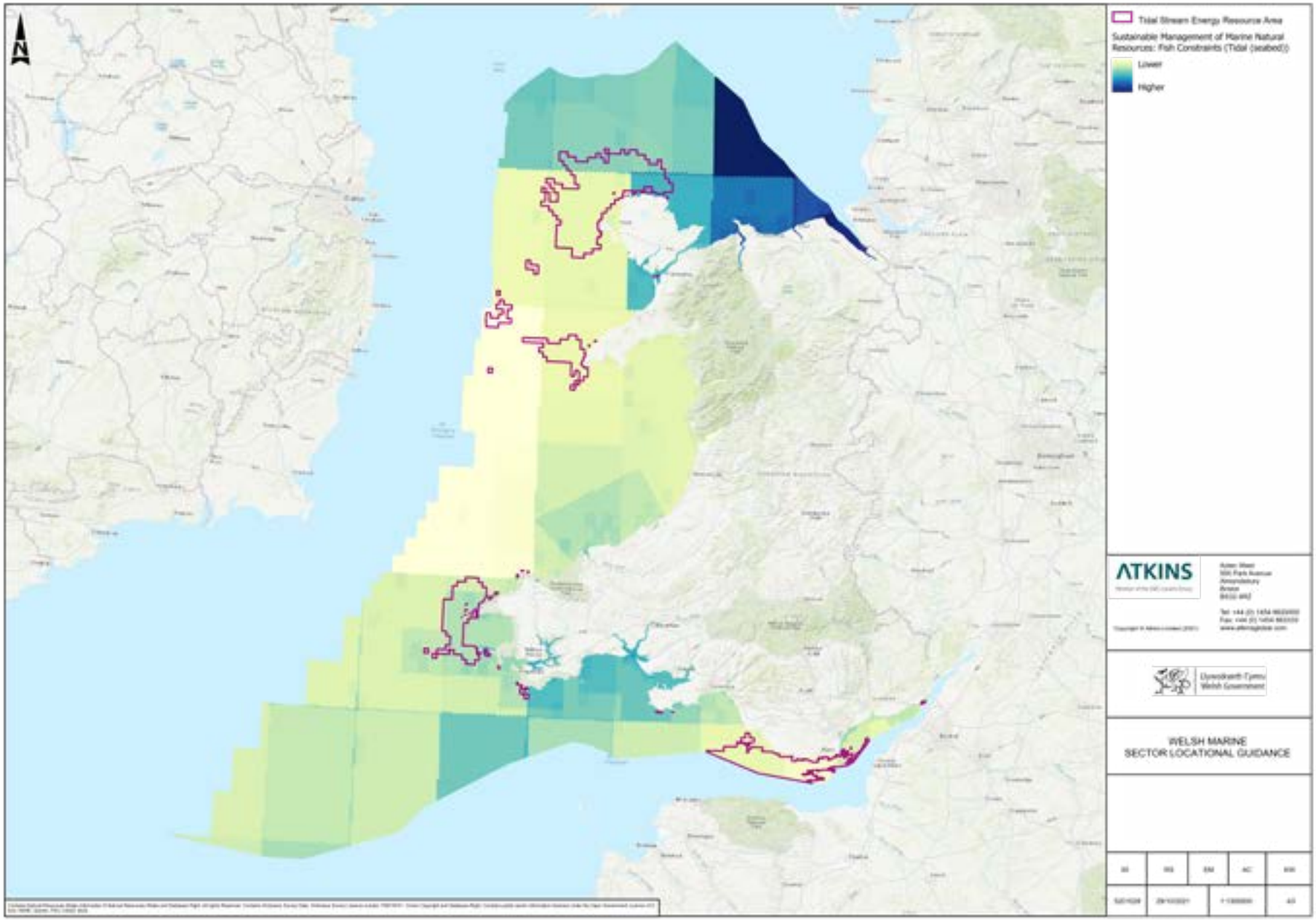
Source: SMMNR, 2021

Figure 7.5: Relative potential marine mammal constraints for tidal stream energy



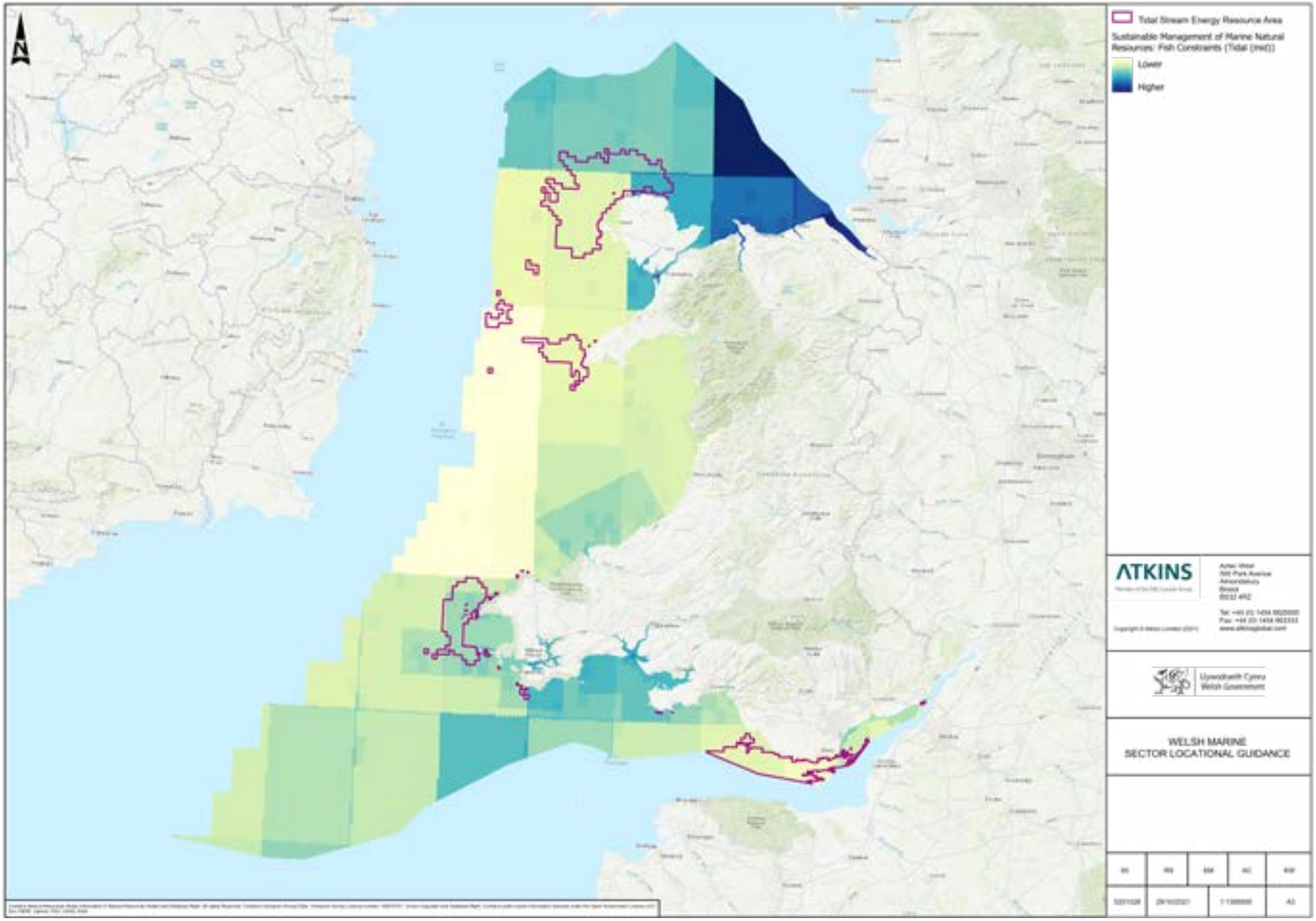
Source: SMMNR, 2021

Figure 7.6: Relative potential fish constraints for seabed tidal stream energy devices



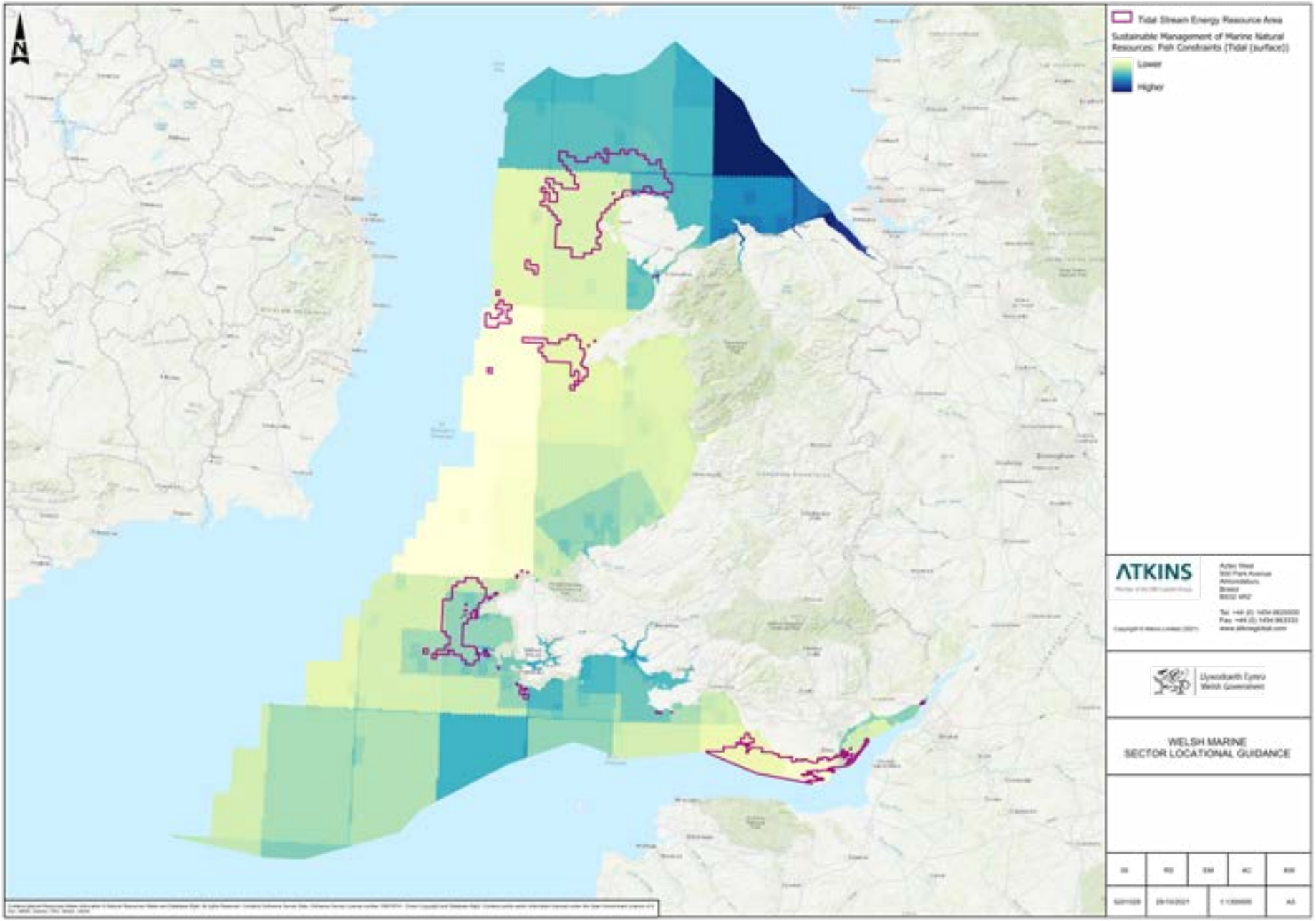
Source: SMMNR, 2021

Figure 7.7: Relative potential fish constraints for mid-water level tidal stream energy devices



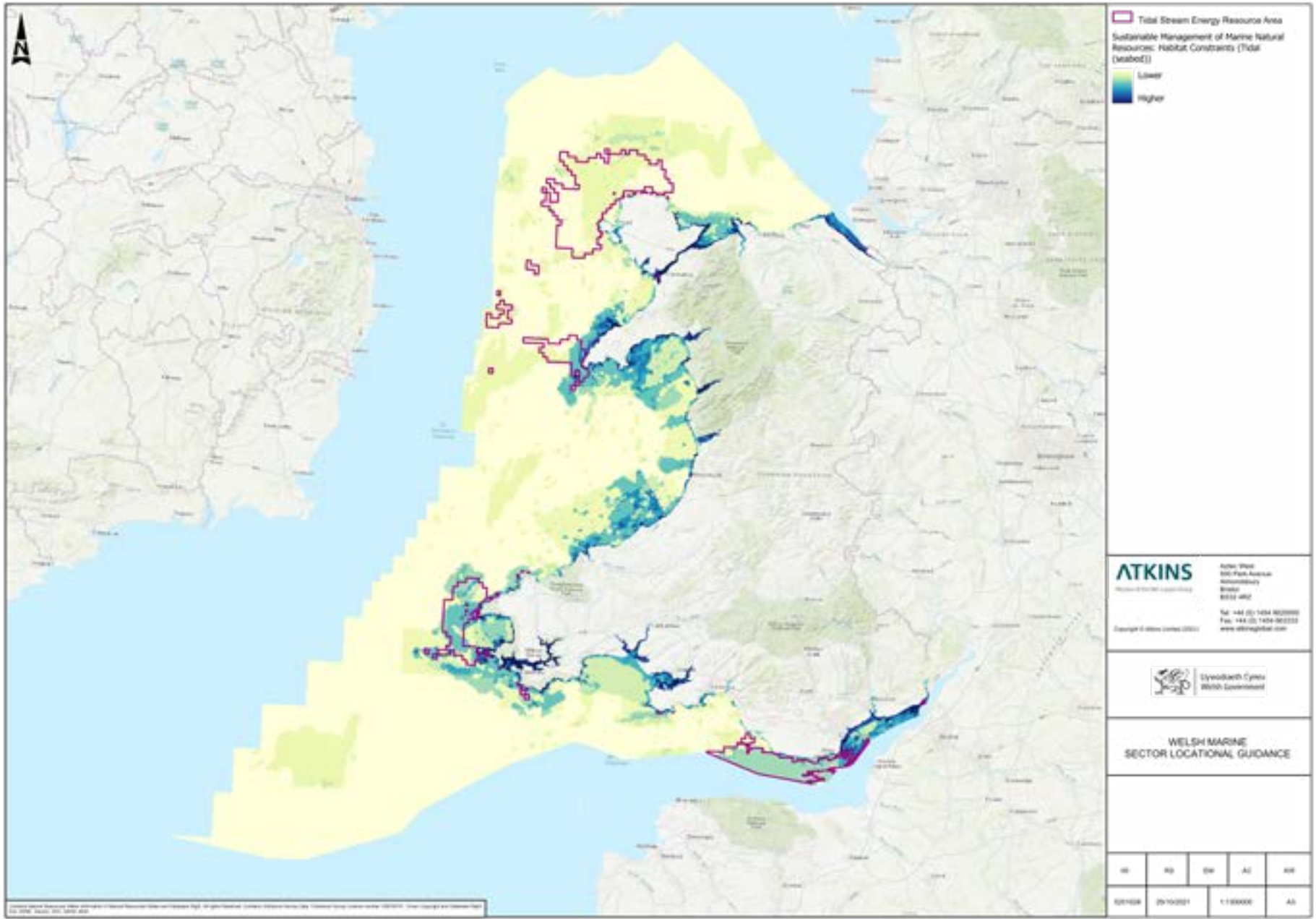
Source: SMMNR, 2021

Figure 7.8: Relative potential fish constraints for surface water level tidal stream energy devices



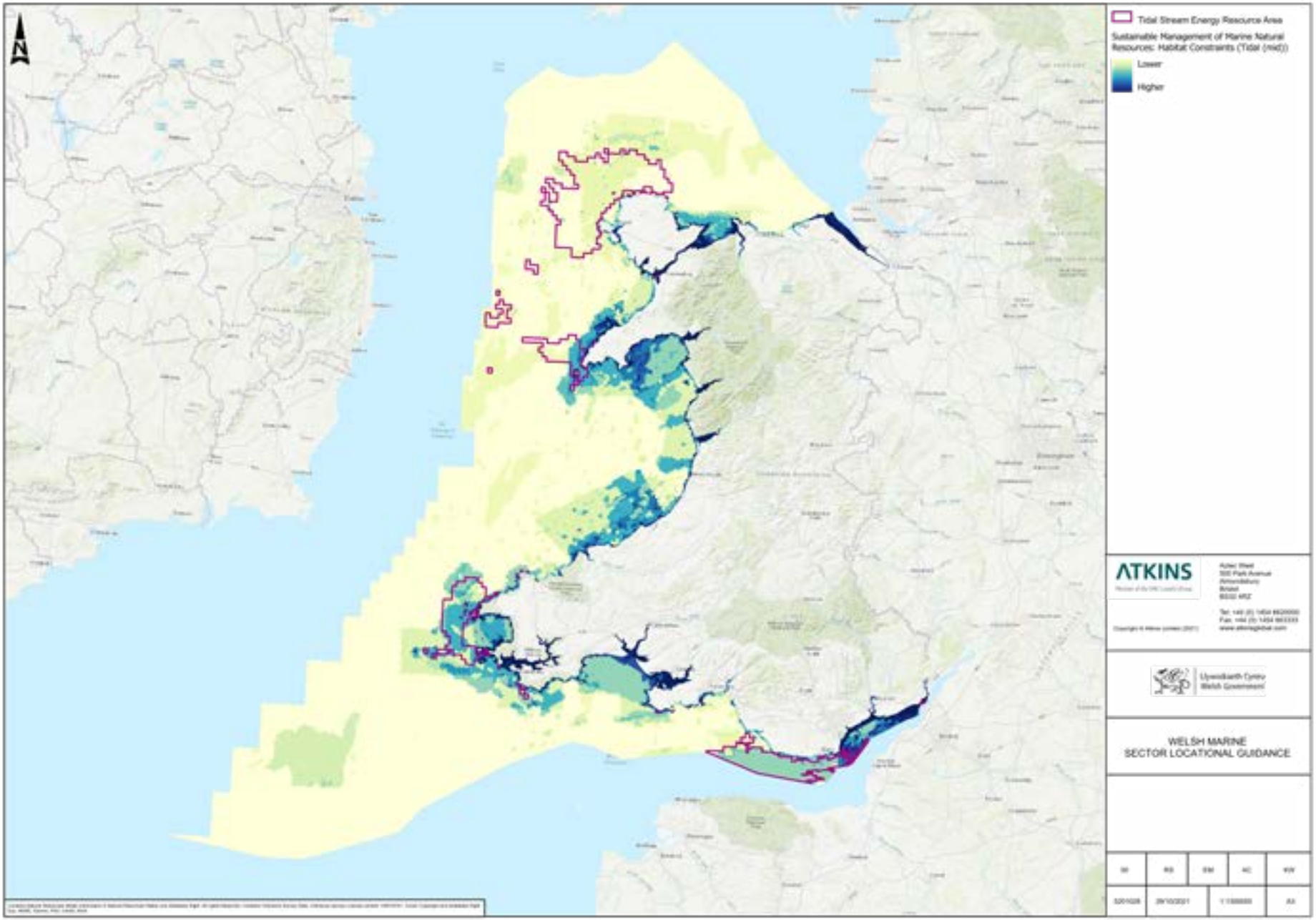
Source: SMMNR, 2021

Figure 7.9: Relative potential benthic habitat constraints for seabed tidal stream energy devices



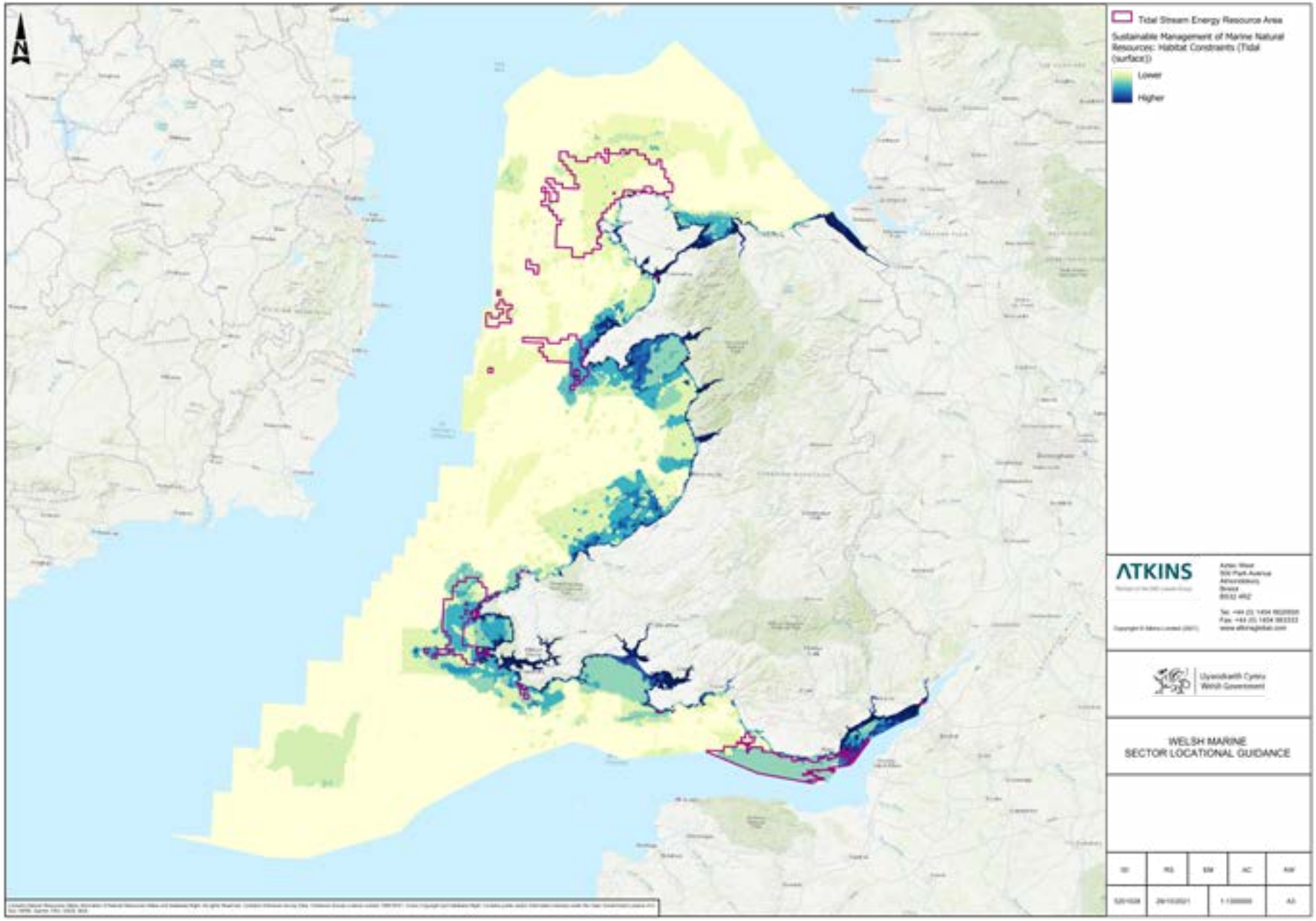
Source: SMMNR, 2021

Figure 7.10: Relative potential habitat constraints for mid-water level tidal stream energy devices



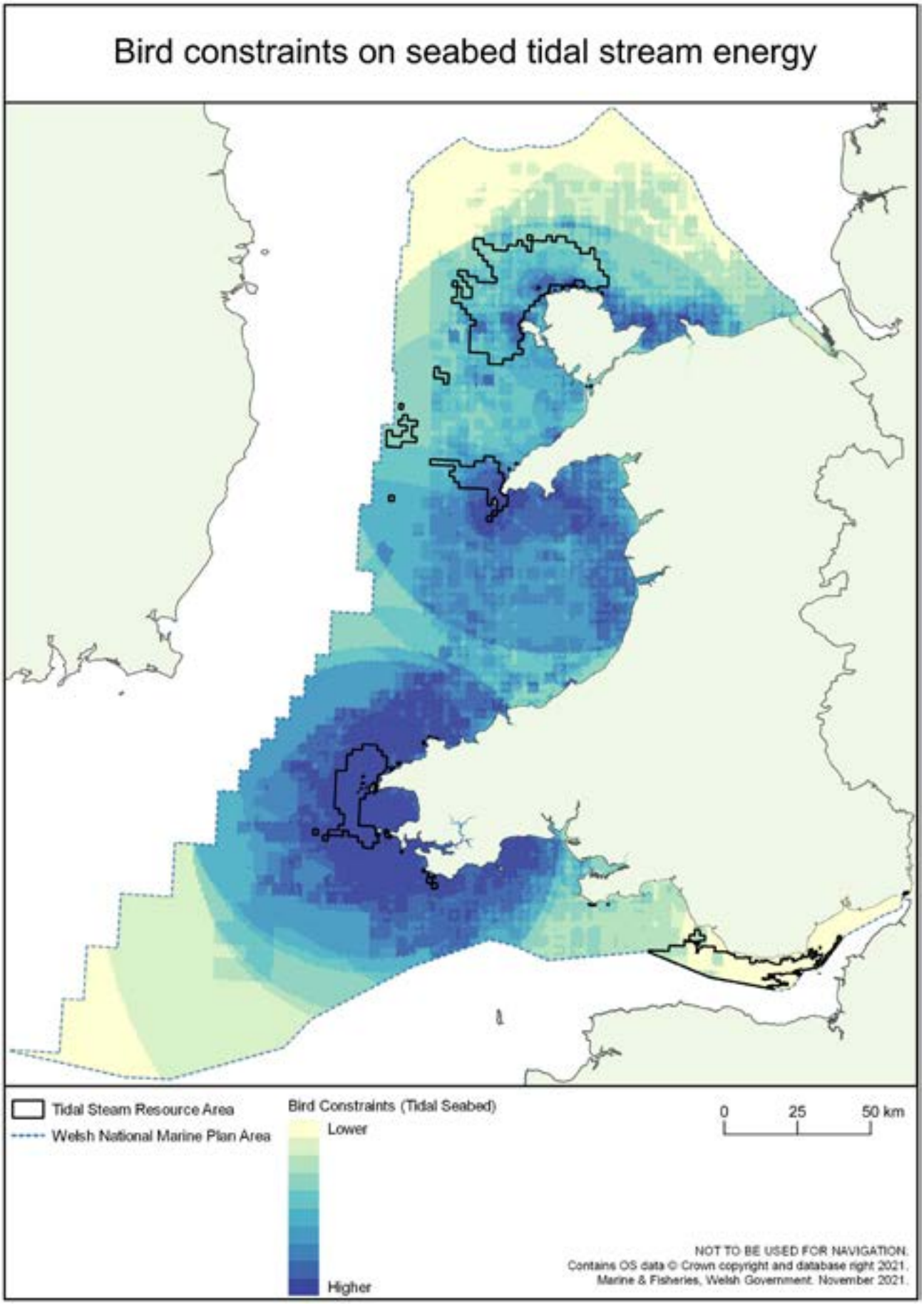
Source: SMMNR, 2021

Figure 7.11: Relative potential habitat constraints for surface tidal stream energy devices



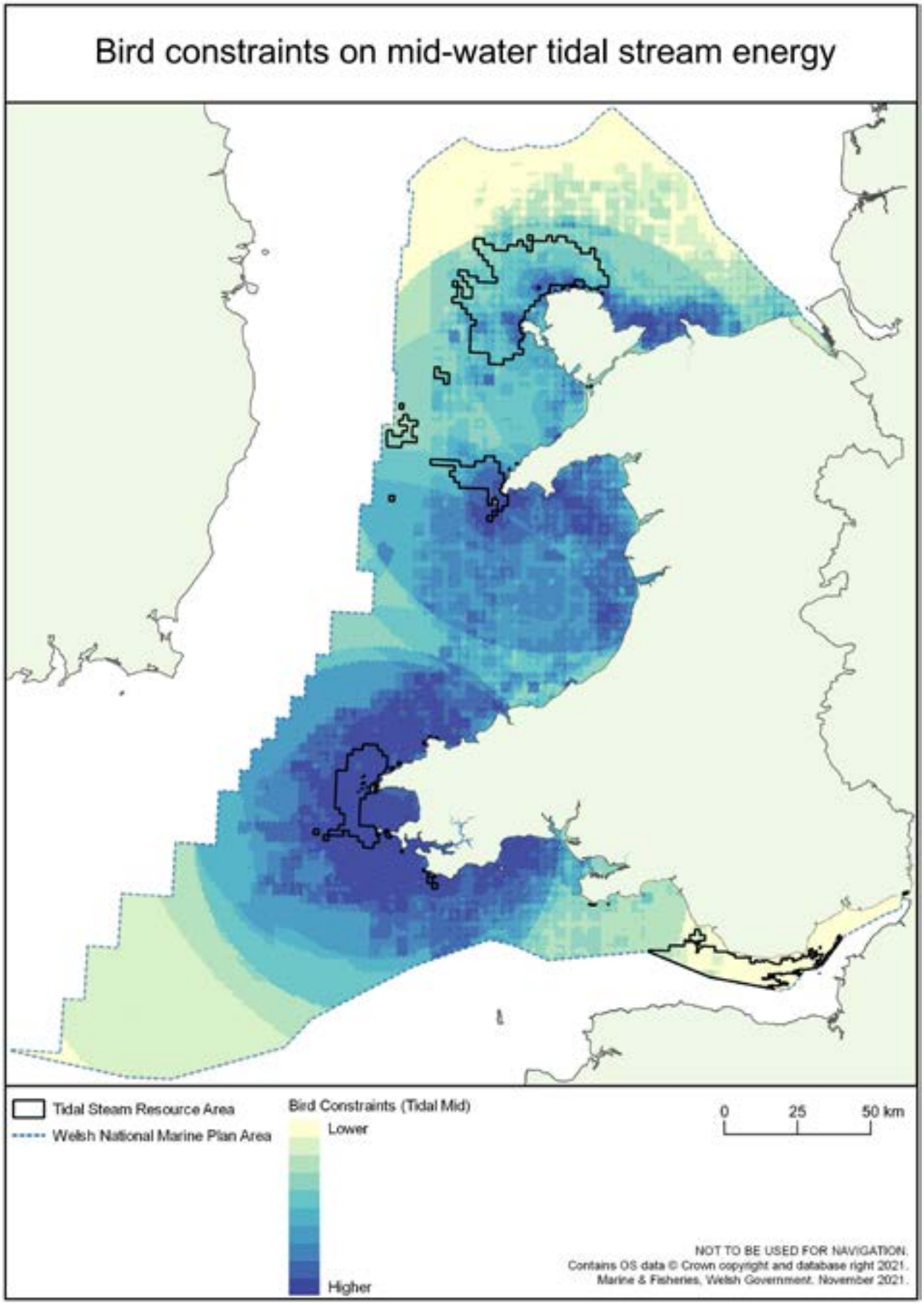
Source: SMMNR, 2021

Figure 7.12: Relative potential bird constraints for seabed tidal stream energy devices



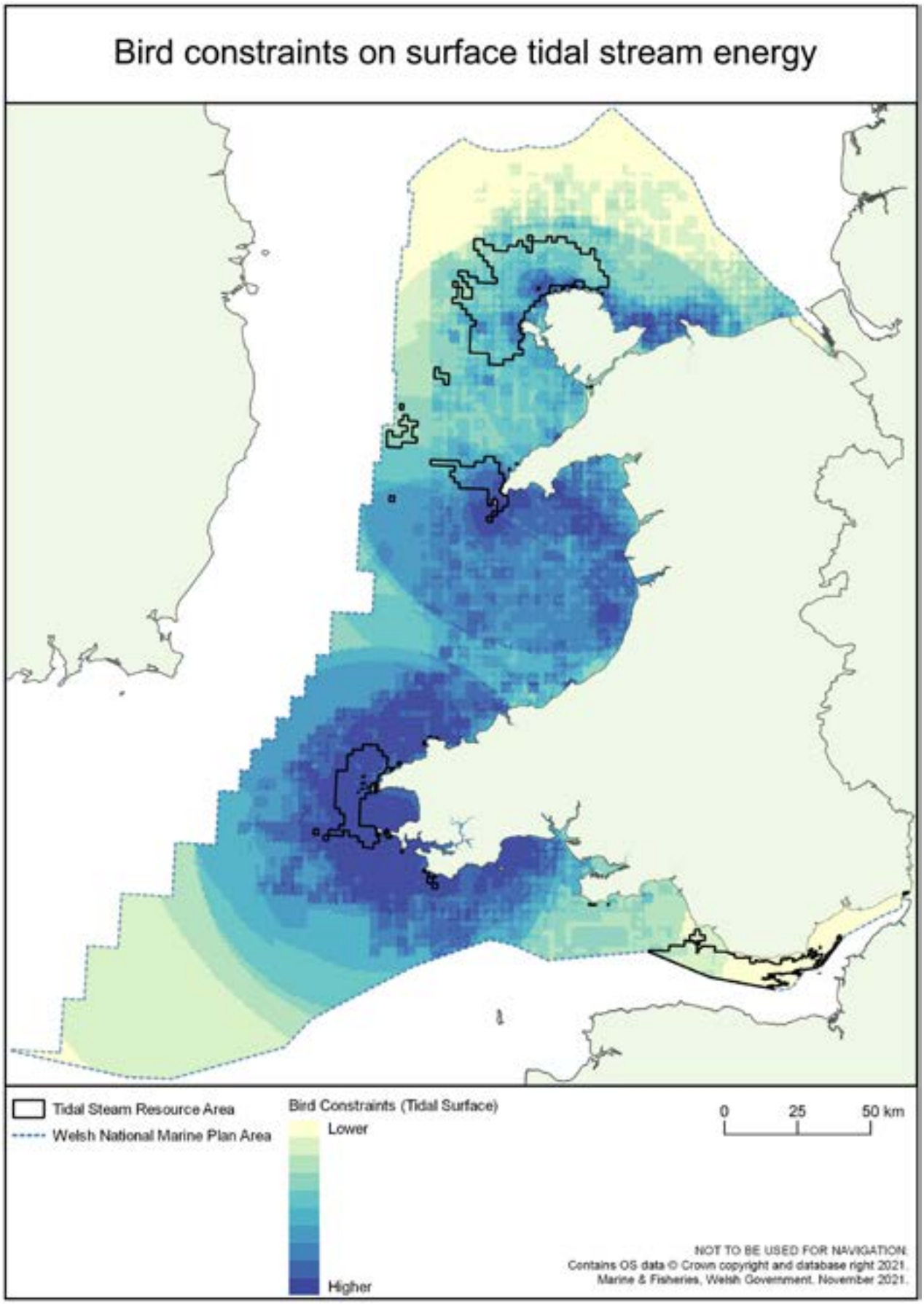
Source: SMMNR, 2021

Figure 7.13: Relative potential bird constraints for mid-water level tidal stream energy devices



Source: SMMNR, 2021

Figure 7.14: Relative potential bird constraints for surface level tidal stream energy devices



Source: SMMNR, 2021

8. Other marine users

This section provides an overview at the national level on where tidal stream resources may be found and where they interact with other marine users' areas of interest. The maps are high level and indicative only. For further, more detailed information on combinations of activities in particular areas within Welsh waters, please use the Marine Planning Portal[36]. SLG users should also refer to Section 2 and Section 9 for cross sector interactions, and Section 10 for further regional considerations.

Although tidal stream energy is considered to be an industry with scope to develop, potentially at scale, it will have to establish itself alongside those developments and activities already taking place around Wales. Tidal stream sector developments have the potential to impact on other marine or coastal activities, either existing or planned, future activities, as well as the RAs of other sectors. In line with WNMP **policy SAF_01 (safeguarding existing activity)**, any proposals for new development are required to assess their likely impact on established activities and demonstrate how they will address any compatibility issues. WNMP **policy SAF_02 (safeguarding strategic resources)**, requires similar consideration of any impacts on Strategic Resource Areas of other sectors, where such areas exist.

Not all activities are able to coexist or share the same space due to conflicting resource or technological requirements. Where a tidal stream energy development is not compatible with an existing activity, this existing consideration will act as a hard constraint. Where coexistence is a possibility, these may represent soft constraints that may need consideration including issues around timing, safety, and consenting. WNMP **policy ECON_02 (coexistence)** requires proposals to consider appropriate opportunities for coexistence with other marine users in order to deliver multiple benefits and optimise the value and use of the marine area.

For coastal communities across Wales, tourism is often the prime economic driver. The total contribution of tourism to Wales, including impacts through the supply chain and capital investment, was £6.2 billion in 2016, accounting for 13.3% of the total economy, with a direct contribution of £2.7 billion (8%). The sector is of significant local importance in the North, Mid and South West Wales RAs where over 40% of the population may be involved. The industry provides considerable numbers of jobs for the 16-24 age bracket and employs a disproportionate number of women, often when other opportunities may be lacking.

The arrival of tidal stream energy developments may cause mixed reactions in communities. Some may welcome the additional opportunities brought, both for employment and for renewable energy generation. Others may be concerned about potential adverse impacts on existing uses, for example, recreational waterborne activities or perceived loss of visual amenity.

Tidal stream energy sector developments have the potential to impact on other marine or coastal seascapes, including terrestrial areas with views of the coast or seas. Seascapes tend to have a distinct character; they range from the spectacular and remote Pembrokeshire Coast National Park and Gower, to built heritage that uses the natural setting, such as Llandudno which is flanked by craggy limestone headlands (NRW, 2015). Their high quality and great diversity provide the sought-after settings for many cultural and economic activities. Seascapes around Wales are important for activities including health and wellbeing, tourism, quality of life and economics (NRW, 2015).

36 **www.lle.gov.wales/apps/marineportal/#lat=52.5145&lon=-3.9111&z=8&tgt=false**

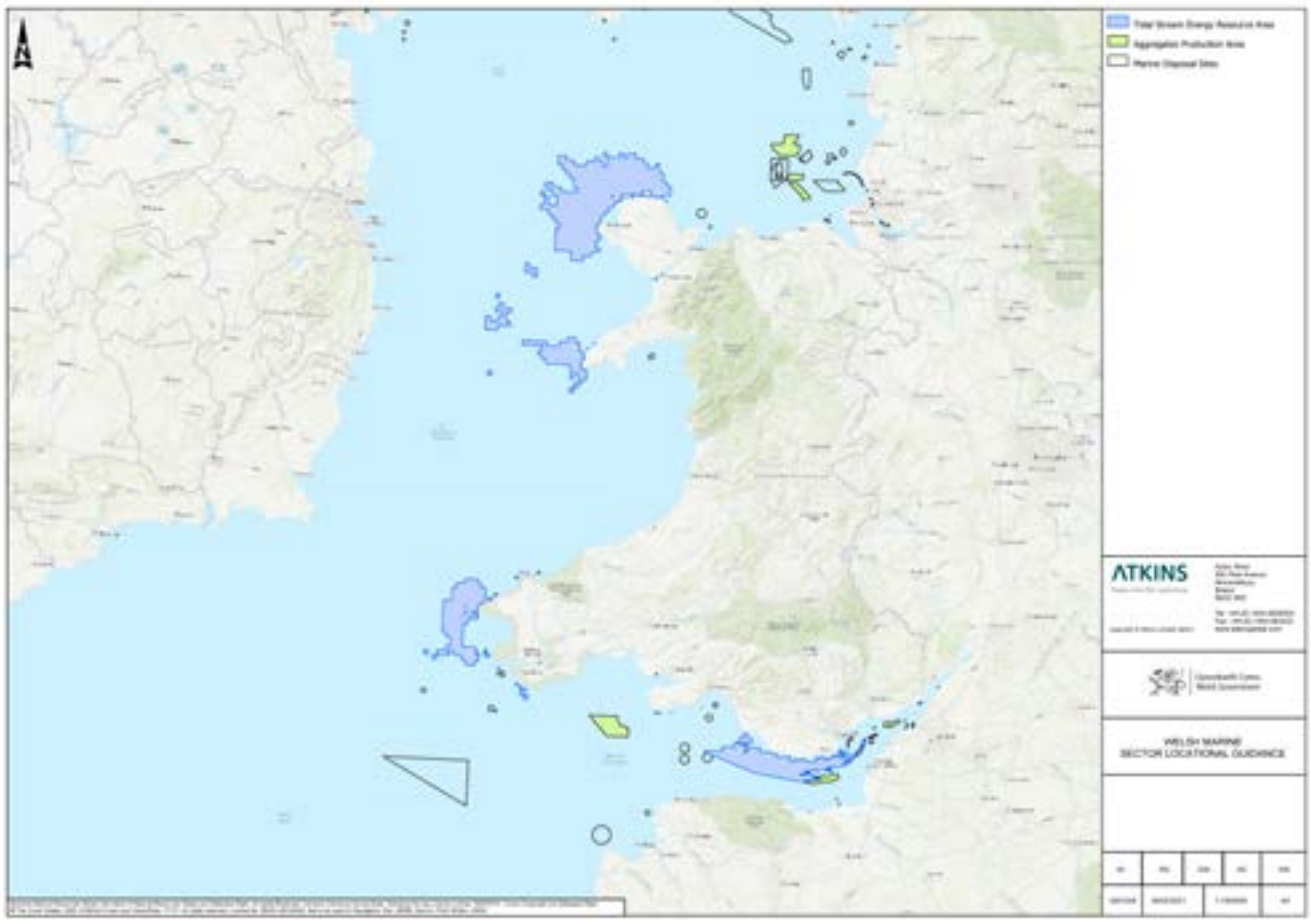
A study looking at the natural heritage evidence to support strategic planning for renewable energy was conducted in 2011, which provides additional details of seascape/landscape character, views and visual amenity and landscape values (CCW, 2011). In addition, a National Seascape Assessment for Wales was conducted in 2015 which provides further details on seascape and marine character areas for Wales (NRW, 2015).

Potential constraints relating to seascape will depend on both the technology type and setting. In line with WNMP **policy SOC_07 (seascapes)**, any proposals for new development are required to assess any potential seascape impacts and demonstrate how they will address these. It is in the early stages of project planning that addressing adverse seascape impact is most effective. Appropriate siting and early consideration of alternatives can help to identify and avoid potential impacts.

Maps of the locations of existing activities and other marine users where these overlap with the tidal stream energy RAs are shown below in relation to marine aggregates and disposal sites (Figure 8.1), aquaculture (Figure 8.2), Military Practice Areas (Figure 8.3), other energy sectors (Figure 8.4 and Figure 8.5), fishing (Figure 8.6 and Figure 8.7), shipping (Figure 8.8 and Figure 8.9), subsea cables (Figure 8.10), and maritime heritage (Figure 8.11). The overlap of existing activities will be a consideration for development proposals in line with **policy SAF_01 (safeguarding existing activity)**.

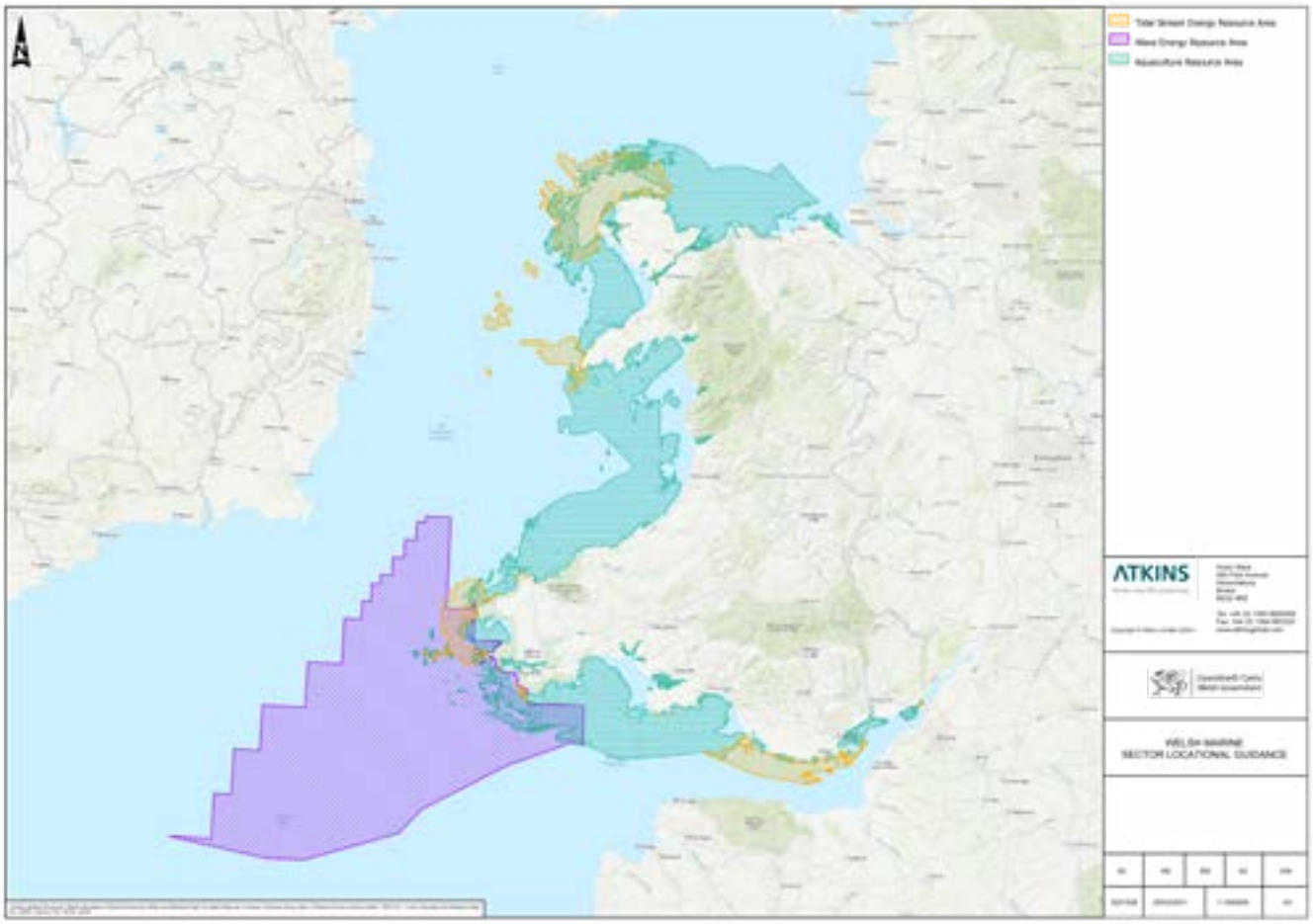
Tidal stream resources coincide with aggregate resources off north Anglesey, Pembrokeshire and within the Inner Bristol Channel. Tidal stream energy development is not considered compatible at the same point in time with aggregate production or dredge disposal areas as the establishment of fixed structures will affect these activities.

Figure 8.1: Marine aggregates and marine disposal areas with tidal stream RAs



Source: TCE, 2021 and Cefas, 2020

Figure 8.2: Tidal stream RA and Wave RA overlapping with aquaculture RAs



Source: Lle, 2020

There is no overlap or interaction between the tidal stream RAs and several and regulating orders for aquaculture in Welsh waters.

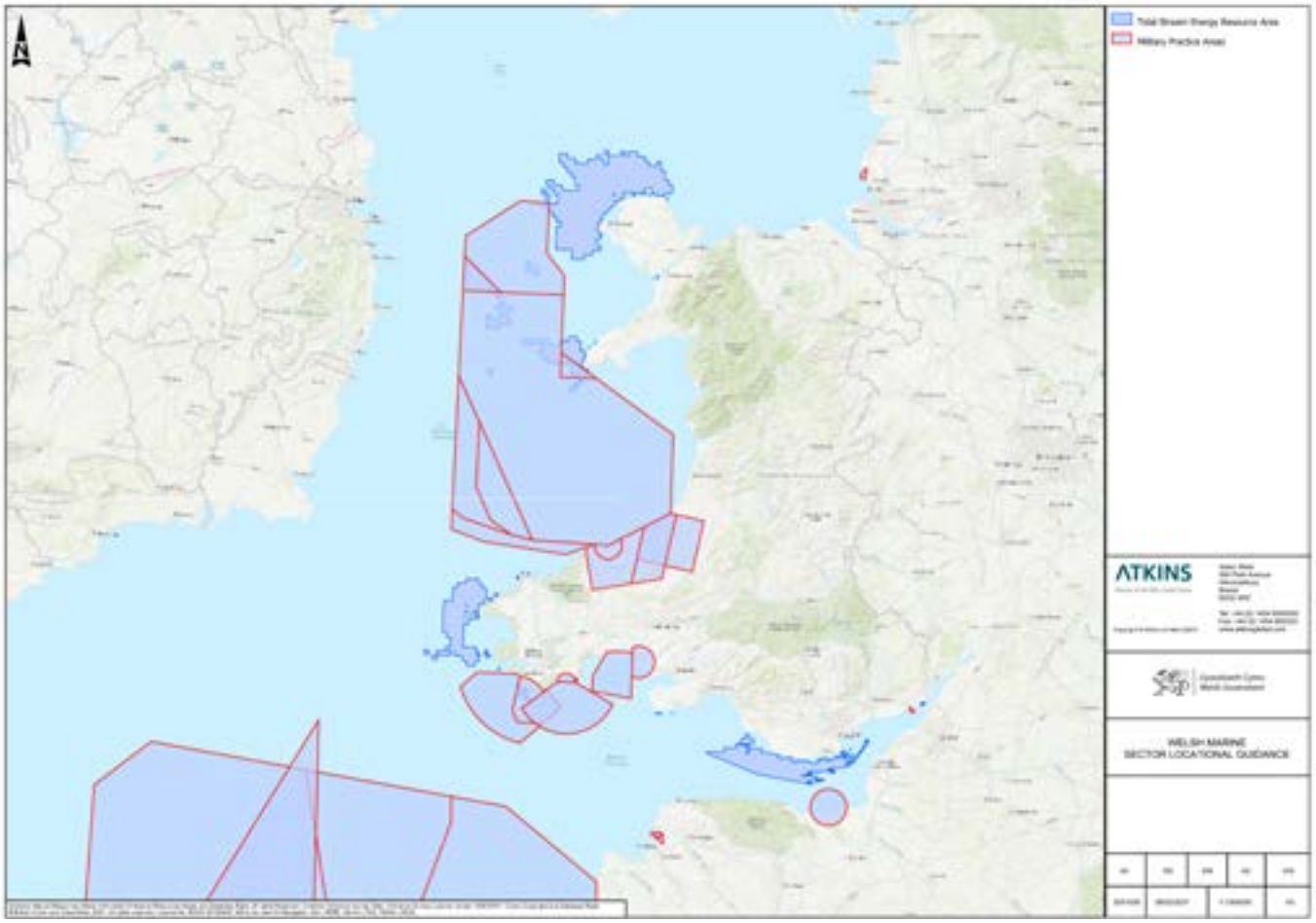
Tidal stream resources overlap with resources for potential seabed aquaculture (shellfish bottom cultivation), in locations such as off the Llŷn Peninsula, Pembrokeshire, and coastal sites in South Wales.

Tidal stream and cage culture RAs overlap in some locations, but tidal stream areas are not considered optimal for caged fish farm operations (SARF, 2014). This is supported by recent stakeholder engagement which suggested that water depth and wave climate around Welsh inshore waters was not suitable for cage culture.

Tidal stream resources overlap with resources for potential rope culture of shellfish off Anglesey, the Llŷn Peninsula, Pembrokeshire, and coastal sites in South Wales near Cardiff. Areas of resource potential are not subject to WNMP **safeguarding policies**; however, an overlap in RAs could indicate potential future competition for space between the two sectors.

There has been some interest in the potential for coexistence of aquaculture projects with marine energy projects. Surface water-level structures could potentially provide shelter to aquaculture in their 'shadow'. However, in the main, prospective areas of tidal stream energy are not a suitable physical environment for aquaculture. The offshore areas of the tidal stream RAs may also be unattractive locations for future stand-alone aquaculture activity due to the distance from shore.

Figure 8.3: Military practice areas with tidal stream RAs



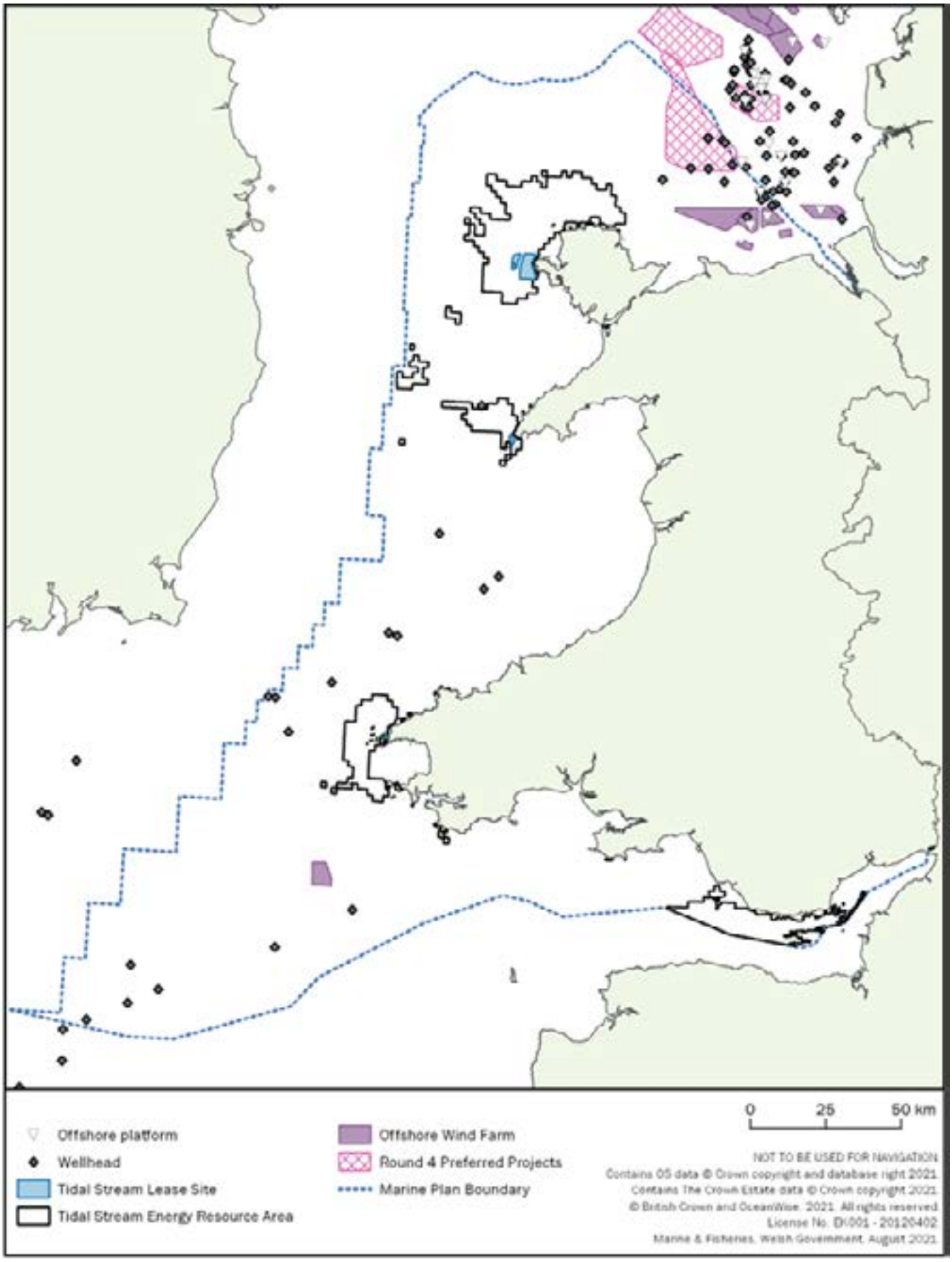
Source: Oceanwise, 2020

There is an overlap of tidal stream resources off Llŷn Peninsula with an existing Military Practise Area.

WNMP **policy DEF_01 (safeguarding)** concerns proposals with the potential to affect Ministry of Defence (MoD) areas or strategic defence interests. A marine licence or other relevant consent/permit will only be granted with the agreement of the MoD and where the MoD is satisfied that the proposal will not cause unacceptable risk to defence and national security. Achieving consent in MoD areas may be difficult but may be possible through detailed consultation with the MoD.

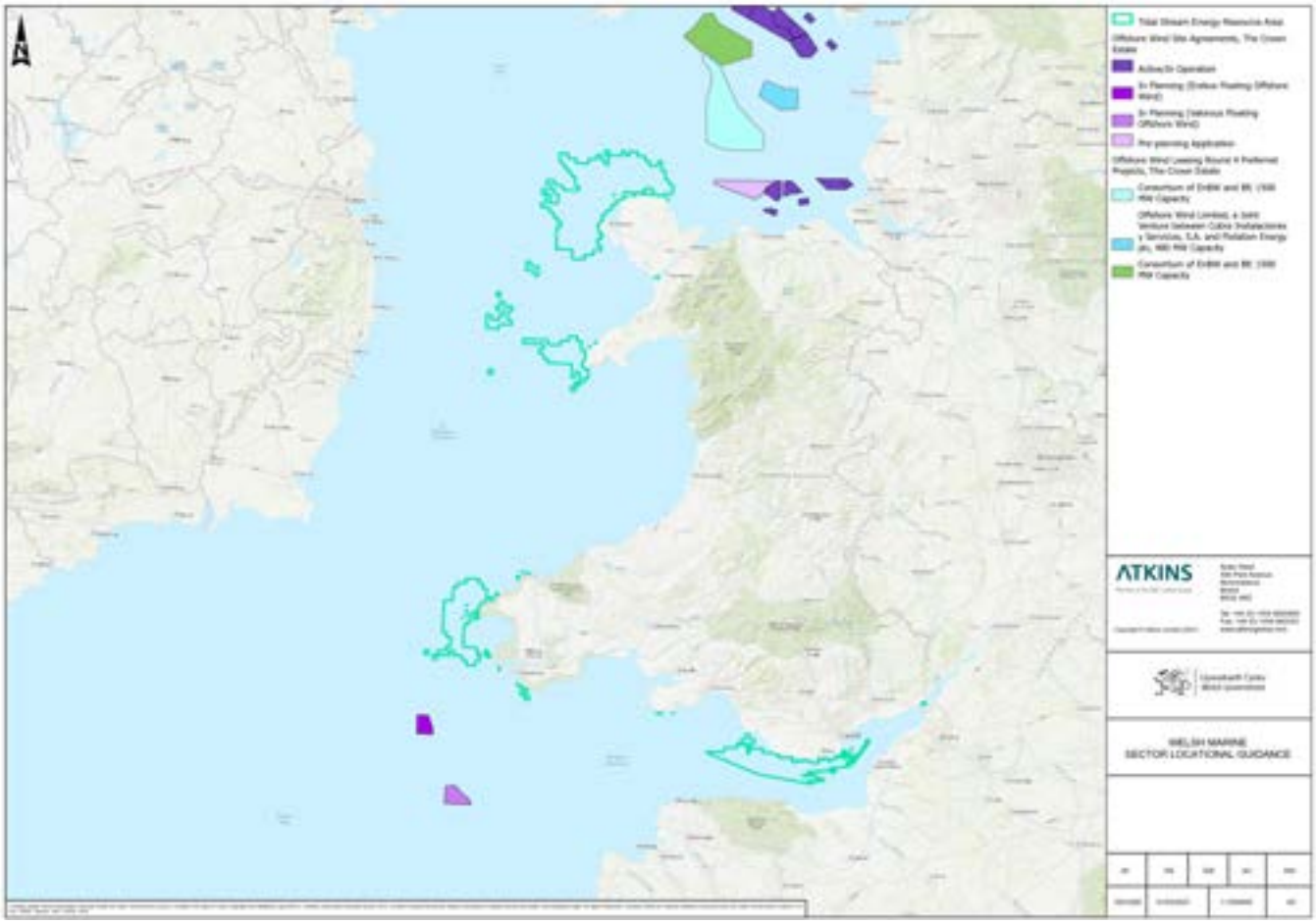
Based on the engagement with the MoD, Military Practice Areas should be treated as 'hard' constraints, with any development in these areas very unlikely to be acceptable. Other defence interests such as Areas of Intense Aerial Activity and Fleet Exercise Areas may not need to be treated as a 'hard' constraints depending on the level of interaction expected; however, engagement with MoD would be required if interaction with these areas was anticipated. For Fleet Exercise Areas, consultation with MoD would be required to establish the usage of the area and potential for interaction, but at this stage it is assumed that this should be treated as a 'hard' constraint for surface water-level devices, with any development in these areas very unlikely to be acceptable.

Figure 8.4: Energy (including low carbon and O&G) with tidal stream RAs



Source: Welsh Government, 2021

Figure 8.5: Energy (offshore wind site agreements) with tidal stream RAs



Source: TCE, 2021

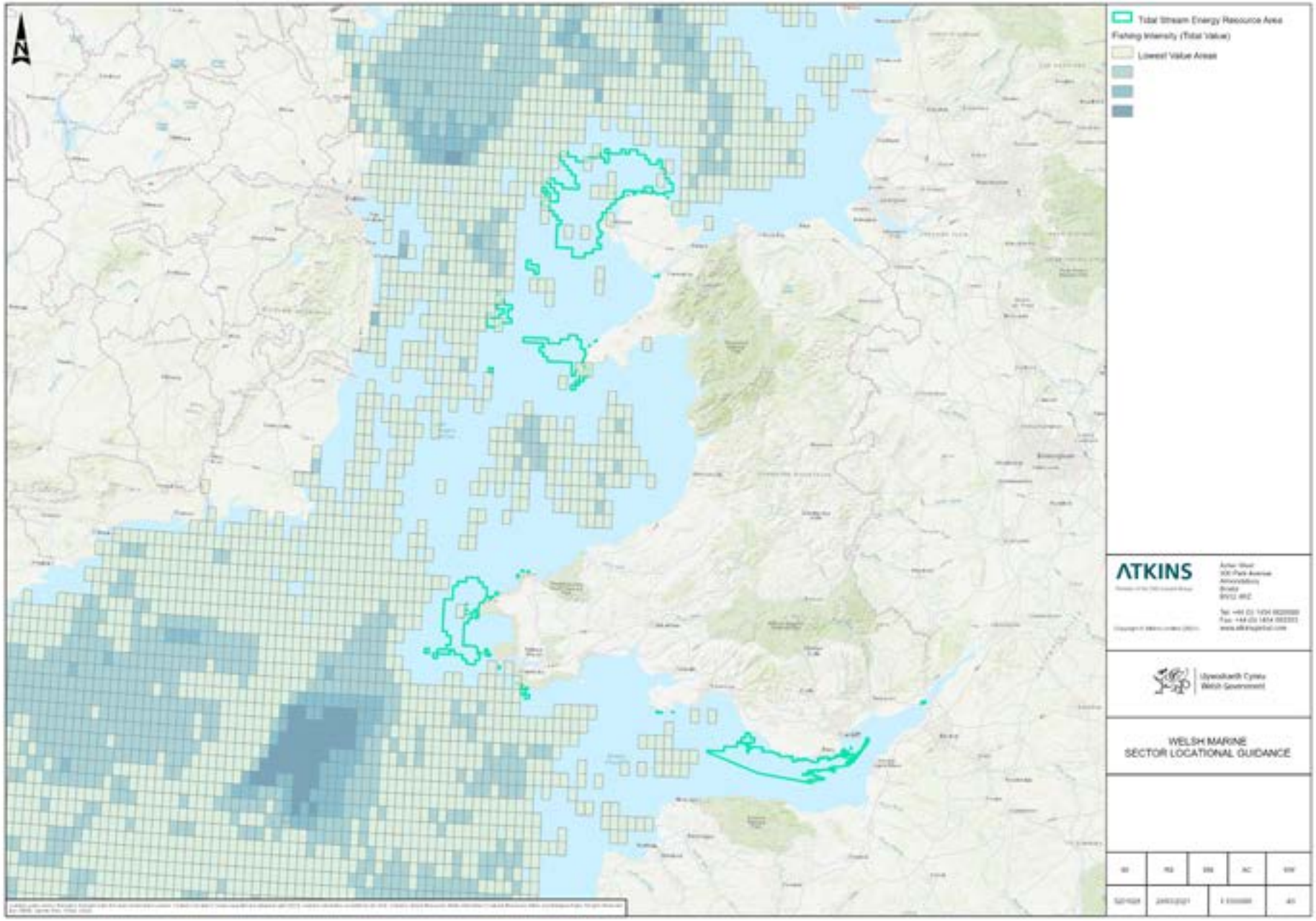
Tidal stream resources coincide with wave resources off the Pembrokeshire coast.

Tidal stream resources overlap with wind energy resources off north Anglesey, around the Llŷn Peninsula, south Pembrokeshire, Carmarthen and Swansea Bay and coastal to Cardiff; and floating wind development in the Celtic Sea. Tidal stream energy is typically located fairly nearshore and, therefore, there is unlikely to be overlap between early-stage tidal stream developments and wind/wave developments. However, as technology develops, lower flow areas may become viable and there may be more overlap with RAs. This could present a potential opportunity for co-location and sharing of infrastructure.

There is potential for co-location between different types of marine renewable energy devices, with wave or tidal stream technology being incorporated into floating wind platforms, as being explored by a number of developers including Marine Power Systems, Floating Power Plant and Bombora. These areas should, therefore, not be treated as a hard constraint at this stage and further research to investigate co-location potential is warranted.

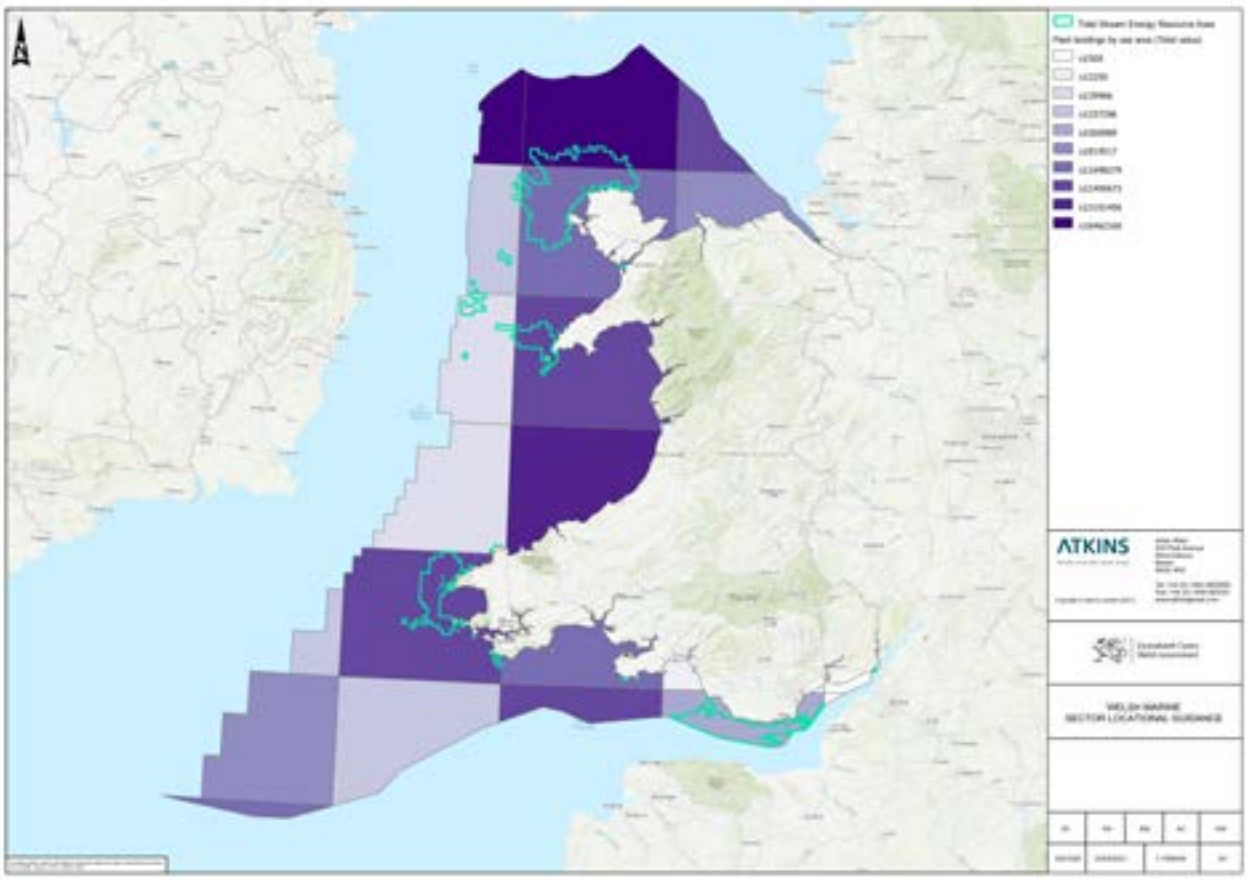
Overlap of tidal stream resources and existing O&G infrastructure is limited. The presence of abandoned O&G sector well heads could act as a constraint to the siting of tidal stream devices. Extant infrastructure of this type is covered under the WNMP **safeguarding policy** for O&G, including any statutory exclusion zones. It is anticipated, however, that any conflicts of this type could be resolved through early planning and micro-siting of devices.

Figure 8.6: Fishing Intensity in relation to tidal stream RAs



Source: ICES, 2021 and MMO, 2017

Figure 8.7: Fleet landings by Sea Area in relation to tidal stream RAs



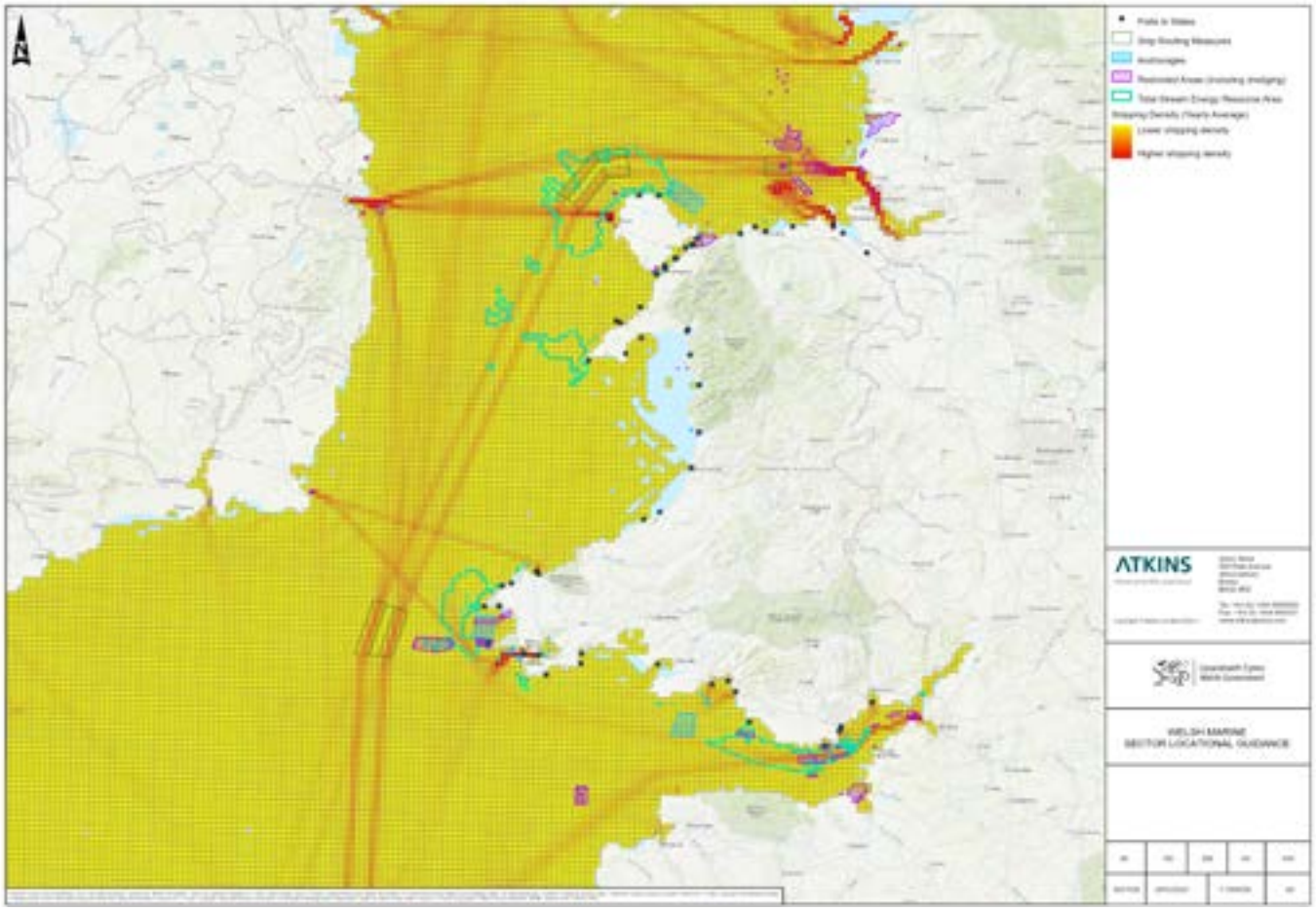
Source: MMO

Commercial fishing is an important sector of the Welsh economy and, as such, impacts on fishing activity should be fully considered at site selection stage. Fisheries activities include inshore (coast to 12 nm) and offshore (beyond 12 nm) commercial fishing. The fishing fleet provides direct income and employment, fresh and local seafood to the retail and hospitality trade, which helps to support a vibrant coastal tourism industry. In addition, the fishing fleet contributes indirectly to local businesses through operational costs such as fuel, ice, gear, etc. Vessels involved in the commercial fishing sector are found all around the Welsh coast and include larger, offshore vessels (> 10 m) and smaller (< 10 m) inshore vessels.

Data on fishing activity in Wales is limited and this SLG has focussed on ICES and MMO data. However, it is acknowledged that this data does not provide an accurate reflection of localised fishing activity, particularly static gear fishing which is not captured in the data available but is a significant component of the Welsh fisheries sector and which operates in inshore waters. As such there may be significant interactions and a need for careful consideration when planning projects. Developers should, therefore, undertake early engagement with fisheries representatives such as the Welsh Fisherman's Association or the National Federation of Fishermen's Organisation to inform site selection.

Fisheries activity, depending on the type, may interact or conflict with tidal stream energy activities. Due to the widespread and changeable nature of fisheries activity, it is difficult to anticipate the potential for interaction. In line with the WNMP **safeguarding policy** for fisheries, any new developments must consider the risk of displacement of vessels from fishing grounds. The existence of established fisheries may not represent a hard constraint; however, consideration of fisheries impacts will be required in the preparation of any new development proposals.

Figure 8.8: Shipping density, ports, anchorage and restricted sites with tidal stream RAs



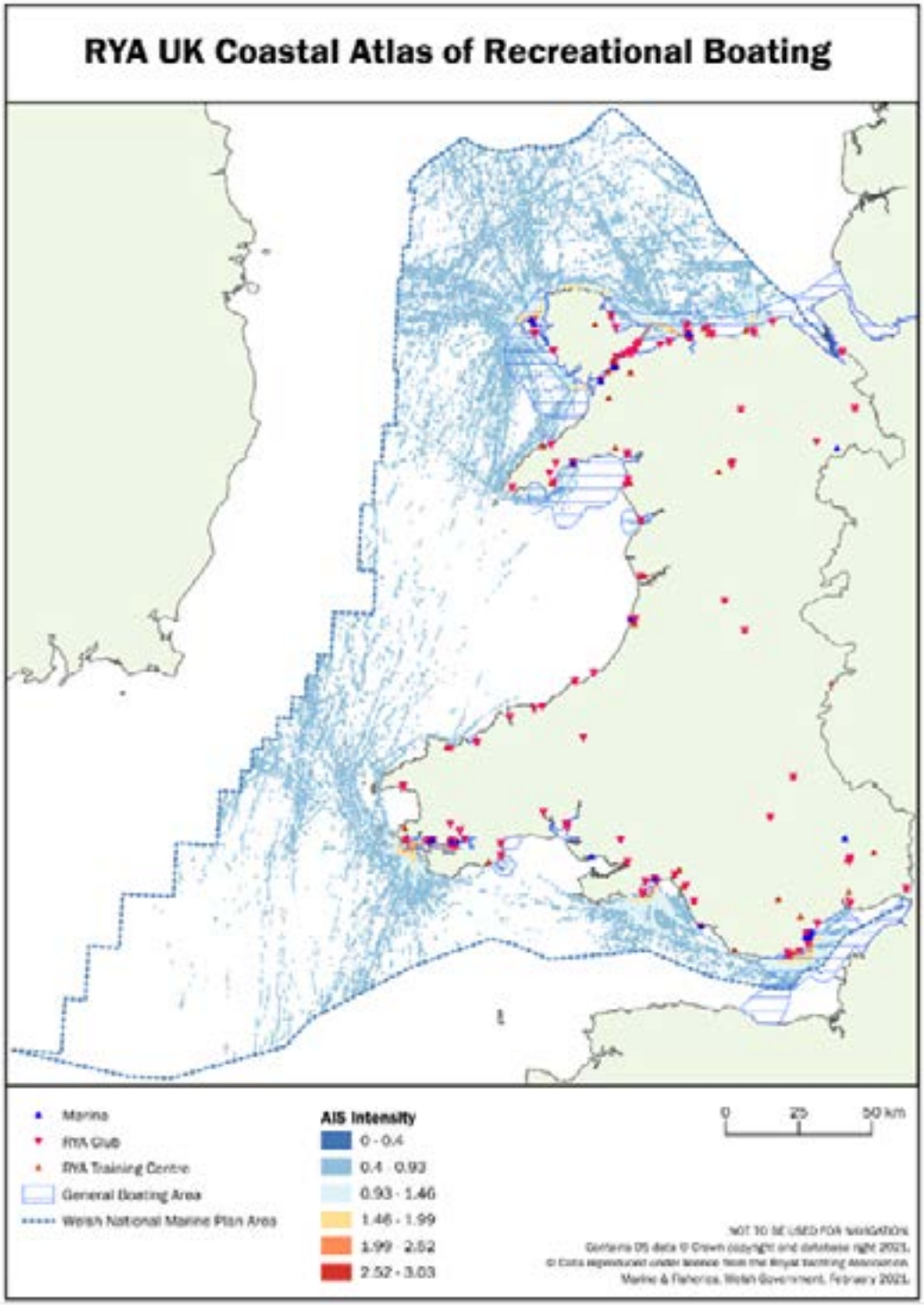
Source: MMO, 2017 and Oceanwise, 2021

Tidal stream RAs coincide with vessel traffic routes including to/from Newport and Cardiff in the Bristol Channel, Swansea Bay, Pembroke/Milford Haven, Holyhead on the north Anglesey coast. Location near to these areas is expected as they offer port infrastructure and ancillary support required for tidal stream energy. Through consultation with shipping agents and the Maritime and Coastguard Agency (MCA), shipping routes may be able to be diverted if determined to be necessary.

Shipping overlaps would need to be treated as a constraint due to the risks posed to navigational safety from the introduction of fixed structures. For surface-level or shallow submerged energy devices shipping would represent a hard constraint. For seabed mounted devices, if adequate keel clearance is able to be achieved and with sufficient safety precautions, shipping may represent a 'soft' constraint.

There is the potential for shipping routes to be diverted, if necessary, through consultation with shipping agents and the MCA; however, this is unlikely to be a viable option for most developments. Management measures can be put in place to address interactions with shipping areas, for example, marker buoys/lighting, and marking on maps/charts, but development near or within busy shipping routes would require extensive engagement with MCA, Trinity House and other navigation stakeholders. This could lead to extended delays and/or objections from these stakeholders could preclude development in these areas altogether.

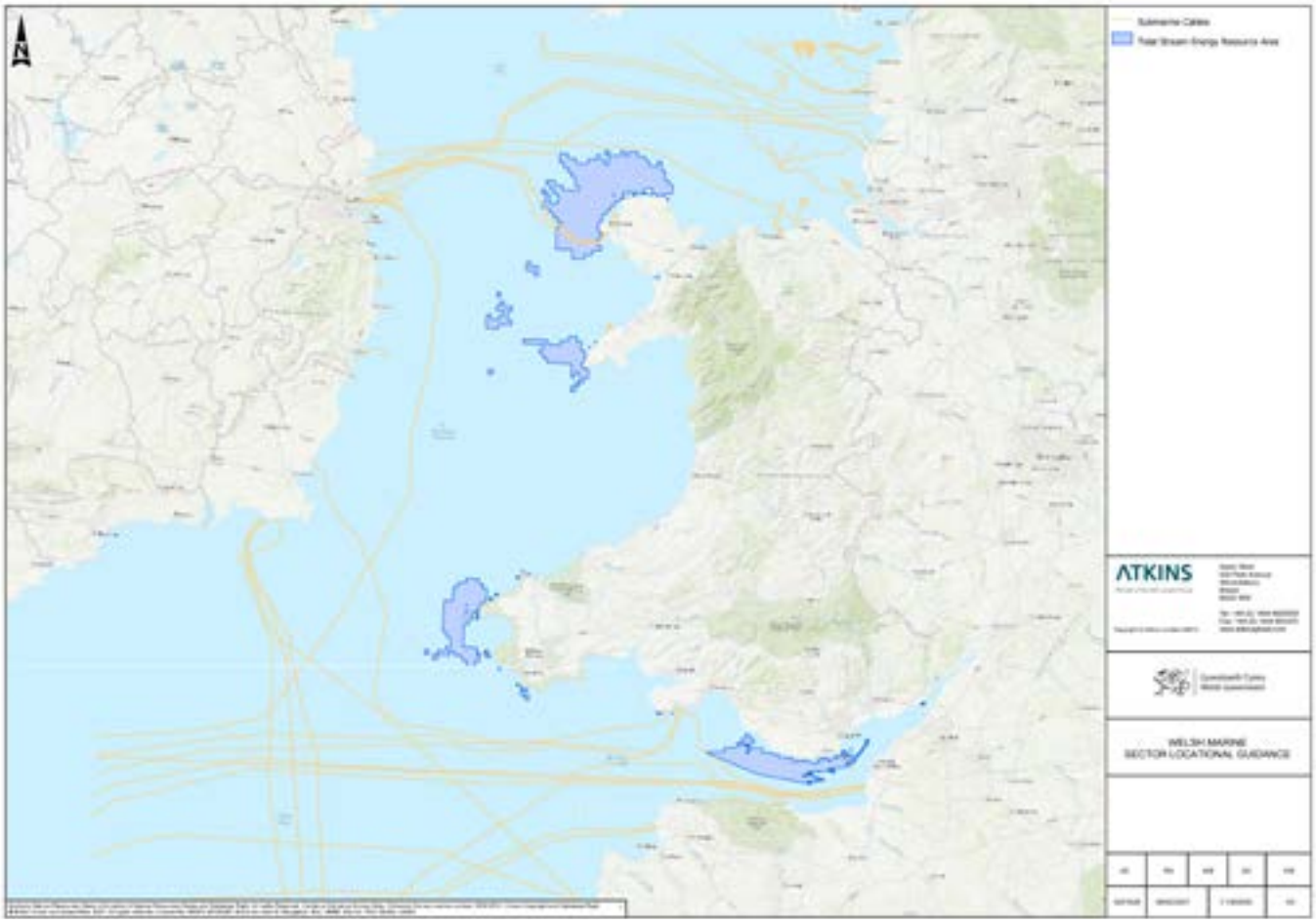
Figure 8.9: RYA clubs, marinas, training centres and general boating areas



Source: Welsh Government using RYA information

Sailing routes overlap with tidal stream RAs at sea. It is unlikely that tidal stream developments will overlap with coastal based marinas. Devices and recreational sailing routes could co-exist, subject to safety measures e.g., device lighting and marking, safe clearance above devices for recreational craft; and recognising the mobile nature of the recreational activity relative to the requirements for siting tidal stream devices (and arrays).

Figure 8.10: Subsea cables overlapping with tidal stream RAs

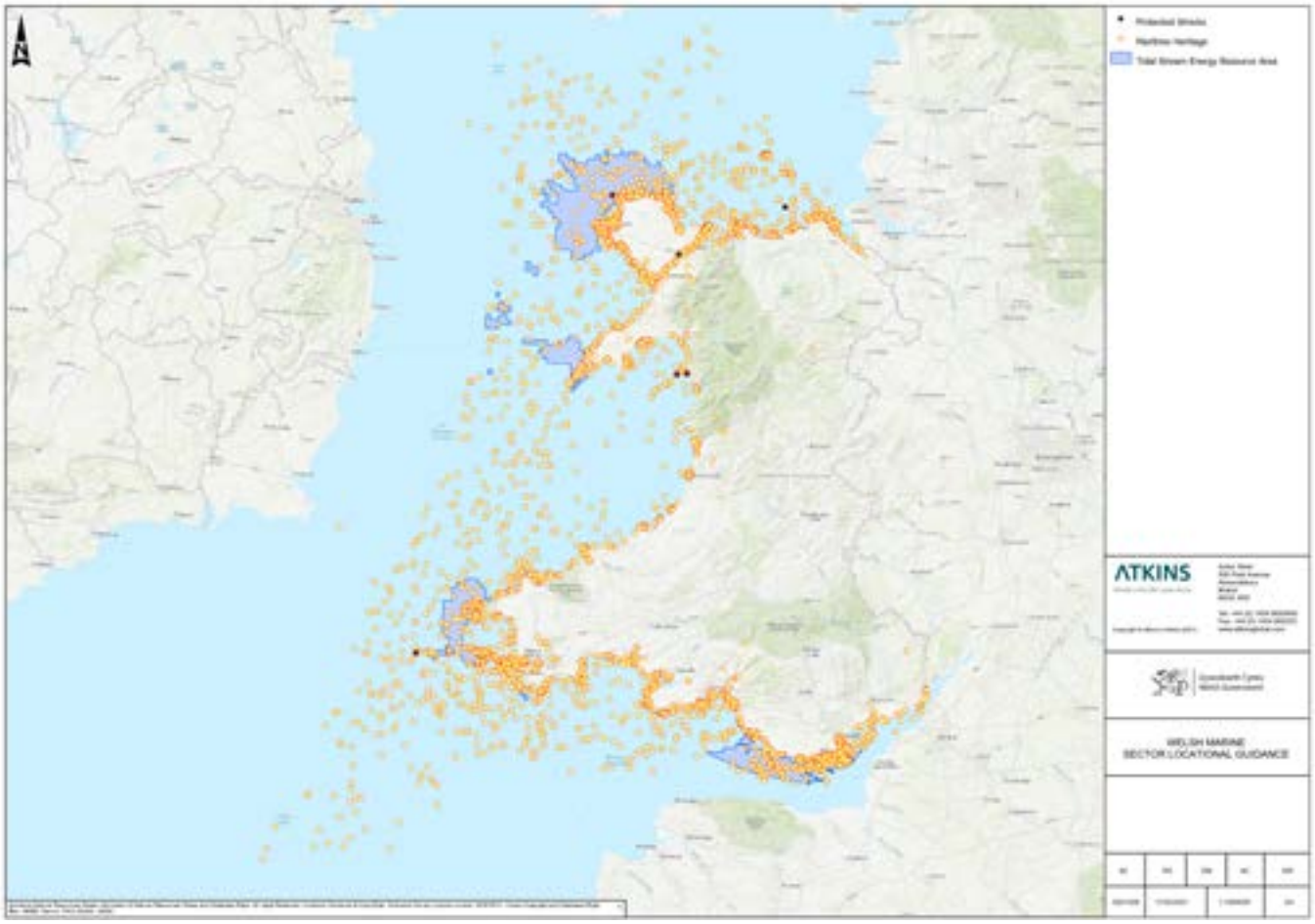


Source: Oceanwise, 2020

Tidal stream resources to the north/north-west of Anglesey coincide with subsea cabling between Anglesey and Ireland. This includes telephone cables operated by TATA Communications, BT, ESAT, Apollo and Global Crossing. A separation of approximately 1 nm is considered good practice between offshore renewable installations and subsea cable infrastructure.

Cable routes would need to be avoided by moorings for energy devices and existing cables are protected by the WNMP **safeguarding policy** for the subsea cabling sector. However, the fact that they are in deeper water suggests they are unlikely to interact with areas of interest for bottom mounted devices. Micro-siting of structures within an area is also an option for avoiding cable interactions.

Figure 8.11: Protected wrecks and maritime heritage in relation to tidal stream RAs



Source: Lle, 2020

There are a large number of maritime heritage assets located in the tidal stream RAs; however, only two of these are identified as protected wrecks. One wreck is located in Anglesey and is classed as a post medieval maritime wreck called the Royal Yacht Mary, the second is located off the Pembrokeshire coast and is classed as an early medieval maritime wreck named 'The Smalls'. Stakeholder engagement raised the issue of protected wrecks, specifically war graves, as being a definite constraint and not an issue that could be mitigated or worked around.

In line with WNMP **policy SOC_05 (historic assets)**, development proposals need to consider any impacts on historic assets and their settings and, where necessary, address those impacts. The **WNMP Implementation Guidance** also notes that the absence of designated historic assets should not be taken to imply that non-designated historic assets are necessarily of lesser significance. Given the logistical difficulties and resource-intensive nature of working underwater the significance of many marine historic assets is yet to be established. As a result, all such assets, and their settings, should be considered in the preparation of a development proposal.

Wrecks, along with any designated and non-designated maritime heritage assets, will represent a hard constraint for tidal stream energy activities and these will need to be avoided. It is anticipated, however, that this can be achieved during site selection and through micro-siting within the wider development site.

9. Cross sector interactions & opportunities

The potential or perceived impact of one marine-related activity making use of marine resources on another activity, or the cumulative interactions between multiple activities, need to be considered as part of the marine planning and consenting process. Where interactions between activities are considered to be likely (or possible), there is the opportunity to consider the prospects for co-location and/or co-existence of such activities in the same spatial area.

Co-location of activities perceived to be in conflict with each other is unlikely to be welcomed by the sectors involved or by the affected communities of interest. However, there are differing degrees of compatibility, and perceived 'conflict' may relate to competition for space that could be alleviated through spatial or temporal management measures. An assessment of interactions that concluded activities were incompatible with each other, on the grounds of health and safety or direct contradiction in uses, e.g., an extractive industry such as aggregate dredging in an area of offshore cultural heritage, may conclude that co-existence could be possible. In the example of aggregates and cultural heritage, advice has been produced to assist the industry and regulators in identifying and understanding issues of archaeological importance when developing dredging areas.

This SLG supports WNMP policies such as **ECON_02 (coexistence)** and **SAF_01 (safeguarding existing activity)** by providing information that may be useful for developers in considering, and demonstrating how they have considered, coexistence opportunities with other compatible activities. The outputs of the sectoral interactions assessment undertaken as part of this SLG are included below. Table 9.1 provides the scoring criteria used for the assessment of interactions, co-existence and co-location with the detailed assessment for relevant sectors provided in Table 9.2. More information on the methodology for this assessment is provided in Section 2.3.

Where co-location is considered possible, it will ultimately depend on the specifics of the technologies/activities being co-located. Therefore, developers should fully investigate the requirements of deployment, O&M and decommissioning for the life cycles of co-located activities. Early engagement between sea users will be important in the achievement of successful coexistence or co-location opportunities.

Sector interactions have focussed on potential future developments, but co-location could still be explored within existing lease or licence areas. In relation to constraints mapping, existing leases or licences have been scored highly as they represent a significant issue/constraint. However, development may be possible in these areas with appropriate management measures if agreement can be reached with existing lease/licence holders, and amendments to existing consents secured.

Table 9.1: Assessment of interactions, co-existence and co-location

	Interaction	Co-existence	Co-location
Yes/Likely	Interactions between activities are believed to be likely, for example, due to overlap in resource and/or proximity between resource and existing development.	Where two or more developments, activities or uses **can** exist alongside or close to each other in the same place and/or at the same time.	Potential for co-location exists and involved sectors are [actively] exploring the opportunities and benefits that co-location of activities would bring.
Possible	Interactions between activities are believed to be possible.	Where two or more developments, activities or uses **could** exist alongside or close to each other in the same place and/or at the same time.	If access to the same resources or areas can be managed by spatial, temporal or other management measures co-location may be possible.
No/Unlikely	Interactions between activities are believed to be unlikely.	Where multiple developments, activities or uses **cannot** exist alongside or close to each other in the same place and/or at the same time because of incompatibility on grounds of safety, adverse environmental impact or other factors.	Opportunities for co-location cannot be resolved through management measures.

Table 9.2: Tidal stream energy possibilities for co-existence

Marine plan sector	Activity	Interaction	Potential to co-exist	Opportunity for co-location
Marine minerals	Marine aggregates	**Possible** – tidal stream resources coincide with aggregate resources off north Anglesey, Pembrokeshire and within the Inner Bristol Channel.	**Unlikely** – for consenting, safety, and operational reasons, licensed aggregate extraction is spatially separated from tidal stream developments.	**No** – unlikely to actively choose to co-locate for safety and operational reasons.
Energy	Wave energy	**Possible** – tidal stream resources coincide with wave resources off the Pembrokeshire coast.	**Possible** – currently for consenting, safety and operational reasons, there is spatial separation of tidal stream devices along/on the seabed or in the water column from wave devices on the sea surface/in the water column. Future projects could be designed so that issues are appropriately managed.	**Yes** – opportunity to share costs associated with electrical infrastructure, grid connection and O&M, and maximise economic potential of an area.
	Offshore wind	**Possible** – tidal stream resources overlap with wind energy resources off north Anglesey, around the Llŷn Peninsula, south Pembrokeshire, Carmarthen and Swansea Bay and coastal to Cardiff; and floating wind development in Celtic Sea. Whilst areas do not currently coincide with tidal RAs based on 1.5 m/s, future technology developments could make lower flow sites further offshore viable.	**Possible** – currently for consenting, safety and operational reasons, there is spatial separation of tidal stream devices present along/on the seabed, or in the water column from offshore wind turbines. Future projects could be designed so that operational issues are managed.	**Yes** – opportunity to share costs associated with electrical infrastructure, grid connection and O&M, and maximise economic potential of an area.

Marine plan sector	Activity	Interaction	Potential to co-exist	Opportunity for co-location
Energy (Cont'd)	O&G	**Unlikely** – overlap of tidal stream resources and existing O&G infrastructure is limited. Petroleum licensing area off the Llŷn Peninsula intersect but further O&G development in Wales is considered unlikely due to focus on decarbonisation.	**Unlikely** – limited potential for interaction.	**No** – limited potential for interaction.
	Hydrogen	**Possible** – interest in offshore production of hydrogen using offshore renewables. Hydrogen production requires electrolysis so is not spatially limited.	**Possible** – potential for hydrogen production to co-exist with tidal stream projects.	**Yes** – opportunity to transport hydrogen either by pipeline or boat which could reduce costs associated with electrical infrastructure in areas where significant grid upgrades would be required.
Aquaculture	Bottom culture	**Possible** – tidal stream resources overlap with resources for seabed aquaculture (shellfish bottom cultivation), in locations such as off the Llŷn Peninsula, Pembrokeshire, and coastal sites in South Wales.	**Possible** – currently tidal stream devices (especially seabed anchored) are likely to be spatially separate from shellfish cultivated on the seabed for safety and operational reasons. However, in future when tidal technology is more established, projects could be designed so that issues are appropriately managed, and potential for infrastructure to be integrated e.g., built into foundations of tidal device.	**Yes** – opportunity to share costs associated with O&M and maximise economic potential of an area.

Marine plan sector	Activity	Interaction	Potential to co-exist	Opportunity for co-location
Aquaculture (Cont'd)	Cage culture (finfish)	**Unlikely** – currently no cage culture in Wales. Tidal stream and cage culture RAs overlap in some locations, but tidal stream areas are not considered optimal for caged fish farm operations (SARF, 2014). Stakeholder engagement suggests that inshore cage culture with current technology is considered unlikely in Welsh waters due to unsuitable water depth and wave climate.	**Unlikely** – whilst there are potential synergies between tidal stream projects and fish farming in some areas e.g., Scotland, there is limited potential for interaction in Wales.	**No** – limited potential for interaction in Wales.
	Rope culture (shellfish)	**Possible** – tidal stream resources overlap with resources for rope culture of shellfish off Anglesey, the Llŷn Peninsula, Pembrokeshire, and coastal sites in South Wales near Cardiff.	**Possible** – currently tidal stream devices (especially seabed anchored) are likely to be spatially separate from shellfish cultivated on the seabed for safety and operational reasons. However, in future when tidal stream technology is more established, projects could be designed so that issues are appropriately managed, and potential for infrastructure to be integrated, e.g., built into foundations of tidal device. Fouling risks would need to be managed.	**Yes** – opportunity to share costs associated with O&M and maximise economic potential of an area.
	Rope culture (seaweed)	**Possible** – tidal stream resources overlap with resources for rope culture of seaweed, mainly off Anglesey.		
	Trestle culture	**Unlikely** – operational tidal stream devices at sea unlikely to interact with intertidal trestle cultivation.	**Unlikely** – limited potential for interaction.	**No** – limited potential for interaction.

Marine plan sector	Activity	Interaction	Potential to co-exist	Opportunity for co-location
Fisheries	Mobile gear	**Possible** – tidal stream RAs coincide with locations where fishing with mobile gears has been known to occur (ICES).	**Unlikely** – for safety and operational reasons, tidal stream devices (notably seabed mounted) and associated anchors/lines, are likely to be kept spatially separate from grounds fished by mobile fishing gears.	**No** – unlikely to actively choose to co-locate for safety and operational reasons.
	Static gear (pots, lines, nets etc)	**Possible** – given the widespread and changeable nature of fisheries activity, tidal stream energy resources could coincide with locations targeted by fishers with static gear, particularly in the inshore area.	**Possible** – tidal stream devices (notably seabed mounted) and associated anchors/lines, likely to be kept spatially separate from grounds fished by static fishing gear for safety and operational reasons. However, potential benefits from hard substrata of tidal stream devices as artificial reef for fauna and overspill to adjacent areas to be considered, and potential for integrating infrastructure into turbine foundations once technology is more established.	**Yes** – potential opportunity to integrate static gear into project design once tidal technology is more established.
	Hydraulic dredging	**Possible** – tidal stream RAs coincide with locations where hydraulic dredging has been known to occur (ICES).	**Unlikely** – for safety and operational reasons, tidal stream devices (notably seabed mounted) and associated anchors/lines, likely to be spatially separate from hydraulic dredging operations.	**No** – unlikely to actively choose to co-locate for safety and operational reasons.

Marine plan sector	Activity	Interaction	Potential to co-exist	Opportunity for co-location
Fisheries (Cont'd)	Rod and line	**Possible** – tidal stream RAs could be used for commercial fishing with rods and lines.	**Unlikely** – for safety and operational reasons, tidal stream devices and associated anchors/lines, likely to be spatially separate from rod and lining.	**No** – unlikely to actively choose to co-locate for safety and operational reasons.
	Hand gathering	**Possible** – hand gathering is primarily intertidal. However, device foundations have been seen to act as artificial reef for fauna.	**Possible** – tidal stream device foundations have been seen to act as artificial reef so could be used by divers for hand gathering if properly managed.	**Yes** – potential opportunity for hand gathering from foundations by diver if properly managed.
Ports & shipping	Shipping – navigation routes	**Likely** – tidal stream RAs coincide with vessel traffic routes including to/from Newport and Cardiff in the Bristol Channel, Swansea Bay, Pembroke/Milford Haven, Holyhead on the north Anglesey coast. Location near to these areas is expected as they offer port infrastructure and ancillary support required for tidal stream energy.	**Possible** – possible for vessels to safely pass over the top of tidal stream devices on the seabed if there is sufficient clearance. Mid water and surface devices unlikely to be able to co-exist. Vessels involved with construction and O&M of the devices, may utilise existing navigational routes and statutory navigational measures. Co-existence potential with appropriate measures in place.	**No** – unlikely to actively choose to co-locate for safety and operational reasons.
	Anchorage areas	**Unlikely** – anchorage sites typically in sheltered areas.	**Unlikely** – limited potential for interaction.	**No** – limited potential for interaction.

Marine plan sector	Activity	Interaction	Potential to co-exist	Opportunity for co-location
Subsea cables	Cables and telecommunications	**Likely** – tidal stream resources to the north/north-west of Anglesey coincide with subsea cabling between Anglesey and Ireland.	**Unlikely** – a separation of approximately 1 nm is considered good practice between offshore renewable installations and subsea cable infrastructure. Mid-water and floating devices could potentially be in same space as cables, but placement of moorings would need to be considered/ microsited. Agreement from the operator would be required which is unlikely due to risk to assets.	**No** – unlikely to actively choose to co-locate for safety and operational reasons.
Surface water and wastewater treatment and disposal	Intakes and outfalls, including licensed discharges	**Unlikely** – intakes/outfalls inshore waters away from likely tidal stream developments.	**Unlikely** – limited potential for interaction.	**No** – limited potential for interaction.
Dredging and Disposal	Designated disposal sites (Active)	**Likely** – tidal stream resources to the north/north-west of Anglesey coincide with a licensed disposal site.	**Unlikely** – for safety and operational reasons, tidal stream devices (notably seabed mounted) and associated anchors/lines, likely to be kept spatially separate from designated disposal sites.	**No** – unlikely to actively choose to co-locate for safety and operational reasons.

Marine plan sector	Activity	Interaction	Potential to co-exist	Opportunity for co-location
Defences	Military exercise areas/ammunition disposal sites	**Likely** – overlap of tidal stream resources off Llŷn Peninsula with an existing Military Practise Area.	**Unlikely** – for safety and operational reasons, defence areas are usually kept separate from tidal stream devices. There are some instances where agreement has been reached with MoD where activities can be managed in tandem. In general, MoD areas are seen as a hard constraint by developers.	**No** – unlikely to actively choose to co-locate for safety and operational reasons.
Tourism and Recreation	Recreational Sea Angling (RSA)	**Possible** – RSA undertaken from chartered vessels around seabed features/wrecks, and islands, could overlap with tidal stream resources.	**Unlikely** – for safety and operational reasons, tidal stream devices and associated anchors/lines, likely to be kept spatially separate from RSA.	**No** – unlikely to actively choose to co-locate for safety and operational reasons.
	Royal Yachting Association (RYA) marinas and sailing routes	**Possible** – sailing routes overlap with tidal stream resources at sea. Unlikely to overlap with coastal based marinas.	**Possible** – devices and recreational sailing routes could co-exist, subject to safety measures e.g., device lighting and marking, safe clearance above devices for recreational craft and recognising the mobile nature of the recreational activity relative to the requirements for siting tidal stream devices (and arrays).	**No** – unlikely to actively choose to co-locate for safety and operational reasons.

Marine plan sector	Activity	Interaction	Potential to co-exist	Opportunity for co-location
Tourism and Recreation (Cont'd)	Water sports (e.g. surfing, kite surfing, diving, rafting)	**Possible** – possible use of the sea surface or water column for water sports, in proximity to tidal stream resources.	**Possible** – for safety and operational reasons, water sports are not likely to occur in the footprint of the devices but may occur around the device (and associated arrays for upscaled tidal stream energy in the future). Interactions likely to decrease over time as devices/arrays are sited further offshore, away from recreational activities.	**No** – unlikely to actively choose to co-locate for safety and operational reasons.
	Shore based activity (e.g. coasteering, hiking, dog walking, kites)	**Unlikely** – shore-based activities.	**Unlikely** – limited potential for interaction.	**No** – limited potential for interaction.
	Wildlife watching – shore based			
	Wildlife watching – boat based	**Possible** – tidal stream resources and boat-based tourism could overlap. Potential for boat-based tourism in proximity to the tidal stream devices, due to the device being of interest, attracting wildlife or through proximity to areas that are wildlife hotspots.	**Possible** – devices (and future arrays of the devices) could co-exist with boat-based wildlife tourism. Though this is likely to be subject to safety measures e.g., device lighting and marking, safe clearance above devices for vessels. Boat-based tourism may also be flexible in locations and visited areas to accommodate tidal stream devices and arrays.	**Yes** – significant interest in offshore renewables, and in how the technology interacts with the environment, so could accommodate both subject to appropriate management of activities.

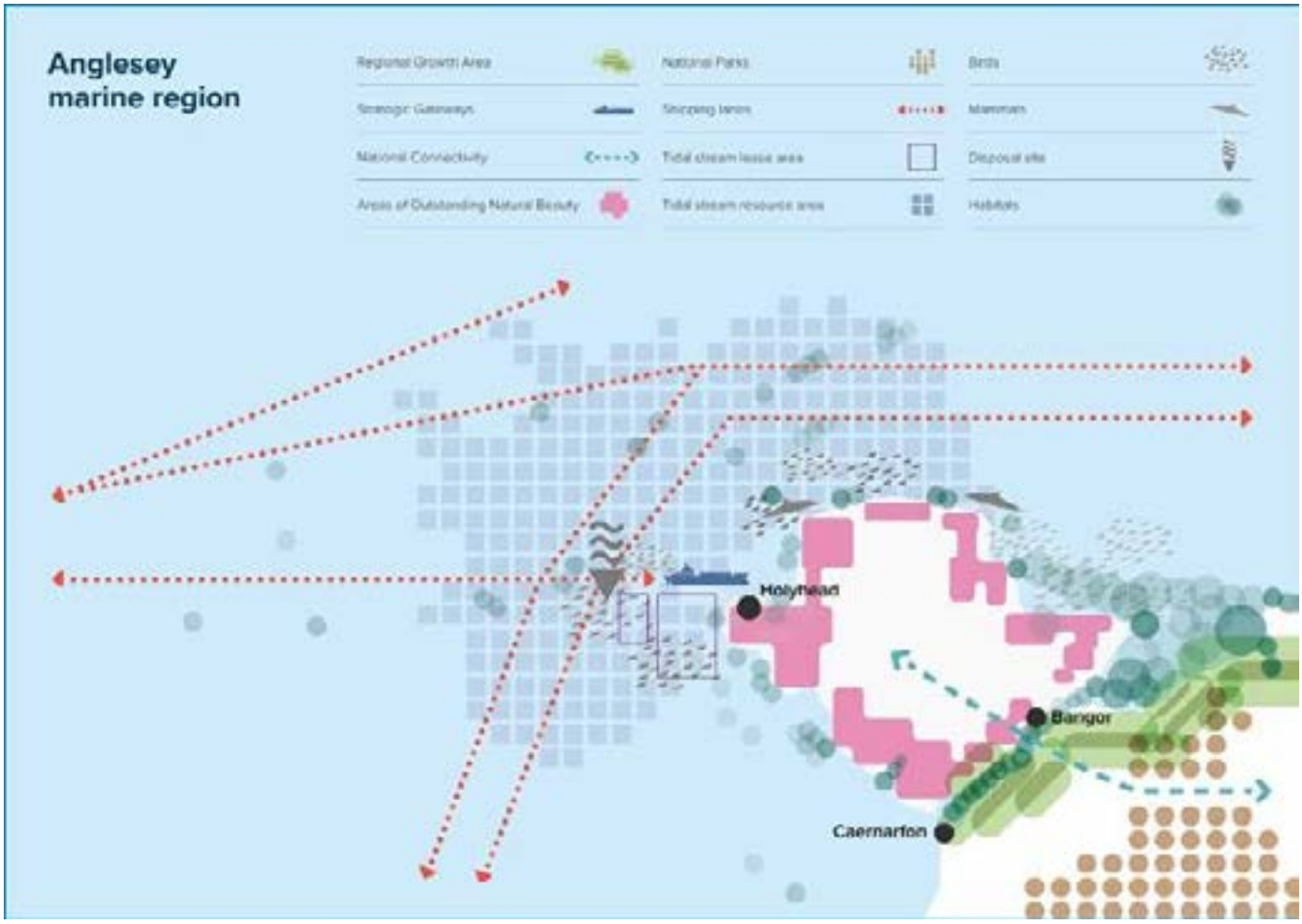
10. Regional characterisation

10.1 Tidal Stream – West Anglesey

The Tidal Stream – West Anglesey RA is the largest of the tidal stream RAs covering waters to the north and west of Anglesey. It has significant potential for tidal stream energy due to its peak spring velocity of over 3 m/s. The tidal current speeds combined with water depth and seabed topography in this area are among the best in Europe (MEW, 2020). Welsh Government's MRESF study estimated 120 MW of potential tidal stream capacity off the west coast of Anglesey, and a further 100 MW off the north coast of Anglesey, although future technology developments could further increase this by making lower flow areas and deeper water sites viable.

Figure 10.1 provides a high-level representation of certain relevant spatial considerations which are a feature of the Tidal Stream – West Anglesey RA. This figure is for illustrative purposes only. For land-based considerations, reference should be made to Future Wales[37].

Figure 10.1: High level representation of spatial considerations within the West Anglesey RA



Source: Welsh Government, 2021

37 gov.wales/future-wales-national-plan-2040-0

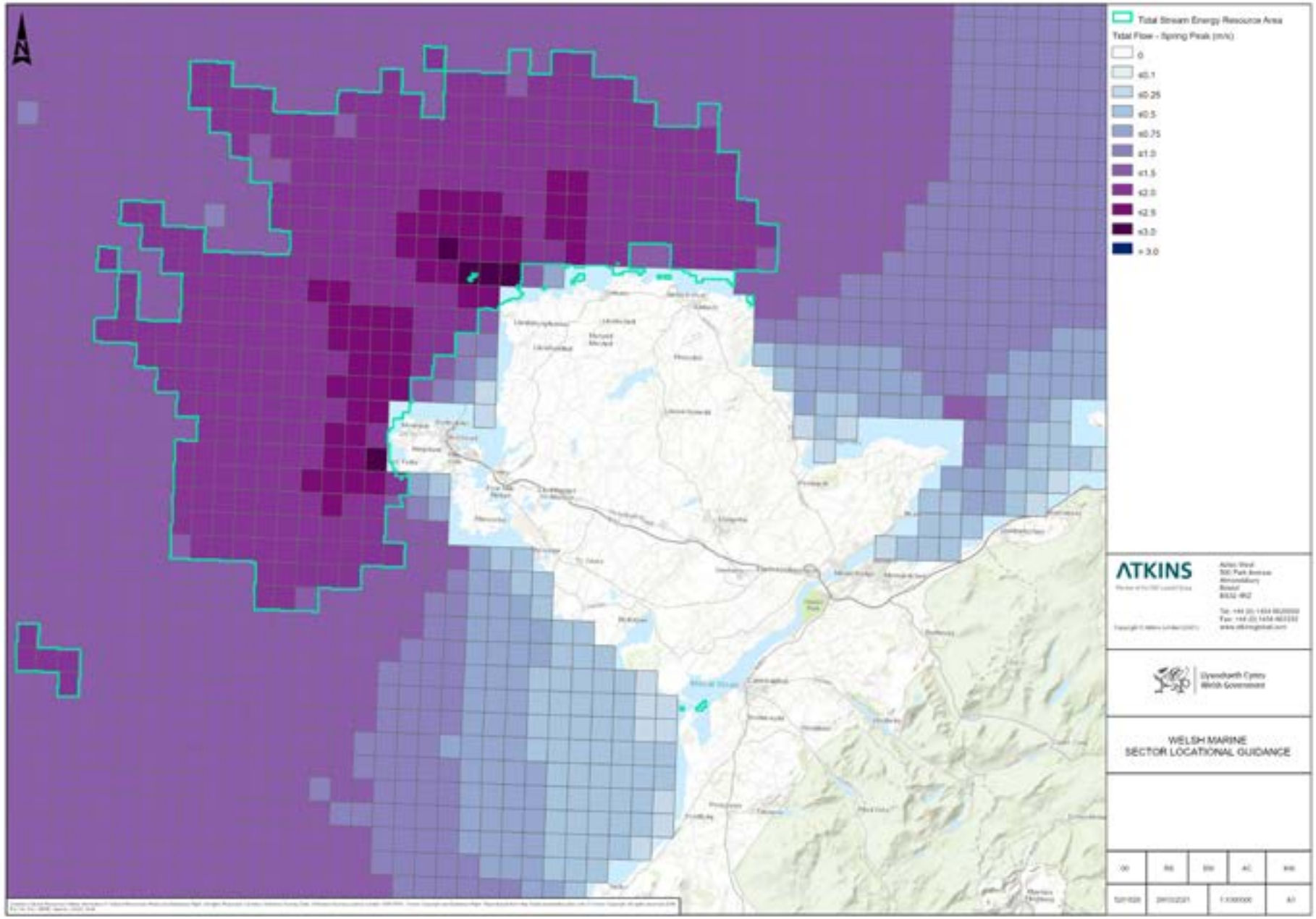
10.1.1 Resource considerations

Table 10.1 outlines the key physical resource considerations for tidal stream developments in the tidal stream – West Anglesey RA and Figure 10.2 illustrates the tidal flow (m/s peak) for the RA. See Section 3 for further details on tidal stream resource.

Table 10.1: Tidal Stream – West Anglesey physical considerations

Topic	Description
Tidal stream resource	Extensive areas of good tidal stream resource (1.5 m/s) off the north coast of the island, with some areas up to 3 m/s peak.
Tidal stream resource data	SEACAMS has undertaken four ADCP deployments to the southwest of Holy Island and another off the north Anglesey coast, north of Amlwch. Bangor University has developed a detailed tidal model through SEACAMS; some of the outputs are available on the Marine Planning Portal.
Physical survey data	Multibeam surveys by SEACAMS for much of the area – data is available through Integrated Marine Data and Information System. Multibeam also known to have been carried out by MCT Siemens for the Anglesey Skerries project – data will be held by TCE. The SMMNR project also carried out multibeam for northwest Anglesey. UK Hydrographic Office holds bathymetry data.
Tidal Stream– West Anglesey RA area (km^2)	1,087.8 km^2
Average water depth of RA	-49.69 m below the surface
Maximum water depth in the RA	-154 m below the surface

Figure 10.2: Tidal flow in the Tidal Stream – West Anglesey RA



Source: Renewables Atlas, 2020

10.1.2 Infrastructure & supply chain

Table 10.2 describes the existing infrastructure and supply chain in the Tidal Stream – West Anglesey RA.

Table 10.2: Population and demographics for Tidal Stream – West Anglesey RA

Topic	Description
Grid	Anglesey has very good grid infrastructure due to Wylfa Nuclear Power station on the northern coast of Anglesey. There is a 400 kV substation at Wylfa which links to a 400 kV line to Pentir, and a 132 kV line to Penrhos substation on Holy Island which the Morlais project is looking to utilise.
Ports	There are two main ports in North Wales with an existing capacity and experience of serving the offshore energy sector. Holyhead Port on Holy Island is well placed to act as a base for both assembly, installation and O&M activities for projects developed in the RA. Holyhead has potential to grow skills in installation and operation and is involved in the North Wales supply chain cluster. The Port of Mostyn is situated in North Wales and has extensive experience in renewable energy development construction and support services. The port has extensive (75 acres) lay-down and storage land adjacent to 310 m of riverside quays, suitable for the laydown of projects before assembly, and warehousing and workshop facilities are also available for indoor storage of electrical and hydraulic components. Welsh ports would also be competing with nearby English port facilities on the Mersey.
Supply chain	Turbine Transfers, based in Holyhead, have provided a range of offshore support vessels and service vessels to existing wind farms in the UK. Faun Trackway in North Wales are manufacturing gravity anchors for the Orbital O2 floating tidal device. A further three companies specialise in installation of drilled and grouted, or driven seabed anchor piles. Minesto engaged significantly with Small and Medium-sized Enterprises across Anglesey and North Wales to support engineering aspects of the project. This included Anglesey Mechanical Solutions, Holyhead Boatyard, Jones Brothers, Anglesey Mechanical Services and Mona Lifting.
Research	Bangor University has extensive experience around Anglesey, with most of the personnel with relevant expertise based in the Marine Centre Wales facility in Menai Bridge. Bangor University is lead partner in the SEACAMS programme that has been extended to 2021. SEACAMS undertakes environmental research focussed on marine energy sector in Wales. MEECE, led by ORE Catapult, supports marine energy related research across Wales and have an Innovation Manager based in North Wales. Wrexham Glyndŵr University offers a single Honours (BEng) and postgraduate courses (MSc) in renewable energy and sustainable energy engineering. Aspects of these courses cover marine renewable energy technologies, but it is not evident if the university conducts research related to other marine economic interests on the Welsh coast. However, the nature of Wrexham's geographic location demonstrates that marine issues are not just studied in the immediate vicinity of the coast. The Canolfan Ynni, Coleg Menai's Energy Centre, is located in Llangefni at the heart of the Energy Island of Anglesey. The facility aims to provide a one-stop-shop for all the skills needed in order to underpin a new generation of energy production.

10.1.3 Social considerations

The Tidal Stream – West Anglesey RA is covered by the Isle of Anglesey LA.

10.1.3.1 Population and demographics

Information on population density demographics, area deprivation and percentage of Welsh speaking individuals is highlighted in Table 10.3. This can provide useful information to developers when looking at establishing teams in the locality, for community engagement, and also to marine planners/regulators during planning and policy decision-making.

Table 10.3: Population and demographics for Tidal Stream – West Anglesey RA

Population density	In 2019, Wales had an average population density of 152 persons per km^2 (ONS, 2020). Approximately 20% of the population of Wales live in areas that are classified as broadly rural. On Anglesey, there is an average population density of 98.4 persons per km^2.
Demographics	Wales has an aging population. Between 1998 and 2018 the proportion of the population aged 65 and over increased from 17.4% to 20.8% (Welsh Government, 2020b). In the Isle of Anglesey LA the highest percentage of the population is in the following age groups: • 45 to 64 (27.8%) • 0 to 14 (16.1%).
Area deprivation	Area deprivation from the Welsh Index of Multiple Deprivation (WIMD) show that a large proportion of Anglesey is ranked as 956-1909 (50% least deprived). Of the 0-10% most deprived Lower layer Super Output Areas (LSOAs) (overall) in Wales, one (Holyhead Town) is located in Anglesey which accounts for 2.3% of the LA and 0.1% in Wales (WIMD, 2019).
Welsh speaking	According to census data (ONS, 2020) there were 866,600 Welsh speakers aged three and over in Wales. 36% of these in North Wales. In the Isle of Anglesey LA approximately 66% (44,900) of residents speak Welsh (ONS, 2020).

10.1.3.2 Cultural identity

More than 75% of the children and over 50% of the adults living on Anglesey can speak Welsh. The island remains one of the strongholds of the Welsh language. Safeguarding and enhancing the Welsh language is a high priority as it adds to social cohesion, local culture and a strong sense of community spirit. The Well-being of Future Generations (Wales) Act 2015 recognises, as one of its 7 well-being goals, the importance of "*a Wales of vibrant culture and thriving Welsh language*" and the Anglesey Strategic Plan 2017-2020 aimed to have every pupil completely bilingual by the time they were 16, able to speak confidently in both English and Welsh in work, social and cultural settings. The area has a rich heritage, with Eisteddfodau held annually in many of the island's communities. The National Eisteddfod was most recently held in Anglesey in 2017, attracting over 150,000 visitors.

The island's natural assets include beaches, coastal scenery and geology that has underpinned economic developments over centuries, from limekilns and copper mining to bird watching and tourism. Its proximity to Ireland has meant it has been a natural point of transit and Thomas Telford's engineering, in the form of bridges across the Menai Strait and the mainline rail route to London, linked the island to the rest of the UK. NRW's 2014 National Landscape Classification report states that part of "*the area's strong identity comes from a varying expression of the relationship of the sea to the land, through cliffs, beaches, estuaries and coastal levels and dunes, lagoons and ports*."

Historically, trade routes ran through the west of the RA, making it one of the busiest shipping areas in the UK in the mid-19th century. Cargo vessels headed to Liverpool from the Americas and West Indies, carrying tobacco and sugar, while passenger ships also steamed by, including the Royal Charter, which was wrecked on the north east coast of the island in 1859. Today, the offshore waters of the RA still support significant commercial shipping travelling through the Irish Sea to north-west England, as well as ferries travelling between Dublin, Holyhead and Liverpool. To manage high levels of vessel traffic, a traffic separation scheme is in place off the coast of the Skerries, to keep ships in designated paths.

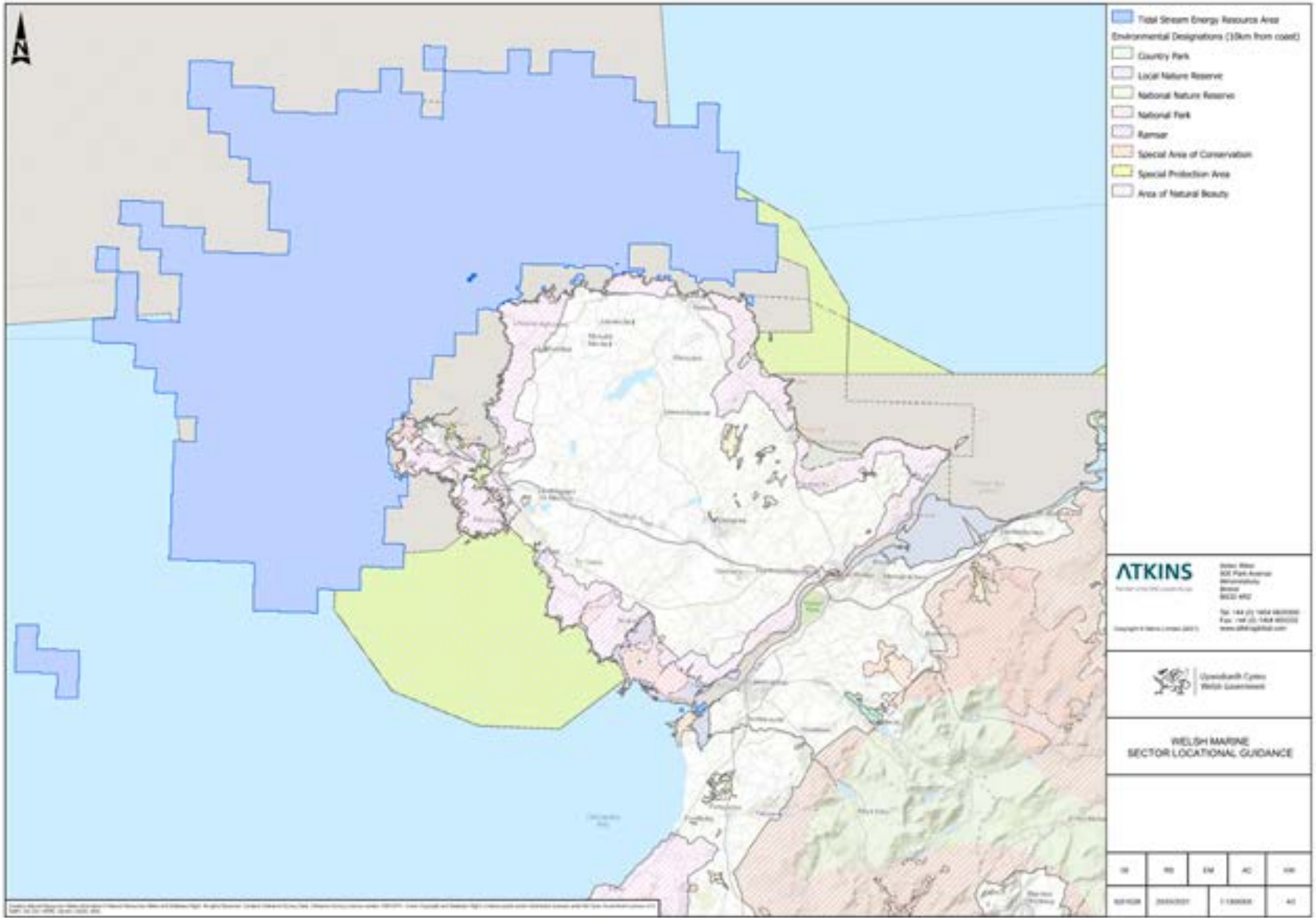
Anglesey is a popular destination for tourism and recreation. Large sections of the coastline are owned by the National Trust. Coastal recreational activities include wildlife watching, sea kayaking, chartered fishing trips and scuba diving. The cliff faces along the north of Anglesey are popular destinations for climbers. The area hosts a number of annual events including the Amlwch Viking festival and Amlwch fishing festival.

Anglesey's coastal communities bear evidence to their former lives as fishing villages in the 1700s, with small sailing boats catching mackerel and herring, although agriculture has also left a legacy of a dispersed rural population and distinct field patterns. Other industries such as limestone quarrying and kilns also made use of coastal resources. Small harbours, many now linked by the Anglesey Coastal Path, trade on that heritage as a visitor attraction. Some small fishing vessels still leave from Beaumaris, Holyhead and Amlwch but the major activity is now for chartered recreational fishing trips. Coastal communities around Anglesey still provide bases for the Royal National Lifeboat Institution but few of today's crews are connected to marine activities. Previously, fishermen or merchant naval seamen, either retired or home on leave, crewed the lifeboats.

10.1.4 Environmental considerations

Figure 10.3 illustrates the environmental designations within the tidal stream – west Anglesey RA. Table 10.4 gives further details on these designations.

Figure 10.3: Tidal Stream – West Anglesey environmental designations



Source: Lle, 2020

Table 10.4: Tidal Stream – West Anglesey environmental considerations

Topic	Description
Designations	The RA overlaps with the North Anglesey Marine Special Area of Conservation (SAC) and Anglesey Terns Special Protection Area (SPA) designated sites. Coastal Sites of Special Scientific Interest (SSSIs) are present along the north and west coast of Anglesey, either encompassed by or close to the tidal stream RA including The Skerries, Glannau Ynys Gybi /Holy Island Coast, Beddmanarch Cymyran, Cemlyn Bay, Glannau Rhoscolyn, Rhosneigr Reefs, Traeth Lligwy, Ty Croes and Ynys Feurig.
Seabirds	Waters around the north and west coast of Anglesey are important for Tern foraging and breeding populations. This has resulted in the designation of the Anglesey Terns SPA, which overlaps with much of the RA. At Cemlyn Bay SSSI, on the north Anglesey coast, there are breeding colonies of Arctic Tern, Common Tern and Sandwich Tern as well as Black-headed Gull. These species are found breeding at the Skerries SSSI and Ynys Feurig SSSI; the latter located off the west coast of Anglesey. The waters within this RA also contain important foraging and loafing areas for other seabirds such as Cormorant, Herring Gull, Razorbill and Guillemot; with bird colonies at Middle Mouse, The Skerries, Ynys Feurig, Cemlyn Lagoon and Holy Island. Notable foraging areas exist for Guillemot and Razorbill around Middle Mouse and off South Stack, Holy Island.
Marine mammals	There is considerable overlap with the RA and North Anglesey Marine SAC, this being designated on account of the persistent high densities of harbour porpoise in these waters. Bottlenose dolphin are also common in this area, particularly in the eastern part of the RA, such as around Middle Mouse, and beyond the southerly extent of the RA, around Caernarfon Bay. Low densities of Risso's dolphins and short-beaked common dolphins have been recorded within the northern and western part of the RA, the occurrence of these species and minke whale increasing within the offshore reaches of the RA. Important grey seal haul-out areas are also present along the north coast of mainland Anglesey, Carmel Head, The Skerries and Holy Island.
Fish	The RA does not overlap with any designated sites which have fish as qualifying features. Although migratory fish such as Atlantic salmon, sea trout and European eel likely passage through these waters, the RA does not overlap with any currently well recognised migratory corridors nor SAC's with migratory fish as designated features. The closest SAC with migratory fish as a designated feature is the Afon Gwyrfai a Llŷn Cwellyn SAC, approximately 30 km from the RA, on the north east coast of mainland Wales. Low intensity spawning areas for species such as mackerel, plaice, sand eel, sole and cod overlap with the RA, as do low-intensity nursery areas for cod, mackerel, sandeel, plaice, sole, spurdog and thornback ray.

Topic	Description
Habitats	There are no SACs with habitats as qualifying features within the RA; however, a number of Annex 1 habitat features are present within the region with large subtidal areas of the seabed a mixture of rocky and stony reefs. These are interspersed with extensive areas of sandy gravel and subtidal mixed muddy sediment. Further inshore, many intertidal communities (Article 17 and Section 7 features) are present along the north and west Anglesey coastline and are encompassed by SSSI's that are designated for these qualifying features, such as Cemlyn Bay SSSI (saline lagoon) and the Glannau Ynys Gybi/Holy Island Coast SSSI which includes rockpools, under boulder communities and sea caves. Similarly, the Beddmanarch-Cymyran SSSI, located in the channel between Anglesey and Holy Island encompasses various Article 17 habitat features, including natural saltmarsh and seagrass habitats, saline lagoons and mudflats, sandflats and intertidal reefs. The Glannau Rhoscolyn SSSI, located along the southern Holy Island coast, also includes designated habitat features, including intertidal reefs, eelgrass, saltmarsh and seagrass. These are a distinct Section 7 habitat feature but are also covered by the Article 17 'reef' feature. Therefore, there are a few subtidal Section 7 habitats and species being present within the RA. Recently, the presence of *Sabellaria spinulosa* reef (Section 7 feature) was recorded in north and west Anglesey subtidal areas during benthic characterisation surveys. Follow-up surveys later confirmed the presence of *S. spinulosa* in the region. Additionally, *Modiolus* (Section 7 feature) are predominantly found along the coastline of north-west Anglesey. These patchy beds are biogenic reef structures that provide an important habitat for a variety of marine life.

In relation to seabirds, the outputs of the SMMNR project suggest that within the West Anglesey RA the relatively high constraints are restricted to localised areas, for example around the Skerries and Middle Mouse islands. In the most offshore regions of this RA, to the north-west of Anglesey, the constraints are notably lower than those indicated inshore to Anglesey and around the Llyn Peninsula and the Pembrokeshire coastline. The main contributor to potential constraints offshore was identified as foraging birds with extensive ranges rather than the presence of seabird colonies.

In relation to marine mammals, the outputs of the SMMNR project also indicate a higher level of potential constraint in the inshore area, and along the coastline in particular. This is due to the presence of seal haul-out and pupping sites in this area. This is particularly the case where the RA overlaps with the North Anglesey Marine SAC which has marine mammals as a qualifying feature. Along the east coast of Anglesey, the distribution of the coastal bottlenose dolphin exotype also contributes heavily to the overall constraints.

Around the north coast of Anglesey high relative constraints are indicated at a localised level around the Skerries and Middle Mouse. In the water around the Skerries the higher constraints are indicative of the proximity to seal haul out sites, the relatively higher density distribution of harbour porpoise and the overlapping SAC. In the waters around Middle Mouse the higher constraints are linked to an increased presence of harbour porpoise and bottlenose dolphin.

In the more offshore areas of the RA, there is an increased occurrence of cetaceans such as harbour porpoise and minke whale, and Risso's dolphin and common dolphin is the main contributor to the constraint output in this RA. The mobile nature of these species means that interactions cannot be ruled out, even in areas of lower constraints.

The relative fish constraints in the West Anglesey RA identified in the SMMNR project are largely as a result of overlaps with spawning and nursery grounds.

Around the north coast of Anglesey, the higher relative constraints are in the offshore regions of the RA. This is largely the result of identified nursery grounds for species such as cod, whiting and sandeel. However, much of the RA has relatively low fish constraints, due to comparably fewer nursery and spawning grounds in this region. Adverse impacts on these important breeding areas can potentially be avoided through careful timing of any impacting activities outside of the breeding seasons for the relevant fish species.

In relation to habitats, the outputs of the SMMNR project highlight that inshore along the Welsh coastline, the relative constraints are notably higher than offshore environments and more than 10-20 km offshore are extensive areas of good tidal stream resource occurring in areas of relatively low known constraints.

Around the north and west coast of Anglesey overlap between RAs and designated sites with habitats as a qualifying feature are limited to highly localised areas which abut the boundaries of SSSIs (e.g., waters adjacent to The Skerries SSSI). Occurrences of higher constraints are primarily driven by the presence of subtidal reef, this feature extending to the north and northeast. Elsewhere, where survey point data has indicated the presence of biogenic reef or stony/rocky reef then these indicate a relatively increased level of constraint.

Inshore of the RA the results of the analysis indicated high levels of constraint. This is a consequence of the range of designated subtidal and intertidal features along the Anglesey coastline (e.g., subtidal and intertidal rocky reef, saline lagoons, sea caves etc.) in addition to numerous SSSI sites (e.g., Holy Island Coast SSSI; Cemlyn Bay SSSI).

10.1.5 Other marine users

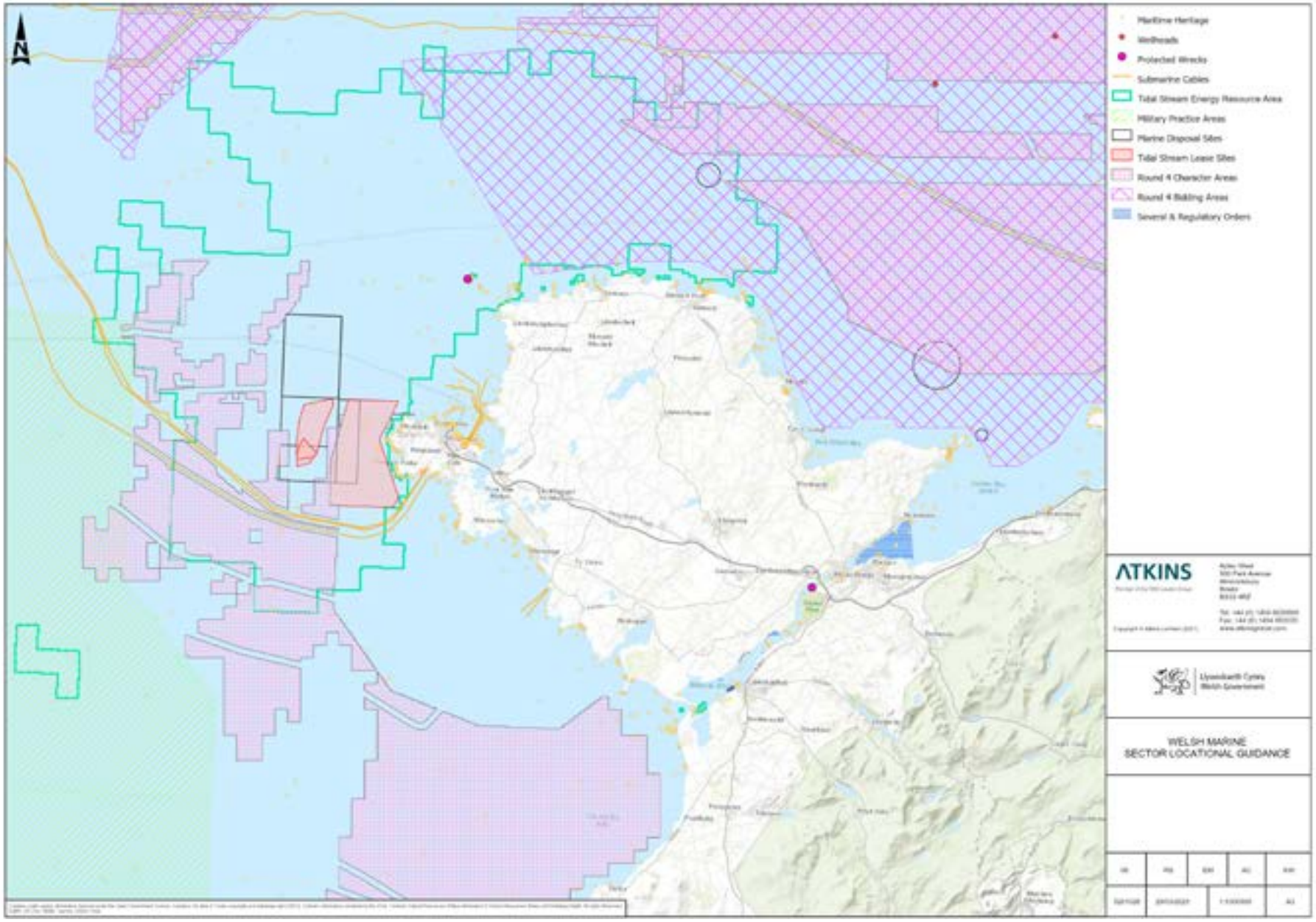
Table 10.5 outlines the other marine users and activities present in the Tidal Stream – West Anglesey RA. Please see Section 8 for more information on other marine users in wider Welsh waters and a high-level assessment of other sector interactions with tidal stream energy. Figure 10.4 and Figure 10.5 show the key features (those assigned a high score in the MRESF constraints analysis) potentially affecting tidal stream energy developments in the RA.

Table 10.5: Tidal Stream – West Anglesey other marine users

Sector	Description
Aggregates	There are no aggregate production areas currently within the RA. The eastern edge of the RA overlaps with an aggregate RA potentially leading to competition for space or constraints in the future for any new aggregate production areas established within the tidal stream – West Anglesey RA.
Aquaculture	Southwest and northeast sides of the RA overlap with aquaculture RAs. This is mostly potential areas for cage culture of salmon and trout in the south west area, ranching of crawfish around the inshore areas, and rope culture of scallops in the south west of the tidal stream RA. Other aquaculture RAs around the north west coast of Anglesey could interact with export cables from projects in the tidal stream RA.
Defence	Western edge of the RA overlaps with the Aberporth military practice area.
Dredging & disposal	Three closed disposal areas in the middle of the RA – Holyhead Deep, Holyhead South and Holyhead East.
Energy (low carbon)	There are already two large tidal stream projects under development to the west of Holy Island: • West Anglesey Demonstration Zone (Morlais) – demo zone lease held by Menter Môn, the third-party manager. The area is divided into 8 subareas each of which will be sublet to technology developers who will develop arrays of up to 30 MW. • Holyhead Deep – Agreements for Lease held by the tidal technology developer Minesto - 0.5 MW test deployment, and 10 MW array. Longer term plans for 80 MW array. Buffer zones will be required around the lease areas for both existing tidal stream projects to ensure there is not an impact on resource. A number of offshore wind farms have been developed off North Wales and development is continuing with the closest lease being for Awel y Môr Offshore Wind Farm, 20 km east of the RA. Much of the RA overlaps with areas identified as favourable for offshore wind development (the eastern end of RA overlaps with the Round 4 Bidding Area for offshore wind, although none of the initial Round 4 lease areas overlap with the RA). There is also interest in demonstration floating wind projects off Anglesey, but this is still at an early stage. Wylfa nuclear power station is situated on northern coast of Anglesey, north of Tregale. Whilst this would not impact on offshore development, it brings a number of benefits including good road access to this part of Anglesey and has ensured a skilled engineering workforce in the locality. Most importantly, it has secured extensive grid infrastructure close to areas of good tidal resource, which is unusual as they tend to be in remote places.
Energy (O&G)	The tidal stream RA overlaps with a number of O&G Blocks Offered: • ref 109/11 overlaps with northwest edge of RA. • ref 108/20 overlaps with western edge of RA.

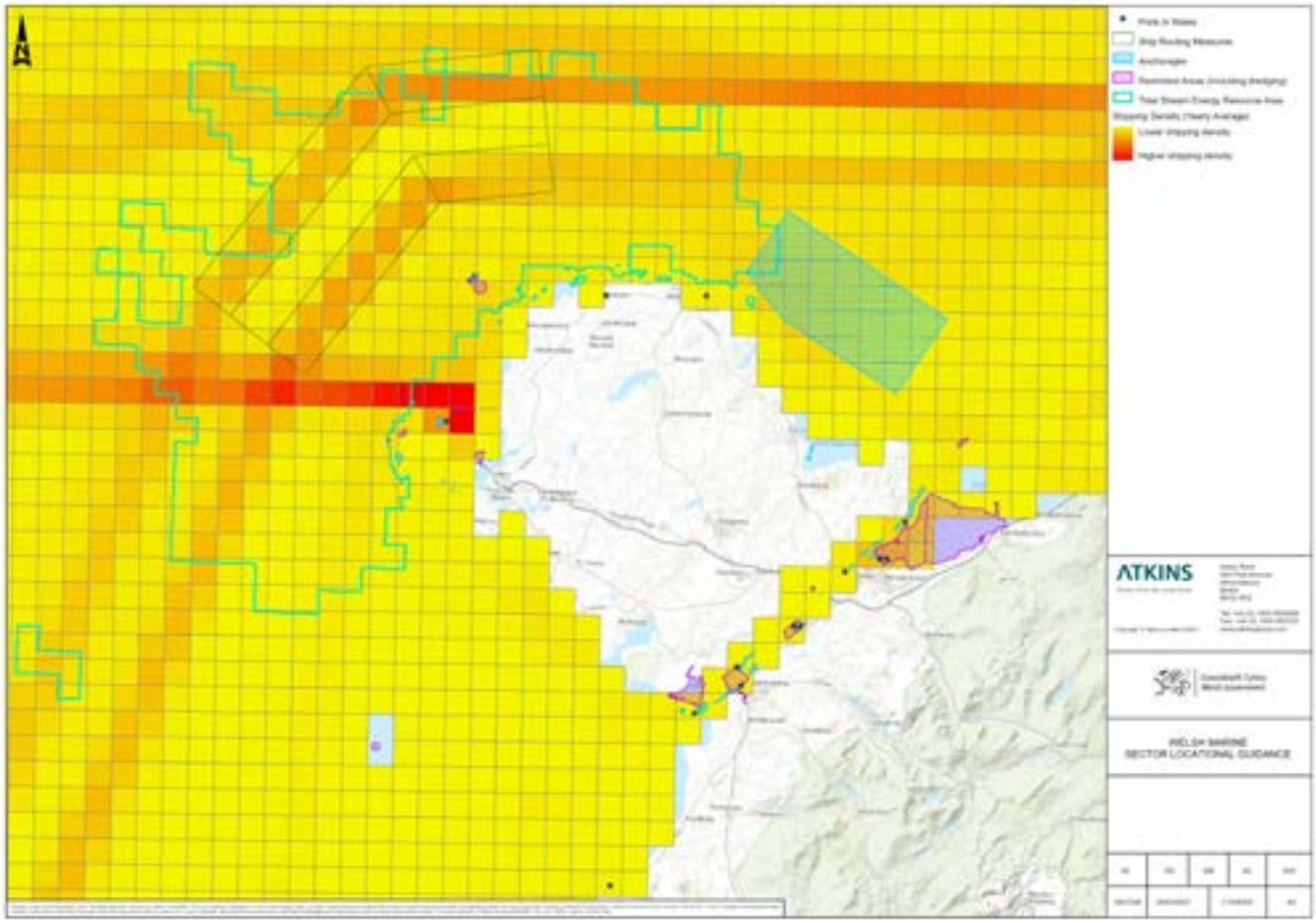
Sector	Description
Fishing	There is still a significant amount of shellfish activity around Anglesey with scallop dredging in particular within the RA. The value of annual shellfish landings around Anglesey, and over much of the RA is estimated to be up to £1.6 million, with areas further offshore overlapping with the north of RA estimated to be £4.9 million. The annual fleet landings of shellfish in Amlwch are estimated to be up to £1 million, and up to £2 million at Holyhead Port (MMO, 2020).
Shipping	Traffic separation scheme north of Skerries covering much of the tidal stream RA. Shipping Automatic Identification System (AIS) data from 2015 highlights passenger ferry routes from Holyhead Port heading west across southern end of RA, and another passenger route along northern edge RA. There are two distinct cargo/tanker routes through the RA and around the traffic separation scheme at Skerries. Restricted area south of Anglesey Skerries, off Carmel Head – specified area designated by an appropriate authority in which navigation is restricted in accordance with certain specified conditions.
Subsea cabling	Three subsea cables cross southern end of the RA and into the southern end of Holy Island. A number of submarine cables extend from the north of Holy Island, which don't overlap with the tidal stream RA, but may interact with export cable routes from projects developed in the RA. A pipeline extends north from Amlwch which overlaps with the RA.
Tourism & recreation	RYA general boating area overlaps with southern edge of tidal stream RA around Holy Island. RYA AIS data from 2014-17 highlights areas of medium boating activity around Holy Island which overlaps with the south eastern edge of the RA.
Seascape	Most of the northwest coast of Anglesey is an Area of Outstanding Natural Beauty (AONB) so seascape impacts would need to be considered for any project with surface piercing elements close to shore.
Wrecks	There are a large number of wrecks in the RA that would need to be avoided in the project design phase.

Figure 10.4: Location of significant issues/constraints in relation to the Tidal Stream – West Anglesey RA



Source: see Table A-1

Figure 10.5: Location of shipping constraints in relation to the Tidal Stream – West Anglesey RA



Source: see Table A-1

10.1.6 Summary of key opportunities and constraints

Several key constraints have been identified that would either potentially cause lengthy decision making for consent or could preclude development altogether. Several opportunities have also been identified which could support or guide future development of the sector.

This SLG aims to highlight features within this region which may influence site selection and/or could present a potential challenge to development in this area. It may be that some features can be easily avoided through micro-siting or applying appropriate buffers at the project design stage. Some features may require more detailed assessment and consultation at project level. Developers should consider the cost and programme implications of progressing developments that impact on key features.

Key constraints:

- **Shipping**: Traffic Separation Scheme located in the north-western corner of the RA. Passenger ferry route heading west from Holyhead Port. Projects could present a risk to safe navigation, so whilst management measures can be put in place, any proposed alteration to shipping routes could lead to extended delays.
- **Subsea cables:** Three subsea cables cross the southern end of the RA. Owners/operators of active cables are unlikely to allow development within the vicinity of their assets due to the risk of damage. A buffer is likely to be required either side of a cable and development would need to be outside of this.
- **Marine mammals:** The RA is almost entirely within the North Anglesey Marine SAC which is designated on account of the high densities of harbour porpoise.
- **Seabirds:** There is considerable overlap with the Anglesey Terns SPA. Whilst not a hard constraint it is likely that this would lead to considerable scrutiny in the consenting process and lengthy decision making.

Key opportunities:

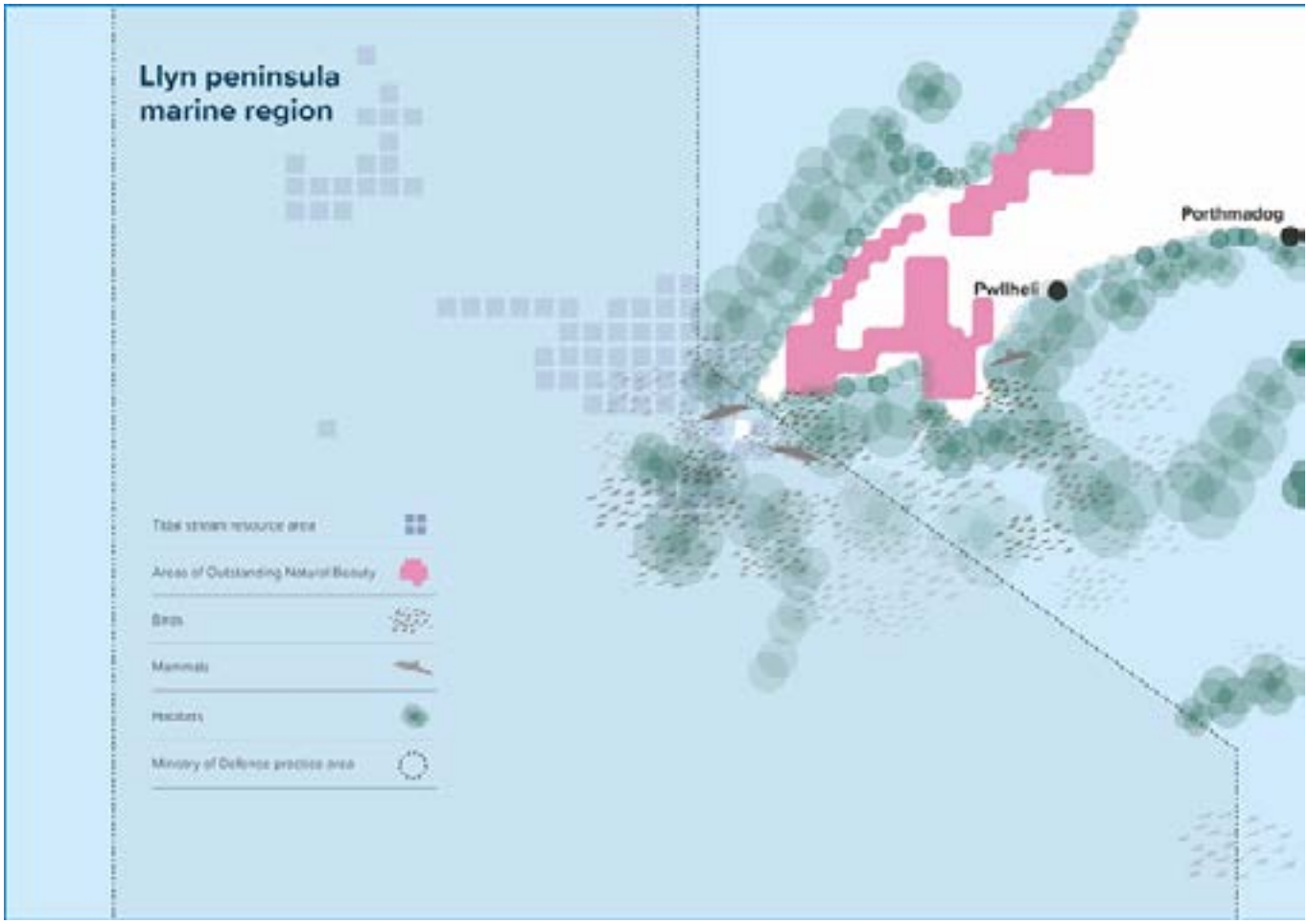
- **Tidal stream resource**: An extensive and potentially significant RA exists around Anglesey with the necessary physical and environmental conditions to support the production of tidal stream energy at a commercial scale. The large extent of the resource, and the reduction in constraints further offshore, provide greater opportunity to locate a suitable area for development.
- **National grid:** Anglesey has very good grid infrastructure due to Wylfa Nuclear Power station on the northern coast of Anglesey. Welsh Government is also exploring a potential Multi Vector Local Energy System for the North Wales region which could enable more generation projects to be developed.
- **Supply chain:** There are several ports in North Wales with existing capacity and experience of serving the offshore energy sector. Faun Trackway in North Wales has developed bespoke mooring anchors for tidal energy devices. A further three companies specialise in installation of drilled and grouted, or driven seabed anchor piles.
- **Co-location:** There is potential for future co-location with floating offshore wind but this would be further offshore, outwith the current RA, and requires further technology development to make lower flow sites viable. The southern end of the RA overlaps with the aquaculture RA for rope culture of scallops, which could be explored for potential co-location. There may also be synergies with onshore aquaculture development in the region which has high energy demand that could potentially be supplied by tidal projects of commercial scale in the future.
- **Research capability:** There is extensive research capability within the RA such as Bangor University which undertakes environmental research focussed on the marine energy sector in Wales, is a lead partner in the SEACAMS programme, and runs the Marine Centre Wales facility in Menai Bridge.
- **Refining of RA:** As a result of the emerging nature of the tidal stream energy sector, there are a large number of opportunities to strengthen the evidence base and further refine the RA and develop an understanding of opportunities for future tidal stream energy activity.

10.2 Tidal Stream – Irish Sea/Llŷn Peninsula

The Tidal Stream – Irish Sea/Llŷn Peninsula RA covers the most offshore group of RAs, some of which are at the limit of Welsh waters, and the west coast of the Llŷn Peninsula with the tidal stream resource encompassing Bardsey Sound.

Figure 10.6 provides a high-level representation of certain relevant spatial considerations which are a feature of the Tidal Stream – Irish Sea/Llŷn Peninsula RA. This figure is for illustrative purposes only. For land-based considerations, reference should be made to Future Wales[38].

Figure 10.6: High level representation of spatial considerations within the Irish Sea/Llŷn Peninsula RA



Source: Welsh Government, 2021

10.2.1 Resource considerations

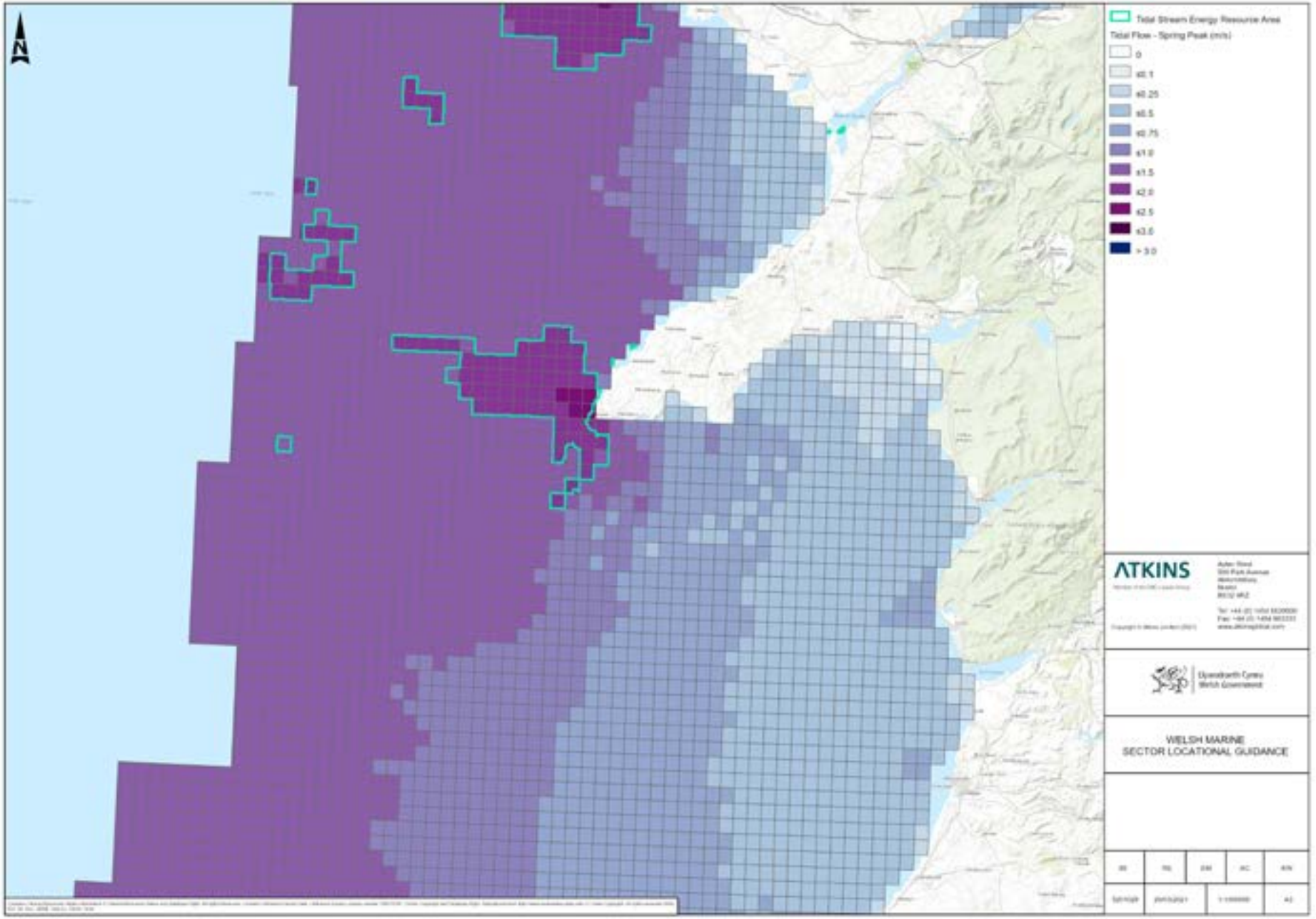
Table 10.6 outlines the key physical resource considerations for tidal stream developments in the tidal stream – Irish Sea/Llŷn Peninsula RA and Figure 10.7 illustrates the tidal flow (m/s peak) for the RA. See Section 3 for further details on tidal stream resource.

38 gov.wales/future-wales-national-plan-2040-0

Table 10.6: Tidal Stream Irish Sea/Llŷn Peninsula – physical considerations

Topic	Description
Tidal stream resource	Majority over 1.5 m/s. Small area north of Bardsey Island that is over 2 m/s. Patchy areas of tidal resource over 1.5 m/s in offshore waters.
Tidal stream resource data	Data limited in offshore waters to what is available from UK energy atlas and hydrodynamic models developed by Bangor and Swansea University. No measured data available in offshore waters. SEACAMS has undertaken multiple ADCP deployments in Bardsey Sound.
Physical survey data	No survey data available for this RA.
Tidal Stream – Irish Sea/ Llŷn Peninsula RA area (km^2)	277.6 km^2
Average water depth of RA	-66.92 m below the surface
Maximum water depth in the RA	-153 m below the surface

Figure 10.7: Tidal flow in the Tidal Stream – Irish Sea/Llŷn Peninsula RA



Source: Renewables Atlas, 2020

10.2.2 Infrastructure & supply chain

Table 10.7 describes the existing infrastructure and supply chain in the Tidal Stream – Irish Sea/Llŷn Peninsula RA.

Table 10.7: Tidal Stream – Irish Sea/Llŷn Peninsula infrastructure & supply chain

Topic	Description
Grid	Anglesey has very good grid infrastructure with both 400 kV and 132 kV lines that present opportunities for connection. The distance of the export cable required would be significant though – circa 35 km at the furthest point (Wylfa power station to the northwest tip of the RA). The electricity network on the Llŷn peninsula is known to be heavily constrained. The nearest High Voltage (HV) network is the Pentir to Trawsfynydd 400 kV circuit, and the distribution network is at full capacity. Currently the only option for a development of 30 MW+ would be a long export cable to Anglesey. Scottish Power Energy Network is exploring options for active network management, but this would still not be enough to accommodate a 30 MW commercial tidal array. A feasibility study, led by the local community group Ynni Llŷn, is being carried out to explore a potential SMART local energy system on the Llŷn which could potentially provide a solution. ORE Catapult is also undertaking a study for Welsh Government looking at where the grid would need to be upgraded to accommodate potential growth in offshore renewables. This is mostly focussed on fixed and floating offshore wind, but other marine energy projects could benefit from any upgrades.
Ports	Holyhead Port on Holy Island is well placed to act as a base for both assembly, installation and O&M activities for projects developed in the RA.
Supply chain	Development support – many of the companies who have the necessary expertise and experience in tidal development have good experience of the RA including Royal Haskoning DHV, MarineSpace, Xodus and Aquatera who have an office on Anglesey itself. O&M – Holyhead Marine based in Holyhead have extensive experience in supporting offshore wind O&M and have been providing engineering support to Minesto.
Research	Bangor University has extensive experience around Anglesey, with most of the personnel with relevant expertise based in the Marine Centre Wales facility in Menai Bridge. Bangor Uni is lead partner in SEACAMS programme that has been extended to 2021. SEACAMS undertakes environmental research focussed on marine energy sector in Wales. MEECE, led by ORE Catapult, supports marine energy related research across Wales and will have an Innovation Manager based in north Wales.

10.2.3 Social considerations

The Tidal Stream – Irish Sea/Llŷn Peninsula RA is covered by the Isle of Anglesey and Gwynedd LAs.

10.2.3.1 Population and demographics

Information on population density demographics, area deprivation and percentage of Welsh speaking individuals is highlighted in Table 10.8. This can provide useful information to developers when looking at establishing teams in the locality, for community engagement, and also to marine planners/regulators during planning and policy decision-making.

Table 10.8: Population and demographics for Tidal Stream – Irish Sea/Llŷn Peninsula RA

Population density	In Gwynedd LA, there is an average population density of 49.1 persons per km^2. On Anglesey, there is an average population density of 98.4 persons per km^2.
Demographics	In the Isle of Anglesey LA the highest percentage of the population is in the following age groups: • 45 to 64 (27.8%) • 0 to 14 (16.1%) In Gwynedd LA the highest percentage of the population are in the following age groups: • 45 to 64 (25.5%) • 15 to 29 (20.9%)
Area deprivation	Of the 0-10% most deprived LSOAs in Wales (Overall), 2 (Peblig (Caernarfon), Marchog) are in the Gwynedd LA which accounts for 2.7% of the LA and 0.1% of those in Wales. According to Office for National Statistics estimates the highest proportion of employees earning below the living wage in 2019 was in Gwynedd (31.4%).
Welsh speaking	The LA with the highest proportion of Welsh speakers was Gwynedd, where 75.1% (89,300) of residents were able to speak Welsh in 2020 (ONS, 2020).

10.2.3.2 Cultural identity

Caernarfon Bay forms a natural harbour which has been considered strategically important since Roman times. Several historical defence sites lie along the coast in the RA, including the promontory forts at Dinas Dinlle and Tywn-y-Parc. Other features of archaeological interest include the prehistoric Ynys Leurad Hut Circles adjacent to the Inland Sea, iron age hillforts and World War II signal stations. There are several tidal watermills on the Inland Sea, which are recognised as Scheduled Monuments. From Malltraeth Marsh there are several medieval coal mines going out to sea.

St George's Channel shipping lanes pass through the south western extent of the RA, which is used by commercial ships passing to and from Liverpool. Several documented historic wreck sites are present off the coast, which carried out historic trade between Ireland and Liverpool.

Parts of the area are also licenced for O&G exploitation although no extraction has taken place to date, and the southern edges fall within the wider Aberporth military practice area, including its offshore firing range.

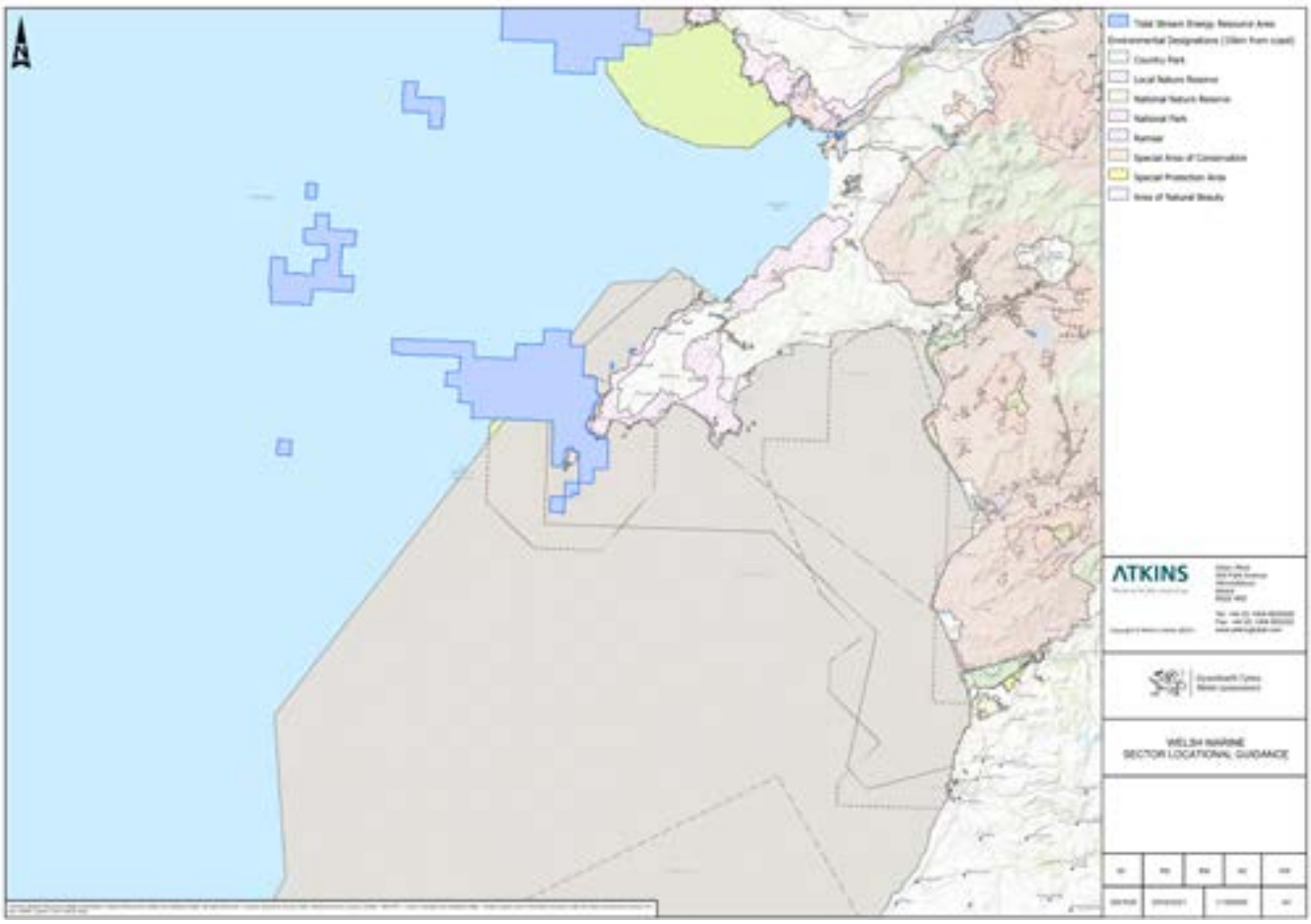
There's a long tradition of fishing on the Llŷn Peninsula. It is primarily a small-scale fishery (< 10 m boats), with fishers targeting queen scallop, scallop, lobster and brown crab. The Llŷn Peninsula is also a popular location for sea angling.

This area of north Wales is very popular for tourism and recreation. Recreational activities include wildlife watching, water sports and high-quality bathing waters at Rhosneigr, Aberffraw and Silver Bay. Tourism and recreation are the main drivers of the economy on the Llŷn Peninsula. Recreational activities include surfing at Hells Mouth, paragliding at Bardsey Island and scuba diving. The Wales Coast Path circumnavigates the Peninsula, with many parts, including Bardsey Island, owned and managed by the National Trust.

10.2.4 Environmental considerations

Figure 10.8 illustrates the environmental designations within the tidal stream – Irish Sea/Llŷn Peninsula RA. Table 10.9 gives further details on these designations.

Figure 10.8: Tidal Stream – Irish Sea/Llŷn Peninsula environmental designations



Source: Lle, 2020

Table 10.9: Tidal Stream – Irish Sea/Llŷn Peninsula environmental considerations

Topic	Description
Designations	Off the tip of the Llŷn Peninsula, approximately half of the RA overlaps with three designated sites: West Wales Marine SAC (designated for harbour porpoise); Glannau Aberdaron and Ynys Enlli SPA (designated for Manx Shearwater) and the Pen Llŷn a'r Sarnau/Lleyn Peninsula SAC (designated for habitats, grey seal and bottlenose dolphin). The Clogwyni Pen Llŷn/Sea cliffs of Lleyn SAC and Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd SPA are also present along the Bardsey Sound coast and overlap with a small portion of the RAs in this geographical area. The mainland coastline adjacent to the RAs forms part of the AONB, as does Bardsey Island. A number of SSSIs are also present in this region including Glannau Aberdaron; Ynys Enlli; Ynysoedd y Gwylanod and Gwylan Islands. The Glannau Aberdaron and Ynys Enlli SPA, encompasses the south-eastern part of the large RA off the tip of the Llŷn Peninsula. Designated for breeding populations of Manx Shearwater and Chough, the waters here are also important loafing and foraging areas for a number of bird species that are found at the colonies on the north and south coast of the Llŷn Peninsula and on Bardsey Island; including, Guillemot from Carreg y Llam; Guillemot, Razorbill, Puffin and Manx Shearwater from Bardsey Island; Puffin and Manx Shearwater from Ynysoedd Gwylan; Kittiwake and Guillemot from St Tudwal's East and St Tudwal's West. No designated sites overlap with the waters in and around the offshore elements of the RAs.
Seabirds	The Glannau Aberdaron and Ynys Enlli SPA, encompasses the south-eastern part of the large RA off the tip of the Llŷn Peninsula. Designated for breeding populations of Manx Shearwater and Chough, the waters here are also important loafing and foraging areas for a number of bird species that are found at the colonies on the north and south coast of the Llŷn Peninsula and on Bardsey Island; including, Guillemot from Carreg y Llam; Guillemot, Razorbill, Puffin and Manx Shearwater from Bardsey Island; Puffin and Manx Shearwater from Ynysoedd Gwylan; Kittiwake and Guillemot from St Tudwal's East and St Tudwal's West. Although some bird foraging potentially occurs in offshore areas e.g. Kittiwake, Fulmar, Guillemot; it is not thought to overlap with key foraging grounds.

Topic	Description
Marine mammals	High densities of harbour porpoise are found within the waters that overlap with the RA but specifically around Bardsey Sound. Minke whale, Risso's dolphin and bottlenose dolphin are also infrequent visitors to the area. An important grey seal haul-out area is present on Bardsey Island, within the Pen Llŷn a'r Sarnau/Lleyn Peninsula SAC. Grey seals are regularly seen within Bardsey Sound and there are important seal haul out sites on Bardsey Island and around the south western tip of the Peninsula. In the offshore areas, records of minke whale, common dolphin and Risso's dolphin are comparatively greater than inshore and coastal regions. Bottlenose dolphin from the offshore ecotype also frequently occur.
Fish	The RA does not overlap with any designated sites which have fish as qualifying features. Low intensity spawning grounds of cod, plaice, sandeel, sole and whiting cover most of the RA off the tip of the Peninsula, as do nursery grounds for anglerfish and whiting. In the northern region of the offshore areas there is overlap with low-intensity spawning areas of cod, mackerel, plaice, sandeel, sole and whiting. Much of the water within these RAs overlaps with low density nursery grounds for anglerfish and whiting.
Habitats	The majority of the offshore region of the large RA supports sandy gravel and mixed muddy habitats, these both being Section 7 features. Extensive areas of Article 17 subtidal reef habitat extend up to 5 km from the coastline, overlapping with the eastern part of the large RA and the small RAs by Penrhyn Mawr and Porth Colman. Reefs are a qualifying feature of the Pen Llŷn a'r Sarnau/Lleyn Peninsula SAC. There are also several other Article 17 and Section 7 features present around Bardsey Sound and along the coast, such as sandbanks, intertidal reef, fragile sponge and anthozoan communities, deep water mud habitats and sea caves. Several Section 7 benthic species have been recorded in the area including the stalked jellyfish (*Haliclystus auricula*); the red alga *Grateloupia dermocorynus montagnei* and the red alga *Cruoria Cruoriiformis* along the south coast of Bardsey Sound. Much of these offshore areas support Section 7 mixed muddy sediment habitats with smaller areas of Article 17 subtidal reef thought to be present.

In relation to seabirds, the outputs of the SMMNR project suggest that around the Llyn Peninsula and Bardsey Island, it is the presence of the seabird colonies at Carreg Llam, Bardsey and Ynysoedd Gwylan which are the main influence to the relatively higher constraints indicated. Further offshore, the small tidal stream RAs towards the limit of Welsh waters, overlap with areas of relatively low constraints. However, the foraging ranges of birds from colonies such as Carreg y Llam (Guillemot) and Bardsey (i.e. Fulmar, Puffin and Manx Shearwater) contribute to the constraint scores at these offshore locations.

In relation to marine mammals, the outputs of the SMMNR project also indicate a higher level of potential constraint in the inshore area, and along the coastline in particular. This is particularly the case close inshore to the Llyn Peninsula and Bardsley Island due to the presence of multiple seal haul-out sites in this area. However, a few kilometres from the coastline it is the density distribution of cetaceans such as minke whale, Risso's dolphin, bottlenose dolphin and common dolphin which are the main influence on the relative constraints, along with the presence of two SACs with overlapping boundaries (Llyn Peninsula and Sarnau SAC; West Wales Marine SAC).

In the further offshore aspects of the RA, there are relatively lower constraints for marine mammals. Approximately 50 km to the west of the Llyn Peninsula, it is the presence of cetaceans such as minke whale, Risso's dolphin, bottlenose dolphin and common dolphin which are the main contributor to the relatively low constraints in the far west offshore waters part of this RA.

The relative fish constraints in this RA identified in the SMMNR project are largely as a result of spawning grounds. There are no designated sites with fish as qualifying features around the Llyn Peninsula, and it is the multiple spawning grounds of species such as cod, plaice and sandeel that provide the main contributor to the constraints. For the offshore RAs approximately 50 km to the west of the Llyn Peninsula, fish constraints are comparatively low, there being few identified high intensity nursery and spawning grounds of selected fish taxa in this area.

In relation to habitats, the outputs of the SMMNR project highlight that inshore and along the coastline, the relative constraints are notably higher than offshore environments with extensive areas of good tidal stream resource occurring in offshore areas of relatively low known constraints.

The presence of multiple Article 17 and Section 7 features (e.g. sandbanks, subtidal and intertidal reef, fragile sponge and anthozoan communities, deep water mud habitats, sea caves) inshore, around the Llyn Peninsula and Bardsey Island, in addition to multiple designated sites (e.g. Llyn Peninsula and Sarnau SAC, Glannau and Aberdaron SSSI, Ynys Enlli SSSI), result in notably higher constraints. More than 10 km offshore these constraints are relatively low, and influenced by the presence of mixed muddy habitats and the western extent of the Llyn Peninsula and Sarnau SAC. No designated sites overlap with the offshore RAs approximately 50 km to the west of the Llyn Peninsula. Constraints here are comparatively low, and the result of overlap with the Section 7 habitat 'mixed muddy sediments'.

10.2.5 Other marine users

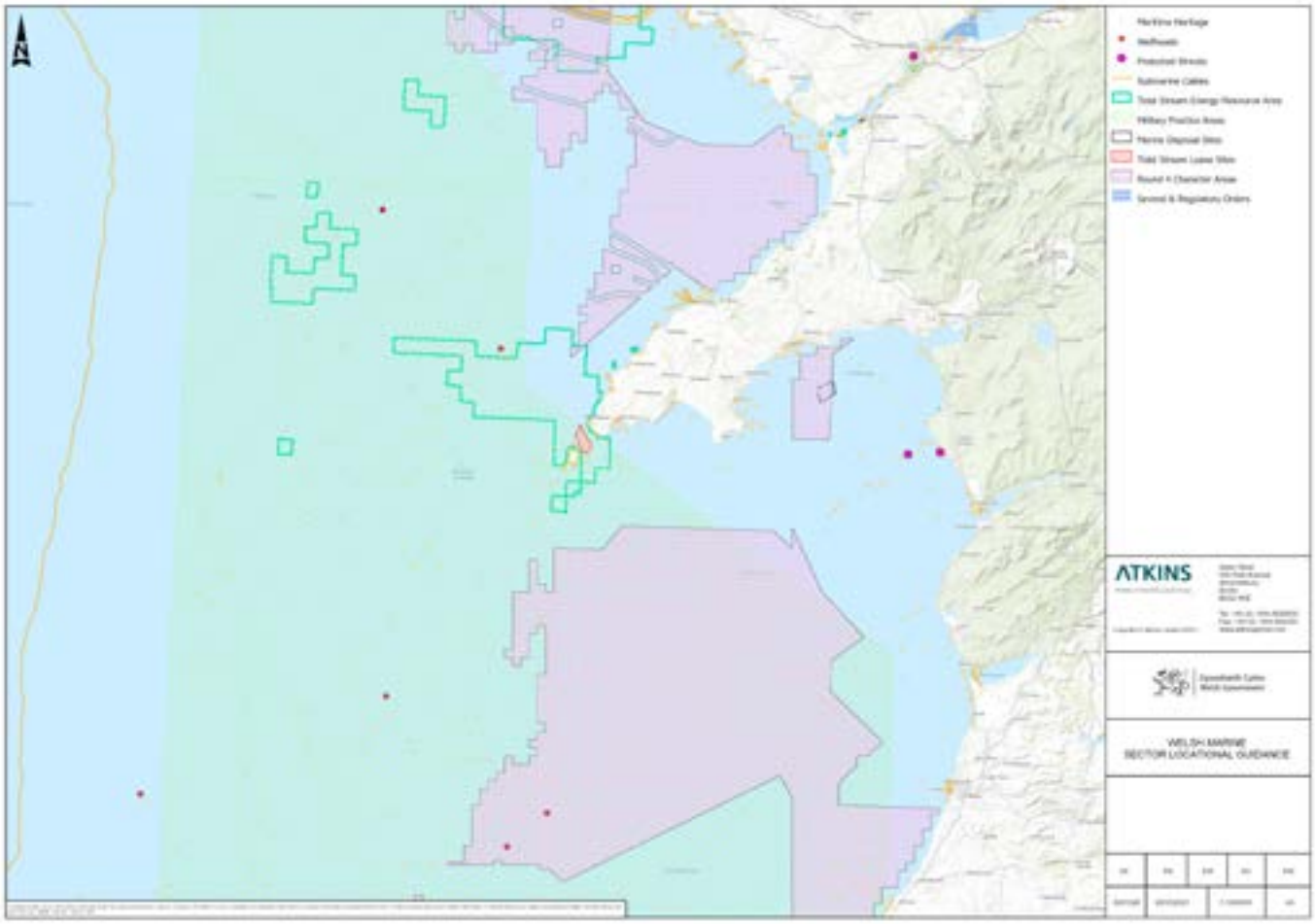
Table 10.10 outlines the other marine users and activities present in the Tidal Stream – Irish Sea/Llŷn Peninsula RA. Please see Section 8 for more information on other marine users in wider Welsh waters and a high-level assessment of other sector interactions with tidal stream energy. Figure 10.9 and Figure 10.10 show the key features (those assigned a high score in the MRESF constraints analysis) potentially affecting tidal stream energy developments in the RA.

Table 10.10: Tidal Stream – Irish Sea/Llŷn Peninsula other marine users

Sector	Description
Aggregates	There are no aggregate production areas currently within the RA. Aggregate RA for sand/gravel to the north of the northern tidal RA, and overlapping with the centre of the main tidal stream RA. Overlap of southern tip of tidal RA with potential aggregate RA for sand & gravel.
Aquaculture	There is no overlap with any existing or potential aquaculture RAs in the offshore areas. The southern tip of the tidal stream RA overlaps with aquaculture RA for bottom culture for king scallops, and small areas for blue mussels and oysters, ranching of crawfish and lobster, rope culture of macroalgae. Overlap of potential area for rope culture for scallops with northeastern edge of tidal stream RA.
Defence	Overlap with Aberporth Military Practice area over most of western and southwestern extents of tidal RA. New tidal stream developments would need the permission of the MoD if planned in the area off Llŷn Peninsula, due to its potential to create navigational hazards for military practices (Cefas, 2020).
Energy (low carbon)	A tidal stream project is under development in Bardsey Sound – with a lease held by Nova Innovation. A buffer would be required around project to ensure any other development does not impact on the tidal resource.
Energy (O&G)	O&G authority well to north east of the tidal stream RA (abandoned phase 3, Total E&P) within O&G Authority blocks offered (106/4, 108/29, 108/30) Abandoned wellhead to north of the RA. Overlap with O&G Authority Blocks offered 106/5, 107/1, 107/6.
Fishing	Beam trawling activity recorded overlapping with main tidal stream RA. Otter trawling activity recorded directly north of the main RA. Overlap with scallop dredging in southern end of the RA. Fishing activity with static gear around Bardsey Island. Morfa Nefyn annual landings of shellfish are estimated to be worth in the order of £750k. Aberdaron £161k and Pwllheli £554k. It is not clear what proportion of this comes from the RA.

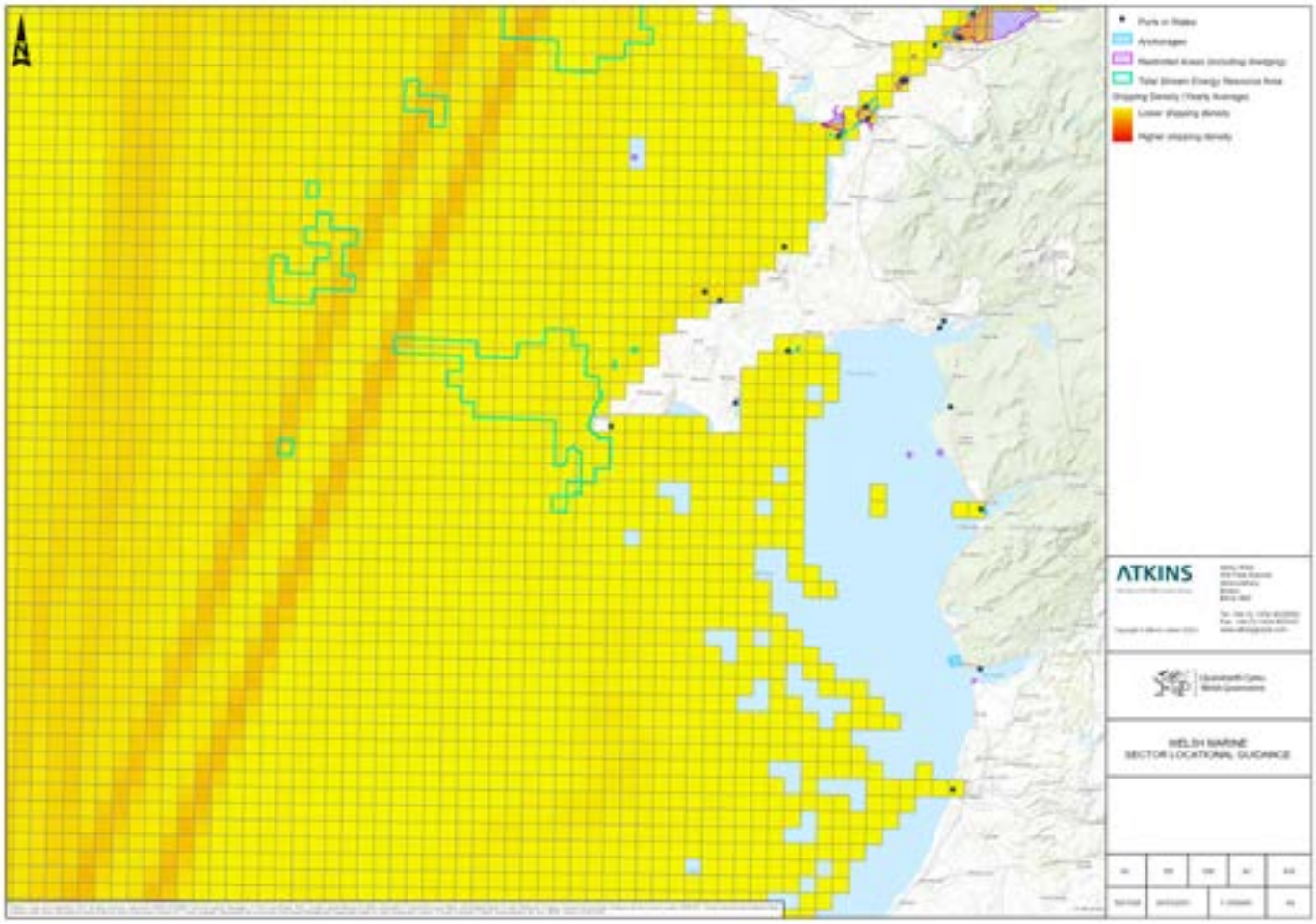
Sector	Description
Shipping	Shipping AIS highlights cargo/tanker route through middle of the RA. Shipping AIS highlights cargo/tanker route overlapping with western-most tip of tidal RA, but most of the RA has low levels of marine traffic. There is a passenger ferry that takes passengers from Aberdaron to Bardsey Island.
Seascape	The majority of the coast on the Llŷn Peninsula is an AONB so this would need to be considered for any projects with a surface piercing element close to shore.
Wrecks	There are a large number of wrecks in the RA, mostly focused around Bardsey Island, that would need to be avoided in the project design phase.

Figure 10.9: Location of significant issues/constraints in relation to the Tidal Stream – Irish Sea/Llŷn Peninsula RA



Source: see Table A-1

Figure 10.10: Location of shipping constraints in relation to the Tidal Stream – Irish Sea/Llŷn Peninsula RA



Source: see Table A-1

10.2.6 Summary of key opportunities and constraints

Several key constraints have been identified that would either potentially cause lengthy decision making for consent or could preclude development altogether. Several opportunities have also been identified which could support or guide future development of the sector.

This SLG aims to highlight features within this region which may influence site selection and/or could present a potential challenge to development in this area. It may be that some features can be easily avoided through micro-siting or applying appropriate buffers at the project design stage. Some features may require more detailed assessment and consultation at project level. Developers should consider the cost and programme implications of progressing developments that impact on key features.

Key constraints:

- **Environmental designations** – Off the tip of the Llŷn Peninsula, approximately half of the RA overlaps with three designated sites: West Wales Marine SAC (designated for Harbour Porpoise); Glannau Aberdaron and Ynys Enlli SPA (designated for Manx shearwater) and the Pen Llŷn a'r Sarnau/Lleyn Peninsula SAC (designated for habitats, grey seal and bottlenose dolphin). The Clogwyni Pen Llŷn/Sea cliffs of Lleyn SAC and Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd SPA are also present along the Bardsey Sound coast and overlap with a small portion of the RAs in this geographical area.
- **Marine mammals** – High densities of harbour porpoise are found within the waters that overlap with the RA but specifically around Bardsey Sound. An important grey seal haul-out area is present on Bardsey Island, within the Pen Llŷn a'r Sarnau/Lleyn Peninsula SAC. Grey seals are regularly seen within Bardsey Sound and there are important seal haul out sites on Bardsey Island and around the south western tip of the Peninsula.
- **Energy (low carbon)** – A tidal stream project is under development in Bardsey Sound – the Agreement for Lease is held by Nova Innovation. A buffer would be required around a project to ensure any other development does not impact on the tidal stream resource.
- **Grid** – The electricity network on the Llŷn Peninsula is known to be heavily constrained. The nearest HV network is the Pentir to Trawsfynydd 400 kV circuit, and the distribution network is at full capacity.
- **Shipping** – Cargo/tanker route through middle of both tidal stream RAs. Projects could present a risk to safe navigation so whilst management measures can be put in place any proposed alteration to shipping routes could lead to extended delays.
- **Defence** – The RA is within the Aberporth military practice area and overlaps with Aberporth Military Practice area over most of the western and south western extents. Developments within or overlapping with MoD areas could present a risk to both the MoD's activities and to the project infrastructure itself so would require extensive engagement and could lead to extended delays.
- **Distance from shore** – this is a challenge for grid connection, installation activities and O&M for offshore (Irish sea) areas only.
- **Wrecks** – There are a number of wrecks in the RA that would need to be avoided in the project design. Whilst not all wrecks are protected, it is likely that a buffer would be required, and development would need to be outside of this.

Key opportunities:

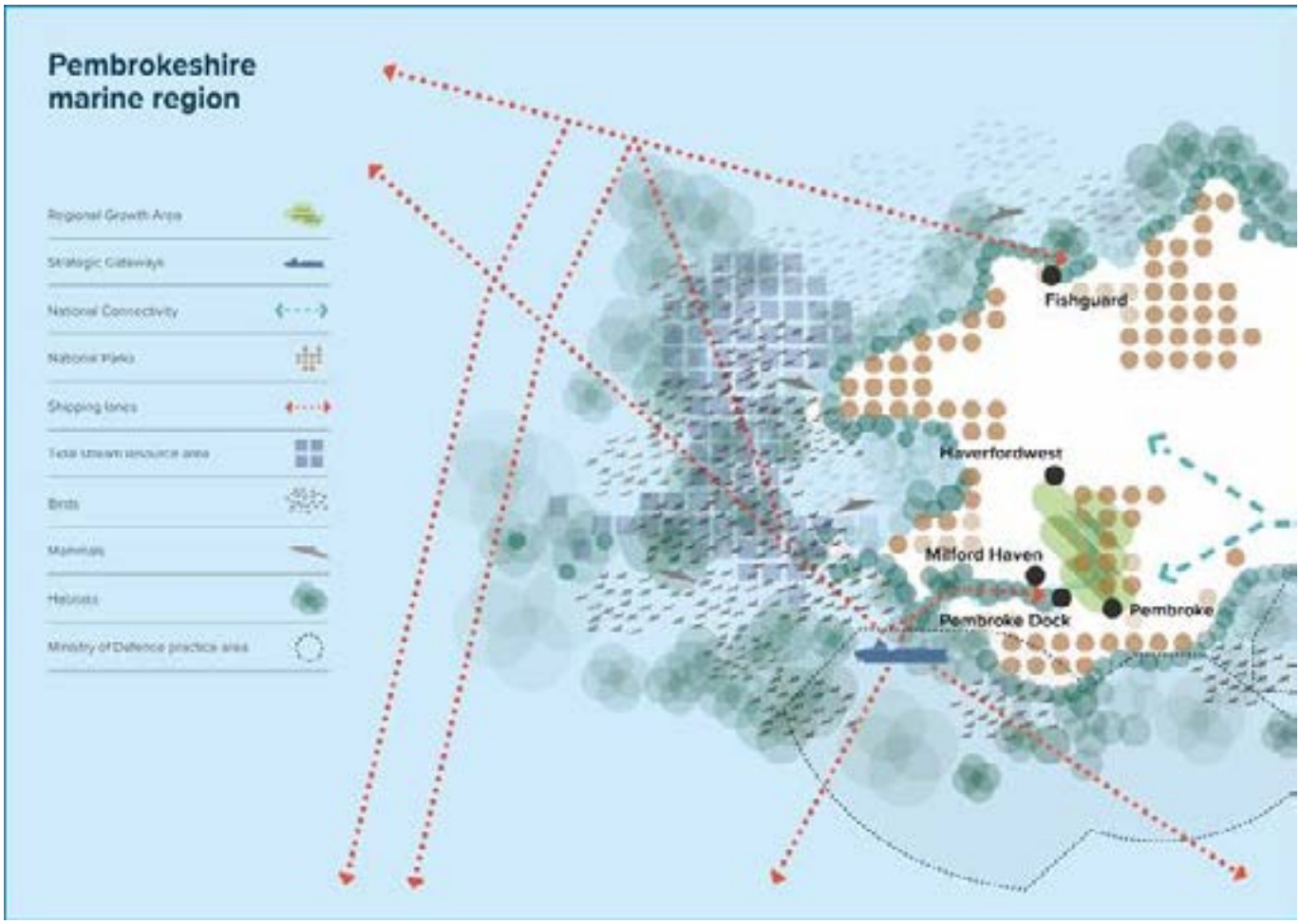
- **Tidal stream resource** – The large extent of the resource, and the notably lower level of constraints further offshore for marine mammals, birds, fish and benthic habitats, provides greater opportunity to locate a suitable area for development.
- **Supply chain** – There are several ports in North Wales with existing capacity and experience of serving the offshore energy sector. Faun Trackway in North Wales has developed bespoke mooring anchors for tidal energy devices. A further three companies specialise in installation of drilled and grouted, or driven seabed anchor piles.
- **Co-location** – There is potential for future co-location with floating offshore wind but no known development activity in this area currently. There is some limited overlap with the aquaculture RA on the southern end of the RA so future aquaculture co-location could be explored in this area.
- **Refining of RA** – As a result of the emerging nature of the tidal stream energy sector, there are a large number of opportunities to strengthen the evidence base and further refine the RA and develop an understanding of opportunities for future tidal stream energy activity.

10.3 Tidal Stream – West Pembrokeshire

The Tidal Stream – West Pembrokeshire RA is an extensive tidal stream RA located off the western edge of the Pembrokeshire coast, offshore from St Brides Bay, incorporating Ramsey Sound, Wildgoose Race and Broad Sound, adjacent to several islands including Skomer and Skokholm.

Figure 10.11 provides a high-level representation of certain relevant spatial considerations which are a feature of the Tidal Stream – West Pembrokeshire RA. This figure is for illustrative purposes only. For land-based considerations, reference should be made to Future Wales[39].

Figure 10.11: High level representation of spatial considerations within the West Pembrokeshire RA



Source: Welsh Government 2021

10.3.1 Resource considerations

Table 10.11 outlines the key physical resource considerations for tidal stream developments in the tidal stream – West Pembrokeshire RA and

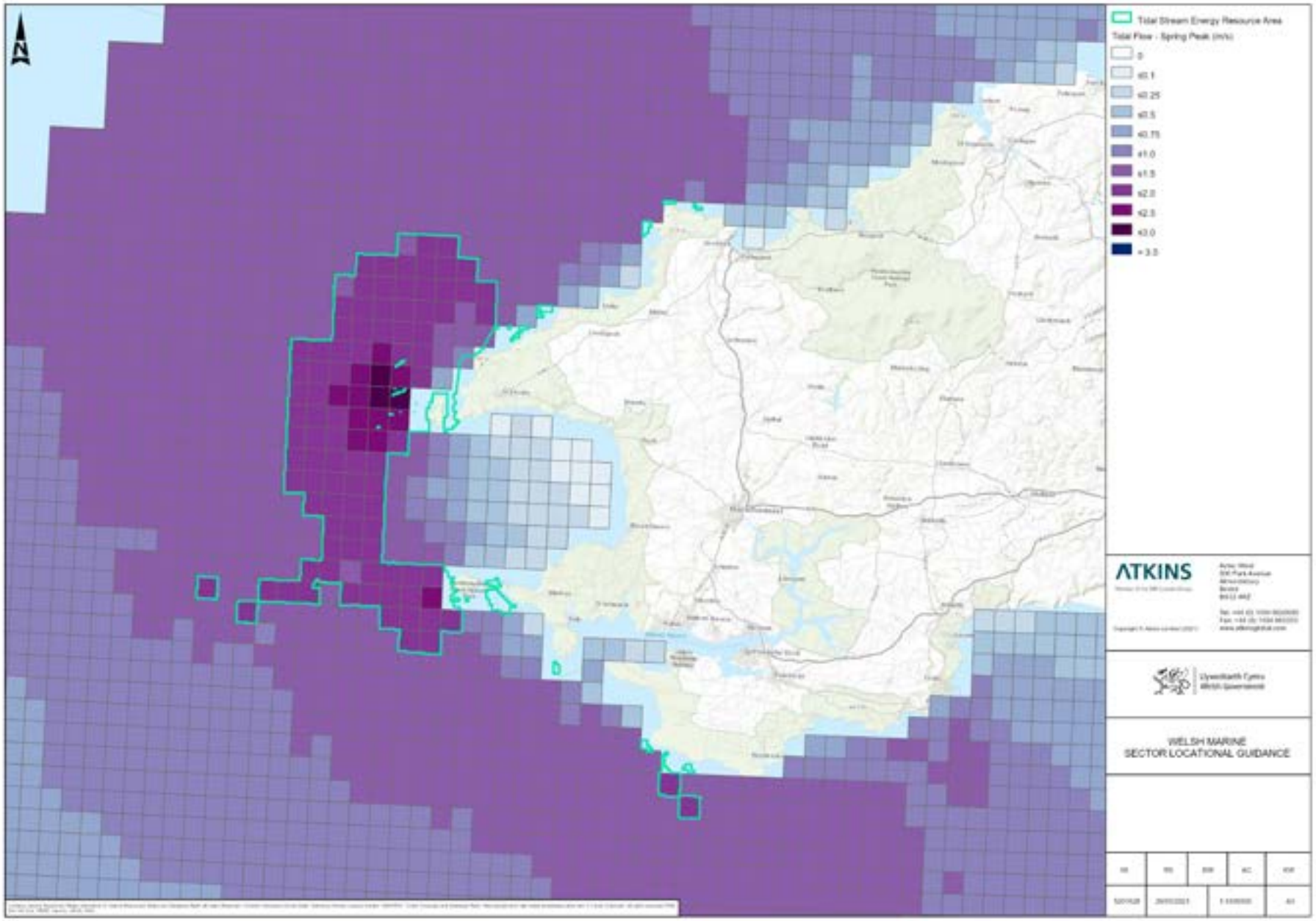
Figure 10.12 illustrates the tidal flow (m/s peak) for the RA. See Section 3 for further details on tidal stream resource.

39 gov.wales/future-wales-national-plan-2040-0

Table 10.11 – Tidal Stream West Pembrokeshire – physical considerations

Topic	Description
Tidal stream resource	Large areas of tidal stream resource over 1.5 m/s.
Tidal resource data	ADCP deployments St David's Head – data held by Tidal Energy Limited. Hydrodynamic model produced by Swansea University that covers this RA.
Physical survey data	Bangor University have undertaken numerous multibeam surveys within the RA through the SEACAMS programme. Multibeam surveys were also undertaken as part of the SMMNR project including one at St David's Head.
Tidal Stream – West Pembrokeshire RA area (km^2)	378.9 km^2
Average water depth of RA	-51.23 m below the surface
Maximum water depth in the RA	-91 m below the surface

Figure 10.12: Tidal flow in the Tidal Stream – West Pembrokeshire RA



Source: Renewables Atlas, 2020

10.3.2 Infrastructure & supply chain

Table 10.12 describes the existing infrastructure and supply chain in the Tidal Stream – West Pembrokeshire RA.

Topic	Description
Grid	There is a 400 kV HV power line from substation at Pembroke that goes to Swansea. An alternative to grid connection could be production of hydrogen using electrolysis which is being explored as part of the Milford Haven Energy Kingdom project.
Ports	The Port of Milford Haven is the UK's largest energy port. It is actively diversifying its interest and has a keen focus on marine energy. The Port Authority has worked with different marine energy technology developers to ensure the port is suitable for deploying large arrays. Significant upgrades to the port area are being undertaken as part of the Pembroke Dock Marine project, which are focused on supporting marine renewables. The Pembroke Dock Marine project, is supported by the Swansea Bay City Deal and the European Regional Development Fund through the Welsh Government, alongside private investment to redevelop Quay Four at Pembroke Dock. This will create 20,000 m^2 of open plan fabrication and laydown areas and widen the slipway to up to 65 m. Berthing for workboats will be extended to 100 m. Quay One has a crane strip 15 m back from the water, capable of lifting 300 tonnes, more than the mass of any turbine components that would be lifted during O&M. The port could act as a one stop shop for fabrication, assembly and O&M, using nearby facilities and third-party engineering services to support large commercial-scale projects. Traditionally O&G companies such as Ledood, Altrad and Birwelco USA, who have diversified marine renewables into their portfolio, are based near the port. If the project pipeline opportunity increases sufficiently to warrant further investment, an additional laydown area could be developed, possibly repurposing of the offshore jetty at Hobbs Point. Pembroke Port sees a large opportunity in O&M to support project offices and ongoing engineering activity over the lifetime of projects.
Supply chain	Mainstay Marine is a ship repair company that has been based in Pembroke Dock for over thirty years. They have fabricated a number of wave and tidal devices as well as designing and building wind farm support vessels, workboats and passenger vessels. Leask Marine, with a base in Pembroke Dock, have been contracted on many of Europe's offshore wind farms for anchor handling, towing, diving support and wider uses. Faun Trackway in North Wales are manufacturing gravity anchors for the Orbital 02 floating tidal device. A further three companies specialise in installation of drilled and grouted, or driven seabed anchor piles.

Topic	Description
Research	Both Swansea and Bangor University have extensive experience around Pembrokeshire through work undertaken on the SEACAMS programme (extended to 2021), which undertakes environmental research focussed on marine energy sector in Wales. Swansea University's Energy and Environment Department and Department of Biosciences carry out research and development projects relating to various marine economic interests on the Welsh coast, such as: • SELKIE a €4.2 million cross-border project launched in 2019 that aims to boost the marine energy industry in Wales and Ireland, run in collaboration with University College Cork and also involving Marine Energy Wales and the Pembrokeshire Coastal Forum. Its objective is to improve the performance of marine energy devices and technologies developed by Welsh and Irish businesses and support the marine energy sector by developing technologies and improving services, which will assist developers and supply chain to progress to commercialisation of marine energy projects (SELKIE, 2020). MEECE, led by ORE Catapult and based in Pembroke Dock, supports marine energy related research across Wales.

Pembroke Dock is home to Mainstay Marine, a boat builder that has fabricated wave and tidal stream devices, and Ledwood Mechanical Engineering, an O&G supply chain contractor that has developed its skills and also successfully built devices for offshore renewable energy generation.

10.3.3 Social considerations

The Tidal Stream– West Pembrokeshire RA is covered by the Pembrokeshire LA.

10.3.3.1 Population demographics

Information on population density demographics, area deprivation and percentage of Welsh speaking individuals is highlighted in Table 10.13. This can provide useful information to developers when looking at establishing teams in the locality, for community engagement, and also to marine planners/regulators during planning and policy decision-making.

Table 10.13: Population and demographics for Tidal Stream – West Pembrokeshire RA

Population density	In Pembrokeshire LA, there is an average population density of 77.7 persons per km^2.
Demographics	In the Pembrokeshire LA the highest percentage of the population is in the following age groups: • 45 to 64 (27.9%) • 0 to14 (16%).
Area deprivation	Of the 0-10% most deprived LSOAs in Wales (overall), 4 are within the Pembrokeshire LA (Pembroke Dock: Llanion 1, Haverfordwest: Garth 2, Pembroke: Monkton, Pembroke Dock: Central) which accounts for 5.6% of those in the LA and 0.2% of those in Wales
Welsh speaking	According to census data (ONS, 2020) 34,200 (28%) people can speak Welsh in the Pembrokeshire LA.

10.3.3.2 Cultural identity

West Pembrokeshire has one of the most significant cultural landscapes in Wales. St David's Peninsula and Ramsey Island is designated a Landscape of Outstanding Historic Interest. Skomer Island is also a Landscape of Outstanding Historic Interest. Along the north-facing coast, within the southern extent of West Pembrokeshire, Strumble Head and Garn Fawr form part of a Landscape of Special Historic Interest for their medieval settlements, Neolithic chamber tombs and early Christian sites.

There is a significant historic military presence in West Pembrokeshire. There are historic military airfields associated with the Battle of the Atlantic, with a memorial in place on Whitesands Bay in remembrance of a plane crash during WWII. The remains of WWII cliff defences and 'Highwinds' (a submarine listening post) are present on the slopes of Carn Llidi.

The coastline is characterised by the remnants of historic coastal quarrying, particularly associated with Porthgain and Abereiddi during the late 19th and 20th centuries. At Abereiddi, the 'blue lagoon' is a product of quarrying and acts as an important tourism destination for the area. Porthgain harbour was important for the export of slate, granite and brick – with large, nationally designated brick hoppers which dominate the harbour used to store crushed dolerite before shipment.

Tourism is the main economic driver in West Pembrokeshire, attributed to the Pembrokeshire Coast National Park. Many walkers visit the area to hike the Pembrokeshire Coast Path. Pembrokeshire has numerous sandy beaches, large and small, that attract visitors, with Barafundle Bay consistently being voted one of the best beaches in the UK and making it into the top 25 in the world[40]. There are 11 Blue Flag beaches in Pembrokeshire; the most in any Welsh county.

40 A Welsh beach has been named as one of the best in the world - Wales Online
www.walesonline.co.uk/whats-on/whats-on-news/welsh-beach-been-named-one-12430466

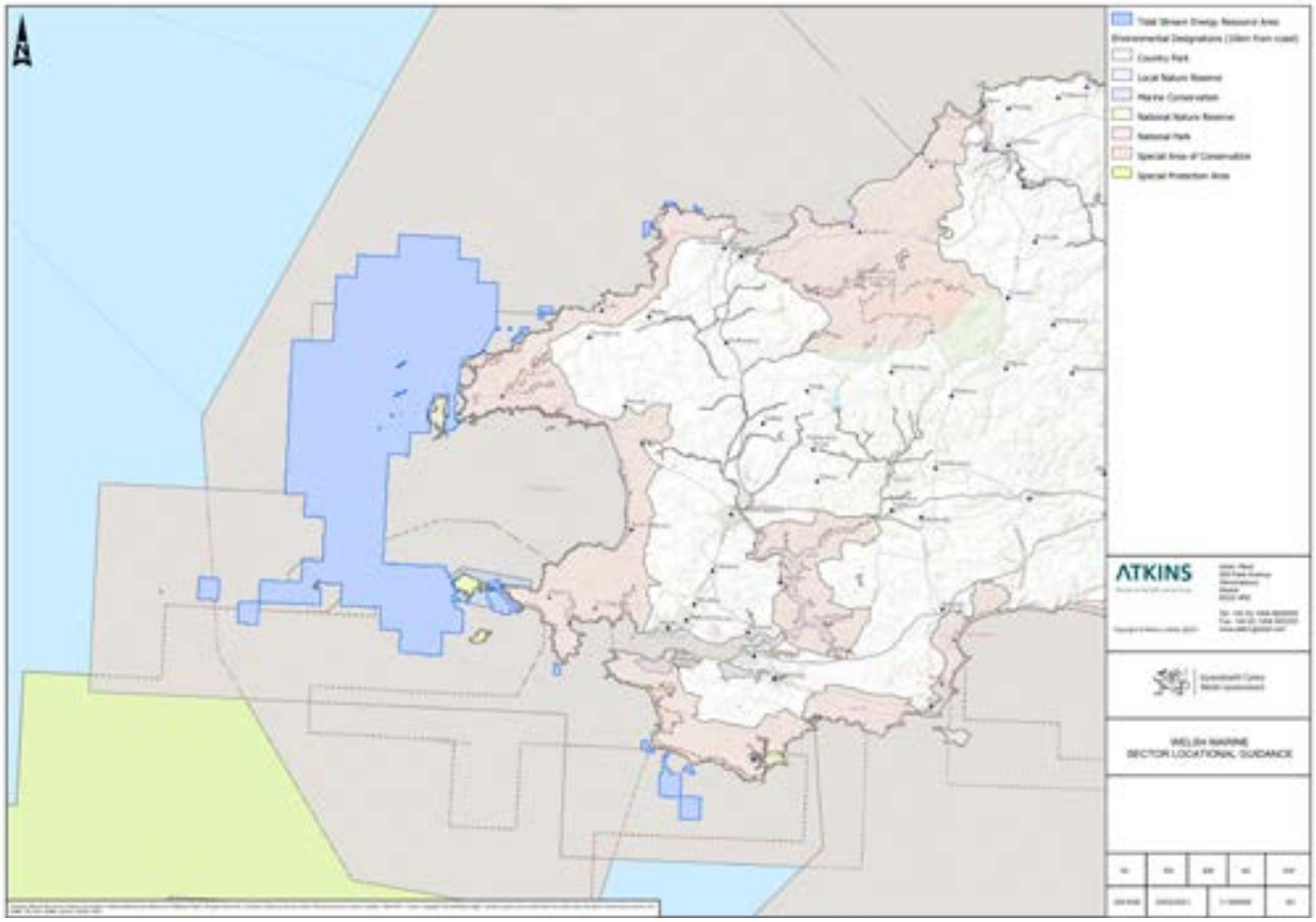
Sea cliffs along the coastline attract climbers to the area, as well as wildlife tourism to view bird colonies, dolphin and seal watching. The Grade II listed Strumble Head lighthouse is also a tourist attraction in the area.

The importance of the shipping lanes, particularly in St George's Channel, made them prime targets from enemy submarines during both the first and second world wars. Patrol aircraft and airships are among some of the wrecks present in the area. Many of the drowned planes are designated as Protected Places under the Military Remains Act 1989.

10.3.4 Environmental considerations

Figure 10.13 illustrates the environmental designations within the tidal stream – West Pembrokeshire RA. Table 10.14 gives further details on these designations.

Figure 10.13: Tidal Stream – West Pembrokeshire environmental designations



Source: Lle, 2020

Table 10.14: Tidal Stream – West Pembrokeshire environmental considerations

Topic	Description
Designations	The large RA off the west coast of Pembrokeshire is fully enveloped by the West Wales Marine SAC (designated for harbour porpoise), in addition to considerable overlap with the Pembrokeshire Marine SAC (designated for habitats, migratory fish and grey seal). The Skomer, Skokholm and the Seas off Pembrokeshire SPA covers the south eastern region of the RA and overlaps with the Skomer Marine Conservation Zone (MCZ). St David's Head SAC is immediately adjacent to the RA and designated for its vegetated sea cliffs. Grassholm SPA (designated for breeding Gannet populations) overlaps with part of the RA and, along with Skomer and Ramsey Island provide important grey seal haul-out areas. Numerous SSSIs are located around the Pembrokeshire Coast in this area such as Dale and South Marloes Coast, St. David's Peninsula Coast, Skokholm, Skomer Island and Middleholm; Grassholm/Ynys Gwales; Ramsey/Ynys Dewi and The Offshore Islets of Pembrokeshire/Ynysoedd Glannau Penfro. The whole coastline and most of the islands are also encompassed by the Pembrokeshire Coast National Park.
Seabirds	A number of important bird colonies exist in the area, including at Ramsey Island, Bishops and Clerks, Skomer, Grassholm, and Skokholm. Seabirds from these colonies utilise the waters within the RAs, making these important foraging grounds for species such as Gannet, Puffin, Fulmar, Guillemot and Razorbill. As many of the bird species from these colonies have foraging ranges of >50 km, much of the waters within and adjacent to the RAs provide foraging grounds. The colony at Ramsey Island is home to populations of Puffins, Fulmars, Great Black-backed Gulls, Herring Gulls, Kittiwakes, Lesser Black-backed Gulls, Razorbills, Shags and Storm Petrels. The Offshore Islets of Pembrokeshire/ Ynysoedd Glannau Penfro SSSI overlaps with the Bishops and Clerks seabird colony, and is home to Great Black-backed Gulls, Herring Gulls, Lesser Black-backed Gulls, Puffins and Storm Petrels. To the south, Skomer Island has important populations of Manx Shearwater, Fulmar, Puffin, Razorbill, Kittiwake and Lesser Black-backed Gull. High concentrations of birds are also found at Grassholm, specifically Guillemot and Gannet. Although the Milford Haven Waterway is beyond the boundary of any RAs it provides important foraging areas for a number of bird species that colonise sites located within or adjacent to a RA.

Topic	Description
Marine mammals	Many grey seal haul-out and pupping areas exist within the RA to the west of Pembrokeshire, but also along the northern coast of Pembrokeshire. As a consequence, density of grey seal is comparatively high in the waters around Ramsey, Skomer and Grassholm. Bottlenose and Risso's dolphin are fairly common within these waters. Minke whale and short beaked common dolphin tend to be more offshore and less commonly seen.
Fish	The RA is fully encompassed by high intensity spawning grounds for sandeel and low-intensity spawning grounds for mackerel and whiting. Spotted ray and tope nursery grounds cover the majority of the area. The Milford Haven Waterway, to the southeast of the RA, is an important corridor for migratory fish species, such as sea lamprey, Atlantic salmon, European eel and shad. These protected species will likely be present in the waters within and around the RA.
Habitats	Article 17 'subtidal reefs' and 'large shallow inlets and bays' are primary reasons for designation of the Pembrokeshire Marine SAC which incorporates most of the RA adjacent to the west coast of Pembrokeshire. Subtidal reefs are particularly extensive throughout the area and St Bride's Bay is completely encompassed by the 'large shallow inlet and bay' feature, which overlaps with the RA in the tide-swept channels. These tide-swept channels which run between the islands of Ramsey and Skomer and the mainland, are a Section 7 feature in themselves. The waters around the islands, overlapping and adjacent to the RA, contain many designated habitats and communities. Around Ramsey Island are Article 17 intertidal and subtidal reefs, sea caves, in addition to Section 7 fragile sponge and anthozoan communities, subtidal mixed muddy habitats, intertidal under-boulder communities and tide-swept channels. To the north of Ramsey Sound, off St David's Head, the inshore environment is still subject to strong tidal streams, and the RA overlaps with Article 17 and Section 7 habitats including intertidal reef (e.g. Bishops and Clerks Islands), subtidal reef and biogenic blue mussel beds. Similarly, within and around the Skomer MCZ are many Article 17 habitats, including intertidal and subtidal reefs, sea caves and sandbanks. Section 7 features are also numerous, including widespread mixed muddy habitat, many examples of fragile sponge and anthozoan communities, and swathes of seagrass. Records also exist for several Section 7 benthic species around Skomer, including stalked jellyfish (*Haliclystus auricula* and *Lucernariopsis campanulata*), ocean quahog (*Arctica islandica*) and pink sea fan (*Eunicella verrucosa*).

In relation to seabirds, the outputs of the SMMNR project indicated that to the south, around the west coast of Pembrokeshire, there are extensive areas of relatively high constraints for birds. Contributing to the high scores here is the Skomer, Skokholm and the Seas off Pembrokeshire SPA, but in particular the multiple bird colonies along the north coast, and especially at Ramsey Island, Bishops and Clerks, Skomer, Grassholm, and Skokholm. Many of the seabirds at these colonies have mean foraging ranges of >50 km (e.g. Gannet, Puffin, Fulmar). The various datasets also indicate potential hotspots for utilisation of these waters by Guillemot, Shag and Razorbill.

In relation to marine mammals, the outputs of the SMMNR project indicate a higher level of potential constraint in the inshore area, and along the coastline in particular. Around Pembrokeshire, especially along the north coastline, there are a number of important seal haul-out and pupping sites. The relatively high constraints shown are mainly indicative of the multiple seal haul out sites along the north coast, Ramsey Island and Skomer Island. There are also multiple designated sites that overlap with the RA (i.e. Pembrokeshire Marine SAC; West Wales Marine SAC;) and nationally designated sites (e.g. Skomer MCZ; Skomer Island and Middleholm SSSI; St David's Peninsula Coast SSSI).

In the further offshore aspects of the RA, it is the presence of cetaceans such as minke whale, Risso's dolphin and common dolphin which are the main influence on the relative constraints, along with the presence of the two SACs northwest of St David's Head, and the increase in grey seal usage.

The relative fish constraints in this RA identified in the SMMNR project are largely as a result of a number of fish nursery grounds. The RA overlaps with the Pembrokeshire Marine SAC and, at a more localised level, the Skomer MCZ, which leads to the comparatively highest constraints for fish indicated within the region of the tidal stream RA.

In relation to habitats, the SMMNR project analysis indicated comparatively higher constraints off the west coast of Pembrokeshire than within the other tidal stream RAs. The comparatively higher constraints are the result of overlaps with Article 17 (subtidal and, to a lesser extent, intertidal reefs; sea caves around Ramsey and Skomer Island; subtidal sandbanks to the west of St David's Head and near Skomer) and Section 7 (e.g. fragile sponge and anthozoan communities, mixed muddy sediments) features. In addition to the presence of the Pembrokeshire Marine SAC, which encompasses much of the RA, at a localised level there are numerous nationally designated sites (e.g. Skomer MCZ; Ramsey SSSI; St David's Peninsula Coast SSSI; Grassholm SSSI; Skomer Island and Middleholm SSSI) which influence the constraints.

10.3.5 Other marine users

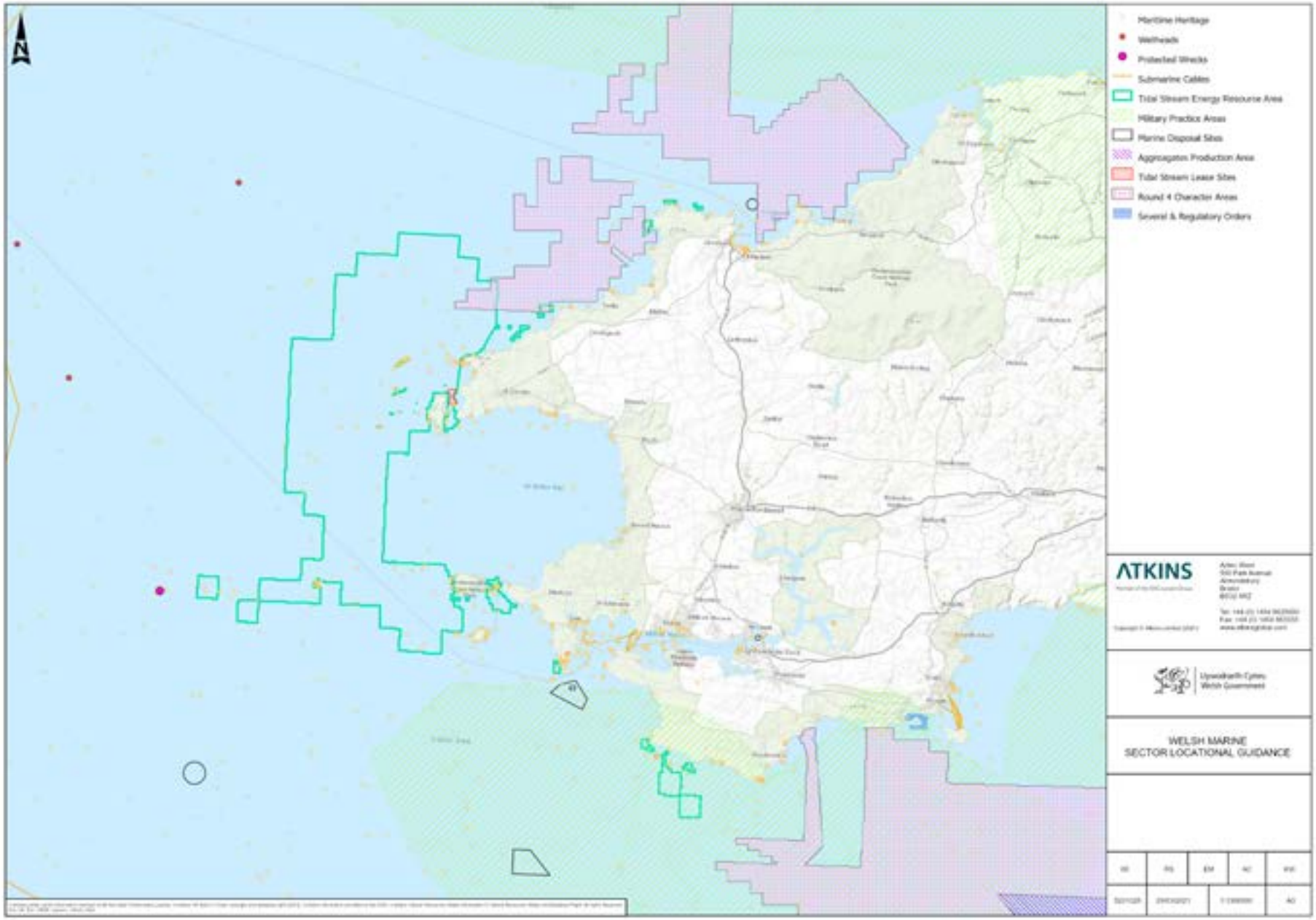
Table 10.15 outlines the other marine users and activities in the Tidal Stream – West Pembrokeshire RA. Please see Section 8 for more information on other marine users in wider Welsh waters and a high-level assessment of other sector interactions with tidal stream energy. Figure 10.14 and Figure 10.15 show the key features (those assigned a high score in the MRESF constraints analysis) potentially affecting tidal stream energy developments in the RA.

Table 10.15: Tidal Stream – West Pembrokeshire other marine users

Sector	Description
Aggregates	There are no aggregate production areas currently within the RA. Overlap with some potential aggregate RAs for sand and gravel.
Aquaculture	Overlap with some potential aquaculture areas for bottom culture (king scallops and oysters), fish cage culture, ranching of crawfish and lobster, rope culture of macro algae and scallops. There are some areas of overlap between the tidal stream RA and aquaculture RA for rope culture, which could present opportunities for co-location in the future once the technology is more mature. There is existing interest in seaweed farming off Pembrokeshire, which could be attractive to developers looking to maximise the potential of lease areas and increase the environmental benefits of projects.
Defence	Main RA has no interaction with defence constraints. Southern tidal RA is within Castlemartin Military Practice Area, and MRESF marked this as an Explosive Dumping Site.
Energy (low carbon)	There is an existing tidal stream project being developed in Ramsey Sound near St David's. This was previously where the DeltaStream tidal device was deployed. This is in the process of being decommissioned, and the lease has been taken on by Cambrian Offshore with the intention of it being used as a test site. A buffer is likely required around area to ensure tidal stream resource is not affected. The RA for wave overlaps with most of the RA. The META, a series of test areas for wave and tidal stream devices, is being developed within and just outside the Milford Haven waterway. This does not overlap with the RA but could be an opportunity to carry out initial testing activity ahead of deployment at a site in the RA. Overlap between the tidal stream RA and wave RA suggest there is the potential for co-location. This would be attractive, as the opportunity to share electrical infrastructure and O&M resource would improve project economics. Currently developers are unlikely to want to co-locate as it could present operational risks and adds potential complications to both the consenting and design of projects. But it is something that could be attractive to developers in the future, once the technology is more mature and there is sufficient confidence in the likely impacts of each generation technology in itself to consider combined/in-combination effects.
Energy (O&G)	No existing O&G activity. Overlap with O&G Blocks Offered on western edge of RA, but future development unlikely due to focus on decarbonisation in Wales.

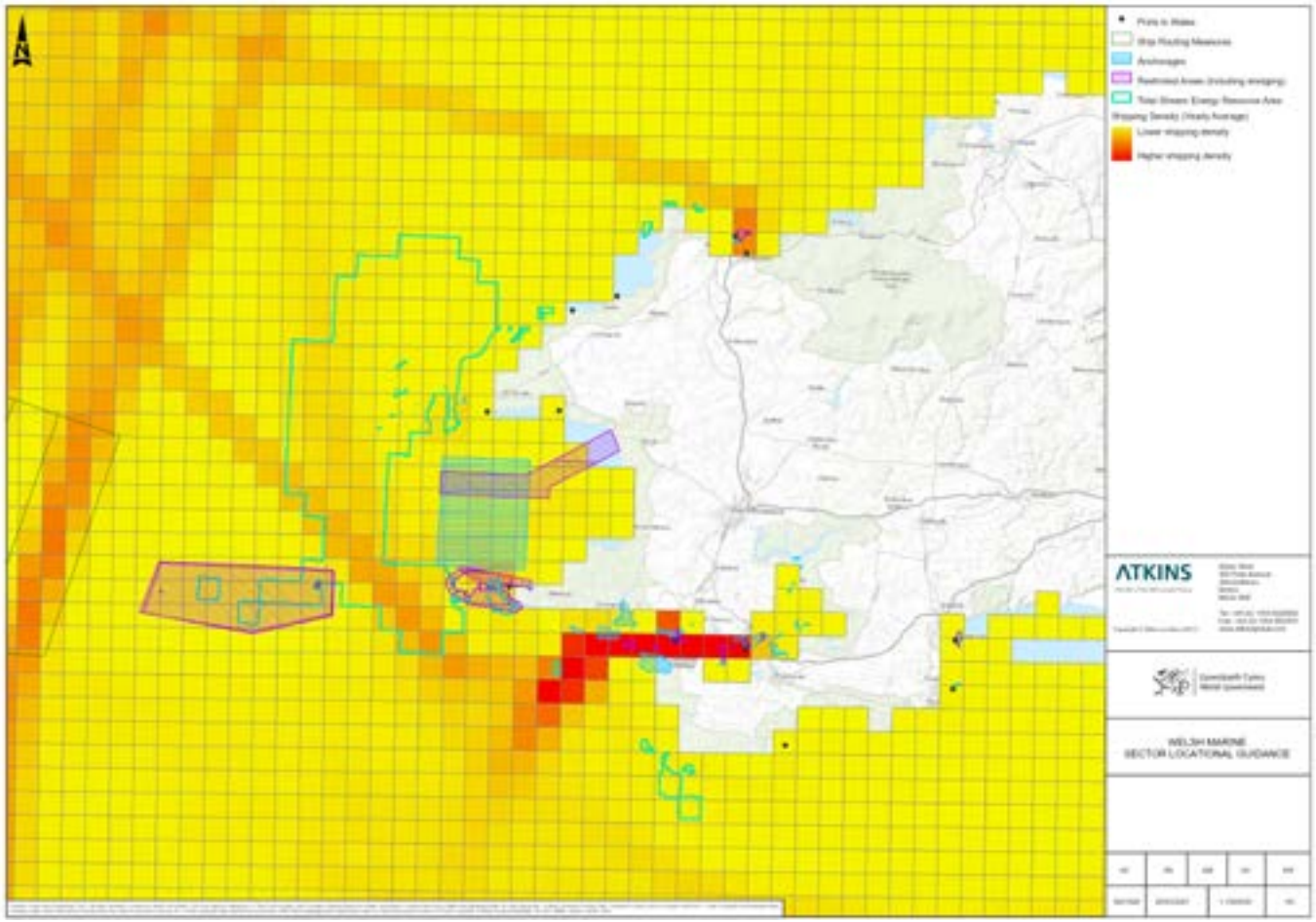
Sector	Description
Fishing	The RA is within an area that has been estimated to be worth over £2.3 million in terms of shellfish landings. It is not clear what proportion of this is from within the RA - ICES data suggests that there is some beam trawling in the centre of the tidal stream RA, but that this accounts for just a small amount of the activity in the region with most activity further offshore.
Shipping	Shipping AIS data suggests tankers and cargo use the RA, likely for mooring rather than for transit. The route of the passenger ferry from Pembroke to Rosslare goes through the RA. The potential for re-routing south of the restricted area between Smalls lighthouse and Grassholm Island could be explored, but this is unlikely to get agreement from the ferry operator and other stakeholders. The route would therefore have to be treated as a hard constraint.
Subsea cabling	Potential route option for Greenlink interconnector passes through southern edge of main RA. Potential for interaction between cable routes for Pembrokeshire Wave Demo Zone, and potential floating wind projects, which may come in at Castlemartin/Fresh West.
Seascape	Most of the coast is a National Park therefore seascape impacts may need to be considered for projects with surface piercing elements in areas close to shore.
Wrecks	Large number of wrecks in the RA that would need to be avoided in the project design phase.

Figure 10.14: Location of significant issues/constraints in relation to the Tidal Stream – West Pembrokeshire RA



Source: see Table A-1

Figure 10.15: Location of shipping constraints in relation to the Tidal Stream – West Pembrokeshire RA



Source: see Table A-1

10.3.6 Summary of key opportunities and constraints

Several key constraints have been identified that would either potentially cause lengthy decision making for consent or could preclude development altogether. Several opportunities have also been identified which could support or guide future development of the sector.

This SLG aims to highlight features within this region which may influence site selection and/or could present a potential challenge to development in this area. It may be that some features can be easily avoided through micro-siting or applying appropriate buffers at the project design stage. Some features may require more detailed assessment and consultation at project level. Developers should consider the cost and programme implications of progressing developments that impact on key features.

Key constraints:

- **Environmental designations** – The RA is fully enveloped by the West Wales Marine SAC (designated for Harbour Porpoise) in addition to considerable overlap with the Pembrokeshire Marine SAC (designated for habitats, migratory fish and grey seal). The Skomer, Skokholm and the Seas off Pembrokeshire SPA covers part of the RA and overlaps with the Skomer MCZ. St David's Head SAC is immediately adjacent to the RA and designated for its vegetated sea cliffs. Grassholm SPA (designated for breeding Gannet populations) overlaps with part of the RA and, along with Skomer and Ramsey Island, provide important grey seal haul-out areas.
- **Birds** – A number of important bird colonies exist in the area, including at Ramsey Island, Bishops and Clerks, Skomer, Grassholm, and Skokholm. Seabirds from these colonies utilise the waters within the RA, making these important foraging grounds for species such as Gannet, Puffin, Fulmar, Guillemot and Razorbill. As many of the bird species from these colonies have foraging ranges of >50 km, much of the waters within and adjacent to the RA provide foraging grounds. The colony at Ramsey Island is home to populations of Puffins, Fulmars, Great Black-backed Gulls, Herring Gulls, Kittiwakes, Lesser Black-backed Gulls, Razorbills, Shags and Storm Petrels. The Offshore Islets of Pembrokeshire/Ynysoedd Glannau Penfro SSSI overlaps with the Bishops and Clerks seabird colony, and is home to Great Black-backed Gulls, Herring Gulls, Lesser Black-backed Gulls, Puffins and Storm Petrels. To the south, Skomer Island has important populations of Manx Shearwater, Fulmar, Puffin, Razorbill, Kittiwake and Lesser Black-backed Gull. High concentrations of birds are also found at Grassholm, specifically Guillemot and Gannet.
- **Marine mammals** – Many grey seal haul-out and pupping areas exist to the west and along the northern coast of Pembrokeshire. As a consequence, density of grey seal is comparatively high in the waters around Ramsey, Skomer and Grassholm. Bottlenose and Risso's dolphin are also fairly common within these waters.
- **Defence** – The southern section of the RA is within Castlemartin Military Practice Area, and MRESF marked this as an Explosive Dumping Site. Developments within or overlapping with MoD areas could present a risk to both the MoD's activities and to the project infrastructure itself so would require extensive engagement and could lead to extended delays.
- **Shipping** – AIS data suggests tankers and cargo use the RA, likely for mooring rather than for transit. The route of the passenger ferry from Pembroke to Rosslare goes through the RA. The potential for re-routing south of the restricted area between Smalls lighthouse and Grassholm Island could be explored, but this is unlikely to get agreement from the ferry operator and other stakeholders. Projects could present a risk to safe navigation so whilst management measures can be put in place any proposed alteration to shipping routes could lead to extended delays.
- **Wrecks** – There are a large number of wrecks in the RA. Whilst not all wrecks are protected, it is likely that a buffer would be required, and development would need to be outside of this.

Key opportunities:

- **Tidal stream resource** – An extensive and potentially significant RA exists around Pembrokeshire with the necessary physical and environmental conditions to support the production of tidal stream energy at a commercial scale.
- **National grid** – Pembrokeshire has good existing grid infrastructure with a substation at Pembroke connecting to Swansea. A programme of expansion of the grid network is already underway in Wales with upgrades planned to accommodate a large expansion of offshore renewable energy. There is also the potential for an alternative to grid connection through the production of hydrogen using electrolysis which is currently being explored as part of the Milford Haven Energy Kingdom project.
- **Ports** – There are several ports in the South Wales region with existing capacity and experience of serving the offshore energy sector. The Port of Milford Haven is the UK's largest energy port and it is actively diversifying its interest with a keen focus on marine energy. The Pembroke Dock project will also increase capacity for servicing future marine energy projects in the area.
- **Supply chain** – There are a number of companies in the Pembrokeshire region with existing capacity and experience in the marine renewable energy sector. Mainstay Marine have been based in Pembroke Dock for over thirty years and have fabricated a number of wave and tidal devices as well as designed and built wind farm support vessels, workboats and passenger vessels. Leask Marine, with a base in Pembroke Dock, have been contracted on many of Europe's offshore wind farms for anchor handling, towing, diving support and wider uses.
- **Co-location** – There is potential for future co-location with wave energy in the region once the technologies are more mature. This warrants further consideration and research on potential in-combination effects. Some areas of overlap between the tidal stream RA and aquaculture RA for rope culture could present opportunities for co-location. There may also be opportunities for co-location of tidal stream energy devices with seaweed aquaculture activities which are of existing interest off Pembrokeshire.
- **Refining of RA** – As a result of the emerging nature of the tidal stream energy sector, there are a large number of opportunities to strengthen the evidence base and further refine the RA and develop an understanding of opportunities for future tidal stream energy activity.

10.4 Tidal Stream – Bristol Channel

The Tidal Stream – Bristol channel RA is located east of Pembrokeshire and the Gower, within the northeast region of the Bristol Channel and up into the Severn Estuary.

Figure 10.16 provides a high-level representation of certain relevant spatial considerations which are a feature of the Tidal Stream – Bristol Channel RA. This figure is for illustrative purposes only. For land-based considerations, reference should be made to Future Wales[41].

Figure 10.16: High level representation of spatial considerations within the Bristol Channel RA

Source: Welsh Government, 2021

41 gov.wales/future-wales-national-plan-2040-0

10.4.1 Resource considerations

Table 10.16 outlines the key physical resource considerations for tidal stream developments in the tidal stream – Bristol Channel RA and Figure 10.17 illustrates the tidal flow (m/s peak) for the RA. See Section 3 for further details on tidal stream resource.

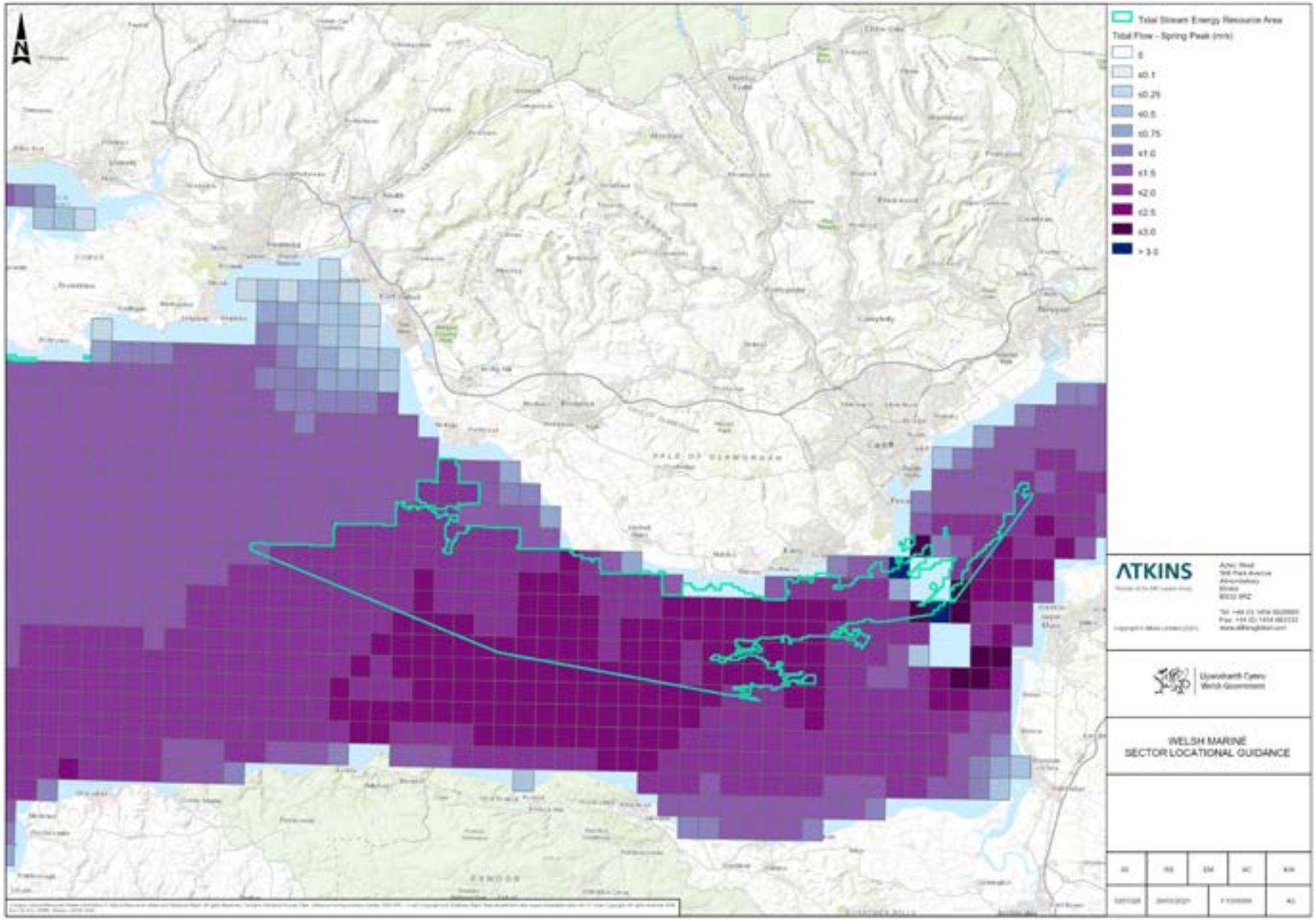
Britain's Bristol Channel and adjoining Severn estuary together form a long and funnel-shaped area of sea, causing the tidal range to increase from a maximum of 7 m at the outer reaches to about 14 m at Avonmouth.[42] The Severn estuary in Britain has the second highest tidal range in the world. As such, the potential for tidal range energy development may be an important consideration within the region and may overlap with potential areas for tidal stream development. However, the estuary and much of the adjoining Bristol Channel are too shallow for current commercial tidal stream arrays of the horizontal-axis type.

Table 10.16: Tidal Stream – Bristol Channel physical considerations

Topic	Description
Tidal stream resource	Large area of tidal resource in excess of 1.5 m/s in Bristol channel.
Tidal resource data	Limited measured tidal flow data in this area. Focus in this area has been on tidal lagoon development so some data may be held by the developer. Swansea University has developed a hydrodynamic model that covers this RA.
Physical survey data	Sub bottom profile data likely held by tidal lagoon developer.
Tidal stream– Bristol Channel RA area (km^2)	419.9 km^2
Average water depth of RA	-19.28 m below the surface
Maximum water depth in the RA	-37 m below the surface

42 Tidal energy from the Severn estuary, UK www.ice.org.uk/getattachment/events/Tidal-energy-from-the-Severn-Estuary,-London/Tidal-energy-from-the-Severn-Estuary.pdf.aspx

Figure 10.17: Tidal flow in the Tidal Stream – Bristol Channel RA



Source: Renewables Atlas, 2020

10.4.2 Infrastructure & supply chain

Table 10.17 describes the existing infrastructure and supply chain in the Tidal Stream – Bristol Channel RA.

Table 10.17: Tidal Stream – Bristol Channel infrastructure & supply chain

Topic	Description
Grid	Aberthaw power station is located on the coast adjacent to the RA; however, this closed in 2020 and future plans are unclear. This means that the associated infrastructure – substation and 275 kV lines could provide an opportunity for new energy development.
Ports	There are large commercial ports at both Cardiff and Barry adjacent to the RA, with Newport docks also close by.
Supply chain	Project developers often prefer in-house resources, especially in project management, but outsourcing is typically used wherever specialist advice is needed. There are a number of consultancies in the region with expertise in environmental impact assessments for marine energy projects, as well as several international engineering consultancies with offices in Cardiff, who all have experience in offshore wind, particularly structural design and resource modelling. There are also many smaller local engineering consultancies with skills across design areas, particularly in mooring and anchor design. Secondary steel stands out as an area of manufacturing that can readily be met within the region. 24 companies, largely clustered in South Wales and several in Cornwall, were identified by the Offshore Renewable Energy Coalition as having potential expertise in serial manufacturing parts such as boat landings, external access ladders, external and internal work platforms, and corrosion protection systems. Tata steel produce two million tonnes of steel coils a year in their steel production plant in Port Talbot. This can be used by fabricators for secondary steelwork for structures. Prysmian Group, an established cable supplier with bases in Wrexham and Aberdare, stands out as having the ability and experience to supply cables to projects, both in the region and exporting more widely. Prysmian Powerlink Services is the subsidiary of the parent company that specialises in offshore wind, which is managed globally. Prysmian Group has upgraded its Wrexham facility to become the first UK facility to manufacture submarine array cable cores. Depending on cable design (insulation type, resistance required), Wrexham may be able to produce cables end to end.

Topic	Description
Research	Cardiff University hosts several research groups which contribute to marine economic interests along the Welsh coast, such as: • Cardiff Hydro-environmental Research Centre conducts research under the following themes of which are of relevance to marine economic interests to the Welsh coast: – performance and impacts of marine turbines, including the design of turbines to exploit potential tidal streams such as the Severn Estuary; – water quality; – flood risk management, including natural flood management measures; – environmental hydraulics including vegetated flows; and – fish-friendly hydropower technologies. • Cardiff Business School has previously undertaken an economic impact assessment for the Port of Milford Haven (CBS, 2011). • Cardiff Marine Energy Research Group is active in the research of tidal turbine technologies. The group conducts research into clean, renewable energy generation from tidal flows.
	Swansea University's Energy and Environment Department and Department of Biosciences carry out research and development projects relating to various marine economic interests on the Welsh coast, such as: • SELKIE a €4.2 million cross-border project launched in 2019 that aims to boost the marine energy industry in Wales and Ireland, run in collaboration with University College Cork and also involving Marine Energy Wales and the Pembrokeshire Coastal Forum. Its objective is to improve the performance of marine energy devices and technologies developed by Welsh and Irish businesses and support the marine energy sector by developing technologies and improving services, which will assist developers and supply chain to progress to commercialisation of marine energy projects (SELKIE, 2020). • Both Swansea and Bangor University have experience in the Bristol Channel through work undertaken on the SEACAMS programme that has been extended to 2021. SEACAMS undertakes environmental research focussed on marine energy sector in Wales, programme extended to 2021. • MEECE, led by ORE Catapult, and based in Pembroke Dock supports marine energy related research across Wales.

Topic	Description
Research (Cont'd)	University of South Wales (Cardiff, Newport and Pontypridd) holds a single honours (BEng) and postgraduate courses (MEng) in civil engineering, as well as a masters in MSc renewable energy and resource management. Aspects of these courses cover marine renewable energy technologies. Outside of these courses, it is not evident if the University of South Wales conducts research related to marine economic interests on the Welsh coast.

10.4.3 Social considerations

The Tidal Stream – Bristol Channel RA is covered by the following LAs:

- Swansea;
- Neath Port Talbot;
- Bridgend County Borough;
- Vale of Glamorgan;
- Cardiff; and
- Newport City.

10.4.3.1 Population and demographics

Information on population density demographics, area deprivation and percentage of Welsh speaking individuals is highlighted in Table 10.18. This can provide useful information to developers when looking at establishing teams in the locality, for community engagement, and also to marine planners/regulators during planning and policy decision-making.

Table 10.18: Population and demographics for Tidal Stream – Bristol Channel RA

Population density	According to census data (ONS, 2020) population densities (persons per km^2) in Tidal Stream – Bristol Channel RA are as follows: • Swansea – 654.1 • Neath Port Talbot – 324.8 • Bridgend – 586.4 • Vale of Glamorgan – 403.4 • Cardiff – 2,604 • Newport – 812.5 The most populated authority in Wales is Cardiff, with an estimated 366,903 residents in 2019.
Demographics	In the Tidal Stream – Bristol Channel RA the highest populations by age group are as follows: • Swansea – 45 to 64 (24.5%), 15 to 29 (22.3%) • Neath Port Talbot – 45 to 64 (27.2%), 30 to 44 (18.4%) • Bridgend – 45 to 64 (27.2%), 30 to 44 (18.5%) • Vale of Glamorgan – 45 to 64 (27.3%), 30 to 44 (18.1%) • Cardiff – 15 to 26 (27.3%), 45 to 64 (21.5%) • Newport – 45 to 64 (25.3%), 30 to 44 (19.9%)
Area deprivation	Of the 0-10% most deprived LSOAs in Wales (overall): • Swansea – 17 are within the Swansea LA which accounts for 11.5% of those in the LA and 0.9% of those in Wales • Neath Port Talbot – 14 are within the Neath Port Talbot LA which accounts for 15.4% of those in the LA and 0.7% of those in Wales • Bridgend – 6 are within the Bridgend LA which accounts for 3.8% of those in the LA and 0.2% of those in Wales • Vale of Glamorgan – 3 are within the Vale of Glamorgan LA which accounts for 6.8% of those in the LA and 0.3% of those in Wales • Cardiff – 39 are within the Cardiff LA which accounts for 18.2% of those in the LA and 2.0% of those in Wales • Newport –23 are within the Newport LA which accounts for 24.2% of those in the LA and 1.2% of those in Wales
Welsh speaking	The number of residents that speak Welsh are as follows: • Swansea – 51,700 (21.7%) • Neath Port Talbot - 29,600 (21.7%) • Bridgend – 23,200 (16.8%) • Vale of Glamorgan – 25,300 (20.4%) • Cardiff – 90,400 (25.3%) • Newport – 25,500 (17.7%)

10.4.3.2 Cultural identity

The Bristol Channel is a key entry point into Britain and has a long-standing history of trade and transport. Particularly following the Industrial Revolution, the channel has been used for the import and export of goods and raw materials through the channel to and from worldwide destinations. Several strategic ports exist in the channel, including Swansea, Bristol, Cardiff and Newport. Cross-channel trade through the channel to ports such as Barnstable and Bideford also flourished during this period.

Historically, the area around the estuary has also been a focus for industrial activity in the last 200 years with developments including steelworks at Llanwern, power generation at Aberthaw, Uskmouth, Hinkley and Oldbury, and chemical works at Barry.

Shipwrecks associated with the two World Wars, deep ocean-going voyagers, and small wooden vessels engaged in coastal trade are present throughout the channel.

In the present day, the channel still serves a strategic role in marine transportation and trade, with thousands of commercial ship movements per day. Areas of the channel are used by container ships and large tankers for anchorage while waiting to dock. Parts of the Bristol Channel are licensed for aggregate dredging, the marine sediments sourced from these licensed areas support a national construction industry. Other uses of the estuary include marine waste disposal and telecommunications.

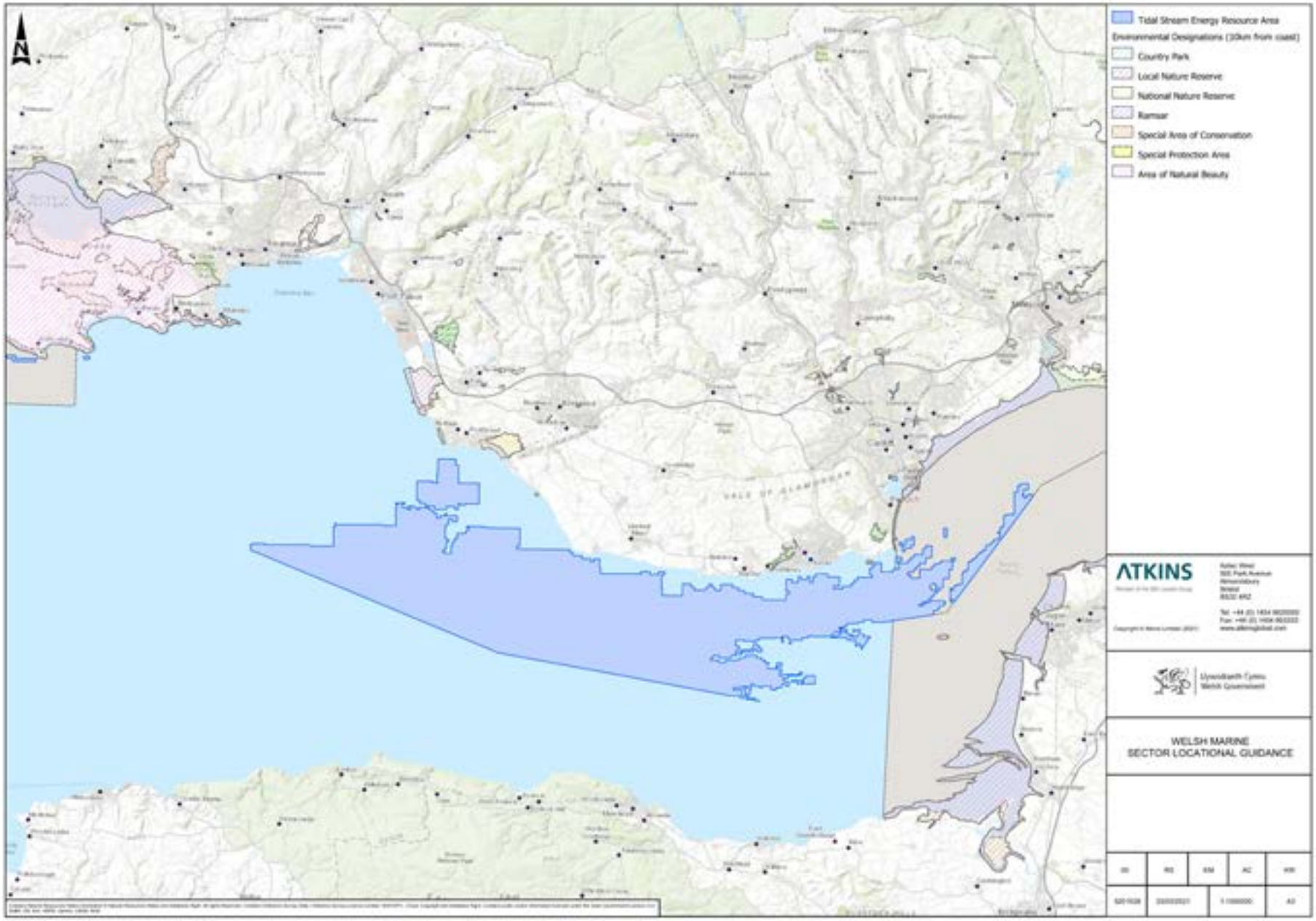
The coastline of the RA is historically important, with Merthyr Mawr Warren registered as a Landscape of Outstanding Historic Interest.

Tourism is one of the largest employment sectors in the Severn Estuary. Recreational activities within the Channel include leisure sailing and boating between destinations along the Welsh and English coasts, as well as fishing charters. The Wales Coast Path crosses the coastline of the Bristol Channel, and the coastline of the western channel has several popular surf beaches.

10.4.4 Environmental considerations

Figure 10.18 illustrates the environmental designations within the Tidal Stream – Bristol Channel RA. Table 10.19 gives further details on these designations.

Figure 10.18: Tidal Stream – Bristol Channel environmental designations



Source: Lle, 2020

Table 10.19: Tidal Stream – Bristol Channel environmental considerations

Topic	Description
Designations	Most of the large RA along the south coast of Wales, through the Bristol Channel and into the Severn Estuary, does not overlap with any designated sites. The exception is the far eastern limits of the RA, which overlaps with the Severn Estuary SAC and, to a much lesser extent, the Severn Estuary SPA and Ramsar. Nonetheless, there are other adjacent designated sites such as Kenfig SAC by Porthcawl. Immediately north and landward of the RA, are many SSSI's along the coastline such as Cynffig/Kenfig, East Aberthaw Coast, Merthyr Mawr, Monknash Coast, Penarth Coast, Southerndown Coast and Sully Island. While the isle of Flat Holm SSSI, at the edge of the Severn Estuary, is surrounded by the RA.
Seabirds	While there are a number of SSSIs which have birds as qualifying features on or near the coast between Swansea and Cardiff (including Merthyr Mawr, Monknash Coast and Sully island), the waters within the RA are not particularly important foraging grounds, especially when compared to the waters within other tidal stream RAs. However, beyond the RA, there are important intertidal foraging areas, particularly near the mouth of the Severn Estuary. The Flat Holm SSSI has Lesser Black-backed Gull as a qualifying feature and this species will use the waters immediately around the island for loafing, and more extensive areas for foraging.
Marine mammals	With the exception of harbour porpoise, cetacean density distribution is low in this area, with no important seal haul-out sites and no SAC with marine mammals as qualifying features which overlap with the RA. Occasional grey seal may be seen in this area and into the estuary.
Fish	The eastern edge of the RA overlaps with the Severn Estuary SAC which has migratory fish species as qualifying features (i.e. twaite shad; sea lamprey; river lamprey). Furthermore, upstream of the estuary are a number of freshwater SACs which have other migratory fish species as qualifying features such as the River Usk SAC and River Wye SAC, both of which include Atlantic salmon, twaite shad and lamprey. The mouth of the estuary, and thus part of the RA, represents an important migratory corridor for a number of these Annex II migratory fish species, and other migratory fish species such as European eel, sea trout and sparling, all of which are Section 7 species. There is minimal overlap with known spawning grounds; however, low intensity nursery grounds for plaice and sole overlap with the RA, as do nursery grounds for spotted ray, thornback ray and tope in the western half of the RA.
Habitats	Article 17 habitat mapping data suggests that the majority of the seabed within this RA is subtidal reef habitat. Just landward of the RA are a number of Article 17 and Section 7 features that line the coast including intertidal and subtidal reefs, saltmarsh habitat, sea caves, sandbanks, saline lagoons. *Sabellaria* sp. saltmarsh and seagrass beds. Where the RA overlaps with the Severn Estuary SAC, along the south coast of the mainland, are important intertidal mudflats and sandflats.

In relation to seabirds, the outputs of the SMMNR project indicate that in the Bristol Channel and towards the mouth of the Severn Estuary, constraints are relatively low when compared to the other tidal stream RAs. There is no overlap with designated sites; however, the eastern end of the RA is adjacent to the Severn Estuary Ramsar site. The data analysed as part of the SMMNR project highlighted relatively few seabird colonies in the area, the Lesser black backed gull population at Flatholm being the closest. The low number of colonies is reflected in the comparatively low-density distributions for the seabird datasets.

In relation to marine mammals, the outputs of the SMMNR project also indicate relatively low constraints across the RA. There are no identified important seal haul out sites in the area and no overlapping or adjacent SAC or SSSI sites with marine mammals as features. Along the most inshore regions of the RA the main contributor to the relative constraints reflect grey seal usage of these waters, while the presence of harbour porpoise is the main contributor to the remainder of the RA. However, the mobile nature of these species means that interactions cannot be ruled out, even in areas of lower constraints.

In terms of fish species, much of the Bristol Channel RA is also highlighted as demonstrating comparatively lower constraints than the other tidal stream RAs. Areas of higher fish constraint are more localised rather than distributed across the RA. Where the eastern extent of this RA overlaps with the Severn Estuary SAC there is an important migratory route for many fish species, and the constraints here are notably higher than elsewhere within the RA. Immediately to the northeast of this area, outside the RA and along the coastline, is the Severn Estuary Ramsar site which is designated for its assemblage of migratory fish species.

In relation to habitats, the SMMNR project analysis indicated a fairly uniform level of low constraint across the tidal stream RA which is primarily linked to its overlap with the Article 17 reef feature ‘subtidal reefs’. However, there are only a few records of Section 7 features (excluding subtidal sands and gravels) within the RA. In the eastern extent of the RA, the overlap with Severn Estuary SAC increases the relative level of constraint. Although outside the RA, much of the coastline demonstrates high level of constraints, indicative of the various intertidal and subtidal features of importance (e.g. subtidal sandbanks around the western and eastern margins of the RA; intertidal rocky reef, seagrass beds near West Aberthaw; intertidal mudflats around Barry Island and Sully Bay).

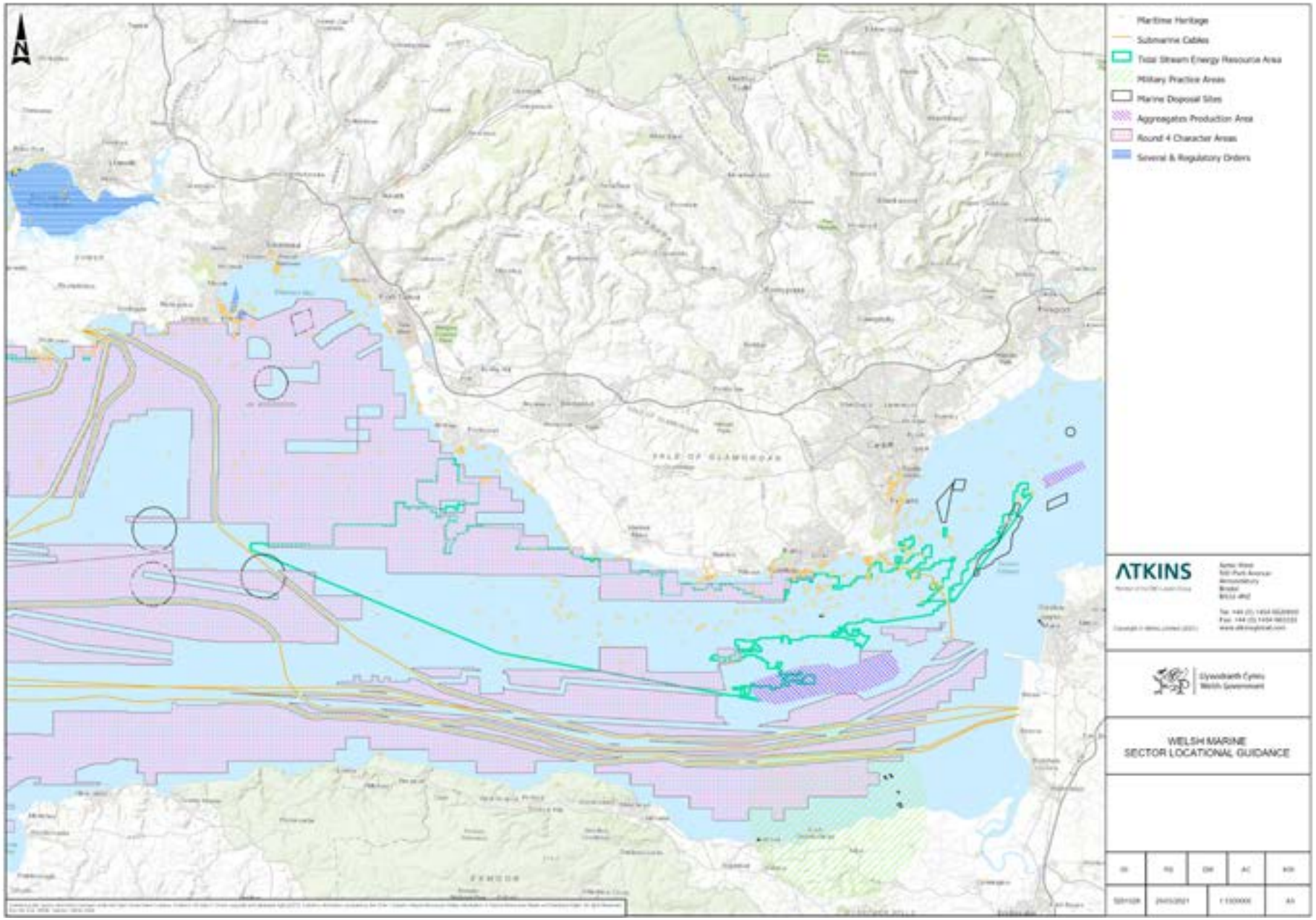
10.4.5 Other marine users

Table 10.20 outlines the other marine users and activities in the Tidal Stream – Bristol Channel RA. Please see Section 8 for more information on other marine users in wider Welsh waters and a high-level assessment of other sector interactions with tidal stream energy. Figure 10.19 and Figure 10.20 show the key features (those assigned a high score in the MRESF constraints analysis) potentially affecting tidal stream energy developments in the RA.

Table 10.20: Tidal Stream – Bristol Channel other marine users

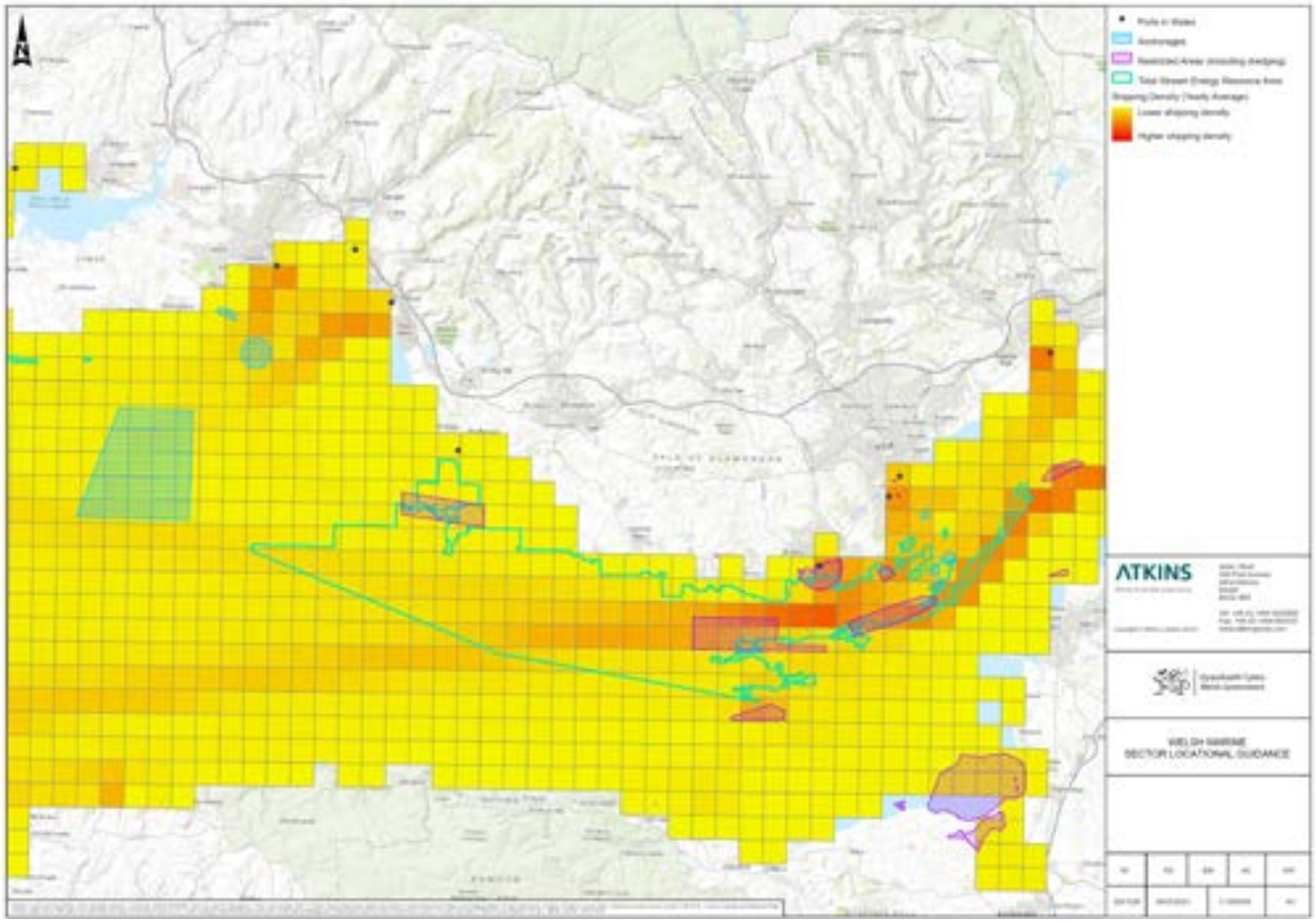
Sector	Description
Aggregates	Southern edge of the RA overlaps with aggregate production area operated by Cemex. Aggregate RAs overlap with much of the RA.
Aquaculture	Some overlap with aquaculture RAs but mostly just on the edges of the RA. Large amount of overlap with RA with potential for ranching for crawfish.
Dredging & disposal	Bristol Holm Deep disposal site along eastern-most edge of RA. Closed disposal site at western most edge of RA.
Energy (low carbon)	No interaction with existing projects. Overlap with the tidal range RA. Tidal Lagoon Power had been developing large tidal lagoon off Cardiff that would have overlapped with the RA but this project is currently on hold.
Shipping	Major route for cargo/tankers and dredging vessels through the middle of the tidal stream RA. Pilot boarding area in centre of tidal RA.
Subsea cabling	Unidentified submarine cable through eastern end of the RA.
Tourism & recreation	Tourism is one of the largest employment sectors in the Severn Estuary. The eastern end of RA overlaps with RYA boating area and high recreational use around Cardiff, Penarth and Barry.
Seascape	The Severn Estuary has many landscape and Seascape Character Areas both at a local and regional level, however they all combine to form the single entity that is perceptually considered to be the Severn Estuary (DECC, 2010). The Severn Estuary acts as backdrop to the lives of many people who live and work around it. It acts as a draw for holiday makers as well as providing a transportation route for shipping. It has rich historical connections but is also the scene for modern industry and commerce. It is a place of great contrast and visual richness with its daily change of character brought about by the tides. National Park and AONB on North Devon coast but surface piercing devices are unlikely to be visible from that distance.
Wrecks	There are a large number of wrecks in the RA that would need to be avoided in the project design phase.

Figure 10.19: Location of significant issues/constraints in relation to the Tidal Stream – Bristol Channel RA



Source: Source: see Table A-1

Figure 10.20: Location of shipping constraints in relation to the Tidal Stream – Bristol Channel RA



Source: see Table A-1

10.4.6 Summary of key opportunities and constraints

Several key constraints have been identified that would either potentially cause lengthy decision making for consent or could preclude development altogether. Several opportunities have also been identified which could support or guide future development of the sector.

This SLG aims to highlight features within this region which may influence site selection and/or could present a potential challenge to development in this area. It may be that some features can be easily avoided through micro-siting or applying appropriate buffers at the project design stage. Some features may require more detailed assessment and consultation at project level. Developers should consider the cost and programme implications of progressing developments that impact on key features.

Key constraints:

- **Environmental designations** – The far eastern limits of the RA overlaps with the Severn Estuary SAC and, to a much lesser extent, the Severn Estuary SPA and Ramsar.
- **Fish** – Important migratory corridor for a number of migratory fish species including some species that are qualifying features of the Severn Estuary SAC which overlaps with the eastern edge of the RA,. The presence of migratory fish is not necessarily a hard constraint but would depend on the technology being used and require detailed assessment at project level which could require changes to the project design.
- **Aggregates** – The southern edge of RA overlaps with an aggregate production area operated by Cemex. Operators or active aggregate sites are unlikely to want any development activity within their site that could interfere with their operations. However, it's possible that some parts of a lease are no longer being used – engagement with the lease holder would be required.
- **Dredging & disposal** – Bristol Holm Deep disposal site is along eastern-most edge of RA. Development is unlikely to be possible within active disposal areas due to operational activity, and risks to project infrastructure.
- **Energy (low-carbon)** – Potential tidal lagoon development. Some parts of this RA have a very high tidal range and the potential for tidal range energy development may be an important consideration within the region. Development in areas with potential for tidal lagoons may be possible. Currently, no Strategic Resource Areas have been identified for either tidal range or tidal stream energy.
- **Shipping** – Major route for cargo/tankers and dredging vessels through middle of the tidal stream RA. Projects could present a risk to safe navigation so, whilst management measures can be put in place, any proposed alteration to shipping routes could lead to extended delays.
- **Submarine cables** – An unidentified submarine cable runs through eastern end of the RA. Owners/operators of active cables are unlikely to allow development within the vicinity of their assets due to the risk of damage. A buffer is likely to be required either side of a cable and development would need to be outside of this.
- **Tourism & Recreation** – The eastern end of the RA overlaps with RYA boating area and high recreational use around Cardiff, Penarth and Barry. Early engagement with navigation stakeholders should be undertaken for any development in these areas. It may be that there is sufficient clearance for recreational craft to pass over seabed mounted devices, but this would need to be assessed at a project level and could require changes to project design.

Key opportunities:

- **Tidal stream resource** – A potentially significant RA exists around the Bristol Channel with the necessary physical and environmental conditions to support the production of tidal stream energy at a commercial scale. Further work may be of benefit in order to understand industry appetite and the practical viability of operating within this area.
- **National grid** – South Wales has good existing grid infrastructure and a programme of expansion of the grid network is already underway in Wales with upgrades planned to accommodate a large expansion of offshore renewable energy. Aberthaw power station is located on the coast adjacent to the RA. This station closed in 2020 and future plans are unclear, but the existing associated infrastructure (substation and 275 kV lines) could provide an opportunity for new energy development in the region.
- **Ports** – There are several ports in the South Wales region with existing capacity and experience of serving the offshore energy sector. There are large commercial ports at both Cardiff and Barry adjacent to the RA, with Newport docks also close by.
- **Supply chain** – There are a number of companies in the South Wales region with existing capacity and experience in the marine renewable energy sector. There are also many smaller local engineering consultancies with skills across design areas, particularly in mooring and anchor design. Secondary steel in particular is an area of manufacturing that can readily be met within the Bristol Channel region.
- **Co-location** – There are areas of cross-over between the tidal stream RA and aquaculture RA on the eastern edge of RA and inshore areas off Llantwit Major, which could potentially be considered for co-location.
- **Refining of RA** – As a result of the emerging nature of the tidal stream energy sector, there are a large number of opportunities to strengthen the evidence base and further refine the RA and develop an understanding of opportunities for future tidal stream energy activity.

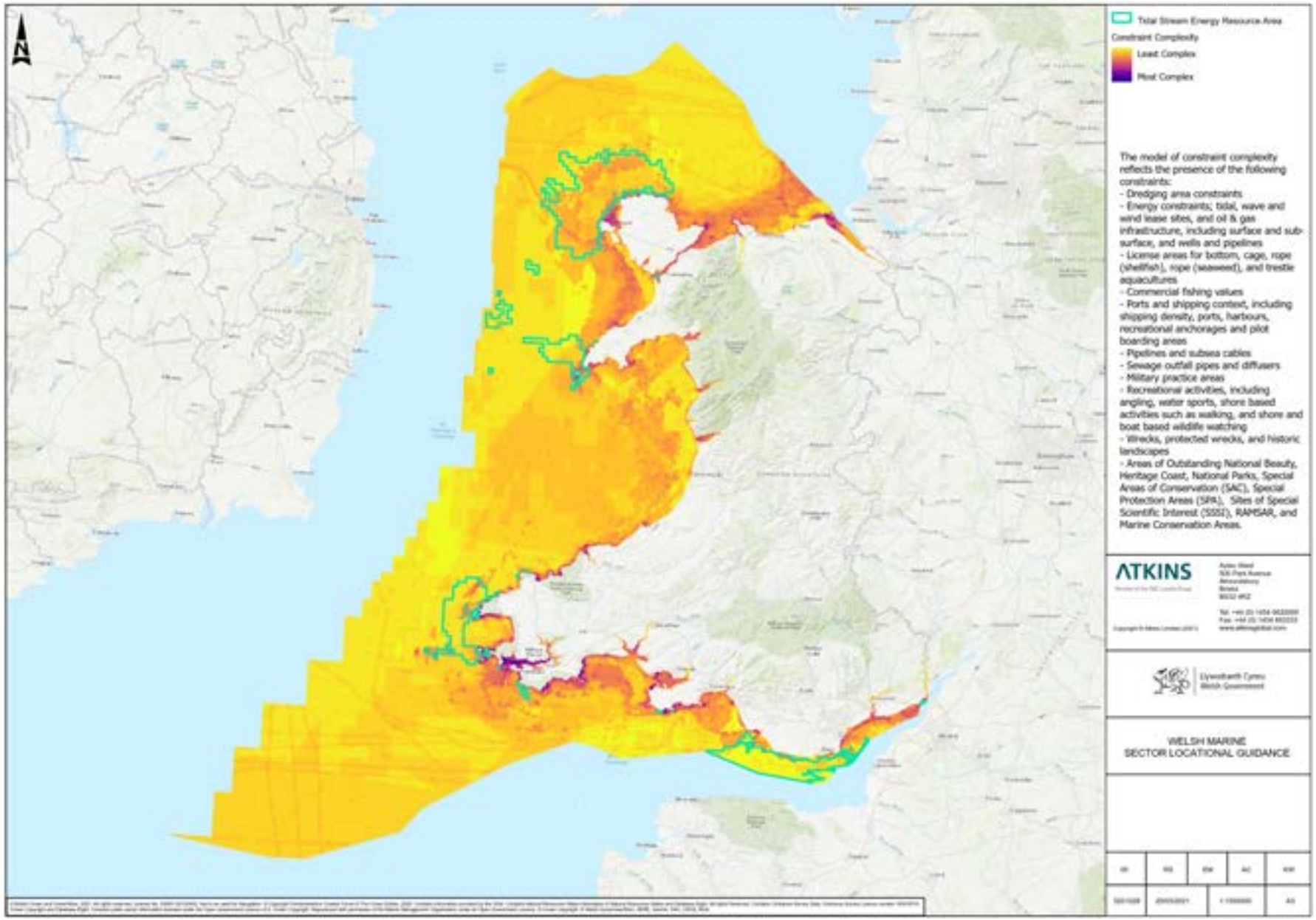
10.5 Summary

This SLG provides an overview of potential spatial constraints which may be important considerations for new tidal stream energy projects. The evidence presented in Figure 10.21 shows the number of constraints potentially affecting tidal stream energy developments in Welsh waters at a national scale presented in a 1 km^2 hexagonal grid. Key features that were assigned a high score in the MRESF constraints analysis have been included in this map. The number of constraints is generally higher inshore; however, it is important to note that not all constraints will have an equal effect on tidal stream energy developments.

Considering the available tidal stream energy resource, the identified constraints (both hard and soft constraints), and the socio-economic context identified, several key opportunities have also been identified. These opportunities could support, promote, or facilitate the development of the tidal stream energy sector in the future, as well as the achievement of Welsh Government targets and objectives linked to employment opportunities in Welsh coastal communities, emissions reduction and climate change adaptation.

The map in Figure 10.21, along with the individual RA constraints maps in the previous sections, whilst showing the location of known constraints within the RAs and around Wales, also indicates areas of potential lower relative constraint. This information can be used to guide discussions within project planning processes on areas for further consideration, where consenting for development could potentially proceed in a quicker and more straightforward manner.

Figure 10.21: Number of potential constraints to tidal stream energy development



Source: see Table A-1

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Appendix A: Data

A.1. Data sources

Data sources used to inform the guidance are outlined in Table A.1 below[43].

Table A.1: Data sources used for Tidal stream SLG

Topic	Core Datasets	Confidence assessment	Figure reference	Model inclusion
Resource Area				
Tidal stream RA	Tidal stream energy RA Accessed Online (2021): **lle.gov.wales/catalogue/item/TidalStreamEnergyResourceArea/?lang=en**	High	All, except Figure 1.1, Figure 1.2, Figure 3.1, Figure 4.1, Figure 4.3, Figure 5.2, Figure 5.3, Figure 5.4, Figure 8.9, Figure 10.1, Figure 10.6, Figure 10.11, Figure 10.16	
Tidal stream potential / flow	Renewables Atlas **www.renewables-atlas.info/downloads/**	Medium	Figure 4.1	
Tidal stream leasing areas	Crown Estate **www.opendata-thecrownestate.opendata.arcgis.com/**	High	Figure 4.2	
WNMP Area	Welsh Marine Plan Area **www.lle.gov.wales/catalogue/item/WelshNationalMarinePlanArea/?lang=en**	High	Figure 1.1	

43 Note that all data links were available at the links in Table A-1 at the time of writing.

Topic	Core Datasets	Confidence assessment	Figure reference	Model inclusion
Conservation Sites				
Designated sites (Ramsar, SACs, SPAs, MCZs, SSSIs)	Designated conservation site boundaries (various): Ramsar, SAC, SPA, MNR, SSSI. On Lle geoportal and Welsh Marine Planning Portal (WMPP) **www.lle.gov.wales/apps/marineportal/** **www.lle.gov.wales/catalogue/item/ProtectedSitesRamsarWetlandsOfInternationalImportance/?lang=en** **www.lle.gov.wales/catalogue/item/ProtectedSitesSpecialAreasOfConservation/?lang=en** **www.lle.gov.wales/catalogue/item/ProtectedSitesSpecialProtectionAreas/?lang=en** **www.lle.gov.wales/catalogue/item/ProtectedSitesSitesOfSpecialScientificInterest/?lang=en** **www.lle.gov.wales/catalogue/item/ProtectedSitesMarineNatureReserves/?lang=en** **www.lle.gov.wales/catalogue/item/ProtectedSitesAreasOfOutstandingNaturalBeauty/?lang=en**	High	Figure 7.1, Figure 7.2, Figure 10.3, Figure 10.8, Figure 10.13, Figure 10.18	✓
Biodiversity				
Seabird foraging	Bird colony locations and counts – Seabird Monitoring Programme (varied years). **www.app.bto.org/seabirds/public/data.jsp** Rationalised list of colonies produced following NRW input Mean foraging range – Woodward et al., 2019	High	Used to inform SMMNR data	
Seabird loafing	Bird colony locations – Seabird Monitoring Programme. Rationalised list of colonies produced following NRW input **www.app.bto.org/seabirds/public/data.jsp** JNCC maintenance extensions **www.archive.jncc.gov.uk/pdf/SAS_Identification_of_generic_maintenance_extensions_to_seabird_colonies_2.pdf**	High	Used to inform SMMNR data	
Royal Society for the Protection of Birds seabird utilisation distributions	RSPB metadata showing utilisation of Kittiwake, Guillemot, Razorbill, Shag – Cleasby et al., 2018 **www.opendata-rspb.opendata.arcgis.com/search?sort=name&tags=Tracking%20Data&type=Feature%20Layer**	High	Used to inform SMMNR data	

Topic	Core Datasets	Confidence assessment	Figure reference	Model inclusion
Seabirds at Sea	Seabird distribution – Seabirds at Sea. Rationalised seabird list produced following NRW input **www.lle.gov.wales/catalogue/item/SeabirdsAtSea/?lang=en**	Medium	Used to inform SMMNR data	
Grey Seal at Sea	Seal at Sea – Russell et al, 2017 **www.data.marine.gov.scot/dataset/estimated-sea-distribution-grey-and-harbour-seals-updated-maps-2017**	High	Used to inform SMMNR data	
Atlas of Marine Mammals of Wales	Atlas of the marine mammals of Wales – Baines and Evans, 2012	High	Used to inform SMMNR data	
Cetacean distribution	Waggitt et al., 2019 **www.datadryad.org/stash/dataset/doi:10.5061/dryad.mw6m905sz**	High	Used to inform SMMNR data	
Seal pupping and haul out sites	Baines et al., 1995; Westcott and Stringell, 2004; Strong et al., 2006 and Clarke et al., 2020 (in prep)	Medium	Used to inform SMMNR data	
Nursery areas	Spawning and nursery grounds of selected fish species in UK waters (Ellis et al., 2012) **www.data.cefas.co.uk/#/View/153**	Medium	Used to inform SMMNR data	
Spawning grounds	Spawning and nursery grounds of selected fish species in UK waters – Ellis et al., 2012 Fisheries sensitivity maps in British waters – Coull et al., 1998; **www.data.cefas.co.uk/#/View/153**	Medium	Used to inform SMMNR data	
Basking Shark distribution	The Marine Conservation Society Basking Shark Watch 20 year report (1987-2006) – Bloomfield and Solandt, 2010	Medium	Used to inform SMMNR data	
Migratory fish transitional waters	Article 17 Estuaries On WMPP and Lle geoportal	High	Used to inform SMMNR data	
Article 17 (Annex I)	Article 17 (Annex I habitats) On WMPP and Lle geoportal	High	Used to inform SMMNR data	
Section 7 and OSPAR habitats	Section 7 and OSPAR habitats On WMPP and Lle geoportal	High	Used to inform SMMNR data	

Topic	Core Datasets	Confidence assessment	Figure reference	Model inclusion
Section 7 and OSPAR species	Section 7 and OSPAR species On WMPP and Lle geoportal	High	Used to inform SMMNR data	
SMMNR Constraints	SMMNR – Fish, bird, marine mammal and habitat constraints **www.lle.gov.wales/catalogue/item/SMMNRConstraintMapping?lang=en**	High	Figure 7.5 to Figure 7.14	
Social				
Administrative boundaries	UK constraints **www.geoportal.statistics.gov.uk/datasets/counties-december-2017-full-clipped-boundaries-in-england**	Medium	All, except Figure 1.2, Figure 4.1, Figure 4.3, Figure 5.2, Figure 5.3, Figure 5.4, Figure 10.1, Figure 10.6, Figure 10.11, Figure 10.16	
LSOA	**www.ordnancesurvey.co.uk/opendatadownload/products.html** **www.geoportal.statistics.gov.uk/datasets/middle-layer-super-output-areas-december-2011-generalised-clipped-boundaries-in-england-and-wales**	High	Figure 6.1	
Boroughs	**www.api.os.uk/downloads/v1/products/BoundaryLine/downloads?area=GB&format=ESRI%C2%AE+Shapefile&redirect**	Medium	All, except Figure 1.2, Figure 4.1, Figure 4.3, Figure 5.2, Figure 5.3, Figure 5.4, Figure 10.1, Figure 10.6, Figure 10.11, Figure 10.16	
Parishes	**www.osdatahub.os.uk/downloads/open/BoundaryLine**	Medium	All, except Figure 1.2, Figure 4.1, Figure 4.3, Figure 5.2, Figure 5.3, Figure 5.4, Figure 10.1, Figure 10.6, Figure 10.11, Figure 10.16	

Topic	Core Datasets	Confidence assessment	Figure reference	Model inclusion
Population density, demographics, area deprivation, Welsh speaking %	WIMD interactive Map **www.wimd.gov.wales/** Stats Wales **www.statswales.gov.wales/Catalogue**	High	Figure 6.1	
Travel time	Travel time layer generated by Atkins	High	Figure 6.2	
Recreation	Recreation data provided by the Pembrokeshire Coastal Forum, covering recreational angling, water sports, shore based activity and wildlife watching	Low	Figure 10.21	✓
Infrastructure & Supply Chain				
Submarine Cables	Submarine cables supplied via email by Welsh Government 15th January, sourced from Oceanwise.	High	Figure 8.8, Figure 10.4, Figure 10.9, Figure 10.14, Figure 10.19, Figure 10.21	✓
O&G lease areas & infrastructure & pipelines	Sourced from the Oil & Gas Authority online portal **www.data-ogauthority.opendata.arcgis.com/**	High	Figure 10.21	✓
National grid overhead powerlines / substations	National Grid **www.nationalgrid.com/uk/electricity-transmission/network-and-infrastructure/network-route-maps**	High	Figure 5.1	
Nuclear power stations	National Grid **www.nationalgrid.com/uk/electricity-transmission/network-and-infrastructure/network-route-maps**	High	Figure 5.1	
Gas pipelines	National Grid **www.nationalgrid.com/uk/electricity-transmission/network-and-infrastructure/network-route-maps**	High	Figure 5.1	
Ports/Harbour Areas/Pilot Boarding Areas & Recreational Anchorages	Ports in Wales – Oceanwise data: Ports and Harbours of the UK Supplied by Welsh Government	Medium	Figure 8.6, Figure 5.1, Figure 10.5, Figure 10.10, Figure 10.15, Figure 10.20, Figure 10.21	✓
Wastewater	Intake and outfalls, including licensed discharges, provided by Welsh Government.	High	Figure 10.21	✓

Topic	Core Datasets	Confidence assessment	Figure reference	Model inclusion
Other Marine Users				
Aggregate production	TCE **www.opendata-thecrownestate.opendata.arcgis.com/datasets/thecrownestate::offshore-minerals-aggregates-site-agreements-england-wales-ni-the-crown-estate**	High	Figure 8.1, Figure 10.21	✓
Dredging Areas	Oceanwise **www.oceanwise.eu/data/marine-themes/**	High	Figure 10.21	✓
Marine disposal sites (licensed)	Cefas **www.data.cefas.co.uk/#/View/407**	High	Figure 8.1, Figure 10.4, Figure 10.9, Figure 10.14, Figure 10.19, Figure 10.21	✓
Marine spoil grounds	Cefas **www.data.cefas.co.uk/#/View/407**	High	Figure 8.1, Figure 10.21	✓
Military practice areas	Oceanwise **www.oceanwise.eu/data/marine-themes/**	High	Figure 8.3, Figure 10.4, Figure 10.9, Figure 10.14, Figure 10.19, Figure 10.21	✓
Offshore Wind	Offshore Wind Leasing – Round 4 **www.opendata-thecrownestate.opendata.arcgis.com/datasets/54dce8a263324a85b36523e31fff20cc_0**	High	Figure 8.4	
Tidal	Tidal RA **www.lle.gov.wales/catalogue/item/TidalStreamEnergyResourceArea/?lang=en** Tidal stream leasing areas **www.opendata-thecrownestate.opendata.arcgis.com/**	High	Figure 8.2, Figure 10 21	✓
Wave	Wave RA **www.lle.gov.wales/catalogue/item/WaveEnergyResourceArea/?lang=en**	High	Figure 8.2, Figure 10.21	✓
Aquaculture	Several Regulating Orders **www.lle.gov.wales/catalogue/item/SeveralAndRegulatingOrders/?lang=en** Aquaculture RA **www.lle.gov.wales/catalogue/item/AquacultureResourceArea?lang=en**	High	Figure 8.2, Figure 10.21	✓

Topic	Core Datasets	Confidence assessment	Figure reference	Model inclusion
Fishing	MMO Fish landings provided by WG These layers are based on MMO Sea Fisheries Statistics. WG have aggregated the datasets by species group and added spatial information. Fishing Intensity **www.ices.dk/sites/pub/Publication%20Reports/Forms/DispForm.aspx?ID=35169**	Medium/High	Figure 8.6, Figure 8.7, Figure 10.21	✓ ✓
Shipping	Ship routing measures, anchorage: Supplied by WG Vessel density **www.data.gov.uk/dataset/vessel-density-grid-2015** RYA data: supplied by Welsh Government but is available from the RYA directly for a fee.	High	Figure 8.7, Figure 10.5, Figure 10.10, Figure 10.15, Figure 10.20, Figure 10.21	✓
Heritage	World Heritage Sites **www.lle.gov.wales/catalogue/item/WorldHeritageSites/?lang=en** Protected Wrecks **www.lle.gov.wales/catalogue/item/CADWProtectedWrecks/?lang=en** Maritime Heritage Assets **www.lle.gov.wales/catalogue/item/NationalMonumentsRecordOfWalesMaritimeHeritageAssets/?lang=en** Historic Landscapes **www.lle.gov.wales/catalogue/item/RegisteredLandscapesOfOutstandingHistoricInterestInWales/?lang=en**	High	Figure 8.11, Figure 10.4, Figure 10.9, Figure 10.14, Figure 10.19, Figure 10.21	✓ ✓ ✓
Seascape	Heritage Coasts Lle – Heritage Coasts **www.lle.gov.wales/catalogue/item/ProtectedSitesHeritageCoast/?lang=en** National Parks **www.lle.gov.wales/catalogue/item/NationalParks/?lang=en** National Trails **www.lle.gov.wales/catalogue/item/NationalTrails/?lang=en** Country Parks **www.lle.gov.wales/catalogue/item/ProtectedSitesCountryParks/?lang=en**	High	Figure 7.2, Figure 10.3, Figure 10.8, Figure 10.13, Figure 10.18, Figure 10.21	✓ ✓

A.2. Data limitations/gaps

Data was reproduced from the SMMNR study,[44] detailing fish, bird, mammal and habitat constraints.

Stakeholder engagement has identified that war graves are a definite constraint to development. However, data on war graves are currently amalgamated with protected wrecks. Data identifying war graves specifically may help with micro-siting and consultation with those with heritage interests.

Data on fishing activity in Wales is limited and this SLG has focussed on ICES data. However, it is acknowledged that this data does not provide an accurate reflection of fishing activity, particularly static gear fishing which is not captured in the data available. More detailed and up to date data would help to develop knowledge and representation of this important sector and help developers engage with fishers from an early stage using more accurate data.

Inshore Vessel Monitoring system (iVMS) data is used for most of marine planning and project level assessment, but it is only for vessels > 12 m. 90% of Welsh fleet is < 12 m therefore there is currently a significant data gap for this sector. iVMS is being implemented on all commercial vessels < 12 m in 2021 so it is hoped this will help inform marine planning and development of projects. Until this data is available developers should consult fisheries representatives at as early a stage as possible, ideally at the site selection phase, so that important fishing areas can be identified.

Spoil Ground data was sourced from Cefas, in projection system WGS84. The authors caveat use of the data, requesting WGS84 to be retained as other projection systems can cause distortion. As the geospatial model is in British National Grid projection, spoil grounds were intersected without prior conversion from WGS84.

Raw RYA data was not available to this study; however, the data has been reproduced by Welsh Government directly.

A.3. Data review

It is the intention of Welsh Government that the analysis and more specifically, the datasets that are used to derive the outputs, are reviewed at regular intervals to allow an opportunity to consider their ongoing suitability. Should more suitable data, or additional data to supplement and amalgamate with selected datasets become available, then these will be incorporated within the analysis accordingly.

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