

NRW's Tidal Lagoon Environmental Research Priorities

Introduction

The purpose of this document is to describe the environmental research that NRW considers is needed to support consenting of tidal lagoons and that should be addressed as a priority by proposals submitted to the Tidal Lagoon Challenge (TLC). Only research relevant to NRW's advisory remit and to those issues that are most likely to hamper consenting are included.

Additional information about strategic research required to address the evidence needs of tidal range development is available via the [ORJIP](#) Ocean Energy website and may be helpful to those developing TLC bids.

NRW's Marine and Coastal Evidence Programme also publishes a list of wider priority evidence needs and collaborative research ideas. These are available on our [website](#) and are updated annually.

This document does not describe the information that will be necessary for environmental assessments that are required to accompany individual project applications. This will be dependent on specific project design and location and NRW has published separate [guidance](#) to support these assessments for tidal lagoon projects in Wales.

Baseline Characterisation Studies

It is recognised that location specific research and monitoring will be necessary for most tidal lagoon projects in order to adequately characterise the receptors that may be affected by lagoon development. The environmental receptors most likely to require characterisation include:

- Physical Processes (especially sediment budgets)
- Fish
- Birds
- Marine Mammals
- Water Quality
- Marine & Coastal Habitats
- Landscape & Seascape
- Flood & Coastal Erosion Risk

Baseline characterisation studies are only likely to be feasible over a defined area. Although the TLC is location-neutral, it nevertheless encourages proposals that may be location-specific and recommends that proposers of such projects consult [Welsh National Marine Plan](#) for maps that show the areas that may be most relevant for tidal range development.

Priority Research Topics

The research topics described below, derived from NRW's evidence programme, are not location specific but focus on critical gaps in our understanding about the effects of tidal lagoons.

Proposals may choose to explore aspects of the research suggested below or may seek to combine research ideas into a single proposal.

Physical Processes

Understanding the near and far field impacts upon physical processes is key to defining the geographical extent of effects on the marine and coastal environment. There can be direct effects on the physical environment and habitats and indirect effects upon other receptors that rely upon the physical environment. Knowledge of the effects on physical processes is critical if we are to understand the capacity to accommodate a single or multiple developments and is a key step in defining the environmental assessment envelope.

1. **How can we predict the rate of sediment erosion, transport and deposition at the coast that would result from tidal lagoon developments?**

There is a need to identify or improve approaches and techniques to quantify and qualify the rate of sediment erosion, transport and deposition caused by a single tidal lagoon and over larger areas as a consequence of multiple lagoons. Studies to address this will also need to factor in the effect of associated works such as aggregate extraction and maintenance dredging and disposal operations.

2. **How can we improve models to predict medium to long term morphological changes from tidal range developments?**

Predicting medium to long-term morphological changes arising from single or multiple tidal range developments is difficult to achieve with any degree of certainty. Existing models, such as ICOAST, explore the use of decadal scale modelling for estuarine and coastal evolution. However, there is a need for these tools to provide increased capability and confidence in numerical model impact predictions and to consider whether they can be applied to longer term assessments. Alternatively, can we learn from the application and limitations of these existing tools to improve our modelling ability?

3. **How can we use models to assess the effects of tidal lagoon decommissioning scenarios on physical processes?**

Generally, construction phase modelling is used to inform the decommissioning impacts but the length of time and future scenarios (e.g. climate change impacts) are not typically factored in. There is a need to establish approaches for assessing decommissioning impacts upon physical processes. This research could involve testing model predictions incorporating climatic change influences (e.g. sea level rise,

increase in storminess) on various decommissioning scenarios to establish the most appropriate course of action.

Mobile Species (Marine Mammals, Birds & Fish)

4. How does habitat loss or change impact mobile species in Marine Protected Areas and within wider populations?

The population consequences of habitat loss or change for mobile species are poorly understood and current population prediction models generally concern disturbance only rather than the effects of habitat loss or change. A modelling framework to predict the effect of these changes on MPAs and wider populations is needed.

5. How can existing collision risk models and parameters be adapted to assess risks to mobile species?

Collision risk models have been or are being developed to understand the risk associated with a variety of tidal turbine designs. A review of, and recommendations for, the best models/techniques that could be applied to lagoons is needed.

6. How can existing detection technologies be adapted to monitor potential mobile species collision?

Instrumentation to monitor mobile species behaviour around tidal turbines has been developed, especially for use in relation to tidal stream technologies. There is a need to understand whether and how these technologies could be used to monitor turbines within lagoon walls.

7. What are the critical inshore and coastal migration routes and marine habitats used by key diadromous and marine fish species in Wales?

There is a need for hydroacoustic tagging and tracking of diadromous fish from a selection of Welsh rivers, to collect distribution data to inform models designed to predict the risk to salmon, sea trout, eel and shad populations.

8. Can we develop better technology for monitoring juvenile fish behaviour?

Development of better fish tagging/tracking technology for juvenile fish and correct methods for obtaining and handling sufficient numbers of fish is needed.

9. How do changes in olfactory cues impact diadromous fish?

A review of the impact of changes in olfactory cues for individual diadromous fish and how these effects on individuals translate into impacts upon populations.

10. Can we use eDNA to study presence of diadromous fish in Welsh waters?

Testing and refinement of field techniques for collecting eDNA to establish presence or effective absence of key diadromous and marine fish species.

Marine & Coastal Habitats

11. The effects of impoundment on coastal habitats within tidal lagoons.

A better understanding is needed of the impacts on marine and coastal habitats especially *Sabellaria*, sea grasses, saltmarsh, vegetated shingle, sand dune and sea cliff where they become functionally separated from habitat outside a lagoon or where they are subject to changes in coastal processes.

12. What impact does introducing hard substrate have on the biological and ecological structure and functioning of designated sediment habitats in Marine Protected Areas?

A better understanding is needed of the way in which hard substrates can change sedimentary habitats and how this alters their ecological and biological characteristics and leads to changes in community structure and function.

13. How to compensate for loss or degradation of sensitive habitats?

Development of a better understanding of the opportunities to compensate for loss or degradation of Habitats Directive Annex 1 features caused by lagoon development. In particular, how can additional levels of protection (such as site designation, feature categoriation or byelaw designations) be applied to undesignated areas that host these features?

Pelagic Communities

14. Are there likely to be any ecosystem level effects of restricted water exchange between tidal lagoons and the area outside?

Tidal lagoons are likely to impede water exchange between different areas. A better understanding of the implications of restricted exchange upon pelagic communities (including plankton) is needed.

Water Quality

15. How will tidal lagoons impact water quality?

Development of approaches and techniques to quantify the impacts of tidal lagoons on water quality receptors. How will lagoons impact turbidity, salinity, temperature, nutrients, dissolved oxygen and phytoplankton communities both inside and outside the lagoon? How will lagoons impact the dispersion of discharges from 3rd party assets such as trade effluents and sewage discharges?

16. What will be the impact of a tidal lagoon on designated Bathing Waters?

If a tidal lagoon were to envelop a designated Bathing Water, what would be the impacts on that Bathing Water? For example, would it become more muddy which could therefore harbour more bacteria? What is the risk to human health?

17. What is the value of Good Ecological Status under the WFD?

Development of methods to determine the monetary value of Good Ecological Status for the cost-benefit analysis to inform WFD derogations.

Landscape-Seascape

18. How can tidal lagoon developments be designed to provide multiple wellbeing benefits for people, and regenerate coastal communities?

Tidal lagoons would fundamentally change coastal character, possibly permanently. This landscape-scale change could be designed creatively to bring new destination appeal and economic regeneration whilst maintaining or enhancing landscape and seascape character. Strategic research and case studies are needed to show how this could be achieved most effectively and in environmentally sustainable ways.