Hinkley Point C Stakeholder Reference Group

The implications of Hinkley Point C for Wales' environment and its people

A report to the Welsh Government

16 March 2021

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Foreword

Wales uniquely has a Well-being of Future Generations Act. In short, the act requires the government and public services in Wales to take account of current and future generations in their decision-making. Decision-makers must think preventatively, long-term, to integrate goals in their decision-making, to involve those about whom decisions are being made and to collaborate to achieve better outcomes.

The act mandates delivery on seven goals, linked to the UN Sustainable Development Goals, which include specific reference to acting on climate change, to living within our environmental limits and to enhancing biodiversity. In the act, prosperity is defined as innovative and low carbon, and public service organisations are required to look upstream to ensure, for example, that the causes of ill health are acted upon. This is a very different approach to the usual target setting; the specific outcomes sought by governments in short political cycles. In the year in which the world will debate the extraordinary level of action that that will be needed to tackle the climate and biodiversity crises, the act provides a very important values framework through which to make decisions.

When the stakeholder group on Hinkley Point C was first formed, we determined to frame our activity according to delivering on the ambition of the Well-being of Future Generations Act (2015) and Wales' Environment Act (2016). We felt this was useful framework through which to assess the environmental impacts of this specific large infrastructure development on Wales; when the structure itself is not in Wales, but where Welsh laws may impact on decisions taken by developers and regulators. We hope that in doing so, we will set a framework for best practice on how the Welsh Government and Wales' public services will be able to better address future large infrastructure developments, irrespective of technology, whether they are in Wales or on its borders.

We agreed a very strong principle at the outset that our enquiry would be evidence-led, and that a strong evidence base would guide our advice to the First Minister. In this report you will find the expert conclusions of the stakeholder members on the basis of the evidence they have been given from key contributors: key players, external advisors and campaigners. Where we believe the evidence is not strong enough to justify decisions made, we say so. You will be able to scrutinise the full minutes of each of our meetings, including the input of those who contributed to our thinking in the interests of full transparency.

There are two points to note which are worthy of further consideration. In the case of Hinkley Point C, this group was not able to influence how the project was developed from the beginning before the first permissions were granted or the first spade was put in the ground as those discussions commenced in 2011. The Group notes that for major projects, in practical terms, governance decisions generally stretch across a number of years, from initial planning permission though subsequent revisions and on to a variety of regulatory decisions that are required to take the project from drawing board to operations. That being the case, the group would advise that there be a presumption that any applications must show that they will deliver at least the same level of environmental protection as that stipulated in the original decision and ideally improve upon it. Perhaps, in the context of future large, cross-border infrastructure projects a group such as ours should be convened, prior to the initial government decisions, in order to influence the conditions under which very large sums of public and private money should be spent –

not just in the interests of the specific outcome of the project, but to ensure that all the relevant legislation and commitments both sides of a legislative border are taken into account.

The second area is the relationship between planning and regulatory control. The Group notes that although this is supposed to be mutually reinforcing, in practical terms the granting of planning permission and the commencement of activity on the ground in effect creates momentum to proceed in a specific direction that can compromise the range of viable regulatory decisions that can be taken thereafter. To this end, it is crucial that for large/sensitive projects, planning and pollution control issues should be addressed in a more integrated manner from the outset.

As chair, I want to thank all the group members and the secretariat for their considerable time and expertise. This has been a very short inquiry as we determined to report to the First Minister while the Senedd is in session and prior to the 2021 Welsh General Election. I hope that our deliberations will help generate a wider understanding of the consequences of the effects of processes which have not yet been designed to interrelate effectively with each other, particularly in the context of cross-border relations. I would also hope that all those reading this report who have a part to play in tackling these important issues for the people of Wales will do so.

Jane Davidson, Chair of the Hinkley Point C Stakeholder Reference Group

March 2021

Introduction

The Hinkley Point C Stakeholder Reference Group ("the Group") was established in July 2020 and tasked with providing the Welsh Ministers with stakeholder views on issues arising from the Hinkley Point C project relevant to Wales and the people of Wales.

The Group met once a month from its inception and committed from an early stage to produce a comprehensive report summarising stakeholder views and providing evidence-based advice.

This report is the culmination of the Group's inquiries and research over an eight month period, during which time it heard from a range of stakeholders and met with experts in the field to gain a deep understanding of the Hinkley Point C project and its implications for Wales. The Group places on record its sincere gratitude to all the individuals and organisations that facilitated and supported its work, and to everyone who made their time available to the Group.

Ways of working

The Group published Terms of Reference and a statement of its working methods, which set the ambitions of the Well-being of Future Generations Act at its core. To demonstrate the Group's transparency and to secure cooperation and insight from all key stakeholders, the Group published short summaries of its meetings on its website. As this report is the conclusion of the Group's work, it is accompanied by the full meeting notes and the collated correspondence it sent and received, so that everyone can see the full breadth of the inquiries made by the Group.

The Group's lifetime coincided with the Covid-19 pandemic which meant it conducted all its meetings and inquiries remotely. This way of working offered clear benefits, including ensuring the Group attracted and retained members with real expertise in their fields, and that it reached key personnel within stakeholder organisations. No member of the Group received any remuneration for their contribution.

The Group adopted a strictly evidence-based approach to its reporting. In each chapter of this report, the Group has sought to summarise the issues that were raised and focus on elements that constituted ***evidence***, rather than opinion or conjecture.

Stakeholders

The Group's objective was to understand, assess and reflect on stakeholder views on the implications of the Hinkley Point C project on Wales. Some stakeholders approached the Group directly to share their views and evidence, while others were invited by the Group to engage in the process via written evidence or by joining the Group's meetings.

Some of the main stakeholders engaged in the Group's inquiries were (in alphabetical order):

- Cefas
- Crown Estate
- Devon and Severn Inshore Fisheries and Conservation Authority
- EDF (and its subsidiary NNB GenCo)
- Environment Agency
- Geiger Bay
- Marine Management Organisation
- Natural Resources Wales

- Office for Nuclear Regulation
- Somerset County Council
- Welsh Government
- Welsh Local Government Association

The Group also received representations from a number of individuals, and it exchanged correspondence with researchers and regulatory bodies such as the Planning Inspectorate. A record of the Group's formal correspondence is included in Annex 2 of this report.

Structure of the Report

This report contains six substantive chapters, each addressing matters of significant importance in the context of the Hinkley Point C project and its implications for Wales. The six chapters emerged over the course of the Group's inquiries, and in each area, a range of stakeholders have provided evidence, contributing to the Group's conclusions. A seventh chapter compiles the primary advice from the six substantive chapters in one place.

The chapters are:

1. Resilience of the Severn Estuary Ecosystem
2. Cross-border relationships and arrangements
3. Radioactive content of Hinkley Point sediments and their assessment for disposal at sea
4. Modelling Studies and Cardiff Grounds Disposal Site
5. Emergency planning for nuclear operations at Hinkley Point
6. Use of powers by the Welsh Government and its agencies in the context of the Hinkley Point C sediment disposal at Cardiff Grounds
7. Advice

Each chapter provides a background and contextual information, and outlines the concerns expressed by stakeholders and identified by the Group in the course of its inquiries. The views of stakeholders and the evidence gathered by the Group is discussed, followed by the Group's conclusions and advice to the Welsh Government.

There are extensive references within each chapter, and every effort has been made to acknowledge these in full. The Report is accompanied by annexes: Annex 1 contains the Group's terms of reference, working methods, full biographies of the Group's members and full meeting notes; Annex 2 sets out the formal correspondence between the Group and stakeholders it engaged. Any publicly available documents referred to in this report can be provided on request by contacting hinkleygroup@gov.wales

Using this report

Advice contained within this report is provided directly to the Welsh Government, as the body that established the Group and set its objectives. The advice combines actions that

the Welsh Government can take unilaterally, and matters where it is suggested it could use its influence to prompt important changes in the wider process.

The Group's hope is that this report will prompt relevant agencies to assess and review their own roles in the Hinkley Point C project and consider whether they have done, and continue to do, everything they reasonably could to safeguard and enhance the environment, and to maximise the multiple benefits that can be accrued from the project. Governments have the ability to legislate and set policies that deliver change, but more immediate impacts can occur when stakeholders take proactive measures to develop and improve their operations.

The Group fully recognises that planning and delivering a new nuclear power station – or any major infrastructure project - is by necessity a complex exercise, and the scope to simplify the consenting and regulatory processes is limited. The Group also recognises that agencies cooperate effectively in many areas to ensure extensive public and environmental protection. We do however identify measures in this report – some of which are quite simple – that could provide the public with greater confidence, particularly in a cross-border context where legislation in relation to environmental matters and to public health and well-being, differs on each side of the Welsh/English border.

By publishing and presenting this report to the Welsh Government, the Group has fulfilled its obligations. It is not a statutory body and it has no powers to formally monitor progress by the Welsh Government and other stakeholders in acting on its advice. Group members have, however, indicated a willingness to reconvene the Group on an ad hoc basis should the next Welsh Government, following the May 2021 Senedd election, wish for it to continue its work.

The Group's membership

The membership was drawn from a balance of disciplines with no one discipline outweighing any other. It reflected a sectoral balance between academia, industry and regulation. Members were appointed as individuals and because of their particular expertise, and not as representatives of organisations. Brief biographies are set out here, with full details provided in annex 1

Chair – Jane Davidson

Jane Davidson is Pro Vice-Chancellor Emeritus at the University of Wales Trinity Saint David. From 2000 - 2011, Jane was Minister for Education, then Minister for Environment and Sustainability in the Welsh Government, where she proposed legislation to make sustainability the central organising principle; the Wellbeing of Future Generations (Wales) Act came into law in 2015. As Environment Minister, she held ministerial responsibility for the Welsh input to the Marine and Coastal Access Act (2009). She introduced the first plastic bag charge in the UK, and her recycling regulations took Wales to among the best in the world. She created a Climate Change Commission for Wales, the post of Sustainable Futures Commissioner, and the Wales Coast Path.

Dr Rhoda Ballinger

Rhoda Ballinger is Reader in the School of Earth and Ocean Sciences, Cardiff University. As a member of the Marine and Coastal Environment research group, Rhoda has engaged in a quest for model institutional and policy frameworks to deliver Integrated Coastal Management. She has undertaken a variety of research projects on aspects of coastal and estuary management for UK government agencies and some of

her projects, notably those for the Countryside Council for Wales, have been benchmark reviews and analyses of the state of coastal management.

Dr Huw Brunt / Dr Sarah Jones

Huw Brunt has worked in the field of environmental public health for over 20 years, in a variety of roles across local and central government, and the NHS in Wales. Huw previously headed up a team in Public Health Wales with responsibilities to assess and manage risks from acute chemical incidents and other environmental hazards. He has a PhD in air quality and public health; his studies focused on integrating public health and local air quality management policy and practice.

Sarah Jones is Consultant in Environmental Public Health with Public Health Wales.

Sarah replaced Huw as a member of the Group in January 2021 when Huw left Public Health Wales and started working for the Welsh Government

Prof Roger Falconer

Roger Falconer is Emeritus Professor in the School of Engineering, Cardiff University. He is a Fellow of the Royal Academy of Engineering, a Foreign Member of the Chinese Academy of Engineering and a Fellow of the Learned Society of Wales. At Cardiff he founded the Hydro-environmental Research Centre and managed the Department of Civil Engineering at his previous university. He has published extensively in the field of computational hydro-environmental modelling and has delivered numerous keynote and external lectures world-wide. He has worked extensively on providing specialist advice, to industry and government departments, on a wide range of water environmental impact assessment (EIA) projects, both in the UK and overseas.

Dr Justin Gwynn

Justin Gwynn is a senior scientist with the Norwegian Radiation and Nuclear Safety Authority (DSA) at the Fram Centre in Tromsø with a focus on marine radioecology. He has held the position of Programme Manager for the Nordic Nuclear Safety Research's (NKS) emergency preparedness and radioecology programme and has chaired the OSPAR Commission's Radioactive Substances Committee since 2010. His current research activities include the use of radioactive tracers to understand ocean circulation and transport pathways of contaminants, the status and fate of dumped nuclear submarines and radioactive waste in the Arctic and the radioecology of discharges of naturally occurring radionuclides in produced water from oil and gas platforms.

Prof Karen Morrow

Karen Morrow has been Professor of Environmental Law at Swansea University since 2007. Her research interests focus on theoretical and practical aspects of public participation in environmental law and policy and on gender and the environment. Karen was founding co-editor of the IUCN Academy of Environmental Law e-journal and the Journal of Human Rights and the Environment. She serves on the editorial boards of the Journal of Human Rights and the Environment, the Environmental Law Review, and the University of Western Australia Law Review.

She is a founder member of the Global Network for the Study of Human Rights and the Environment (GNHRE) and is a member of the United Kingdom Environmental Law Association (UKELA). Karen was also a founding member of the Environmental and Planning Law Association of Northern Ireland (EPLANI).

Karen joined the Group in February 2021

Dr James Robinson

James Robinson is the Director of Conservation for the Wildfowl & Wetlands Trust (WWT) and has over 20 years of experience in the nature conservation sector. He currently leads a large team of wetland conservationists and is based at Slimbridge, situated on the banks of the River Severn in Gloucestershire. He has had previous roles as the Royal Society for the Protection of Birds' (RSPB) Director for Eastern England, Head of Nature Policy, Director for Northern Ireland, and Conservation Manager for Northern Ireland, at WWT as Head of Wetland Biodiversity Unit, and as Research Assistant at the University of Durham. James is also a member of the IUCN UK Executive Committee, the Board of Greener UK, and the Management Working Group and Scientific and Technical Review Panel of the Ramsar Convention on Wetlands.

Rachel Sharp

Rachel Sharp has worked for the Wildlife Trusts for 25 years and became the CEO of Wildlife Trusts Wales in 2011. Her previous roles include Head of Biodiversity at Avon Wildlife Trust and CEO of both Hereford and Brecknock Wildlife Trusts. She is now a leading advocate for nature recovery in Wales. She is an external advisor on Welsh Waters Independent Environment Advisory Panel and Welsh Governments European Advisory Group. She is also a trustee of the Wales Environment Link and a member of the Wales Marine Action and Advisory Group.

Chapter 1

The Resilience of the Severn Estuary Ecosystem

This chapter examines the development activities at Hinkley Point C (HPC) concerning potential impacts on the ecosystem resilience of the Severn Estuary European Marine Site (EMS) and its implications for Welsh interests. This assessment examines if the principles and aims of the Well-Being of Future Generations (Wales) Act[1] (WFG Act) and the Environment (Wales) Act[2] are being met both now and in the future. The review is based on the evidence and communications received by the Group as well as other additional sources. It examines concerns raised by stakeholders, with particular reference to evidence from the Environment Agency (EA) and Natural Resources Wales (NRW). Advice from the Group is given based on the review of the evidence.

1.1 Background

The Severn Estuary is globally recognised for its ecological importance and receives protection as an EMS[3], comprising areas designated as Special Area of Conservation (SAC), Special Protection Area (SPA) and Ramsar site and a suite of Sites of Special Scientific Interest (SSSI) on the Welsh and English sides of the estuary. These designations are covered in detail in Table I(a) in appendix I. Designated sites are protected from development or activities causing harm. Conservation Objectives, as referred to in the Conservation of Habitats and Species Regulations 2017[4] (as amended from time to time), provide a framework which should inform any Habitats Regulations Assessments (HRAs) that a Competent Authority may be required to make in relation to the EMS. In addition, they can be used to inform any measures necessary to conserve or restore sites designated within the EMS and/or to prevent the deterioration or significant disturbance of their qualifying features, complementing advice on operations. Those areas notified SSSI come with a list of activities requiring consent from statutory nature conservation organisations in England and Wales. NRW and Natural England (NE) aim to ensure these sites are maintained or enhanced to meet their Conservation Objectives and steer landowners on appropriate management, taking further action if required. The ultimate aim is for all sites to be in favourable condition. For cross-border sites like the Severn Estuary, close collaboration between these bodies is essential if favourable condition is to be achieved. The Group's view on these arrangements is covered in Chapter 2.

The WFG Act's Resilient Wales Goal requires 'a nation that maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change'. The legislation requires action to be long-term and integrated with involvement, collaboration and prevention; known as the five ways of working in the Act.

The Environment (Wales) Act requires the sustainable management of natural resources, which ensures that the way in which they are used and the impacts of human activity on our natural resources does not result in their long term decline. As the new nuclear power plant at HPC is already approved, the Group can only examine these requirements in

[1] https://www.futuregenerations.wales/wp-content/uploads/2017/01/WFGAct-English.pdf

[2] https://www.legislation.gov.uk/anaw/2016/3/enacted

[3] http://publications.naturalengland.org.uk/publication/3184206?category=3229185

[4] https://www.legislation.gov.uk/uksi/2017/1012/made

terms of the present construction and future operation of the plant. However, although the plant is being built in England, it does and will continue to affect Welsh interests and therefore needs to meet the legislative requirements of both countries.

1.2 The Seven Estuary ecosystem

The health of an ecosystem is measured, in part, by its resilience, that is, its ability to maintain key functions and processes when stresses or pressures are placed upon it. Most of the features of interest within the designated areas, particularly the qualifying fish features, are currently in unfavourable condition (detailed in Table 1.1 below). This means that the Severn Estuary's marine ecosystem is not presently resilient and needs support to adapt to the considerable pressure that it already receives from human activities.

Table 1.1. Summary of indicative condition assessments for Severn Estuary/Môr Hafren SAC (NRW, 2018).

Designated features	Indicative condition assessment	Confidence in assessment
Estuaries	Unfavourable	Medium
Mudflats and sandflats not covered by seawater at low tide	Unfavourable	Medium
Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	Unfavourable	Medium
Sandbanks which are slightly covered by seawater all the time	Favourable	Low
Reefs	Unknown	Not Applicable
Sea lamprey (*Petromyzon marinus*)	Unfavourable	High
River lamprey (*Lampetra fluviatilis*)	Unfavourable	High
Twaite shad (*Alosa fallax*)	Unfavourable	High

The threats and pressures placed on the Severn Estuary SAC and SPA, and the active management needed is considered in site improvement plan and are listed in Table 1.2 below. As most site features of the SAC are in unfavourable condition, any additional pressure could further reduce their ability to resist and adapt to any future stressors such as climate change. Further stress, therefore, compromises the restoration of key habitats and species communities in the estuary and their long term viability.

The Severn Estuary SAC and SPA form part of the UK's commitment to a number of international agreements on Marine Protected Areas (MPAs) including the establishment of an ecologically coherent network (ECN) of MPAs. Active management and condition improvement of MPAs within Wales is currently under review and development by NRW through the Marine Area Statement. The UK network will act as a contribution to wider European network, in partnership with neighbouring countries, based on OSPAR Convention, World Summit on Sustainable Development and Convention on Biological Diversity. However, substantial resources are needed to meet the necessary criteria to restore and enhance these sites.

Table 1.2. The threats and proposed management measures for the features shown in Table 1.1 (IPENS, 2015).

Pressure/threat	Proposed management measures
Public Access/Disturbance	Identify/reduce impacts of disturbance to birds, and damage to habitats
Physical modification	Reduce, remove (where possible), and prevent barriers to migratory species
Impacts of development	Inform strategic planning decisions to minimise impact of development
Coastal squeeze	Limit coastal squeeze, provide sustainable coastal defences, improve existing structures, deliver compensatory habitat
Change in land management	Maintain appropriate levels and timing of grazing, and management of intertidal saltmarsh habitat
Changes in species distributions	Understand/prepare for changes in species distribution (caused by climate change/other events)
Water Pollution	Identify any existing issues and prevent/reduce the decline in water and sediment quality (applying relevant measures to all relevant tributaries in England and Wales)
Air Pollution: impact of atmospheric nitrogen deposition	Develop a Site Nitrogen Action Plan
Marine consents and permits: minerals and waste	Ensure in combination/cumulative impacts from aggregate extraction, maintenance dredging and disposal are fully considered
Fisheries: Recreational marine and estuarine	Establish levels and location of the activity (recreational bait digging and recreational fishing/angling) and potential for impact
Fisheries: Commercial marine and estuarine	Identify any threats to site features and habitats from commercial fisheries activity, and establish and ensure compliance with any necessary management measures
Invasive species	Assess the risks from, and control the spread of invasive non-native species
Marine litter	Investigate sources of marine litter and implement actions for removal/ shoreline clean up
Marine pollution incidents	Minimise impact from marine pollution incidents and clean up response

1.3 Hinkley Point C development

In 2011, NNB Generation Company (NNB GenCo - a subsidiary of EDF) submitted an application to the UK Infrastructure Planning Commission for a third nuclear power plant at Hinkley Point in Somerset known as HPC. The plant is spread over a 230 acre site and is expected to be completed in 2023 and be operational for 60 years.

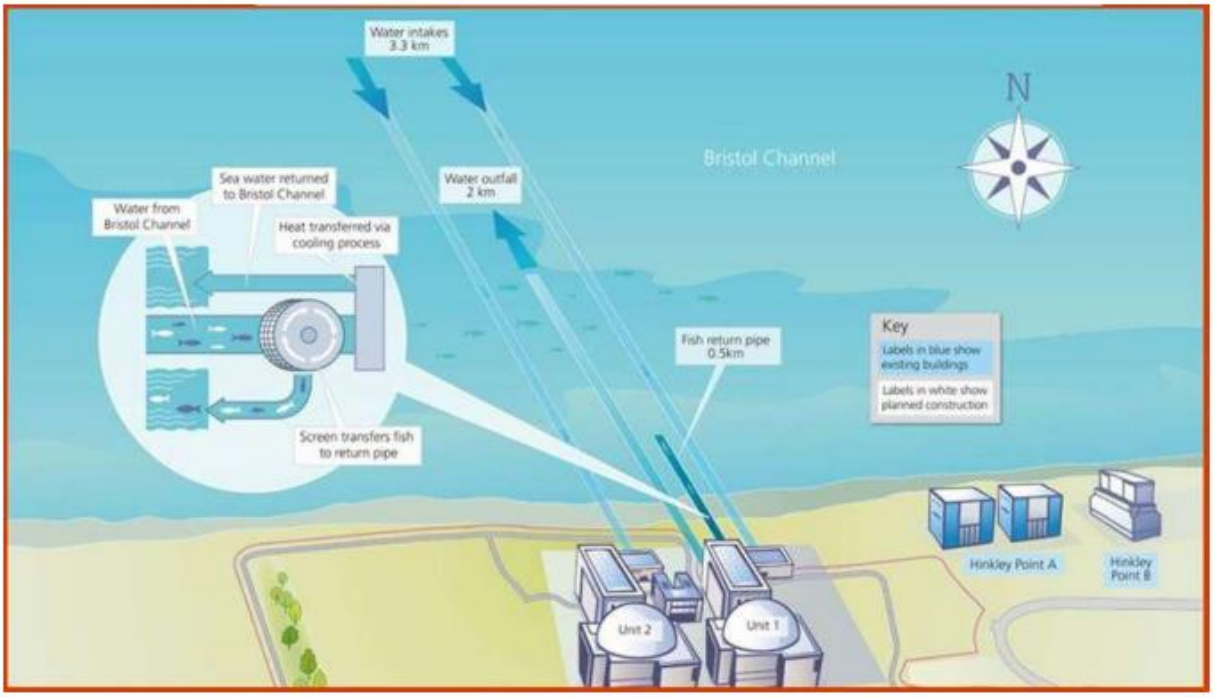
HPC is within and adjacent to European sites (SAC and SPA) and therefore required a HRA. This considered the individual impact of activities of the development at HPC, the combined impact of the development at HPC, and other pressures, such as other planned developments, upon the feature interests and other designated sites that could be affected. The HRA process revealed a number of detrimental impacts which would occur without mitigation; therefore, several permit conditions were applied through a Development Consent Order (DCO)[5]. The main area of concern was the abstraction of cooling water directly from the Severn Estuary. As this abstraction will suck in biota, most notably fish, the Water Discharge Activity environmental permit[6] (as part of the DCO) required a combined system with three fish mitigation measures. This incorporated Best Available Technology (BAT) as proposed by the EA, of a Fish Recovery and Return (FRR) System, an Acoustic Fish Deterrent (AFD) system and Low-Velocity Side Entry (LVSE) intake heads.

The Group concentrated its work on the examination of the direct cooling water system (see Figure 1.1), which extends 3km into the Severn Estuary. The seawater is sucked into the system along with any biota (living organisms) into the intake tunnels and will then pass through a series of screens onto which any organisms (mostly fish) larger than the mesh size will become impinged (trapped) and returned to the estuary via a FRR System including an Archimedes Screw. Any living organisms smaller than the mesh size will become entrained within the system and will be returned to the estuary via the cooling water discharge. To reduce the number of fish entering into the intake system, the EA concluded that a behavioural deterrent was needed in the form of an AFD system to audibly alert fragile hearing-specialist fish species to the danger and allow them to avoid the intake, as they are less likely to survive the FRR. In addition, Low-Velocity Side Entry (LVSE) intake heads were added to the design to reduce the flow of the intake water to stimulate avoidance behaviour (enable fish to swim away).

[5] https://www.legislation.gov.uk/uksi/2013/648/contents/made

[6] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291296/LIT_7947_e754c0.pdf

Figure 1.1. Summary of HPC cooling water abstraction and FRR system (taken from EA 2020).



1.2 Concerns

1.2.1 Potential impacts on fish populations

The Severn Estuary is home to many fish species, including those that are common, rare and migratory. Different fish species live at different depths, and have different behaviours, abilities to hear, and life cycles. Therefore, different fish species need to be deterred from entering the intake pipes using different methods. Although there is often a focus on ensuring rarer species are not impacted by human development, when examining the possible impact on the resilience of the ecosystem, consideration of common species is just as important, not least because they provide food sources for other species. The Severn Estuary is also an important destination for migratory species at key times of their lifecycle, such as the globally critically endangered European Eel *Anguilla anguilla*. Therefore, there are serious concerns surrounding the proposed removal of the AFD requirement from a WDA environmental permit issued in 2013 (and any subsequent variations to the DCO and marine licence) at HPC. These concerns have been brought forward by a wide range of stakeholders to the Group and through written evidence to associated consultations. The most pertinent concerns are listed here:

- The Hinkley Point C (Nuclear Generating Station) Order was made by the Secretary of State in 2013. The intake pipe design accepted for this DCO included three elements: the LVSE, FRR and AFD to work in collaboration. The concern is that the removal of one element means that the combination of measures will no longer provide the mitigation impact that is required to ensure the EMS features will not significantly be impacted by the direct cooling water system. Fish Guidance Systems Ltd have pointed out that NNB GenCo's own analysis shows that the removal of the AFD will result in an estimated loss of an additional 37 tonnes annually (as Equivalent Adult Values) of fish from the Severn Estuary's fish assemblage (including SAC features of interest: such as Twaite Shad) and that these losses may be exacerbated by the impacts of climate change. This value has

been contested as an underestimation by several stakeholders, one of whom, Dr Peter Henderson, who has been involved in impingement research at Hinkley Point B (HPB), has calculated that the estimated annual capture rate (impingement) of the system will be over 182 million fish, and it is likely that many of these will not survive.

- EDF has stated that they do not think that an AFD is needed as its removal would have a negligible impact on the fish populations in the Severn Estuary, with the other two fish protection measures in place. It is suggested there are technological and logistical difficulties that mean an AFD is not a viable option. However, AFD technology has seen significant developments since EDF's original proposal, through Active Pressure Compensation Systems for the Sound Projectors, new Power and Communication Hubs, and improved software and hardware providing greater monitoring and control over the systems, which Fish Guidance Systems suggest could now be considered by NBB GenCo to mitigate impacts. This has raised the question with the Group, that if the technology was not viable at the time of the WDA permit approval, then why was its use considered BAT, and why have other options such as a closed system not been considered as alternatives?
- The original reasoning behind designing a direct intake system has been questioned because this type of system is no longer used in other countries due to the damaging impact it has on fish populations, and therefore consideration of a redesign to an indirect cooling plant, or another alternative technology, should be considered.

The Cefas assessment report TR456, submitted by EDF as evidence of "*negligible impact on fish populations*", provides their rationale for removing the AFD. However, the removal of the AFD from the intake design was questioned by other stakeholders, and some have also questioned the evidence provided in the TR456 report, with the following concerns:

- The impacts of the reduction in the size of the mesh screen from 10mm to 5mm have been significantly underestimated, given the likely impingement and mortality for some fish species. The Group understand that Cefas has not used data available from entrainment studies at HPB to estimate the number of fish that presently penetrate the 10mm mesh and become entrained;
- Assumptions have been made that the LVSE is sufficient to mitigate the removal of the AFD but this has not taken into account the impacts of the unusually high suspended sediment levels in the Severn Estuary;
- The assessment of the impact of the 'capping system' on reducing impingement mortality is likely to be flawed, not least because capped systems do not reduce impingement rates for all fish species, and the exemplars provided within the report are not comparable to the site at HPC;
- Screen orientation relative to tidal flows may not reduce impingement mortality as predicted;
- The assumption that screen impingement has a linear relationship with water flow is incorrect and underestimates impingement and mortality rates considerably;
- The use of ICES stock assessments is considered to be inappropriate due to the large geographical area used by these assessments and the lack of consideration of the dynamics of the fish populations within the Severn Estuary ecosystem leading to an underestimation of mortality;

- There is an absence of data on the impact on fish populations from entrainment that will lead to an underestimation of mortality and overall impact;
- There is an inadequate reference to current and relevant research on fish populations within the Severn Estuary;
- There is a lack of consideration of changes to the fish assemblage due to climate change leading to an underestimation of impact;
- Data used from the monitoring programme at HPB have been extrapolated for the assessments, but there is no consideration of the different location of the intake pipes, and the full data set has not been used, leading to an underestimation of impact;
- The assessment assumes that the removal of fish by a direct intake system is comparable to any other fishing activity within the area, which is regulated and adjusted through adaptive measures process; and
- There is no contingency plan if the AFD is not included together with the FRR nor any suggestion of other mitigation measures that could be used in its place.

1.2.2 Sediment dredging and disposal

Chapter 3 examines the composition of dredged material; this chapter examines if the disposal of dredged material at Cardiff Grounds could impact the local ecology. The underlining principle is that if sediments are dredged within a SAC, that this material is re-deposited elsewhere within the same system to ensure no sediment loss within the system. The Severn Estuary is an extremely dynamic system both in terms of tidal range but also the outflows of several major rivers. Modelling is, therefore, the best method to try and predict any negative impacts, such as the smothering of key ecological habitats by deposited material. Chapter 4 highlights that what little modelling there is, is not conclusive and the Group discussed the need for further modelling. Towards the end of the consultation, EDF has sought a licence to dispose of dredged materials at Portishead. In view of the Group's commitment to report before the Senedd elections, there is a lack of information and time for the Group to consider any additional evidence particularly pertaining to potential ecological impacts.

1.2.3 Thermal properties of Hinkley Point C water discharge

Concerns were raised by stakeholders over the thermal impacts of the discharge waters. A predicted discharge, of up to 11.6 million cubic metres, of cooling water, will be returned at a maximum of 12.5°C above the ambient seawater temperature. This could impact the ecological community surrounding the outflow, particularly any non-mobile species. Although this impact will be temporary and will only occur for the lifetime of the operations (~60 years), considerations of the short and medium-term impacts on the directly affected habitats and associated species are needed. One concern is that there may be an influx of warmer water species, including non-natives, which could establish populations out-competing existing native species. There is also a concern that higher temperatures could impact local thermally-sensitive species and habitats.

1.2.4 Chemical properties of Hinkley Point C water discharge

Issues raised included concerns about:

- Toxicity of biocides (used to control biofouling) and their residual toxicity, including the rate that these chemicals degrade and disperse in the environment. Specific

concerns were raised regarding their impact on important food species such as the macroinvertebrates (e.g. *Macoma balthica*) within the sediment.

- The use of chlorination to remove biofouling within the intake system and the potential bioaccumulative impacts of the chemicals used on the immediate and wider marine ecosystem. NNB GenCo documentation states that the use of chlorine could kill 0.05% of the Inner Channel phytoplankton (the basis of the food web), and there could be cumulative impacts over the life of the operation (~60 years).

1.2.5 Further habitat considerations

Wider issues of ecological concern were discussed, and these included:

- The damage to the nationally important *Corallina sp.* pools on the foreshore at Hinkley Point after impacts of a Wave Walker, used to set pylons during the construction for a jetty, were underestimated. Since the damage, EDF has been maintaining artificial bunds to preserve the original environmental conditions.
- Ensuring no damage to the saltmarsh habitat that has been recently created close to Hinkley Point. This habitat has become an important juvenile and nursery habitat for various fish species and so needs to be protected.
- The need to consider climate change and the likely increase in sea levels that will result in coastal squeeze, which could mean a more significant proportion of fish eggs and young within the Severn Estuary being pushed towards the development site.
- The lack of evidence that an ecosystem-based approach has been considered, with a lack of assessment of the cumulative ecological impacts of the development.
- Issue of unexploded ordnance (~150 items) in the area to be dredged was raised by the MMO. Further assessment is needed in regards to how this ordnance will be removed. If this includes on-site detonation, then the direct and indirect effects (sound/vibration) on EMS features need to be assessed.

1.3 Review of evidence

1.3.1 Will the intake pipes cause fish deaths?

The impacts of cooling water abstraction on wildlife arise because fish and other species are unintentionally drawn into the power station along with the cooling water. The proposed development and construction of HPC and its associated cooling water system was assessed by the EA through a Habitats Regulation Assessment (HRA). This process is to ensure that there is no adverse effect on the integrity of the Severn Estuary EMS, and other relevant designated sites (see Annex II, Table 1c). The HRA DCO was determined in 2013 and requires a complementary set of mitigation measures needed to approve a direct cooling system. The combination approved was for a LVSE, FRR and AFD and was based on the EA's Best Available Techniques device[7],[8]. The awarded DCO requires that this combined system is in place for the operation of HPC.

[7] Environment Agency 2005. Screening for Intake and Outfalls: a best practice guide. Environment Agency Science Report SC030231/SR3.

[8] Environment Agency 2010 Cooling Water Options for the New Generation of Nuclear Power Stations in the UK SC070015/SR3..

However, in 2018 NNB GenCo submitted a request to the Secretary of State for the removal of the AFD from the permit requirements due to predicted technical difficulties in installation and maintenance. The EA reviewed technical report TR456 (2018, Edition 2) submitted by Cefas as evidence to support their conclusion that the 'absence of an AFD system at HPC will not give rise to significant effects associated with the impingement and entrainment of fish'. Neither the EA, NRW, nor NE, nor Devon and Severn Inshore Fisheries Conservation Agency (D&S IFCA) support this conclusion. To determine the level of impact that this would have on the integrity of the Severn Estuary EMS, the EA began to undertake a new HRA and, during the initial stages, EDF determined that their request would not be successful and subsequently launched an appeal to the Secretary of State. The appeal is now being overseen by the Planning Inspectorate (PINS). In the meanwhile, the EA concluded that the HRA would still require an AFD, however the final decision will now be determined by PINS. The decision by PINS cannot be appealed but may be challenged through a Judicial Review process.

PINS are consulting on the appeal and the EA completed the HRA process and through this have responded by stating that

> "*insufficient information has been presented to consider effects against the conservation objectives*" and "*insufficient information is available to consider the robustness of the predicted impingement figures*" and have stated that they "*unable to advise that adverse effects to the integrity of the SAC/Ramsar/SPA sites would be avoided*", a view that they confirm is also held by NE.

The EA, in their response to questions posed by the Group, explained that the LVSE intake heads need to work in combination with a behavioural cue, such as an AFD, to deter more fragile hearing-specialist fish species that are unlikely to survive the journey through the FRR and that the removal of the behavioural cue of the AFD "*greatly reduces the benefit of the LVSE as a mitigation measure for those hearing species*". The FRR alone provides no mitigation for fragile species without a behavioural cue, and the LVSE will only allow those species with the swimming ability to avoid being drawn in to not enter the FRR.

Through discussions with agencies and other stakeholders, the Group has developed significant concerns over the potential impacts that a direct intake system, without adequate mitigation measures, would have on the already pressurised fish assemblage and, therefore, the resilience of the Severn Estuary ecosystem and its species. The EA concluded through the latest HRA process that they are "*unable to conclude, beyond scientific doubt, no adverse effect alone on-site integrity for Twaite shad, Allis shad, Atlantic salmon, migratory fish assemblage and assemblage of fish*". This concern extends to the legislative requirements of the WFG and Environment (Wales) Acts.

This means that if NNB GenCo is permitted by PINS to construct and operate the intake system without an AFD, there could be considerable impacts upon the resilience of fish populations in the Severn Estuary EMS and would be against the Welsh interests.

1.3.2 Will the dredged sediment disposal have any impacts on the ecology?

The development at HPC requires dredging of the surrounding seabed for the construction of the temporary jetty (now completed) and to allow for the drilling of six vertical shafts for the direct water intake cooling system. The dredged marine sediment from the site will need to be disposed of in an established designated disposal site. One site is known as LU110 Cardiff Grounds, and NNB GenCo was permitted to deposit sediments there in 2018, with further works planned for early 2021. A second disposal site at LU070 Portishead is now also under consideration. Both proposed operations are

undergoing Environmental Impact Assessments (EIA), and this topic is considered further in Chapter 4.

1.3.3 Is the temperature of water discharged warmer than sea temperatures and if so, is this of concern?

As seawater is used to cool the reactors at HPC this water is heated and so when returned to the estuary is warmer than the surrounding seawater. This creates a thermal plume (increased temperature) around the outflow pipe with the temperature of this water dissipating as it mixes with the surrounding seawater. Cefas responded that their modelling of the thermal plume has shown that it "*does not impact the Welsh coast either directly or due to its influence on dissolved oxygen levels*". However, Cefas did not provide further information on the potential impacts upon the area directly within the outflow, nor how any effect to this area could cause ecosystem changes (affect fish nursery grounds and/or specific species). No evidence was provided of consideration of how creating a temporary habitat (warm waters) may be suitable for species that cannot typically reside in the cooler waters of the estuary. The lack of clarity on this matter does raise concerns with the Group. This matter is considered in further detail in Chapter 4.

1.3.4 Could chemicals added to discharge water damage the ecology of the Severn Estuary?

Cefas and EDF have stated that prevailing environmental conditions at Hinkley Point mean that chlorination, to prevent biofouling, is not required. Despite this, assessment has been undertaken in case chlorination is required in the future. The Group inquired as to how the Total Residual Oxidants (TRO's) produced by the bromine-based chemicals if used would pose a threat to the ecology of the estuary. These chemicals have an initial rapid decay followed by a slower exponential decay. Cefas informed the Group that the half-life for clear water is given as ~13 minutes and stated that values derived for turbid conditions were used in assessments. However, these values have not been shared with the Group. The Group is therefore, unsure as to what the impacts would be for the feature interests of the EMS.

Cefas also responded that they have considered how contaminants bioaccumulate and persist in determining the biological effects of the individual contaminants in their assessments and that it is "*not standard practice in the UK to carry out ecotoxicology on particular sensitive species or ecosystems unless the risk of harm cannot be reasonably screened out*". They also explained that these assessments are based on ecotoxicological data from the US as they do not have the UK focused bioassay dataset. This is of concern to the Group as data relating to UK species is needed to ensure that assessments are relevant to local communities and environmental conditions.

1.3.5 Have other habitat impacts been considered?

Stakeholders raised concerns over the development at HPC and assessments undertaken, listed above in section 1.2.6. Whilst these were not discussed directly with the consultees, the understanding of the Group is that the HRA process strives to consider proposed impacts and the cumulative effects of the development and other projects within the vicinity. However, its assessments cannot predict the cumulative impacts upon the already pressurised ecosystem in the future especially from climate change. This underlines the importance of restoring the resilience of the Severn Estuary ecosystem.

1.4 Advice

The Severn Estuary ecosystem is one of the most highly protected ecosystems in the UK. In order to ensure that the resilience of the Severn Estuary is restored and enhanced for future generations, it is essential that the features recognised in the awarding of these designations are protected and, where necessary restored. Therefore, a failure of the process to uphold the original requirements of the DCO permissions will show how short-term policy decisions do not meet longer-term outcomes of the Well-Being of Future Generations (Wales) Act.

The evidence provided and responses to the Group lead to the conclusion that there remain considerable uncertainty and substantial evidence that the proposed removal of the AFD from the intake system at HPC would compromise existing best available technological advice and hasn't considered developments in AFD design (discussed above). The conclusions of the EA's HRA demonstrates that there could be an adverse impact upon the Severn Estuary ecosystem and its fish assemblage, which contradicts Welsh legislative and policy aims and would therefore be against the Welsh interest. Annex II provides a detailed examination of the evidence in the context of Welsh legislation and policy.

Advice 1: The original requirements of the Development Consent Order should be upheld to avoid any significant adverse short-term or long-term impact upon the features of the Severn Estuary European Marine Site. If the removal of the Acoustic Fish Deterrent is approved by the Planning Inspectorate, then we believe other mitigation measures must be considered and used to support the already pressurised fish community in this ecosystem and that Welsh bodies (Natural Resources Wales) be consulted on any mitigation measures to take Welsh legislation into consideration. If mitigation measures are ignored, the impacts upon the Severn Estuary would be felt in both the short and long-term.

If no suitable mitigation is available, we advise the development can then only be approved provided three tests required by the Conservation of Habitats and Species Regulations (2017) are met:

- There are no feasible alternative solutions to the plan which are less damaging.
- There are "imperative reasons of overriding public interest" for the plan to proceed.
- Compensatory measures are secured to ensure that the overall coherence of the network of European sites is maintained.

Advice 2: The deleterious impact of continuous abstraction of water raises the question of whether alternative water abstraction systems should be considered. Closed water cooling systems such as those using cooling pools are now considered best practice elsewhere and would considerably reduce the pressure on marine ecosystems. Our advice is that relevant stakeholders should be engaged in discussions on these steps, especially on alternatives and potential compensation measures, following the determination of the Planning Inspectorate. In the future, abstraction systems that affect protected waters should not be considered.

Advice 3: To further the resilience of the Severn Estuary, active management of all designated sites in the Estuary needs to be resourced, and should include measures to address impacts on features of interests. Also, wider management within the estuary should be considered such as the active management and restoration of fish movement pathways for migratory fish across the riparian network to counter built infrastructure

barriers to fish spawning grounds. Resources are needed to ensure that active management can be effective in restoring and enhancing the resilience of the ecosystem.

1.5 Future Considerations

To give current and future generations a good quality of life, Wales need to think about the long term impact of the decisions made. Therefore, proposals need to consider the long term and how they could compromise future generations.

Throughout the conversations with EDF, little consideration has been made about both the climate change and ecological crisis. As these crises deepen, consideration has to be made on how to stop the damaging activity and to mitigate any increased pressures. Policy and regulations provide evidence-based decisions that need to be viewed not as technical obstacles but in the spirit of enabling sustainable development.

Advice 4: If the Planning Inspectorate find in favour of the NNB GenCo request to the Secretary of State for the removal of the Acoustic Fish Deterrent, then an appeal cannot be raised. This then brings into question if the original ecological safeguards identified in the HRA are being upheld. The only further challenge would be through a Judicial Review. This is extremely costly, complex and time consuming and only considers if correct process is followed so limits the ability of an individual citizen to challenge the decision. This compromises the aims of the Aarhus Convention, which requires all citizens to have the right to participate in environmental decision-making and the right to review procedures to challenge public decisions.

Advice 5: Any future mitigation measures must include input from Welsh bodies to ensure the requirements of Welsh legislation are fulfilled. If the Planning Inspectorate determine in favour of EDF they may require mitigation measures for impacts on fish populations. These measures would be determined by the Environment Agency, who should then consult with Welsh bodies to ensure Welsh legislation is upheld.

Advice 7: Any future cross-border infrastructure projects need to consider Welsh legislation from a project concept stage. This would then enable a process that develops a project that follows the five ways of working principles in the Well-being of Future Generations Act and that all considerations to ensure sustainable development are made from the outset.

Appendix I: Summary of designations for Môr Hafren/ Severn Estuary European Marine Site

Table I(a). Features and designations of the Severn Estuary European Marine Site (taken from NE/CCW 2009).

Feature	Severn Estuary SAC	Severn Estuary SPA	Severn Estuary Ramsar Site	Severn Estuary SSSI	Bridgwater Bay National Nature Reserve	Bridgwater Bay SSSI
Estuary	Yes	Supporting habitat to designated bird interests	Yes	Yes	Yes	No
Subtidal sandbanks	Yes	No	No	No	Yes	Yes
Intertidal Mud and Sand	Yes	Supporting habitat to designated bird interests	Component of Ramsar "estuaries" feature and supporting habitat to designated bird interests	Yes	Yes	Yes
Atlantic salt meadow / salt marshes	Yes	Supporting habitat to designated bird interests	Component of Ramsar "estuaries" feature and supporting habitat to designated bird interests	Yes	Yes	Yes
Reefs	Yes	No	Intertidal Honeycomb worm (*Sabellaria)* reef contiguous with subtidal reefs is a component of the hard substrates sub-feature of the Ramsar "estuaries" feature	No	No	No
Migratory fish (river & sea lamprey & twaite shad)	Yes	No	Yes	Yes	No	No
Migratory fish (salmon, eel, sea trout and Allis Shad)	Part of notable species sub-feature of estuary feature	No	Yes	Yes	No	No
Assemblage of fish	Notable species sub-	No	Notable species sub-feature of estuary feature	Yes	No	No

species (>100 species)	feature of estuary feature					
Internationally important populations of migratory bird species	Notable species sub-feature of estuary feature	Yes (Bewick's swan, European white-fronted goose, dunlin, redshank, shelduck, gadwall, curlew, Northern pintail, ringed plover)	Yes Internationally important populations of waterfowl	Yes (curlew, dunlin, grey plover, redshank, ringed plover, shelduck)	Yes (shelduck, dunlin, teal, wigeon, curlew, grey plover, avocet, black-tailed godwit)	Yes (black-tailed godwit, curlew, dunlin, redshank, shelduck, snipe, teal, whimbrel, wigeon)
Internationally important populations of wintering bird species	Notable species sub-feature of estuary feature					
Assemblage of nationally important populations of waterfowl	Notable species sub-feature of estuary feature	Yes (as above plus wigeon, teal, pochard, tufted duck, grey plover, whimbrel, spotted redshank, lapwing, mallard, shoveler)	Yes	Yes	Yes	Yes
Hard substrate habitats (Rocky shores)	Notable species sub-feature of estuary feature	Supporting habitat to designated bird interests	Component of Ramsar "estuaries" feature and supporting habitat to designated bird interests	Yes	No	No
Freshwater grazing marsh / Neutral grassland	No	Supporting habitat to designated bird interests within SPA but outside European Marine Site		Yes (currently England only)	No	Yes

Table I(b). The features of Welsh designated sites considered through the HRA.

European Site	**Designation**	**Primary features (and qualifying features)**
River Wye/Afon Gwy	Special Area of Conservation	Sea lamprey Twaite shad Atlantic salmon (Allis shad)
River Usk/Afon Wysg	Special Area of Conservation	Sea Lamprey Twaite shad Atlantic salmon (Allis shad)

Appendix II: Welsh legislative context concerning the removal of AFD

Table II(a). Welsh legislative and policy context of the potential impact of permit changes on migratory fish assemblage and features.

Welsh legislation/policy		**Effect of removal of the mitigation measure (AFD)**
Well-being of Future Generations Act 2015	"*Sustainable development principle - must act in a manner which seeks to ensure that the needs of the present are met without compromising the ability of future generations to meet their own needs*."	If there is an adverse impact upon fish assemblages, this could compromise the resilience of the Severn Estuary ecosystem, contrary to the aims of Goal 2. Also, future generations will not be able to enjoy the fishing culture of the Severn Estuary nor be sustained through its tourism potential.
Environment (Wales) Act 2016	To maintain and enhance the resilience of ecosystems and the benefits that they provide.	An adverse impact upon the fish community will have consequences for the rest of the food web, reducing its resilience to future pressures compromising principles of Sustainable Management of Natural Resources.
Marine and Coastal Access Act 2009 - UK Marine Policy Statement – Section 44	Ensure a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets.	The marine ecosystem of the Severn Estuary is current in unfavourable status and the potential of this impact would cause a further decline in its health would affect its ability to function.
UK Marine Strategy Regulations 2010 (Marine Strategy Framework Directive (MSFD))	Biological diversity is maintained; Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock; All elements of the marine food web, to the extent that they are known, occur at normal abundance and diversity levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.	The adverse impact upon the fish community would impact upon the biological diversity, particularly for commercially exploited fish and there could be considerable impacts upon the migratory species.

Conservation of Habitats and Species Regulations 2017	Special Areas of Conservation and Special Protection Areas	Features would be further impacted upon, and the marine food web could alter depending upon the severity of impact.
Wildlife and Countryside Act 1981	Designation of Sites of Special Scientific Interest and partial protection of Allis shad and Twaite shad under Schedule 5.	No adverse impact could not be concluded for both shad species that are already under pressure.
Ramsar	Assemblage of migratory fish species (sea lamprey, river lamprey, twaite shad, allis shad, salmon, sea trout and eel).	No adverse impact could not be determined for the assemblage of migratory fish species which are already under pressure.
Marine Area Statement	Building resilience of marine ecosystems theme	The unfavourable condition of the EMS means that the MPA network is not currently ecologically coherent, and any further pressures could make it harder to restore and enhance.
National Marine Plan for Wales	Fish species and habitats (ENV_07) – fish lifecycles and ecosystems on which they depend need to be sustained; Precautionary principle should be applied where there are reasonable grounds that human activities may bring about hazards to harm living resources and marine ecosystems; Adaptive management; Where benefit to public outweighs the damage to the environment, compensatory measures must be secured to ensure the overall coherence of the network.	The potential significant impacts on the mortality of fish species in the Severn Estuary could impact upon their life cycles, especially as HPC also has a smaller intake mesh screen than has been used at HPB. Adaptive management is implemented for fishing activities, but the activity of HPC would be indiscriminate and at this time, EDF has not suggested any compensatory measures.
Nature Recovery Action Plan for Wales	To recover nature we must build resilient ecological networks and mosaics across our whole land and seascape to safeguard species and habitats and the benefits they provide.	The potential of an adverse impact upon the fish assemblage would not allow the ecosystem to recover and would therefore not be a resilient seascape.

Chapter 2

Cross-border arrangements

2.1 Introduction: the need for cross-border arrangements

The shared natural system of the Inner Bristol Channel and Severn Estuary demands that appropriate cross-border arrangements are in place for managing this dynamic and complex environment. Many natural features and processes, including sediment and fish movements, operate at an estuary scale and wider, transgressing jurisdictional boundaries. There are also other cross-border implications which need to be taken into consideration in the context of Hinkley Point C (HPC), including transboundary and cumulative impacts of human interventions, and associated management measures including pollution control measures and marine licences. As a signatory to the Convention on Biological Diversity[9], UK Government is required to follow the ecosystem approach, a 'strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.' This approach also underpins the approach to the sustainable management of natural resources under The Environment (Wales) Act (2016)[10] and Welsh Government's approach to marine planning. However, actioning the ecosystem approach for cross-border areas is generally recognised as challenging, as a result of the complexity and fragmentation of roles and responsibilities[11].

Group concerns

The overarching aim at the start of the review was to understand:

- The adequacy of cross-border relationships for addressing transboundary and cumulative impacts across the Severn Estuary/Bristol Channel

In order to achieve this aim, the Group sought to clarify:

- The effectiveness of estuary-scale plans and strategies in providing a consistent and coherent strategic context for local decision-making on key environmental concerns related to Hinkley Point C
- The efficacy of cross-border arrangements associated with the granting of permissions, consents and licences for activities/works on either side of the estuary

The chapter commences with a brief overview of relevant plans and strategies (Section 2.2), informed by a desk-top, online study of relevant documents as well as written and verbal evidence received by the Group. Section 2.3 examines the cross-border arrangements associated with decision-making processes relating to the

[9] https://www.cbd.int/

[10] Welsh Government (2016) *Sustainable Management of Natural Resources*, Environment (Wales) Act 2016 Factsheet, 2pp., https://gov.wales/sites/default/files/publications/2019-05/environment-wales-act-2016-sustainable-management-natural-resources.pdf

[11] Gilliland, P.M. and Laffoley, D., 2008. Key elements and steps in the process of developing ecosystem-based marine spatial planning. *Marine Policy*, *32*(5), pp.787-796.

issuing of permits, consents and licences. It is largely based on verbal and written evidence received by the Group from a range of organisations including relevant government departments and agencies. Where further details regarding the adequacy of some of these arrangements occurs in other chapters, this is indicated.

2.2 Review of evidence

2.2.1 Estuary-scale plans and strategies

There are various estuary-wide plans and strategies relevant to the Severn Estuary and Inner Bristol Channel of relevance to Hinkley Point C. These provide the context for local decision-making on a range of matters including the issuing of consents for coastal and offshore activities, including Water Discharge Activity (WDA) Permits and Marine Licences. In the case of the Bristol Channel Standing Environment Group's Activation Plan (2018), the only plan which covers the entire Bristol Channel, this provides operational guidance and a framework to guide the group's activities in the event of a maritime pollution incident. This plan is discussed further in Chapter 5 and the key characteristics of this and other relevant plans are summarised in Table 1. Those deemed most relevant to the Group's remit, and providing the context for the discussion in Section 2.3, are discussed in the following sub-sections.

2.2.1.1. Severn Estuary Marine Site and the Single Management Scheme

As noted in Chapter 1, the Severn Estuary's protected area status is important to the overall management and integrity of the estuary's designated habitats and species. This has significant implications for marine licencing applications around the estuary as noted in Chapter 3, to the extent that the Hinkley Point C Development Consent Order (2013) included a condition (PW23) that the '*disposal of dredged material arising from the authorised project shall not be disposed of except within the Severn Estuary Special Area of Conservation*[12]'.

The importance of the Conservation of Habitats and Species Regulations (2017)[13] in providing 'a single legislative instrument' and maintaining consistency for cross-border sites was recently highlighted by the Economy, Skills and Natural Resources Department, Welsh Government[14]. This Explanatory Memorandum noted that '*a single set of regulations recognises wildlife knows no borders*.' In addition to this, Regulation 33 advice, Joint Conservation Advice for the entire Severn Estuary Site, was published by Natural England (NE) and the Countryside Council for Wales (now NRW) in June 2009. Recently, a pilot study between NRW and NE investigated the updating of the joint advice package, but it was agreed not to proceed with this and

[12] HM Government (2013) The Hinkley Point C (nuclear generating station) Order 2013, See: https://www.legislation.gov.uk/uksi/2013/648/contents/made

[13] And the *Habitat Regulations: the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019* *http://www.legislation.gov.uk/uksi/2019/579/contents/made*

[14] *Economy, Skills and Natural Resources Department, Welsh Government (2013)* Explanatory Memorandum to The Conservation of Habitats and Species Regulations, 5pp., *https://business.senedd.wales/documents/s68629/Paper%2013%20Explanatory%20Memorandum.pdf)*

so the 2009 document remains the current agreed advice for the Site. In this context it should be noted that NE and NRW have a duty to provide advice to Relevant Authorities on the Conservation Objectives for the Site, as well as advising on activities and pressures that might cause deterioration or disturbance to designated features. Such advice along with Conservation Objectives[15] has provided the context for the production of the ASERA Management Scheme[16] (Table 1), a single coordinated scheme of management for the entire site which guides Relevant Authorities in the exercise of their functions in relation to land or waters within or adjacent to that area or site. Whilst the Scheme provides a coordinated framework to aid decision-making across the estuary, discussions with Welsh Government Marine Team[17] suggested there may be a place for more specific guidance on 'threshold limits' associated with this Scheme. They noted that this might be appropriate for things such as fish deterrent systems. However, the practical challenges of developing and introducing such thresholds was recognised.

As mentioned in Chapter 1, following the UK's withdrawal from the EU, there is some uncertainty regarding cross-border negotiations associated with future appeals associated with trans-boundary sites. As noted, previously these would have been heard by the European Court of Justice, but post-Brexit, there are now separate assessment bodies in England and Wales (currently the interim Environmental Protection Assessor for Wales and the Interim Office for Environmental Protection, prior to their formal establishment under Welsh legislation and as part of the Environment Bill for England).

2.2.2.2 Marine plans

Marine plans inform and guide the regulation, protection and use of offshore areas and support the UK Government's vision for 'clean, healthy, safe, productive and biologically diverse oceans and seas.'[18] As statutory plans, public authorities have a statutory obligation to make decisions in accordance with these. Such decisions include those relating to planning consents, marine licensing and coastal operations to marine compliance and enforcement.[19] As these plans only apply to proposals for new developments and activities, they do not affect any previous licenses or decisions, although it is clear that they 'should be used for any changes or additions to existing developments or activities'[20] and so are very relevant to current applications related to HPC. As indicated in Table 2.1, there are two marine planning areas for the Severn Estuary/Inner Bristol Channel, with Welsh Government

[15] Including the Habitat Regulations: the Conservation of Habitats and Species (amendment) (EU Exit) Regulations 2019, See: *http://www.legislation.gov.uk/uksi/2019/579/contents/made*

[16] Association of Severn Estuary Relevant Authorities (ASERA) (2018) *Severn Estuary European Marine Site Management Scheme 2018 – 2023*, 63pp., https://asera.org.uk/wp-content/uploads/sites/3/2018/05/Severn-Estuary-EMS-Management-Scheme-2018-2023-May-2018-2.pdf

[17] Welsh Government (Marine Team), Verbal evidence: 01/03/21

[18] Marine and Coastal Access Act 2009; see: https://www.legislation.gov.uk/ukpga/2009/23/contents

[19] Marine Management Organisation (2015) *Marine plan: user guide;* see: https://www.gov.uk/government/publications/marine-plan-user-guide/marine-plan-user-guide

[20] *Op.cit.*

responsible for the development of the Wales National Marine Plan (2019)[21] and the Marine Management Organisation holding similar responsibilities for the marine plan for the South West, currently a consultation draft (MMO, 2020)[22].

With respect to the need for a coherent and coordinated marine planning system for the estuary, the Marine Policy Statement (2011)[23], prepared and adopted in relation to Section 44 of the Marine and Coastal Access Act 2009, is noteworthy. This provides high-level policy context for the preparation of all marine plans. Section 1.2.1 states that the UK Administrations are committed to the co-ordination of marine planning across administrative boundaries, noting that

> *'coordination will include planning for activities which extend across national or Marine Plan area boundaries, the sharing of data between plan authorities and the timing of the development of Marine Plans for any area. Concordats between UK administrations will enshrine the close cooperation and mutually beneficial approach to marine planning that is in place*.'

Whilst no such concordats appear currently publicly available, the Group received written and verbal evidence from Welsh Government (Marine Team) indicating a clear commitment to the co-ordination of marine planning across administrative boundaries. The evidence noted regular liaison between Welsh Government and the Marine Management Organisation to 'ensure coherence across marine planning approaches between England and Wales.' Such liaison ''*includes quarterly meetings, regular bilateral meetings during plan development and attendance at each other's stakeholder engagement events, in addition to the provision of written advice, feedback and comments on developing policies".*[24] It was also pointed out that the ''*MMO provide input to the Welsh Government Marine Planning Stakeholder Reference Group and Marine Planning Decision Makers Group, and that within such meetings cross-border issues are a regular agenda item.*[25]

The scrutiny of both the Welsh and emerging South West marine plans through Sustainability Appraisals (SAs) and Habitat Regulations Assessment (HRA) processes has revealed how important these assessment processes have been in highlighting potential transboundary issues and how these processes have led to the strengthening of policies to improve plan coherence.[26]

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[21] Welsh Government (2020) *Wales National Marine Plan*, 180 pp.

https://gov.wales/sites/default/files/publications/2019-11/welsh-national-marine-plan-document_0.pdf

[22] Marine Management Organisation (2020) *South West Inshore and South West Offshore Marine Plan Draft for consultation* January 2020, 56pp.; see: https://www.gov.uk/government/publications/draft-south-west-marine-plan-documents

[23] HM Government Northern Ireland Executive Scottish Government Welsh Assembly Government (2011), *UK Marine Policy Statement*, 51pp., https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69322/pb3654-marine-policy-statement-110316.pdf

[24] Written evidence and verbal evidence (01/03/21) from Welsh Government (Marine Team)

[25] *Op. cit.*

[26] MMO (2019). *South West Inshore and Offshore Marine Plans Sustainability Appraisal Part 1*: Introduction and Methodology. Draft Report. A report produced for the Marine Management Organisation, MMO, September 2019, 45pp., see: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/85

SAs for the WNMP have also highlighted the potential need for formal consideration of cross-border and cumulative effects of the WNMP both alone and in-combination with other plans and programmes (including the marine plans of surrounding administrations) through the plan's implementation and monitoring stages.[27] The SAs have also raised the possibility of the development of additional guidance to support cross-border marine planning[28], a point which was also raised in written evidence from Welsh Government[29] in which the intention to undertake further joint cross-border work with the MMO was stated (once the English adjoining marine plans have been finalised).[30]

As a result of active dialogue, the published WNMP[31] and the consultation draft of the South West Marine Plan[32] include clear policies relating to cross-border areas and express the need for consideration of trans-boundary impacts (Table 2.2). This is stressed in the SWMP Technical Annex[33] and in the WNMP Implementation Guidance (2020)[34] in advice to plans users, including proponents applying for an authorisation. It is also noteworthy that para. 1257 in the former suggests further consideration of estuary management plans could aid the management of cross-

7284/SW_SA_Report_Part_1.pdf; MMO (2019). *South West Inshore and Offshore Marine Plans Sustainability Appraisal. Part 2: Scoping Information*. Draft Report. A report produced for the Marine Management Organisation, August 2019, 101pp., see: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/857285/SW_SA_Report_Part_2.pdf; Welsh Government (2019) *Sustainability Appraisal for WNMP* (Nov 2019), 281pp.; See: https://gov.wales/sites/default/files/publications/2019-11/wales-national-marine-plan-sustainability-appraisal.pdf; Welsh Government (2019) *Sustainability Appraisal Addendum* WNMP Nov 2019, 277pp. https://gov.wales/sites/default/files/publications/2019-11/wales-national-marine-plan-sustainability-appraisal-addendum.pdf; Welsh Government (2020) *Sustainability Appraisal: Post Adoption Statement* WNMP 2019, 41pp. See: https://gov.wales/sites/default/files/publications/2019-12/welsh-national-marine-plan-sustainability-appraisal-post-adoption-statement.pdf

[27] *Op. cit.*

[28] *Op. cit.*

[29] Written evidence and verbal evidence (01/03/21) from Welsh Government (Marine Team)

[30] *Op. cit*.

[31] Welsh Government (2020) *Wales National Marine Plan*, 180 pp., see:

https://gov.wales/sites/default/files/publications/2019-11/welsh-national-marine-plan-document_0.pdf

[32] Marine Management Organisation (2020) *South West Inshore and South West Offshore Marine Plan*. *Draft for consultation* January 2020, 56pp.; see: https://www.gov.uk/government/publications/draft-south-west-marine-plan-documents

[33] Marine Management Organisation (2020) *South West Inshore and South West Offshore Marine Plan Technical Annex* - Draft for consultation January 2020, 311pp. See: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/857300/DRAFT_SW_Tech_Annex.pdf

[34] Welsh Government (2020) *Welsh National Marine Plan Implementation Guidance*, 108pp., https://gov.wales/sites/default/files/publications/2020-06/welsh-national-marine-plan-implementation-guidance.pdf

border effects and opens the way for a possible joint (non-statutory) estuary plan to inform future marine plan policies in the adjoining administrations.

Table 2.2 also summarises policies relating to the disposal of sediments offshore as well as those associated with the protection of the Marine Site. As such, these provide context for the discussions in the remainder of this chapter.

2.3 Cross-border arrangements associated with the granting of permissions, consents and licences

In the context of permissions and decisions associated with HPC, there are various processes which operate at a UK national level which have had and continue to have implications for Wales, its environment and people, and are worthy of consideration. Within such processes, there is a need to review the extent to which Welsh interests are being represented and realised, as noted below. These include the provision of Development Consent Orders and the oversight of emergency planning. For details regarding the latter, reference to Chapter 5 should be made where the implications of the application of the Radiation Emergency Preparedness and Public Information Regulations (REPPIR) for Wales are considered.

In terms of the application for a Development Consent Order for HPC as a Nationally Significant Infrastructure Project, this was made under the Planning Act 2008 to the Planning Inspectorate (PINS). The Secretary of State granted the Hinkley Point C Development Consent Order (DCO) (2013) and, whilst prior to this Group's establishment, it is noteworthy that the Countryside Council for Wales (CCW) made contributions to the process, including a written submission to the Report on the Implications for European Sites (RIES: 2012). It is also noted that CCW has been recorded as being content with the sufficiency of the RIES at a hearing in August 2012 on Habitats Regulations Assessment matters[35].

The Group recognises the environmental considerations underpinning this DCO and, as such, considers that this DCO should provide the baseline for environmental standards, mitigation measures and planning obligations associated with the project. As a consequence, the Group has expressed some concern regarding the current appeal which is now lodged with PINS relating to modifications of the agreed plan, noting the contradictory views of Cefas and the conservation agencies on both sides of the estuary regarding the implications of the removal of the AFD from the project design. As highlighted in Chapter 1, there remain questions over how Welsh legislation and policy will be regarded within the PINS decision-making process. As noted, this could be a concern for Wales, if the decision contravenes the advice of NRW and the other conservation agencies. The Group also suggest that any departures from agreed plans could undermine the credibility of, and public trust in UK planning and infrastructure consenting systems. Whilst the decision of the Planning Inspector is outstanding at the time of writing of this report, the Group are keen that the outcome of this appeal should not lessen or weaken the commitments expected of the Developer under this DCO.

[35] https://infrastructure.planninginspectorate.gov.uk/projects/south-west/hinkley-point-c-new-nuclear-power-station/

Within the context of cross-border impacts, there is a need to consider the adequacy of cross-border relationships and agency liaison associated with permitting and licensing processes and decisions on either side of the estuary/Channel. In the context of Hinkley Point C, Water Discharge Activity (WDA) Permits from the Environment Agency (EA) as well as various marine licences have and are being sought. These include the original marine licence granted by the MMO in 2013 for works within the HPC Development Project site and several revisions of this licence, including Revision 3 (2017), permitting dredging disposal in MMO disposal grounds. However, it is the recent intentions of EDF to apply for offshore sediment disposal at two sites across the estuary which have been of concern to the Group, particularly given the jurisdictional divide across the estuary. Currently, EDF is separately and simultaneously seeking consents for the same dredged material from NRW and from MMO for marine licences at Cardiff Grounds Disposal Site (on the Welsh side of the estuary) and the Portishead Disposal Site (on the English side), respectively. It appears the decision over which site is preferable will rest with the developer rather than being a joint decision of the regulating bodies, or indeed one where the relative merits of each site for the estuary (and Wales) can be assessed.

On questioning the agencies and organisations with environmental interests in these processes, it was clear to the Group that there are good working relationships between these bodies. NRW, EA, MMO and the D&S IFCA provided clear statements[36] suggesting regular and frequent liaison and sharing of information as well as exchange of views throughout relevant processes, in addition to responses to formal statutory consultations. As an example, extensive discussions were noted with regard to the marine licence applications for sediment disposal between NRW and MMO.[37] Evidence received from the EA[38] highlighted the close working relationship between NRW and EA and a Memorandum of Understanding (MoU) between the two organisations. The specialist nuclear resource provided by EA to NRW was also elaborated upon. Reference was also made to the processes in place to manage and resolve the very rare occurrences where there are differences of opinion between the two bodies. Particular mention was also made of the EA's provision of technical assistance and advice to NRW in relation to sediment disposal at the Cardiff Grounds site and its assistance in dealing with specific concerns from some stakeholders[39].

A further cross-border matter relates to the role and use of the Centre for Environment, Fisheries and Aquaculture Science (Cefas) in informing decisions relating to permitting and licensing for a range of clients including the UK Government, NRW and EDF. The potential removal of the AFD from the permit for HPC and the contradictory views of Cefas and the conservation agencies on both sides of the estuary have already been noted in Chapter 1 and illustrate this concern.

[36] Devon and Severn IFCA Written Response 16/12/20; MMO Written Response

[37] MMO Written Response

[38] EA Verbal Evidence, 21/12/21.

[39] NRW Written Response

2.4 Discussion and concluding comments

The planning landscape for the offshore environment in the Severn Estuary/Bristol Channel has been notoriously complex for decades.[40] However, the introduction of new planning regimes in recent years has complicated the situation still further and is of concern given increasing plan-led regulatory regimes. Required under different legislative and policy contexts, there remain concerns regarding the inter-relationship between some of the plans, particularly where planning boundaries and timescales do not align or facilitate inter-agency and cross-border working.

However, consultation processes and Strategic Environmental Assessments associated with all the plans have ensured some consideration of cross-border matters, including dialogue between agencies and other bodies across the estuary. The Group notes and welcomes Welsh Government's and MMO's intentions for continued scrutiny of the effectiveness of cross-border marine planning arrangements and the possibility of further supplementary guidance on this matter, particularly given the emerging plan-led system for offshore consenting. The facilitation of cross-border planning through the development of a UK-wide marine evidence base, as noted in the Marine Policy Statement (2011)[41], is also to be welcomed. However currently, the separate marine portals for Wales and England do not facilitate this and so there remains reliance on informal arrangements and networks, such as that provided by the Severn Estuary Partnership[42] and the Severn Estuary Ecological Research Forum[43] for information and knowledge sharing.

Whilst there is no single planning framework, the Conservation Regulations for the Marine Site provide an estuary-wide focus from an ecological perspective, ensuring that plans and proposals with the potential to damage the integrity of the site are scrutinised through Habitat Regulations and Appropriate Assessment processes. Even with the Single Scheme of Management through ASERA, there remain concerns about the capacity of the overall planning framework for the estuary to identify and address cumulative impacts. Whilst the Severn Estuary Strategy (2016)[44], which involved broad stakeholder input through its formulation, could be seen to provide a strategic vision for the estuary, this is non-statutory. It is also not detailed enough to inform local decision-making regarding consents, licenses and permits, even though it was developed using the high level marine objectives from the UK Marine Policy Statement.

As Section 2.3 demonstrates, separate and fragmented processes associated with the granting of permissions, consents and licences on either side of the estuary,

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[40] Ballinger, R. and Stojanovic, T., 2010. Policy development and the estuary environment: a Severn Estuary case study. *Marine pollution bulletin*, *61*(1-3), pp.132-145.

[41] HM Government Northern Ireland Executive Scottish Government Welsh Assembly Government (2011), *UK Marine Policy Statement*, 51pp., https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69322/pb3654-marine-policy-statement-110316.pdf

[42] https://severnestuarypartnership.org.uk/

[43] https://www.devonandsevernifca.gov.uk/Latest-News-and-Information-Items/Severn-Estuary-Ecological-Research-Forum-November-2020

[44] Severn Estuary Partnership (2016) *Severn Estuary Strategy, 2017 – 27*, 20pp. https://severnestuarypartnership.org.uk/wp-content/uploads/sites/2/2018/03/2017-2027-Severn-Estuary-Strategy.pdf

undermine coherent cross-border decision-making. Whilst the public bodies involved are actively engaged in dialogue there are few formal mechanisms for joint decision-making. In turn, this may lead to piecemeal decisions regarding applications for individual licenses which may not be in the overall estuary's and Welsh people's interests. There also remain concerns regarding the role and influence of Welsh legislation and policy within UK decision-making processes, particularly with respect to the PINS process.

Advice 1 – *the need for guidance for regulators, planners and plan users including developers to simplify and clarify the planning system for the estuary*

In the light of the complexity of the planning framework approach, there is a need for greater clarity on the roles and interrelationships between the various planning systems, particularly as these influence local decisions relating to key matters such as pollution and development control. The production of a 'road map' to enable understanding of the system, as advocated within the Severn Estuary Strategy[45], may be appropriate here.

Advice 2 – *explore measures for strengthening cross-border planning*

Welsh Government should continue to liaise with the Marine Management Organisation over appropriate measure to strengthen cross-border marine planning in the light of monitoring of plan effectiveness. This will be particularly important as the plan-led system of licensing emerges and matures for the estuary. The possibility of joint supplementary guidance for the estuary should be considered as part of this.

Advice 3 – *use Memoranda of Understanding to secure effective, long-term good working relationships between relevant public bodies on either side of the estuary*

Memoranda of Understanding (MoU) could be developed and updated to secure effective relationships between relevant government bodies and agencies, where these do not already exist. The efficacy of such MoU should be reviewed periodically in the light of evolving cross-border issues and the handling of these.

[45] Severn Estuary Partnership (2016) *Severn Estuary Strategy, 2017 – 27*, 20pp. https://severnestuarypartnership.org.uk/wp-content/uploads/sites/2/2018/03/2017-2027-Severn-Estuary-Strategy.pdf

Table 2.1 Relevant plans and strategies relating to the Severn Estuary/Bristol Channel

Types of plans	*Name of plan / strategy*	*Characteristics*	*Organisations involved (including lead organisation)*	*Geographical*	*Relevance to Hinkley C*
Management Scheme for Marine Site	Severn EMS Management Scheme (2018 - 2023)	Under UK law Regulation 38 of the Conservation of Habitats and Species Regulations 2017 Guides Relevant Authorities (RA) in the exercise of their functions in relation to land or waters within or adjacent to that area or site Includes updated Action Plans for each RA	The Association of Severn Estuary Relevant Authorities (ASERA) Relevant Authorities include most of the conservation agencies, port and harbour authorities (including Bridgwater Port Authority, adjacent to Hinkley) around the EMS	A transboundary Scheme - includes intertidal areas immediately adjacent to Hinkley and around the Severn Estuary Scheme covers the Severn Marine Site: the Severn Ramsar site; the Severn Special Protection Area (SPA); the Severn Special Area of Conservation (SAC)	Relevant Authorities must, within their areas of jurisdiction, have regard to both direct and indirect effects on an interest feature of the site. This may include consideration of issues beyond the boundary of the EMS. RA Action Plans provide guide for the need for Habitats Regulation Assessment for activities likely to impact on the site
Marine Plans	Wales National Marine Plan (2020)	Required under the Marine and Coastal Access Act 2009: public authorities have a statutory obligation to make decisions in accordance with these when issues planning consents and marine licences	Welsh Government	Covers Welsh waters from High Water Mark to the middle of the estuary/Channel	Form the context for the issuing of Marine Licences
	South West Marine Plan Consultation Draft (MMO, 2020)		Marine Management Organisation	Covers English waters from High Water Mark to the middle of the estuary/Channel	
Emergency plan for the Bristol Channel (2018)	Bristol Channel Standing Environment Group – Activation Plan	provides operational guidance and a framework to assist the Bristol Channel Standing Environment Group member organisations to	Public Health bodies; Environment Agency and Natural Resources Wales; Natural England;	Transboundary - Covers Inner Bristol Channel and Severn Estuary	Cover chemical incidents (including hazardous and noxious substances) Notes the membership and role of the group and its members

		achieve functionality and operate effectively as a result of a maritime pollution incidents where there is likely to be a threat of sea, land or air pollution.	Fisheries departments of MMO and Welsh Government; Devon and Severn IFCA; local authorities (Monmouthshire & Bristol)		including some details of tasks and procedures
River Basin Management Plans (RBMP)s (2016) Updated plans all due to be published (following consultation) in 2021	Severn RBMP South West RBMP Western Wales RBMP	Under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 River Basin Management Plans are prepared for each River Basin District Plans set out legally binding objectives for each quality element for each of the protected areas and water bodies in the river basin district, including an objective for the water body as a whole.	*Severn RBMP* Responsibility for planning the future of the Severn river basin district is shared between the Environment Agency and Natural Resources Wales Plan approved by the Secretary of State for the Environment, Food and Rural Affairs and Welsh Government *South West RBMP* Environment Agency *Western Wales RBMP* Natural Resources Wales	Severn RBMP – lies to the north of Hinkley South West RBMP lies offshore Hinkley Western Wales RBMP lies offshore (on Welsh side of Channel)	All public bodies must have regard to these objectives when making decisions that could affect the quality of the water environment. Provide the context for the issuing of Water Discharge Activity (WDA) Permits
Shoreline Management Plans	The Severn Estuary Shoreline Management Plan2 (2017)	Aa high level non-statutory policy document designed to assist coastal flood and erosion risk management planning	Severn Estuary Coastal Group (a partnership by local authorities, regulators and other stakeholders) https://severnestuarycoastalgroup.org.uk/	Covers littoral areas from Lavernock Point/Hartland Point upstream to N of Gloucester	Determines the preferred policy options for coastal defence decisions

Table 2.2 Relevant policies in the marine plans for the Severn Estuary/Bristol Channel

Welsh National Marine Plan (2019)	**South West Marine Plan (Consultation Draft) 2019**
Policy GOV_02 Cross border and plan compatibility	SW-CBC-1 Cross-border cooperation
Relevant public authorities, in making their decisions, should have regard to: • any applicable policy in a relevant marine plan … a. Proposals likely to have significant adverse impacts upon an established activity covered by a formal application or authorisation must demonstrate how they will address compatibility issues with that activity. Proposals unable to demonstrate adequate compatibility must present a clear and convincing case for the proposal to progress under exceptional circumstances. b. Proposals likely to have significant adverse impacts upon an established activity not subject to a formal authorisation must demonstrate how they will address compatibility issues with that activity. Proposals unable to demonstrate adequate compatibility must present a clear and convincing case for proceeding. b. Under SAF 01 a and b, compatibility should be demonstrated through, in order of preference: • Avoiding significant adverse impacts on those activities, and/or	Proposals must consider cross-border impacts throughout the lifetime of the proposed activity. Proposals that impact upon one or more marine plan areas or impact upon terrestrial environments must show evidence of the relevant public authorities (including other countries) being consulted and responses considered.
D&D_01: Dredging and Disposal (supporting)	SW-DD-1
Proposals that maintain navigable channels and long term access to open at-sea disposal sites for appropriate material 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.	In areas of authorised dredging activity, including those subject to navigational dredging, proposals for other activities will not be supported unless they are compatible with the dredging activity.
SAF_01: Safeguarding existing activity	SW-DD-2
	Proposals that cause significant adverse impacts on licensed disposal areas should not be supported. Proposals that cannot avoid such impacts must, in order of preference: a) minimise b) mitigate or c) if it is not possible to mitigate the significant adverse impacts, proposals must state the case for proceeding.

• Minimising significant adverse impacts where these cannot be avoided; and/or • Mitigating significant adverse impacts where they cannot be minimised	
SAF_02: Safeguarding strategic resources	SW-DD-3
Proposals which may have significant adverse impacts upon the prospects of any sector covered by this plan to engage in sustainable future strategic resource use (of resources identified by an SRA) must demonstrate how they will address compatibility issues with that potential resource use. Proposals unable to demonstrate adequate compatibility must present a clear and convincing case for proceeding. Compatibility should be demonstrated through, in order of preference: • Avoiding significant adverse impacts on this potential strategic resource use, and/or • Minimising significant adverse impacts where these cannot be avoided; and/or • Mitigating significant adverse impacts where they cannot be minimised	Proposals for the disposal of dredged material must demonstrate that they have been assessed against the waste hierarchy. Where there is the need to identify new dredge disposal sites, proposals should be supported which are subject to best practice and guidance.
ENV_02: Marine Protected Areas	
Proposals should demonstrate how they: • avoid adverse impacts on individual Marine Protected Areas (MPAs) and the coherence of the network as a whole; • have regard to the measures to manage MPAs; and • avoid adverse impacts on designated sites that are not part of the MPA network.	

Chapter 3

The radioactive content of Hinkley Point sediments and their assessment for disposal at sea

This chapter will review the evidence and concerns with regard to the radioactive content of the sediments at Hinkley Point that have been and are planned to be disposed at the Cardiff Grounds disposal site. This chapter will examine the processes and methodologies behind the sampling, analysis and dose assessments that have been carried out to determine whether the Hinkley Point sediments can be disposed at sea. The review will be based on the evidence and communications received by the Group from the involved organisations and interest groups as well as any additional and relevant resources. Advice from the Group is given based on the review of the evidence.

3.1 Background

Nuclear power plant operations at Hinkley Point commenced in 1965 with the commissioning of the Magnox Hinkley Point A (2 x 960 MWt) and later in 1976 with the commissioning of the AGR Hinkley Point B (2 x 1494 MWt). Hinkley Point A was decommissioned in 2000. Airborne and liquid discharges have occurred over the lifetime of the operation (HP A and B) and decommissioning (HP A) of the reactors at the Hinkley Point site, with liquid discharges having been released into the Severn Estuary. Other nuclear facilities that have had liquid discharges of radionuclides into the Severn Estuary are the nuclear power plants at Oldbury (from 1967, decommissioned in 2012) and Berkeley (from 1962, decommissioned in 1989) and the Amersham radiochemical production centre in Cardiff (from 1980s). Other sources of man-made radionuclides to the Severn marine environment are global fallout, the Chernobyl accident in 1986 and marine transported discharges from other nuclear facilities along the west coast of the UK, most notably the nuclear reprocessing facility at Sellafield. Liquid discharges from Sellafield have been many orders of magnitude higher than from UK nuclear power plants, and particularly in the 1970s. In addition, all marine sediments contain natural levels of natural occurring radionuclides from the Uranium-238 and Thorium-232 decay chains as well as Potassium-40.

In 2018 and as part of the overall Hinkley Point C project, EDF carried out licensed dredging of sediments off Hinkley Point and disposal of these sediments at Cardiff Grounds. Hinkley Point lies within the Severn Estuary Special Area of Conservation (SAC), and sediment dredged within the SAC should be disposed within SAC in order to maintain sediment balances in this conservation area. Licensing of the dredging and disposal was approved by Natural Resources Wales (NRW) with a final volume of 156,351 m^3 of sediment disposed at Cardiff Grounds. In connection with the 2018 marine licence, sediments had been sampled at Hinkley Point in 2009, 2013 and 2017. An overview of the samples taken during these years is given in Table 3.1. All analysis of these samples as well as dose assessments have been carried out by the Centre for environment, fisheries and aquaculture science (Cefas). In each case and based on the analyses conducted, Cefas reported that doses to individual members of the dredging/disposal crew, the general public, and the collective dose, were within the *de minimis* criteria of 10 micro Sieverts per year (individual doses) and 1 man Sievert per year (collective dose), respectively (Cefas

2013, 2017 and 2019). Cefas stated that '*since the conservative generic radiological assessment procedure indicated that doses received were below recommended limits, a subsequent more detailed case specific assessment was not necessary*'. Cefas concluded that '*from radiological considerations, there is no objection to this material being dredged and dumped*'.

EDF then announced plans to carry out further dredging at Hinkley Point as part of the necessary works to install cooling water intakes in the Bristol Channel, with a further 470,000 m^3 sediment to disposed at Cardiff Grounds. Following concerns expressed in the Senedd/Welsh Parliament, and by other stakeholders regarding the disposal of Hinkley Point sediments at Cardiff Grounds, NRW and EDF agreed a more extensive sampling and analysis programme in 2020 as part of the marine licence application for this work. In addition, NRW requested that EDF submit an environmental impact assessment as part of their marine licence application. The samples collected in 2020 included cores with samples taken at various depths which were then analysed by gamma and alpha spectrometry by Cefas (Cefas 2021a and 2021b). Based on the analysis of the samples collected in 2020, Cefas again reported that doses to individual members of the dredging/disposal crew, the general public, and the collective dose, were within the *de minimis* criteria of 10 micro Sievert per year (individual doses) and 1 man Sievert per year (collective dose), respectively. Cefas concluded that '*from radiological considerations, there is no objection to this material being dredged and disposed of to sea*'. As of February 2021, EDF have now submitted a marine licence application to NRW to carry out the planned 2021 dredging with disposal at Cardiff Grounds. EDF have also applied for a marine licence application to the Marine Management Organisation (MMO) for the same dredging work, but with disposal at Portishead, which also lies with the SAC.

Table 3.1. Summary of sediment sampling carried out at Hinkley Point for radiological analyses

	No. of sampling stations/ Was sub-surface sampling carried out			
	2009	2013	2017	2020
Surface	5	17	12	22*
Sub-surface	Yes	No	No	Yes

* 6 surface grab samples, 22 cores and 6 replicate cores to collect further samples for reassurance purposes.

3.2 Concerns

- Is there sufficient information/transparency concerning the discharge histories of Hinkley Point A and B?
- Have the sampling and analysis strategies to assess the radionuclide content of Hinkley Point sediments been robust?
- Is there evidence of 'hot particles' in sediments off Hinkley Point?
- Are the assumptions/methodologies used to assess any impact from the radionuclide content of Hinkley Point sediments robust?

- From a radiological perspective, can sediments dredged from around Hinkley Point be disposed at sea?
- Has there been any impact on levels of radionuclides around Hinkley Point from construction work at Hinkley Point C?

3.3 Review of evidence

3.3.1 Is there sufficient information/transparency concerning the discharge histories of Hinkley Point A and B?

With regard to the discharge history of Hinkley Point A and B, the Group were provided with a copy of the report NRPB-M173 (by Neil McEvoy MS and Geiger Bay), that had been described as a '*Westminster*' or '*UK Government report*'. This document is a Working Group 1 (WG1) report from the MARINA project that was published by the former National Radiological Protection Board (NRPB) in 1990. The MARINA project was a Commission of European Communities (CEC) project set up in 1985 to assess the impact of radioactivity in Northern European marine waters and involved invited experts from member states. WG1 consisted of members from the Netherlands, Germany, Belgium, the UK, Denmark, Spain and Ireland. The remit of WG1 was to provide information on discharges from civilian nuclear facilities and the report contains discharge data from 72 sites across different European countries that discharge directly or indirectly into Northern European waters. All this information is provided in the abstract and foreword to the report. The report is not available electronically, but it was published in 1990 so this is not entirely unexpected. However, the report is listed in the International Atomic Energy Agency's (IAEA) library database[46] and was cited 6 times in the 1990s by scientific publications[47]. The MARINA project was followed up by the MARINA II project, which included an update to the report from the MARINA WG1 (Gerchikov et al., 2003).

A graph provided by Keith Barnham using data from the MARINA WG1 report also referenced discharge data for Hinkley Point A from the former Ministry for Agriculture, Fisheries and Food (MAFF). This data was published in the MAFF Radioactivity in surface and coastal waters of the British Isles reports (which later became the Radioactivity in Food and the Environment reports (RIFE)) and which are available from the Cefas website[48]. This graph was annotated with the query as to whether '*Westminster stopped plutonium testing after 1984?*', but the MARINA WG1 report only covered the period up to 1984. Discharge data from Hinkley Point A (1972 onwards) and B (1976 onwards) are also reported in the report series Radioactive effluents from Nuclear Power Stations and Nuclear Fuel Reprocessing Plants in the European Community, published by the European Commission. It should be noted that discharge data reported in earlier MAFF and European Commission reports was often stated as total activities discharged, rather than as detailed information for individual radionuclides such as Plutonium-239. As such the MARINA WG1 report is a valuable resource for discharge data from nuclear facilities

[46] https://inis.iaea.org/search/search.aspx?orig_q=RN:22068698

[47] https://scholar.google.com/scholar?cites=14914259701084414 94&as_sdt=2005&sciodt=0,5&hl=en

[48] https://www.cefas.co.uk/

across Northern Europe for this time period. Detailed discharge data for Hinkley Point A and B from 1995 onwards has been reported to OSPAR[49] and is available from the online European Commission Radioactive Discharges Database[50].

All nuclear facilities have airborne and liquid discharges of radioactive substances, which are authorised by national regulations. The relative amounts of individual radioactive substances that are discharged can change and will reflect different operations carried out over the lifetime of the facility. The graph provided by Keith Barnham showed a comparison of normalised discharge data of Plutonium-239 for Hinkley Point A taken from the MARINA WG1 report (NRPB, 1990), with normalised 'gamma' discharge data from MAFF. The graph was further annotated with '*1982, larger plutonium peak but no gamma peak*'. The discharge data used in this graph had been normalised by dividing discharge data for each year by the discharges reported in 1969. Normalising data in this manner can be useful to highlight variations over time in discharges of an individual radionuclide. However, comparing normalised discharges of different radionuclides where there is a significant difference in the magnitude of those discharges may not give the complete picture. Figure 3.1a shows discharge data for Plutonium-239 and Caesium-137 taken from the MARINA WG1 report (NRPB, 1990), normalised in each case to the amount discharged of these respective radionuclides in 1969. Caesium-137 has a half-life of 30 years and is the main man-made gamma emitter reported in Hinkley Point sediments by Cefas. Figure 3.1b shows the actual amount of Plutonium-239 and Caesium-137 discharged from Hinkley Point A. When comparing these figures, although a peak in normalised Plutonium-239 discharges can be seen in 1982, it is clear that the actual amount of Caesium-137 discharged in 1982 was greater (12.4 times) than the amount of Plutonium-239 discharged. It is worth adding that there were discharges of both Plutonium-239 and Caesium-137 (as well as other radionuclides) from Hinkley Point B in 1982, albeit at levels far lower than from Hinkley Point A, as well as discharges from other nuclear facilities on the Severn Estuary.

[49] https://odims.ospar.org/

[50] https://europa.eu/radd/index.dox

Figure 3.1a. Normalised (to 1969 data) discharges of Plutonium-239 and Caesium-137 from Hinkley Point A. Source: NRPB (1990)

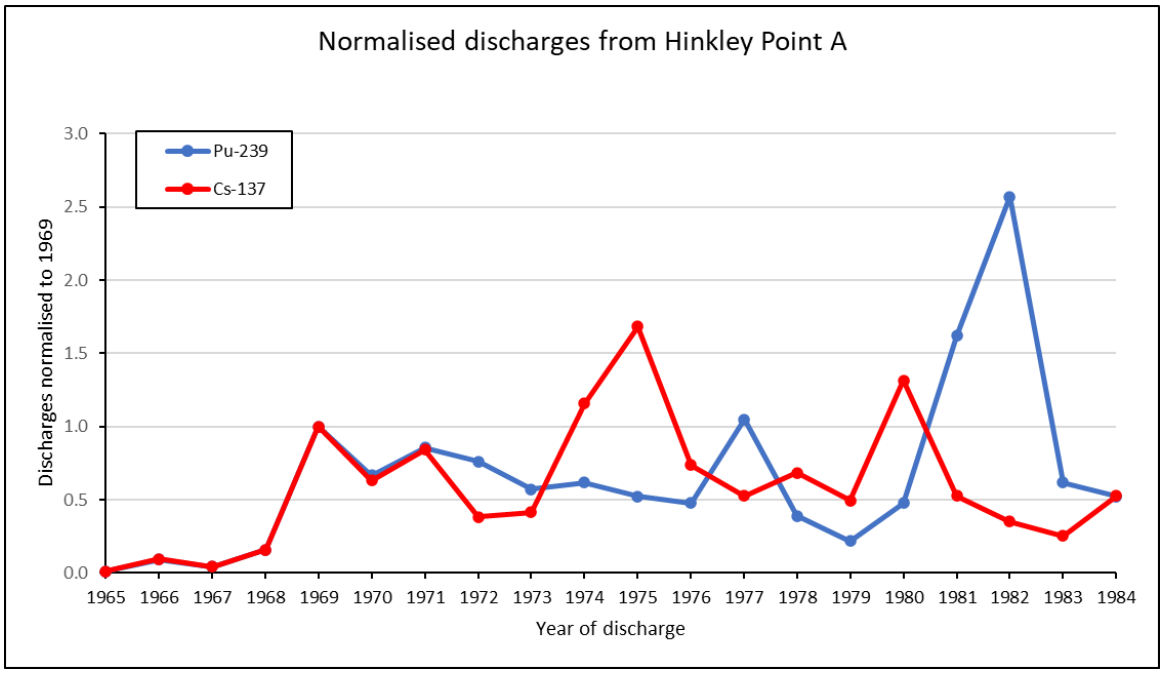
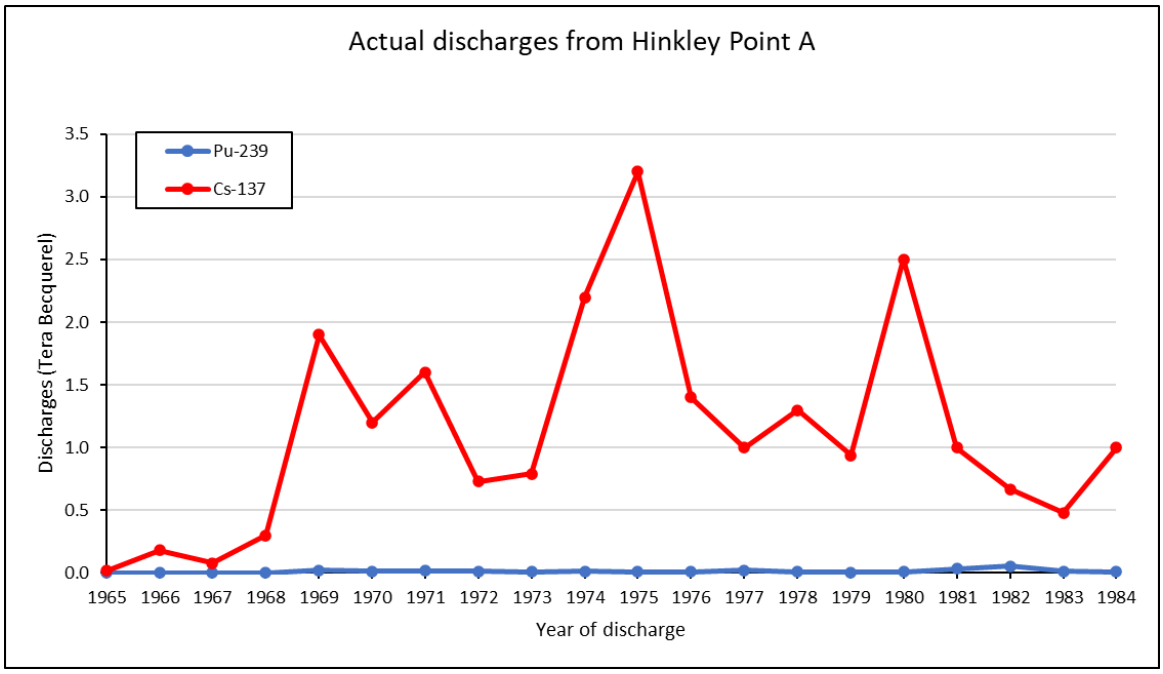


Figure 3.1b. Actual discharges of Plutonium-239 and Caesium-137 from Hinkley Point A. Source: NRPB (1990).



3.3.2 Have the sampling and analysis strategies to assess the radionuclide content of Hinkley Point sediments been robust?

In the case of Cardiff Grounds, the consent to dispose of sediments falls under the jurisdiction of NRW rather than the MMO, but there is no fundamental difference in the marine licence application process. When developing a sampling and analysis strategy to support an application for a marine licence for capital dredging and

disposal, the MMO website[51] recalls that the UK is signed up to the London Convention & Protocol and OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic. Similarly, the NRW website states that material '*must first be analysed for a range of physical and chemical properties, in line with OSPAR guidelines*' before it can deemed suitable for dredging and disposal at sea. The MMO website states that a sediment sampling plan must be agreed with the MMO in consultation with Cefas, which will set out the sample locations as well as the specific biological, chemical and physical analysis required. The NRW website states that the production of an agreed sampling and analysis plan is carried out using external advisors.

OSPAR Agreement (2014-06) states guidelines for the management of dredged material at sea (OSPAR, 2014) and indicates the number of separate sampling stations required to obtain representative results, assuming a reasonably uniform sediment distribution in the area to be dredged: (Table 3.2).

Table 3.2. Indicated number of sampling stations for volumes of sediment to be dredged as per OSPAR Agreement (2014-06) (OSPAR, 2014)

Amount dredged (m^3)	Number of Stations
Up to 25 000	3
25 000 - 100 000	4 to 6
100 000 - 500 000	7 to 15
500 000 - 2 000 000	16 to 30
>2 000 000	extra 10 per million m^3

The OSPAR Agreement (2014-06) further states that

> *'§5.2 A survey of the area to be dredged should be carried out. The distribution and depth of sampling should reflect the size and depth of the area to be dredged, the amount to be dredged and the expected variability in the horizontal and vertical distribution of contaminants. Core samples should be taken where the depth of dredging and expected vertical distribution of contaminants suggest that this is warranted. In other circumstances, grab sampling will usually be sufficient.'*

The MMO includes radiological analysis as one of the types of contaminant analysis that may be required[52], but detailed analytical guidance is only given for other types of contaminants. OSPAR guidelines only list trace metals and organic contaminants as required analytes (OSPAR, 2014), and these are the only types of contaminants

[51] https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans

[52] https://www.gov.uk/government/publications/marine-licensing-physical-and-chemical-determinands-for-sediment-sampling/chemical-determinands

that are included on the NRW website[53]. The Group was informed by the MMO that they rarely receive applications for marine licences to dredge and dispose sediment at sea, where the sampling and assessment of radioactive substances are required to be considered.

Cefas stated that '*no radiological assessment (for the purpose of a dredging application) was originally requested or carried out by Cefas'* as part of the analytical contract undertaken in 2009 on behalf of an external client who was working for EDF at Hinkley Point. However, *'in anticipation of a dredging application, Cefas recommended to the customer that both surface and bottom sediment samples be taken to ensure any subsequent radiological assessment was more robust*.'

Cefas stated that

> *'based upon expert knowledge on the sources, environmental concentrations and behaviour of man-made radionuclides in sediment around the UK, gathered from decades of monitoring data, the normal procedure for radiological assessment of dredged sediments is to take surface samples only. The only exception to this is in the vicinity of Sellafield (NE Irish Sea), where sub-surface peaks of artificial radionuclides are known to exist and are potentially radiologically significant. The recommendation to take bottom samples was primarily because naturally occurring radionuclides are known to be the largest contributor to doses (giving significantly higher dose contributions than those from measured/estimated for man-made radionuclides). Secondly, it was also considered prudent to assess the potential effect of the transport of radionuclides from the elevated discharges in the 1970s from Sellafield.'*

The bottom samples collected for radiological analysis in 2009 were taken from depths of between 2 and 5 m below the sediment surface. The results of the radiological analysis (Cefas, 2019) and other contaminant analyses (Cefas, 2011) of these samples and other samples taken at intermediate depths (other contaminants only) would suggest that modern industrial contaminants including man-made radionuclides are only present within the top 1 to 2 m of the sediment in the area sampled. If this is the case, then analysing samples from the bottom of these cores would not have identified any potential effect of the transport of radionuclides from the elevated discharges from Sellafield in the 1970s.

Hinkley Point A and B have discharged a range of radionuclides into the Severn Estuary over their operational and decommissioning lifetimes. The radionuclides discharged have different physical half-lifes and different behaviours when discharged into the marine environment. Discharges of radionuclides with relatively short physical half-lifes would not be expected to contribute significantly to the radiological content of sediments over a period of 50 to 60 years. All radionuclides, both man-made and natural, have distinct chemical behaviours that control their ability to bind to sediments or remain in the water column. The process by which radionuclides bind to sediments is dynamic, meaning that they may be released back into the water column and vice versa at rates specific for an individual radionuclide, its chemical form, sediment type and the environmental conditions (e.g. salinity of overlying water and level of oxygen within the sediment). Strontium-90 has a half-life

[53] https://naturalresources.wales/permits-and-permissions/marine-licensing/sediment-sampling-and-analysis/?lang=en

of 29 years but tends to remain in the water column when discharged to the marine environment. So rather than binding to sediments, discharged Strontium-90 would be transported further afield by ocean currents. Other radionuclides such as Plutonium isotopes, Americium-241 and to a lesser degree Caesium-137 have the ability to bind more readily to sediments, which may allow for a sediment record of historical inputs of these radionuclides, such as discharges from a nuclear facility or fallout from the Chernobyl accident. However, the process of sediment deposition is rarely undisturbed, with biological, physical and chemical processes normally affecting the fate of sediment particles and any radionuclides (or other contaminants) bound to these particles. The Severn Estuary has the highest energy levels of any estuary in the UK, resulting in a continuous vast movement of sediment within the estuary. So, it can be expected that even discharges of those radionuclides that readily bind to sediments would be subject to transport away from the area around Hinkley Point due to the strong tidal currents in the Severn Estuary. The sediments around Hinkley Point will undoubtedly contain man-made radionuclides discharged from nuclear operations at Hinkley Point, but these will not reflect the total discharged activity from the lifetime of Hinkley Point A and B.

The range of activities for the man-made radionuclides Cobolt-60, Caesium-137 and Americium-241 and the naturally occurring radionuclides Radium-226, Thorium-232 and Uranium-238 for sediment sampled off Hinkley Point in 2009, 2013 and 2017 are given in Table 3.3 (Cefas, 2013, 2017, 2019). All values for Cobolt-60 and the majority of values for Americium-241 were below the limits of detection. This does not necessarily imply that these radionuclides are not present in the sediment, but simply that the amount of the radionuclide is below the detection limit for the methodology that has been used. From an examination of the gamma spectral reports for the sediment samples collected in 2017, the only man-made gamma emitting radionuclide that was evident in these samples was Caesium-137. The values and detection limits reported for Cobolt-60, Caesium-137 and Americium-241 in these sediment samples are low as seen in an environmental context. The values reported above detection limits for Caesium-137 and Americum-241 in surface sediment are likely to be mainly due to contemporary discharges from Hinkley Point A and B. Table 3.3 also shows the range of activities for the same man-made radionuclides and naturally occurring radionuclides for sediments sampled off Hinkley Point in 2020 as determined by gamma spectroscopy (Cefas 2021a). The surface sediments collected in 2020 show very similar levels of both man-made and naturally occurring radionuclides as previous surface samples. For sediment cores, maximum levels of Caesium-137 were typically found in the surface samples, with only 12 cores showing sub-surface levels of Caesium-137 above the detection limit. All sub-surface samples showing levels of Caesium-137 above the detection limit were taken from the top 1 to 2 m of the sediment core. There was no evidence of any enhanced sub-surface levels of Cobolt-60 or Americium-241. The Group recognises that these results indicate that the sampling and analysis of surface sediments alone would have provided a conservative estimate of the total radioactive content of the volume of sediment to be dredged.

Table 3.3. Range of activities for man-made and naturally occurring radionuclides in sediments sampled off Hinkley Point (Cefas, 2013, 2017, 2019, 2021a)[1]

		Range of activities in sediment (Becquerel per kg dry weight)					
	Depth	Co-60	Cs-137	Am-241	Ra-226	Th-232	U-238
2009	S	<0.3 - <0.5	1 – 43	<0.4 - <1[a]	16 - 25	22 - 34	31 - 50
	SS	<0.3 - <0.4	<0.3	<0.5 - <1	28 - 74	26 - 41	41 - 7
2013	S	<0.3 - <0.5	7 - 32	0.6 - 3[b]	11 - 25	14 - 34	19 - 46
2017	S	<0.3 - <0.5	13 - 20	<0.6 - <2	20 - 24	27 - 38	42 - 66
2020	S	<0.1 - <0.7	<0.1 - 35	<0.5 - <4[c]	8 - 26	9 - 41	9 - 43
	SS	<0.1 - <0.9	<0.1 - 29	<0.3 - <5[d]	8 - 73	9 - 56	7 - 58

1 - Results as determined by gamma spectroscopy. S - surface sample; SS - Sub-surface sample; a - One value of 0.7 reported above detection limits; b - 3 out of 17 samples with values above detection limits; c - 4 out of 28 samples with values above detection limits; d - 2 out of 137 samples with values above detection limits

Cefas has developed a tiered approach to the radiological assessment of sediments for dredging and disposal (Cefas, 2006), where the initial assessment is based on analysis of sediments by gamma spectroscopy only. As part of this first step, activities of alpha emitting Plutonium isotopes (for use in calculating doses) are estimated from the data for Americium-241 using ratios based on available information. This is a reasonable approach as both Americium-241 and Plutonium isotopes would be expected to behave in similar ways when discharged into the marine environment. In the assessments carried out on Hinkley Point sediments, Cefas have used ratios for Americium-241 to Plutonium isotopes based on Sellafield discharges. According to the tiered approach further steps that would include the analysis of Plutonium isotopes and Americium-241 by alpha spectrometry, would only be warranted if indicated by the initial assessment based on results determined by gamma spectroscopy. The radiological assessment would then be repeated using both gamma and alpha results to determine if the sediment was suitable to be disposed at sea.

As part of the more extensive analysis programme for the samples collected in 2020, 2 grab samples and 3 cores (and some samples from a reserve core) were analysed by alpha spectrometry. Table 3.4 shows the values derived for Americium-241 (average from gamma spectroscopy) and Plutonium-239,240 and Plutonium-238 (estimated from Americium-241 value) that would have been used in any initial assessment compared to the average values for these radionuclides as determined by alpha spectrometry.

Table 3.4 Comparison of values for Americium-241 and Plutonium isotopes that would have been used in initial assessment against average values of these radionuclides as determined by alpha spectrometry

Radionuclide	Average/estimated values that would have been used in initial assessment (Becquerel per kg dry weight)	Average values as determined by alpha spectrometry (Becquerel per kg dry weight)
Americium-241	1.66[a]	0.13[a]
Plutonium-239,240	0.95	0.12[a]
Plutonium-238	0.16	0.017[a]

a - All average values calculated using the full value of detection limit reported.

As can be seen, the average value determined by alpha spectrometry for Americium-241 is more than 10 times lower than the average value determined by gamma spectrometry. Alpha spectrometry is a far more sensitive analytical method, which involves chemistry to concentrate the amount of alpha emitters present in a sample. This can allow for results at levels far lower than possible for gamma spectroscopy. Even though the assumed ratios of Americium-241 to plutonium isotopes are somewhat higher than the real ratios, the actual levels of plutonium isotopes in the sediment are between 8 and 9 times lower than the estimated levels. The Group recognises that the use of data from gamma spectroscopy along with estimated levels of plutonium isotopes for the first step of the Cefas tiered approach (Cefas, 2016) would result in a conservative dose assessment.

3.3.3 Is there evidence for 'hot particles' in sediments off Hinkley Point?

Small high-activity radioactive particles of diameters ranging from around 1 mm down to several micrometres can form and be released into the environment due to accidents and normal operations at nuclear facilities. Such radioactive particles are often referred to as 'hot particles' and their existence has raised concerns when considering the implications and impact of such particles in dose assessments.

According to the IAEA (IAEA, 2011), nuclear fuel particles are rarely detected in discharges during normal operating conditions of nuclear power plants. Nonetheless, particles from failed nuclear fuel elements can be released into the coolant and thus transported to other parts of the power plant. More often, activated metallic particles or corrosion particles can be released to the coolant where they can be transported in and outside the primary circuit. Particles may also be released from spent nuclear fuel assemblies once they have been removed the reactor and stored in storage ponds.

Cefas stated that

> *'the suggestion that large numbers of 'hot particles', containing significant levels of plutonium, would be present in sediments around Hinkley Point is contrary to that observed from environmental measurements over several decades from annual routine monitoring. Unlike at Sellafield, 'hot particles' have not been identified around the Hinkley Point coastline.'*

Cefas further stated that '*gamma spectroscopy is the accepted method for detecting hot particles in the environment (IAEA, 2011)*' and that '*no 'hot particles' have been identified in the Sellafield area that only include pure alpha and beta emitting radionuclides.*' 'Hot particles' from the Sellafield area are classified as either being alpha-rich, beta-rich or Cobalt rich, but all of these contain gamma emitters and usually Caesium-137 which is a beta and gamma emitter. Spent nuclear fuel will contain a number of different plutonium isotopes including Plutonium-238, 239, 240, 241 and 242. Where plutonium is present in any 'hot particle', the radioactive decay of the different plutonium isotopes will give rise to gamma emitting daughter radionuclides (e.g. Americium-241 and Uranium-237) that can be used to indicate the presence of plutonium isotopes. 'Hot particles' containing alpha emitters can be detected by using CR-39 track detectors, but these will be detected by gamma spectroscopy through the additional presence of gamma emitting radionuclides. The analysis that Cefas has carried out as the first step in their tiered approach would have highlighted the presence of any 'hot particles'. None of the sediment samples analysed to date have shown elevated levels of gamma emitting radionuclides that would indicate the presence of activation or plutonium containing 'hot particles'. This is further supported by the alpha spectrometry results from the samples collected in 2020.

3.3.4 Are the assumptions/methodologies used to assess any impact from the radionuclide content of Hinkley Point sediments robust?

Cefas has developed a tiered approach to the radiological assessment of sediments for dredging and disposal (Cefas, 2006) based on guidance and exemption criteria developed by the IAEA. On the basis of any radiological assessment, if the expected effective dose to any member of the public or dredging ships' crew is of the order of 10 micro Sieverts or less in a year and if the expected collective effective dose to the public or dredging ships' crew is not more than 1 man Sievert per year, then the sediment is deemed to contain *de minimis* levels of radioactivity (i.e. it is not considered to be radioactive) and may be disposed at sea if it fulfils all the other criteria. For perspective, the average background dose to the UK population is around 2700 micro Sieverts per year.

For the dose assessment for sediments sampled at Hinkley Point in 2009, 2013 and 2017, Cefas has used the average of the analytical values reported for the man-made and naturally occurring radionuclides. In calculating average values for Cobalt-60 and Americium-241, the Group recognises that Cefas has adopted a conservative approach by using the full detection limit values in those instances where analytical results were reported as being below the detection limit. As stated previously, the initial assessment includes dose contributions from plutonium isotopes, estimated from the gamma results for Americium-241.

The pathways of exposure to members of the dredging ships' crew from man-made and natural radionuclides in the sediment that Cefas have considered are external exposure as well as internal exposure from inadvertent ingestion of sediments and inhalation of resuspended sediments. For the general public, Cefas has considered the ingestion of seafood caught in the vicinity of the disposal site, external exposure to radionuclides deposited on the shore, inadvertent ingestion of beach sediment, inhalation of resuspended beach sediment and inhalation of sea spray. The occupancy time over the course of a single year used by Cefas for the general public on beaches for the dose assessment was 67 days.

The Group recognises that the dose assessment used by Cefas is based on guidance from the IAEA and the International Commission on Radiological Protection (ICRP) which has been developed through international consensus. Differences of opinion on ICRP risk factors have been voiced by the independent European Committee on Radiation Risk (ECRR). For clarification, the ECRR is not a formal scientific advisory body to the European Commission or the European Parliament. It is not within the scope of the Group to comment in detail on these differences of opinion, but it should be noted that the Health Protection Authority (now Public Health England) have previously reviewed the methodology proposed by the ECRR and concluded that it does not have a sound scientific basis (e.g. Mobbs et al., 2011).

3.3.5 From a radiological perspective, can sediments dredged from around Hinkley Point be disposed at sea?

Table 3.5 gives a summary of the dose assessment results based on the analytical results for sediment samples collected off Hinkley Point in 2009, 2013 and 2017. In each case the individual and collective doses derived were below the *de minimis* criteria used by Cefas and developed by the IAEA. In each case, the naturally occurring radionuclides in the sediment gave a higher contribution to the overall dose than detected or estimated levels of man-made radionuclides. The Group recognises that information on the vertical distribution of man-made radionuclides in the sediment off Hinkley Point obtained from the cores sampled in 2020 would indicate that surface sampling alone would give a conservative estimate of the radionuclide content of the total volume of sediment to be dredged. The Group recognises therefore that from a radiological perspective, the sediments that were dredged in 2018 were suitable for disposal at sea according to the London Convention & Protocol. For the sediments sampled in 2020, the individual and collective doses derived from gamma spectrometry data were identical to the doses derived from gamma and alpha spectrometry data. This is because the contribution from alpha emitters to the overall doses is very low. In both cases, the individual and collective doses derived were below the *de minimis* criteria. The Group would expect therefore that from a radiological perspective, the sediments that are planned to be dredged in 2021 would be deemed suitable for disposal at sea according to the London Convention & Protocol.

Table 3.5. Summary of dose assessments based on analytical results for sediment samples collected off Hinkley point (Cefas 2013, 2017, 2019, 2021a, 2021b)

	Individual dose (micro Sievert per year)		Collective dose
	Dredging crew	General Public	(man Sievert per year)
2009	5.6	1.9	0.044
2013	4.8	1.6	0.035
2017	5.8	1.9	0.035
2020 (gamma only)	3.9	1.2	0.038
2020 (gamma and alpha)	3.9	1.2	0.038
De minimis criteria	10	10	1

3.3.6 Has there been any impact on levels of radionuclides around Hinkley Point from construction work at Hinkley Point C?

Geiger Bay and Tim Deere-Jones have both raised concerns of increased levels of (and doses from) man-made radionuclides in the marine environment around Hinkley Point following the construction work on Hinkley Point C. In particular, potential increases in the level of Americium-241 in sediments around Hinkley Point have been highlighted. Tim Deere-Jones submitted the data for levels of Americium-241 in sediments around Hinkley Point as taken from the RIFE reports for 2016 to 2018 (Environmental Agency et al., 2017 to 2019), stating that at the different sampling sites there had been between a 24% and 158% increase in values for 2018 compared to 2016 (Table 3.6). It should be noted that all the reported values are detection limits and all the stated detection limits are low in an environmental context. Using the full value of any of the detection limits in Table 3.6 in the Cefas dose assessment methodology would not result in any dose above the *de minimis* criteria. Stating that values have increased by a certain percentage has little meaning when such values are low in the first place. Furthermore, there are a number of other factors that should always be considered when comparing changes in low environmental levels, particularly when such values are reported as detection limits. As stated previously, data reported as detection limits does not imply that the radionuclide is not present in the sample, but simply that the amount of the radionuclide is below the detection limit for the methodology used. Detection limits for gamma spectroscopy can be influenced not only by the amount of the radionuclide in the sample, but by the amount of sample analysed, how long the sample is analysed as well as the type of detector used. More importantly, there will always be an inherent variation in environmental levels when sampling at the same site over a long time period. Changes in inputs of radionuclides can impact on environmental levels, but environmental factors such as storm events that can result in the movement of large volumes of sediment can also influence the levels of man-made radionuclides in surface sediments over time.

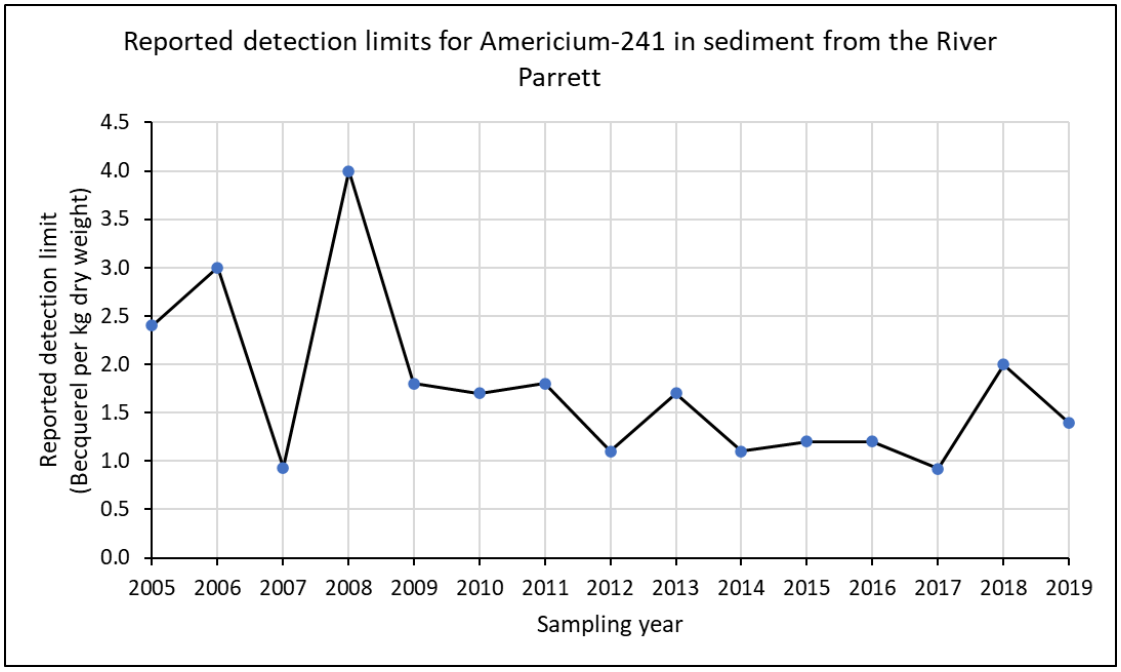
Table 3.6 Americium 241 in sediments (Becquerel per kg dry weight) from sampling sites around Hinkley Point between 2016 and 2018 (Environment Agency et al., 2017 to 2019).

Sampling Site	2016	2017	2018
Pipeline	<0.50	<0.69	<0.78
Stolford	<0.66	<0.79	<1.70
Steart Flats	<0.52	<0.66	<0.88
River Parrett estuary	<1.20	<0.92	<2.00
River Parrett Bridgwater	<0.65	<0.78	<1.60
Weston	<0.38	<0.48	<0.47
Burnham	<0.37	<0.45	<0.54

Looking at the time series of Americium-241 in sediment at the River Parrot sampling station over a longer time period from 2005 to 2019, all values were reported as detection limits as was the case for all other sampling stations in the area around Hinkley Point (Environment Agency et al., 2006 to 2020). Over the entire period from 2005 to 2019, there was far greater variation in the reported detection limit than over the period from 2016 to 2018 (Figure 3.2).

The Group recognises that it is not really possible to conclude anything from the observed variation in these detection limits, other than that all the reported values are low.

Figure 3.2 Reported detection limits for Americium-241 (Becquerel per kg dry weight) in sediment from the River Parrott between 2005 and 2019 (Environmental Agency et al., 2006 to 2020).



3.4 Advice

One of the main reasons for convening the Group originally was over public concerns that sediment from Hinkley Point may pose a radiological health and environmental risk when disposed in Welsh waters. However, the Group was reassured by the analytical results for sediment samples collected off Hinkley Point in 2009, 2013, 2017 and in 2020, when samples were taken from different depths in the sediment to be dredged and when these samples were analysed for both gamma and alpha emitting radionuclides. Based on the samples collected in 2009, 2013 and 2017, the individual and collective doses derived were below the *de minimis* criteria used by Cefas and developed by the International Atomic Energy Agency (IAEA) (i.e. the sediments were not considered to be radioactive). In each case, the naturally occurring radionuclides in the sediment gave a higher contribution to the overall dose than detected or estimated levels of man-made radionuclides. The Group recognises therefore that from a radiological perspective, the sediments that were dredged in 2018 were suitable for disposal at sea according to the London Convention & Protocol. For the sediments sampled in 2020, the individual and collective doses derived from gamma analysis were identical to the doses derived from gamma and alpha analysis. This is because the contribution from alpha emitting radionuclides to the overall doses is very low. In both cases, the individual and collective doses derived were below the *de minimis* criteria. The Group would expect therefore that from a radiological perspective, the sediments that are planned to be dredged in 2021 would be deemed suitable for disposal at sea according to the London Convention & Protocol.

However, it is apparent to the Group that there is a lack of guidance on the MMO and NRW website for situations where radioactive substances need to be addressed in any required sampling and analysis plan to support a marine licence application to dredge and dispose of sediment at sea. Although there is detailed information on the MMO website for the sampling, analysis and assessment of trace metal and organic contaminants, there is no such similar guidance for radioactive substances. Radiological analysis is not even mentioned on the NRW website as one of the types of contaminant analysis that may require consideration. Such guidance should cover the situations where surface sampling for radioactive substances would be sufficient, when sub-surface sampling is required for other contaminants as set out in OSPAR Agreement (2014-06) §5.2.

Advice 1. The Group suggests it would aid prospective marine licence applicants and stakeholders alike if guidance could be included on the Marine Management Organisation and Natural Resources Wales websites as to;

a) when radioactive substances should be considered as part of any sampling and analysis plan

b) what sampling, analysis and assessment might be required for radioactive substances, including the need, or not, to take samples at different depths.

Issues relating to radioactivity in general often cause concern for the general public. The subject can be very emotive and difficult to understand without expert knowledge, particularly with regard to exposures to low levels of radioactivity and the degree of health or environmental risk. Good and clear communication to the general public to improve the understanding of risk perception related to any radiation exposure is as important as it is challenging. In the case of Hinkley Point, the Group recognises that data from cores taken in 2020 supports the expert knowledge and view of Cefas that '*the normal procedure for radiological assessment of dredged sediments is to take surface samples only*'. However, as part of the communication process to stakeholders in situations such as Hinkley Point, consideration should be given to demonstrating that sub-surface distributions of radionuclides are not of concern where such information is not already available.

Advice 2. The Group suggests that when developing a sampling plan for radioactive substances in support of an application for a marine license to dredge and dispose sediment at sea, there can be value in demonstrating that sub-surface distributions of radionuclides are not of concern, if appropriate and where such information is not already available.

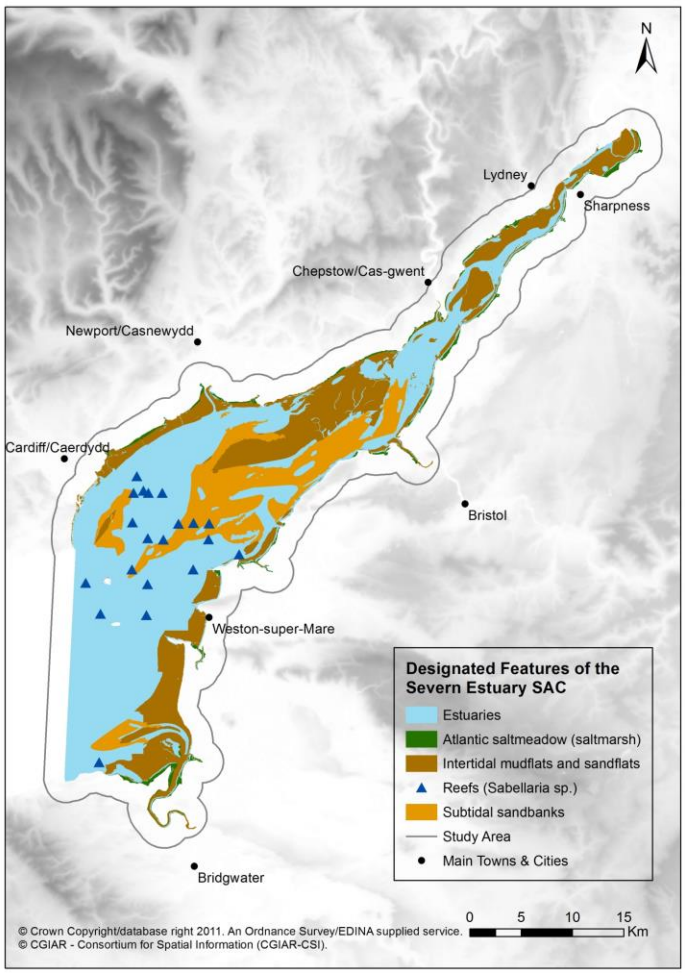
Chapter 4

Modelling Studies and Cardiff Grounds Disposal Site

4.1 Introduction

This chapter will firstly report on the modelling studies undertaken by Cefas to assess the predicted effects of a new nuclear power station, being built at Hinkley Point C, on the water quality characteristics in the Severn Estuary and Bristol Channel. The modelling studies were undertaken by Cefas (commercial arm under the BEEMS programme) and hereinafter referred to as Cefas (commercial), and used for advisory purposes to government agencies by Cefas (advisory). The studies are described in two reports provided to the Hinkley Point C Stakeholder Reference Group (the Group) by Cefas (commercial) including: TR186 2011, and Version 2, Edition 2, TR267 (undated). Secondly, this chapter will review the suitability of the Cardiff Grounds marine disposal site, in terms of accommodating the future quantity of sediments proposed for disposal at this site. Consideration will be given to the likely impact of the sediments remaining in the Severn Estuary, as desirable to meet the requirements of the Severn Estuary Special Area of Conservation (SAC), with its extent being shown in Figure 4a below.

Figure 4a. Boundaries and Designated Features of the Severn Estuary SAC



4.2 Background

In 2010 the UK Government announced eight sites for new nuclear power stations across the UK, with Hinkley Point C (HPC) being one of these sites. In November 2012 a nuclear site licence was granted and in July 2016 the EDF Board approved the project, subsequently approved by the UK Government in September 2016. In the meantime, Cefas (commercial) reported in July 2011 on the details of a modelling study to predict the impact of a proposed cooling water discharge from HPC on the receiving water quality in the Bristol Channel and Severn Estuary, with the impacts being considered for HPC, being operated both as a standalone power station and in combination with Hinkley Point B. The report of this study, Cefas TR186, was provided to the Group, with a higher resolution model study being submitted to EDF in January 2017 and November 2020, and subsequently made available to the Group.

The main concern relating to the hydro-environmental impacts from the HPC power station, affecting the ecology of the Severn Estuary, relate to the typical discharge from the cooling water outfall being 125 m^3/s and with the discharge temperature rise being typically 11.6^{o}C above the intake temperature. This is a relatively large heat flux to be discharged from a power station into an estuary. To put this discharge into perspective, this is approximately six times the mean flow in the River Taff, at Pontypridd, where the mean discharge is 20.9 m^3/s[54].

Another concern relating to the impact of HPC on the Severn Estuary ecosystem relates to plans by EDF to carry out further licensed dredging of sediments off Hinkley Point and dispose of these sediments at either Cardiff Grounds (LU110) or Portishead (LU070) disposal sites for dredged material, as outlined in Chapter 1. In 2018 licensed dredging was approved by Natural Resources Wales (NRW) to dispose of 156,351 m^3 of sediment at Cardiff Grounds. In 2021, and as part of the works to construct the cooling water intakes and outfalls, EDF plan to dispose of up to a further 470,000 m^3 (i.e., close to three times the amount licensed in 2018) at Cardiff Grounds or Portishead sites.

This chapter reviews the evidence made available to the Group and advises on three key potential concerns, including: (i) the original modelling studies undertaken by Cefas (commercial) in 2011, (ii) the subsequent finer resolution General Estuarine Transport Model (GETM) modelling studies, and (iii) the suitability of the Cardiff Grounds disposal site to receive a substantial amount of further dredged sediments and whether this additional sediment load is likely to remain within the Severn Estuary. It is noted that the modelling studies referred to in (i) and (ii) above were undertaken by Cefas (commercial) and then subsequently audited by Cefas (advisory) in advising regulatory authorities on the impact of HPC on the estuarine environment. We comment in Chapter 6 on the desirability of removing the perception of conflict which can surround this arrangement and the lack of an independent audit.

[54] NRFA Station Mean Flow Data for 57005 - Taff at Pontypridd (ceh.ac.uk). Accessed on 15 February 2021.

4.3 Assessment of Original Hydro-environmental Modelling Study, Cefas TR186

The original report provided by EDF and their modelling contractor Cefas (commercial) to the Group, relating to the hydro-environmental and ecological modelling studies undertaken to assess the impacts of the new HPC nuclear power station, is entitled: Predicted Effects of New Nuclear Build on Water Quality at Hinkley Point[55]. This report: "summarises as at July 2011: (a) The understanding of UK legislation that relates to aspects of the water quality that may be influenced by the development and operation of the proposed --- (HPC); (b) The potential areas of uncertainty with respect to compliance with existing or possible future regulation; and (c) An evaluation of the compliance of the proposed HPC cooling water discharge with water quality standards both stand alone and in combination with HPB using results of the Stage 3a modelling."

The main environmental and ecological impact from the outfall of HPC relates to the predicted thermal plume from two outfalls, located approximately 1.8 km offshore from HPC, with cooling water being supplied from four intake tunnels located approximately a further 1.7 km offshore. The typical total discharge through the tunnels would be 125 m^3/s, and with the temperature rise of the discharge from the outfalls being approximately 11.6^oC above the intake temperature. Two numerical model studies were undertaken to assess the hydro-environmental and ecological impact of the thermal discharge on the estuarine receiving waters, including: a Delft3D model study, subcontracted to ABPMer, and a Generalised Estuarine Transport Model (GETM) study undertaken by Cefas (commercial).

In the first instance, in undertaking a major hydro-environmental modelling study to assess the impact of a new build structure on the estuarine ecology and water quality etc. it is increasingly common practice, both in the UK and internationally, for such highly technical computational modelling studies to be reviewed by an independent expert, or group of experts, in the field. This is deemed to be particularly important when the scale of the project and its potential environmental and ecological impacts are of general public concern. The predictive results of such complex computer modelling studies are crucial to the design and operation of large-scale projects and particularly with regard to establishing the impact of the project on the estuarine and/or coastal environment. For example, in the UK it is now common practice for water companies (such as Dŵr Cymru Welsh Water) to have hydro-environmental modelling studies audited by an independent assessor for bathing water compliance studies. Furthermore, in a not dissimilar project to HPC (in terms of being high profile and of general public concern), in the International Tribunal for the Law of the Sea (ITLOS) Malaysia v. Singapore land reclamation dispute[56], in its Order of 8th October 2003, ITLOS prescribed that Malaysia and Singapore cooperate and jointly establish a group of 4 international experts to oversee a major hydro-environmental impact assessment study of Singapore's proposed land reclamation on the Malaysian coast. This major modelling study covered an assessment of the impacts of the reclamation on all aspects of the hydrodynamics, water quality, morphology and ecology on the estuarine and coastal receiving waters. The detailed

[55] Cefas, "Predicted Effects of New Nuclear Build on Water Quality at Hinkley Point", TR186, September 2011, pp. 148.

[56] Hean, C.K., Koh, T. and Yee, L. Malaysia & Singapore the Land Reclamation Case. Strait Times Press Pte Ltd. 2013, pp. 122.

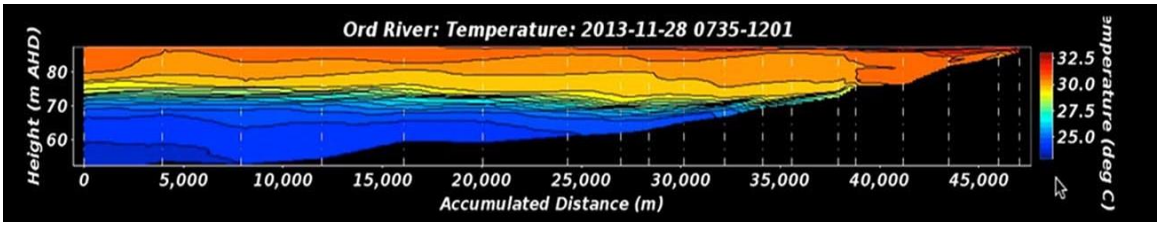
modelling studies lasted just over a year, with many detailed technical reports being made available in the public domain. For such a high profile and major new build nuclear power station, i.e., HPC, it is therefore surprising that the complex modelling studies were not overseen from the onset by either an individual independent expert or, preferably, a small group of experts. It appears from discussions between the Group and EDF and Cefas that in this case the modelling review was undertaken by Cefas (advisory). We believe that this arrangement raises understandable public concern about the degree of independence of the review process.

In reviewing the model studies and outcomes reported in Cefas TR186, a number of key concerns arise and are summarised below (in the order documented in the report):

- In the ITLOS EIA modelling studies outlined above, only 3 internationally recognised commercial models were deemed to be appropriate for such a high-profile project, including: Mike21 and Mike 3 (developed by the Danish Hydraulic Institute - Dhi), Delft2D/3D (developed by Deltares, the Netherlands) and TELEMAC (developed originally by EDF and now HR Wallingford). Likewise, in similar EIA studies in the UK these three models are increasingly deemed to be the most appropriate models to be used for such studies. It is therefore not clear why one of these internationally recognised models was not used from the outset for this high profile EIA modelling study.
- In the studies reported in Cefas TR186 two modelling studies were undertaken, namely Delft3D and GETM. However, it is not clear why two similar modelling studies were undertaken in parallel, rather than focusing resources on using one model and predicting the impacts for a finer grid resolution and for longer simulation times.
- In the report provided to the Group very limited details are provided of the model studies. In particular, no information is given on the grid structure, the location and details of the open boundary conditions (i.e., does the model go to the Continental Shelf and the Severn Estuary tidal limit?) etc.
- Within the model domain details are given in general terms of the grid sizes. This includes, in the GETM model, a ‘100 m x 100 m horizontal resolution and 20 layers in the vertical over the entire Severn Estuary, whereas the Delft3D model has a 50 m x 50 m grid resolution close to the intake and outfall structures, and 8 layers in the vertical’. However, again it is not clear if the horizontal resolution in the GETM model goes all the way up the Severn Estuary to the tidal limit. Also, the resolution in the region of the outfall is relatively coarse for such a high-profile project. Likewise, for the Delft3D model it is not clear where the 50 m grid resolution starts, relative to the outfall and intake, and how information was transferred from the coarse to the fine grid domain, assuming it was a structured vis-à-vis unstructured grid. For example, no information is provided as to how various fluxes were transferred and conserved normally, and particularly tangentially, from the coarse to fine grid domains.
- No details are provided as to the treatment of the outfall itself. This is key to the model predictions as it is important to predict the thermal plume characteristics as accurately as possible, particularly when discharging such a high flow and temperature increase into a relatively large grid size (even at 50 m x 50 m). It is also not clear as to why, in the GETM model, the assumption was made in

representing the outfall plume, which was assumed to discharge evenly at all depths under the assumption that the water column would be fully mixed'. This assumption is questionable, as comparable studies reported in the literature for somewhat similar studies show significant stratification for thermal plumes, with such plumes only mixing slowly through the vertical water column when plume dynamics is included[57] – see the example below from Imberger for the River Ord, discharging seawards through Lake Argyle, in Western Australia, and compare this typical sharp thermal front with the predicted excess temperatures, for a much larger temperature gradient, shown in the Cefas report (Figure 17) and where there is limited evidence of stratification.

Figure 4b Plot of a thermal plume from the river Ord, with a flow of 125 m^3/s



- No details are provided in the report of the crucial bed roughness values included in the model or comparisons to check the level of accuracy in the related predictions of the tidal currents. Such calibration and validation simulations (conventionally for spring and neap tides respectively) need to be reported for sites located in the region of interest, near the outfall, as well as across the domain, i.e., from the seaward to landward boundaries. Furthermore, the bed roughness representation affects the vertical eddy viscosity distribution and governs the vertical diffusivity of heat and thereby the characteristics of the thermal plume. In contrast to the pronounced stratification shown in Figure 4a, obtained for a similar discharge, but a much smaller temperature difference, the widely publicised CAEDYM model shows a much more extensive and preserved thermal plume than that shown in Figures 17, 20 and 21 of the Cefas TR186 report. These results raise concerns about the model set-up (particularly at the outfall site) and its accuracy in predicting the corresponding extent of the thermal plume in the receiving estuarine waters.
- No details are given in the report of the surface heat exchange coefficient used in the models. It is important that an independent reviewer can assess the dependence of this parameter on various local conditions, and the sensitivity of the plume characteristics to the assumed coefficient. In particular, the size of the plume predicted in Figures 20 and 21 appears to be rather small, bearing in mind the relatively large heat flux from the outfall and, whilst it is unlikely that this plume would have a significant impact in terms of raising the estuarine water temperatures along the Welsh coast, the area along the south and east coast of the Bristol Channel and Severn Estuary is understood to be a breeding ground for various fish species, and hence it is desirable to ensure that the thermal plume is predicted accurately, as this could have an impact on fish migration pathways and thereby the ecological status and sustainability of the Severn Estuary.

[57] Luketina, D.A. and Imberger, J. 1987, Characteristics of a surface buoyant jet. *Journal of Geophysical Research.* 92(5), 5435-5447.

- No detailed information is provided in the report as to how decay rates for total residual oxidant (TRO) and other water quality indicators were obtained, other than in general terms. For example, the value for the half-life of TRO is cited as 784 s (or 13 min) on page 57 of the report, but this seems to be relatively short compared to several comparable studies reported in the literature, such as Richardson et al[58], with such a short half-life potentially unduly reducing local concentrations. Again, sensitivity comparisons would have been more reassuring.
- No details are given in the report on several key kinetic and heat flux processes represented in the modelling studies. For example: (i) the heat flux at the free surface will be highly dependent on the local ambient air temperature and which will be diurnal and vary with irradiation etc.; (ii) the diffusion and dispersion of the buoyant plumes in the transport equation will be dependent on the plume dynamics and the spatially varying eddy diffusivity and dispersion within each layer; (iii) the decay rates for various water quality indicators are likely to change markedly with salinity, turbidity and irradiance (leading to significant differences between night and day-light conditions); etc. For these examples it is again not clear as to how these complex processes were represented in the model studies and all, or many, of which could cumulatively affect the predicted thermal plume characteristics.

4.4 Assessment of the Subsequent Hydro-environmental Modelling Study Cefas TR267

Following concerns expressed by the Group about the modelling studies reported in TR186, at a meeting with EDF and the Cefas (commercial) team that had carried out the modelling studies on 16th November 2020, Cefas subsequently provided details of additional modelling studies, reported in an undated report, numbered TR267, first drafted in 2013 and submitted to EDF in 2017[59]. This report presents “the setup and validation of a 25 m resolution General Estuarine Transport Model (GETM) model of Hinkley Point”. This edition of the report “presents the results of annual model runs for HPB and HPC, together with additional validation results from the annual model runs”.

In the Executive Summary of the report, Cefas advise that “a detailed evaluation of the GETM model performance --- concluded that the GETM model was fit for purpose for modelling the Hinkley Point C thermal plume but indicated that the thermal predictions for the GETM model overestimated the far field thermal impacts at the seabed”. These findings are consistent with the concerns expressed about the previous model report and the assumption that the thermal plume is well-mixed at the outfall site. To overcome these over predictions of thermal impacts, Cefas decided to run the model at a finer grid resolution ‘due to insufficient model resolution, leading to incorrect estimates of the initial plume mixing’. ‘In particular, it was noted that the 100 m model resolution was considered insufficient to accurately model the HPB plume – in the vicinity of the HPB discharge culvert and that --- it did

[58] Richardson, L.B., Burton, D.T., Helz, G.R. and Rhoderick, J.C. 1981. Residual oxidant decay and bromate formation in chlorinated and ozonated sea-water. *Water Research.* Vol.15, 1067-1074.

[59] Cefas, “Hinkley Point: GETM Plume Model 25m model setup, validation and results of annual model runs for HPB and HPC”, TR267, Undated, pp. 69.

not produce the expected amount of plume stratification close to the outfall'. This finding is not surprising compared to the predictions of Imberger (Figure 4a); an independent expert review of the modelling from the onset could have raised concerns about the representation of the outfall in the original model at an earlier stage.

As stated in the report 'the validation study shows that the 25 m GETM model represents a significant improvement over the previous model, producing equivalent hydrodynamics (as expected), but with a much more realistic stratification of the discharge plume'. The method of representing the discharge of the plume at the outfall site by assuming 'that the vertical column over the cell over which the outfall is located is well mixed' remains a simplified representation of a very complex buoyant plume trajectory. Comparable studies of thermal plumes generally use more sophisticated and accurate representations of plume dynamics through the use of plume models, such as the CORMIX model, now provided by the US Environmental Protection Agency (USEPA)[60].

In reviewing the model setup of the 25 m model of Bridgwater Bay reported in Cefas TR267, further key concerns arise and are summarised below (in the order documented in the report):

- The fine grid 25 m model, presumed to be a structured grid, only covers a relatively small plan-surface area of the Bristol Channel and Severn Estuary, with no details being provided as to how key fluxes are conserved, particularly tangential to the boundary, between the coarse and fine grid domains. Full momentum conservation across linked models can commonly be challenging in structured grid models, with unstructured grid models generally being conservative and enabling a higher grid resolution at sites of interest, such as an outfall. Furthermore, for the model shown in Figure 4, page 9, the graphs suggest that the landward boundary is in the highly tidal region of the Severn Estuary and close to the Second Severn Crossing. If correct, it is not clear why this model boundary was not taken to the tidal limit, near Gloucester, thereby being driven by the river flow and ensuring a more precise boundary condition and particularly in an estuary where tidal resonance is pronounced.
- In general, and as expected, the predictions obtained from the finer grid model, particularly with regard to the thermal plume characteristics, give better results than those reported using the previous grid resolutions, i.e., Cefas TR186. Nevertheless, and as for the earlier model, several key points relating to missing information to assess the details of the processes included in the model remain.
- A comment is provided in the report on page 10 about the bottom roughness, where the value used was '0.005 m'. This value equates to a Nikuradse sand grain roughness of 5 mm, which is unduly small for an estuary with such a complex bathymetry. Comparable estuarine studies in the literature suggest that a more realistic bottom roughness value would be typically about 0.2 m, representing the more dominant form drag roughness associated with ripples and dunes, rock outliers, gravel etc. on the estuary bed. Accurate predictions of the hydrodynamics in a long estuary (such as the Bristol Channel and Severn Estuary) are generally highly dependent on the bed friction coefficient. Engineers

[60] www.cormix.info. USEPA. Accessed on 15 February 2021.

frequently work with a Manning roughness coefficient for bed friction. In an estuary region with a typical depth of 10 m and a mean current of 1 m/s (values typical of the region around the outfall site), a roughness value of 0.005 m would equate to a Manning roughness coefficient of 0.014, which would represent the bed friction for uniform flow 'in smooth straight canals lined with concrete', as given in Chow[61] - regarded as a classic text in this field. In contrast the 'normal' Manning coefficient for a canal described as: 'clean, straight, full stage, no rifts or deep pools' and with 'more stones and weeds' is quoted as being greater than 0.03. This is consistent with minimum values measured in the Conwy Estuary[62] and more recently in south San Francisco Bay[63]. For the same flow conditions as before, this would give a bottom roughness value of 0.24 m, or 240 mm. Such a difference in the bottom friction would be expected to have a noticeable impact on the hydrodynamic predictions, the turbulence characteristics and mixing, and the predicted plume and water quality characteristics in the region.

- Another comment reported on page 10 is that 'the critical and minimum depth allowed in the drying and flooding schemes were 0.5 and 0.2 m, respectively'. These are rather limiting values, particularly for drying, and presumably mean that a grid cell is removed from the domain when the grid cell depth is less than 0.5 m. In comparison with flooding and drying algorithms included in the models developed at Cardiff University, the minimum depth requirements, both for flooding and drying, are typically twice the bed roughness height[64], i.e., 0.01 m for the roughness height of 0.005 m used in the GETM model. The Severn Estuary basin experiences extensive flooding and drying, due to the high tidal ranges, and particularly along the inter-tidal mudflats in the Severn Estuary SAC. If drying cells are removed too early, or flooded too late, in the tidal cycle, then the true plan-surface area is reduced and the tidal currents and mass fluxes in the region are also reduced, thereby potentially giving different predictions of the local tidal currents, tidal excursion, and sediment and concentration levels.
- Whilst the fine grid model does not appear to raise concerns about the thermal plume from HPC affecting the surface water temperatures along the Welsh coast, any impacts on fish migration up the Severn Estuary may be of concern regarding ecological sustainability of the estuary SAC in the future.

4.5 Suitability of Cardiff Grounds for Disposal of Dredged Sediments

As stated in Chapter 3, in 2018 EDF carried out licensed dredging of sediments off Hinkley Point and disposed of these sediments at Cardiff Grounds (disposal site LU110). NRW approved the final disposal of 156,351 m^3 of sediment at Cardiff Grounds in 2018. EDF has since applied to NRW to carry out further dredging and

[61] Chow, V.T. Open Channel Hydraulics. McGraw-Hill Book Co. Inc. 1960. pp.680.

[62] Knight, D.W. 1981. Some field measurements concerned with the behaviour of resistance coefficients in a tidal channel. *Estuarine, Coastal and Shelf Science,* 12(3), 303-322.

[63] Egan, G. et al. 2019. Observations of near-bed shear stress in a shallow wave- and current-driven flow. *Journal of Geophysical Research: Oceans*, 124, 6323-6344.

[64] Falconer, R.A. and Chen, Y.P. 1991. An improved representation of flooding and drying and wind stress effects in a 2-D tidal numerical model. *Proceedings of the Institution of Civil Engineers, Part 2, Research and Theory.* 91(4), 659-678.

disposal in 2021 with up to an additional 470,000 m^3 of sediment being discharged either at Cardiff Grounds and/or Portishead. As also stated in Chapter 3, Hinkley Point lies just within the SAC, illustrated in Figure 4a, and sediment dredged within the SAC should be disposed of within the Severn Estuary SAC, as stated in The Hinkley Point C Development Consent Order 2013 (DCO): "PW23 Dredged material arising from the authorised project shall not be disposed of except within the Severn Estuary Special Area of Conservation"[65]. Cardiff Grounds and Portishead both lie within the Severn Estuary SAC shown in Figure 4a.

To put this quantity of sediment proposed for disposal at Cardiff Grounds in 2021 by EDF into perspective, this volume would equate to 33 rugby pitches (each of area 7,000 m^2) placed side by side and covered with sediment to a depth of 2 m (i.e., the height of a tall adult). Although this seems a relatively large volume of sediment, this volume is approximately only 50% of the typical volume licensed annually by NRW for disposal by other organisations at this site. The public concern about the level of contamination of the dredged sediments from Hinkley Point has been dealt with in the previous chapter. In this section consideration will focus on the suitability of Cardiff Grounds to be used as a dispersive disposal site in the longer term, particularly in the context of complying with the DCO and the requirement to dispose of dredged material within the Severn Estuary SAC. In an accompanying note to the Active Marine Licences relevant to LU110, and provided by NRW to the Group, NRW advise that: "based on the current evidence made available to NRW, the LU110 (Cardiff Grounds) disposal site is behaving in a dispersive nature and operating as a sustainable disposal site, as the Severn Estuary is naturally highly dynamic".

In a paper prepared by Group members for the fourth (October) meeting of the Group, it was reported that 'to maintain the health of an aquatic ecosystem, it is important to retain sediment within the same hydrodynamic system', as required in the DCO, i.e., any sediments dredged within the Severn Estuary SAC should remain within the Severn Estuary. In 2020 Cefas (advisory) completed a review of Welsh disposal sites and reported on modelling studies of sediment plume trajectories from Cardiff Grounds[66]. The paper also reports that the NRW pre-application advice states that: "whilst it is impossible to guarantee no single particle from LU110 (Cardiff Grounds) will ever reach the Penarth/Barry coastline, material disposed will join the naturally highly dynamic region off Cardiff and move in a general North East direction towards the long-term sinks of the Newport Deeps and River marches". The report also goes on to state: "In addition, the WNMP (Welsh National Marine Plan) notes that whilst there is a requirement to ensure adequate provision for port access and disposal sites, beneficial use of dredged material is to be encouraged. Beneficial use in this case may include, but is not limited to, retaining sediment within the natural sediment system to support sediment-based habitats, shorelines and infrastructure (known as Sustainable Deposit), as well as habitat restoration, beach nourishment, and shoreline stabilisation/protection".

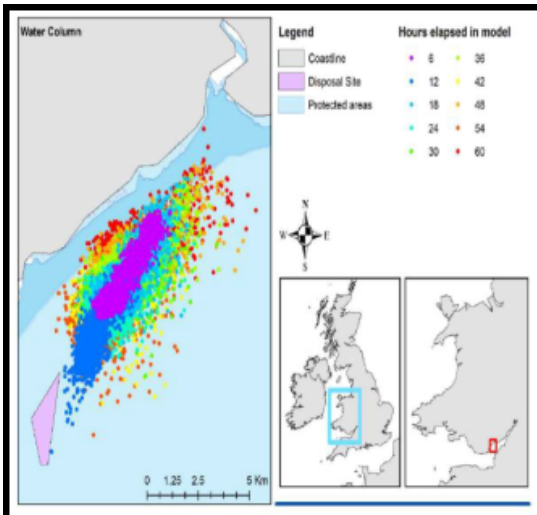
The modelling results from previous studies and the summary for Cardiff Grounds disposal site, within the Severn Estuary, are summarised in Table 4a below. These modelling results are, in key respects, at variance with several different hydrodynamic model studies undertaken for the Bristol Channel and Severn Estuary,

[65] https://www.legislation.gov.uk/uksi/2013/648/contents/made, Accessed on 3 March 2021.

[66] Cefas, "Welsh Disposal Site Review", C6268U, March 2021, pp. 70.

using Cardiff University's 2-D and 3-D models, as well as using (or overseeing) widely used commercial models, including TELEMAC and Delft 3D (operated in 2D mode).

Table 4a. Modelling results and summary for Cardiff Ground disposal site



LU110 - Cardiff Grounds

- 650,000 tonnes per annum (average) with a maximum of 1,022,874 tonnes in 2011.
- Within Severn Estuary SAC.
- Material remains largely within the water column and is retained within 10km of the site.
- Dispersive site.
- Plume spreads northeast, overlapping with boundaries of Severn Estuary SPA, SSSI and Ramsar site.
- Proximity to coastline may mean site is further influenced by other factors such as wave dynamics.
- Recommendation by review: further investigation into the sensitivities of the protected area features may be beneficial.

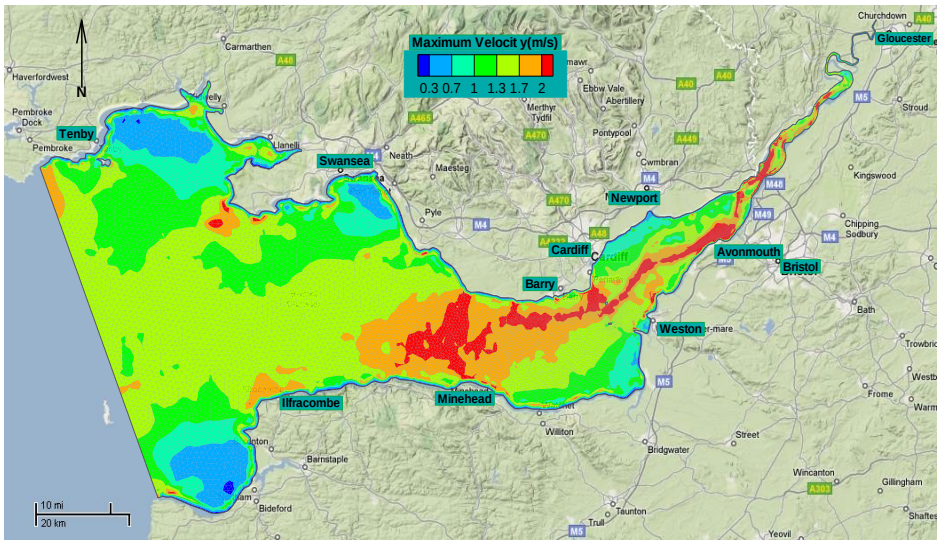
In the Cefas (advisory) report there is limited information about the details of the hydrodynamic model, in that no information is provided with regard to a number of key parameters for predicting the trajectory of this sedimentary plume, including: (i) grid resolution within the Severn Estuary, and particularly in the region of Cardiff Grounds, (ii) extent of the boundary up the Severn Estuary and whether the model went up to the tidal limit of the Severn, i.e., to Gloucester weir, (iii) were discharges included in the model for the key rivers, particularly the Severn, (iv) what bottom roughness values were assumed to represent bed friction and turbulence generation, (v) what degree of model calibration and validation was undertaken in the Severn Estuary, and particularly in the region around Cardiff Grounds, etc. In particular, the model simulations in Table 4a show that 'material remains largely within the water column and is retained within 10 km of the site' and the plume is shown to propagate in a North Easterly direction, i.e., upstream, and further into the Severn Estuary. This predicted plume trajectory after 60 hr is a little surprising, in that the tidal current structure off Penarth Pier and Cardiff tidal sites (both close to Cardiff Grounds) indicate that the current is slightly stronger on the ebb vis-à-vis flood tide, based on tidal times for the ebb and flood tide durations respectively, and as partly explained by the estuarine dynamics and the flows from the main rivers upstream, including the Severn, Wye, Avon and Usk.

The Cardiff University 2D unstructured grid DIVAST model was originally refined to investigate the hydrodynamics in the Bristol Channel and Severn Estuary and to assess the hydro-environmental impact of a Severn Barrage, from Cardiff to Weston[67], across the Severn Estuary. A finite volume boundary fitting model was

[67] Xia, J., Falconer, R.A. and Lin, B. 2010. Impact of different tidal renewable energy projects on the hydrodynamic processes in the Severn Estuary, UK. *Ocean Modelling.* 32(1-2), 86-104.

used, which initially had boundaries located at the mouth of the Bristol Channel, from Stackpole Head (Wales) to Hartland Point (England) and with the upstream boundary extending to the tidal limit at Gloucester. An early illustration of the tidal currents is given in Figure 4c, where the maximum tidal currents in the region of Cardiff Grounds are predicted to be approximately 1.3 to 1.7 m/s. In several subsequent studies over the past decade this model has been further refined to include extending the seaward boundary to the Continental Shelf, as well as refining a range of hydrodynamic and water quality parameters. More recently, parallel model development work has also been undertaken using the TELEMAC model (originally developed by EDF), which is based on an unstructured finite element grid. Details of this model are given in Guo et al[68].

Figure 4c. Model predicted peak tidal currents in the Bristol Channel and Severn Estuary



In assessing the hydrodynamic features in the Severn Estuary, particularly around Cardiff Grounds, Dr Athanasios Angeloudis, at the University of Edinburgh[69], and Dr Reza Ahmadian, in the Hydro-environmental Research Centre at Cardiff University, were invited to provide predictions to the Group of the current structure in the vicinity of Cardiff Grounds. In both cases the peak currents in the region of Cardiff Grounds exceeded 1 m/s, as shown in Figure 4c. Dr Ahmadian and his Research Associate Dr Man Lam[70] then produced two animations of tracked particles released from the Cardiff Grounds at high tide (ebb flow) and low tide (flood tide) respectively, with tidal phases being relative to the tidal times at the seaward boundary. The simulations of the particle trajectories were both run for 10 tides, with the resulting particle locations shown after 5 tidal cycles for high (Figure 4d (i)) and low (Figure 4d (ii)) tide initial

[68] Guo, B., Ahmadian, R., Evans, P. and Falconer, R.A. 2020. Studying the wake of an island in a macro-tidal estuary. *Water.* 12(5), 1225, 1-18. Open Access.

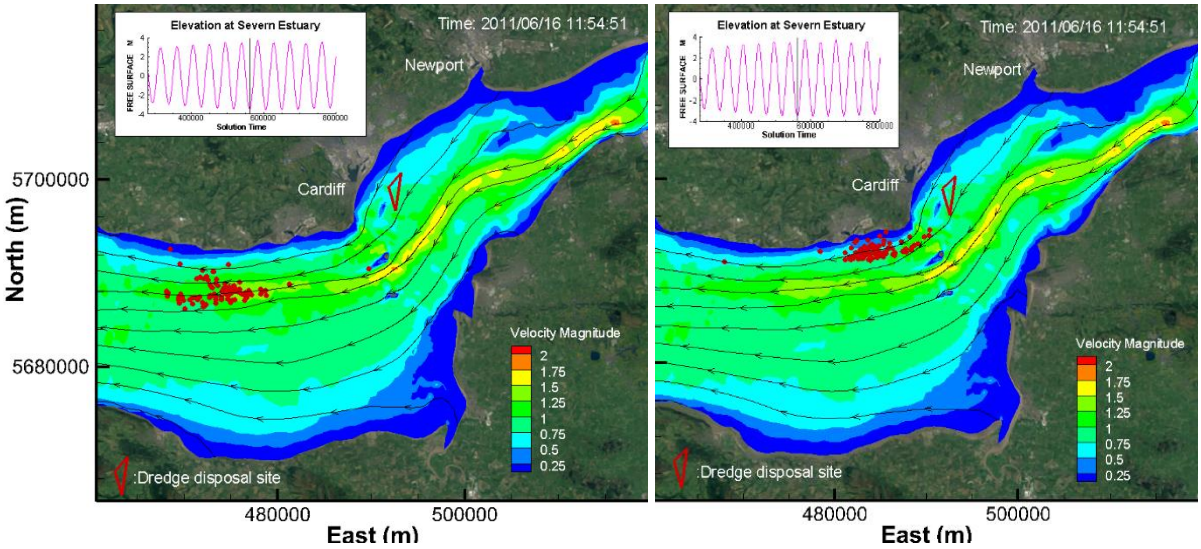
[69] Angeloudis, A. Private Communication on hydrodynamic modelling in the region of Cardiff Grounds. University of Edinburgh, 2020.

[70] Ahmadian, R. and Lam, M. Private Communication on modelling plume trajectory from Cardiff Grounds. Cardiff University, 2021.

releases. Five tidal cycles correspond to 62.1 hr, which is just slightly longer than the trajectory given in Table 4a, of 60 hr in the Cefas C6268U report plume trajectory.

The resulting model predicted trajectories shown in Figure 4d illustrate that for both ebb and flood neap tide releases the plume particle trajectories (illustrated with red dots) are both in the South Westerly direction, and that at the end of 5 tides the bulk of the particles are seen to have left the Severn Estuary SAC, as shown in Figure 4a. These results differ significantly from the plume trajectories reported in the Cefas C6268U report and bring into question the more general point as to the appropriateness of Cardiff Grounds as a site for dredged sediment disposal. These results suggest that ideally a more comprehensive modelling study should be undertaken in the near future to study the case for Cardiff Grounds being used as a suitable disposal site for dredged sediments and particularly in terms of sustaining the unique ecological characteristics of the Severn Estuary SAC.

Figure 4d Predicted location of particles (red dots) released from Cardiff Grounds after 5 tides at (i) high and (ii) low tide, relative to seaward boundary



(i) High (ebb) tide release (ii) Low (flood) tide release

In any modelling studies undertaken in the future, to focus on establishing the plume trajectory from Cardiff Grounds, it would also seem prudent to include predicting sediment plume trajectories from Portishead disposal site. Such a comprehensive modelling study should include the key hydro-morphological processes associated with sediment transport, including erosion and deposition, and for cohesive and non-cohesive sediments. Such a study would enable key stakeholders to establish the impact of the disposal of marine sediments at either, or both, the Cardiff Grounds and Portishead sites on the ecological status and sustainability of the Severn Estuary SAC.

4.6 Concluding Remarks

This chapter reports on the evidence provided to the Group, relating to the computational modelling studies undertaken by Cefas (commercial), to assess the likely impact of a new nuclear power station at Hinkley Point C. These hydro-environmental and ecological modelling studies are important in terms of assessing the tidal current structure in the Bristol Channel and Severn Estuary and then establishing the impacts of the thermal discharge from the outfalls on the water quality and ecology, particularly in the Severn Estuary SAC and along the Welsh coast.

A review of the modelling evidence provided to the Group has led to 3 key concerns and advice from the Group. These concerns and advice are summarised below:

- Limited information is provided in the reports made available to the Group to comment on the quality of the modelling studies undertaken to assess the hydro-environmental and ecological impacts of HPC on the Severn Estuary SAC. Whilst the predicted thermal plume is unlikely to have any significant impact on the water temperatures along the Welsh coastline, the thermal plume could have an impact on local fish breeding grounds in the vicinity of Hinkley Point and the subsequent migratory pathways of fish in the Severn Estuary. The limited information provided on the modelling studies has made it difficult to assess with confidence the predicted thermal plume trajectories.
- For such a major nuclear power station project, sited in a SAC and within a highly dynamic and unique estuary, the only assessment of the modelling studies undertaken by Cefas (commercial) appear to have been undertaken by experts working in Cefas (advisory). This is highly unusual, in that such modelling studies are increasingly independently audited by an expert, or group of experts, with such auditing being routinely undertaken in the UK and internationally. In this case it is difficult to see how the public can have confidence in the model predictions when the modelling has been done by Cefas (commercial) operating under contract to EDF and that advice on the modelling is provided to the UK and Welsh Government agencies by Cefas (advisory) operating in its more public facing role.

Advice 1. Concerns are expressed by the Group on the original modelling undertaken by Cefas (commercial) and the lack of an independent audit of these studies, particularly for such a high-profile project of understandable public concern. Questions remain unanswered about the efficacy of the commercial arm of Cefas undertaking the modelling and colleagues elsewhere in the organisation providing advice to government agencies based on the predictions from the modelling studies. This engagement of Cefas as the modeller and Cefas as an independent advisory body to government agencies, is not an arrangement which is likely to inspire public confidence when associated with such a high-profile infrastructure project.

- Following the request by the Group for details of the modelling studies and a review of the Cefas report TR186, the Group expressed a number of concerns to EDF and Cefas about a lack of information in the report on the model details etc. Following the meeting Cefas provided a more recent report (TR267) to the Group on further hydro-environmental modelling studies, using only the GETM model. Whilst this subsequent study involved modelling part of the estuary (in

the vicinity of the HPC outfalls and intakes) with a finer resolution mesh, several concerns remain. For example: (i) the bottom roughness value used is appreciably lower than that normally used for such an estuarine model study, (ii) there are no details in the report as to how the heat flux was represented in the model, (iii) how the heat flux varied with the ambient air temperature, etc. It is therefore difficult to ensure a high level of confidence in the modelling of the thermal plume, based on the evidence provided to the Group. Whilst the thermal plume is unlikely to have an impact directly on the ecology of the estuarine waters along the Welsh coast, it could affect the fish breeding grounds close to Hinkley Point and the fish migratory pathways upstream in the Severn Estuary SAC.

Advice 2. A number of key concerns remain about the accuracy and transparency of the modelling of the hydrodynamic and water quality processes and, in particular, on the characteristics of the thermal plume. This is particularly relevant for such a high profile project with a significant cooling water outfall discharge and temperature rise. Questions remain about the accuracy and transparency of the the impact of the high thermal heat flux on the ecological sustainability of the Severn Estuary SAC and fish migratory pathways.

- Based on extensive model simulations of the Bristol Channel and Severn Estuary, undertaken over the past 15 years at Cardiff University, for a range of hydro-environmental impact assessment studies (particularly for barrages and lagoons), tidal current model predictions have been provided by the universities of Edinburgh and Cardiff on the hydrodynamics and (for the latter) neutrally buoyant sediment trajectories in the vicinity of Cardiff Grounds. These preliminary results do not consider sediment erosion and deposition but assume the sediments to remain in suspension. Nevertheless, the results contradict earlier, and recent, model studies included in the Cefas C6268U report submitted to NRW. The Cardiff University results, consistent with some anecdotal evidence, predict that a sediment plume from Cardiff Grounds dispersive site will transport the sediments to the South West of the Severn Estuary, and out of the SAC, rather than North East and further up the estuary, as predicted in earlier model studies and reported by Cefas. These findings bring into question the suitability of Cardiff Grounds as an appropriate site for discharging sediments in the future, bearing in mind that the site is within the Severn Estuary SAC and public concern about sustaining the unique and high-quality ecological status of the Severn Estuary.
- It is noted that EDF are also considering applying to discharge a relatively large quantity of dredged sediments at the disposal site at Portishead. Any significant quantity of sediments disposed of at this site may also have an impact on the hydro-ecological characteristics of the Severn Estuary SAC and it would therefore also seem prudent to model the hydro-morphological characteristics of the Portishead disposal site.

Advice 3. In view of the uncertainty in the model predictions of the sediment trajectory plume from Cardiff Grounds dispersal site, questions are raised about the efficacy of this site in terms of sustainably supporting the unique ecological characteristics of the Severn Estuary SAC, and the Hinkley Point C Development Consent Order (2013). In the recent Cefas C6268U report to NRW the analysis of

model predictions showed that the sediment plume from Cardiff Grounds would travel North East, and up the Severn Estuary. In contrast, model predictions undertaken by Cardiff University indicate that the plume will travel South West and out of the Severn Estuary SAC. Such a difference is significant, and it is advised that either the Welsh Government or NRW consider undertaking more comprehensive modelling studies in the future to assess the hydro-morphological processes in the locality of Cardiff Grounds. It would also seem prudent to investigate the hydro-morphological characteristics of the Portishead disposal site as part of the same study, as this site could also affect the ecological sustainability of the Severn Estuary SAC.

Chapter 5

Emergency planning for nuclear operations at Hinkley Point

This chapter will review the development, coordination and implementation of off-site emergency plans for nuclear operations at Hinkley Point with regard to UK regulations and the implications for Wales. The review will be based on the evidence and communications received by the Group from the involved organisations as well as any additional and relevant resources. Advice from the Group is given based on the review of the evidence.

5.1 Background

Emergency planning for nuclear emergencies should ensure that arrangements are in place to effectively respond to any emergency on the site where the emergency situation occurs as well as off-site where members of the public might be affected. In the UK, the Radiation Emergency Preparedness and Public Information Regulations (REPPIR) sets out the framework for preparedness measures to ensure that arrangements are in place to effectively respond to any emergency. These regulations were revised in 2019 (REPPIR19) replacing the previous regulations (REPPIR01). REPPIR19 and REPPIR01 Both REPPIR01 and REPPIR19 require that a defined Detailed Emergency Planning Zone (DEPZ) to be designated in the area around a nuclear facility. The DEPZ is a defined zone around a site where it is proportionate to pre-define protective actions which would be implemented without delay (e.g. within a few hours) to mitigate the most likely consequences of a radiation emergency. The local population within a DEPZ will be contacted if there is an incident on site that might result in a release and informed as to what action to take (e.g. evacuation and to where).The guidance in REPPIR draws upon recommendations published by the International Atomic Energy Agency (IAEA), but uses different terminology (IAEA, 2013). The IAEA recommends Precautionary Action Zones (PAZ), that are equivalent to the UK DEPZ, related to the total thermal rating (MW(th)) of all reactors on a site and the estimated doses as a result of severe accidents. For sites with reactors producing more than 1000 MW(th), the IAEA recommendation for the PAZ is between 3 and 5 km in radius.

Under REPPIR19 (ONR, 2019), operators of nuclear facilities must present a technical assessment for the required DEPZ to the responsible local authority in advance of any significant radioactive material being brought on site (i.e. nuclear fuel). The assessment by the operator should include modelling of any potential release and associated exposure doses. The local authority should then review the assessment of the operator and make recommendations to enlarge the DEPZ to take into account any situations that are not already covered by the DEPZ (e.g. to make evacuation orders easier to carry out). The Office for Nuclear Regulation (ONR) can provide further recommendations as required to the operator or the local authority. In the case of Hinkley Point, the responsible local authority is Somerset County Council (SCC).

The current DEPZ for the Hinkley site is 3.5 km (Somerset CC, 2012). All operators of nuclear installations and all local authorities which have active off-site emergency plans for nuclear installations in the UK, must now produce revised plans under REPPIR19. EDF presented its revised consequences report for Hinkley Point B in September 2019, with a recommended minimum DEPZ of 1 km. SCC are in the

process of developing their off-site emergency plan for Hinkley Point B which will include any changes to the currently defined DEPZ.

Outline planning zones (OPZ) operate at distances beyond the DEPZ. The presence of an OPZ should assist local authorities in planning for extremely unlikely but more severe events. The IAEA states that urgent protective action planning zones (UPZ), that are equivalent to the UK's OPZ, should be between 5 and 30 km for sites with reactors producing more than 1000 MW(th). Under REPPIR01 there was a requirement to consider extending planning zones under a severe release scenario but not an OPZ as now defined under REPPIR19. Under the new REPPIR19 regulations, the predetermined OPZ in the UK for civilian nuclear power plants is 30 km (whether in operation or undergoing decommissioning but where irradiated fuels are still present), where the OPZ extends from a clearly indicated centre point.

Under the off-site emergency plan for Hinkley Point that was developed under REPPIR01 and published by SCC in 2012 (SCC, 2012), an extended release scenario zone was defined with a radius of 15 km from the perimeter of the DEPZ (3.5 km), giving a total radius of 18.5 km. The 2012 off-site emergency plan also stated a further zone of 15 to 40 km for Food/Water Restrictions and notes that local authority interest in this zone includes:

- Vale of Glamorgan
- Cardiff
- Newport
- Caerphilly
- Rhondda Cynon Taf

The Welsh Government and the aforementioned Welsh local authorities were also included in the Off-Site Nuclear Emergency Alert & Notification Chain by SCC.

EDF's revised consequences report for Hinkley Point B (EDF, 2019) now includes an OPZ of 30 km that includes parts of South Wales (Figures 5.1a and 5.1b). The consequences report further states that

> *'It is recommended that advice be issued within 24 hours to restrict consumption of leafy green vegetables, milk and water from open sources/rain water in all sectors of the Detailed Emergency Planning Zone and downwind of the site to a distance of 43km'.*

The prevailing wind direction for the Hinkley area and the area of South Wales within 43 km of Hinkley Point B are shown in Figures 5.2 and 5.3.

A revised REPPIR19 off-site emergency plan for the Hinkley Point site is currently under development by SCC. A further revised consequences report and off-site emergency plan for the Hinkley site will be required before nuclear fuel is installed at Hinkley Point C, but the OPZ will remain the same (i.e. 30 km), as predetermined by REPPIR19.

Figure 5.1a. 30 km OPZ around Hinkley Point B

Figure 5.1b. Region of Wales within the 30 km OPZ around Hinkley Point B

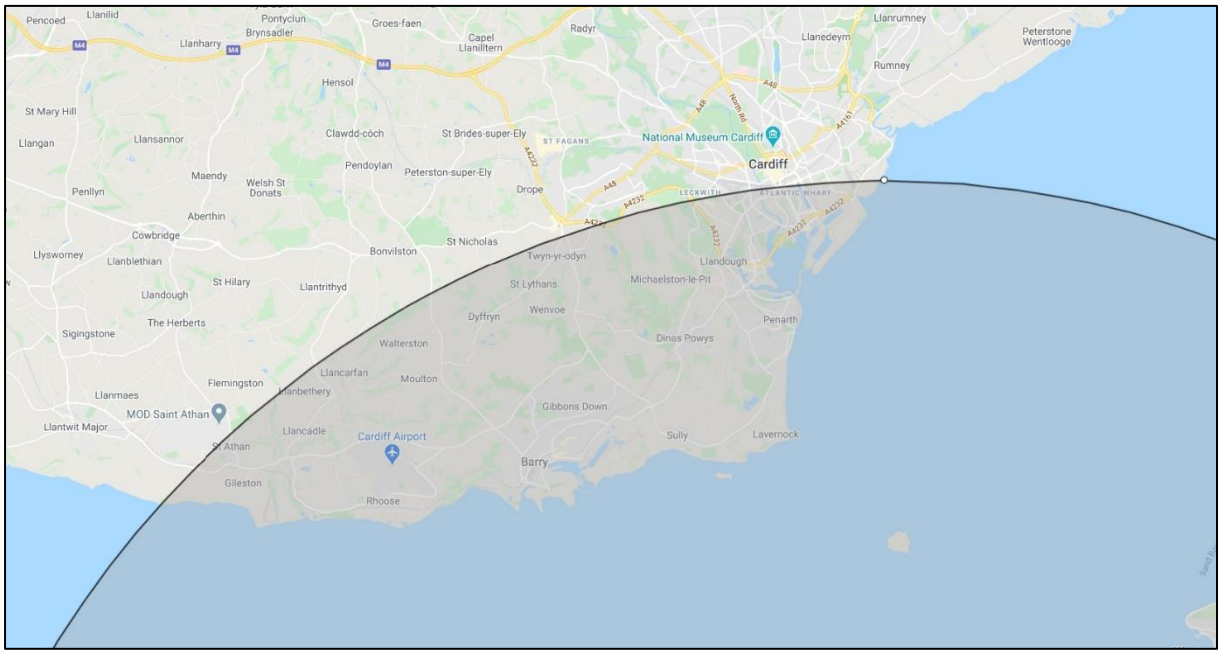
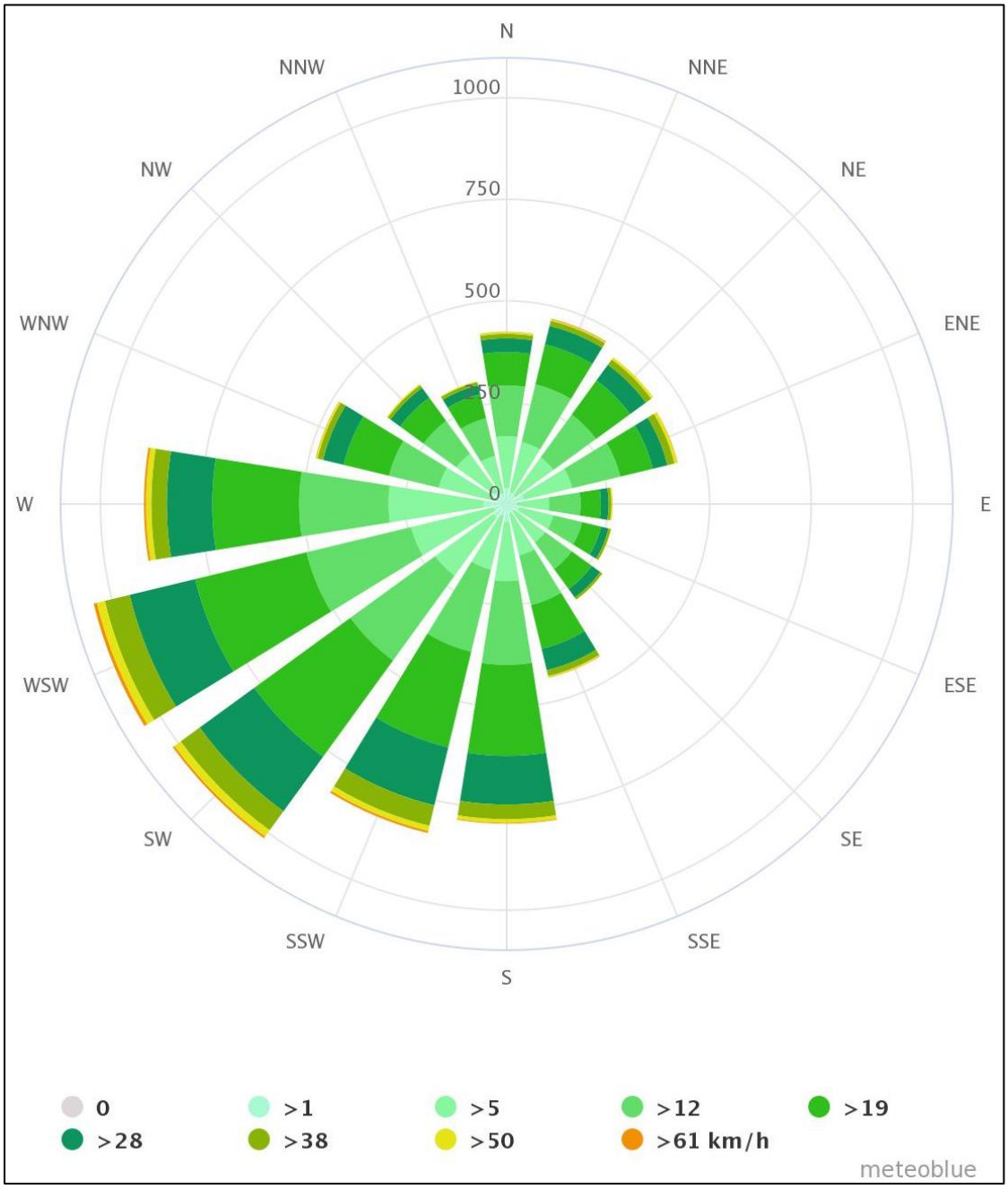
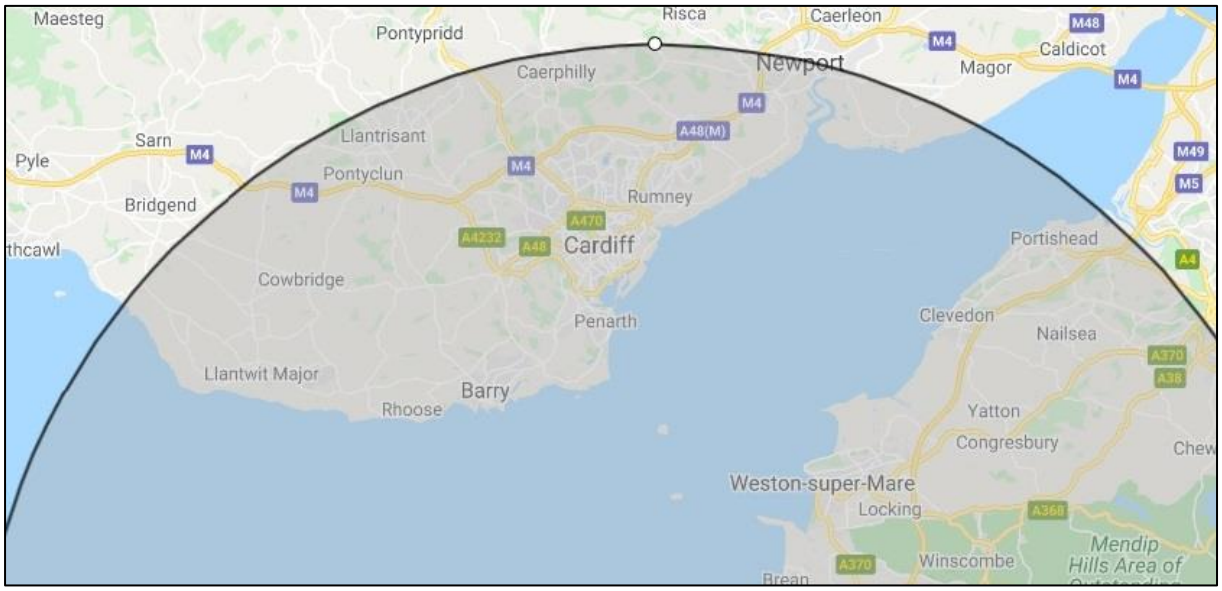


Figure 5.2. Wind rose for Weston-Super-Mare based on 30 years of hourly weather model simulations, showing the number of hours per year the wind blows from the indicated directions[71].



[71] https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/weston-super-mare_united-kingdom_2634308

Figure 5.3. Region of Wales within a 43 km zone around Hinkley Point B



5.2 Concerns

- Has the Welsh Government, relevant Welsh local authorities, local resilience fora and emergency services been involved in the development of any off-site emergency plans for nuclear operations at Hinkley Point?
- What requirements are placed on such Welsh authorities/organisations in relation to preparing and maintaining plans or procedures relating to potential nuclear emergencies at Hinkley Point?
- Are such Welsh authorities/organisations aware of these requirements and what has been done to meet these requirements?

5.3 Review of evidence

5.3.1 Has the Welsh Government, relevant Welsh local authorities, local resilience fora and emergency services been involved in the development of any off-site emergency plans for nuclear operations at Hinkley Point?

Concerning what requirements are in place to ensure that the Welsh Government, relevant local authorities, local resilience fora and emergency services are informed of, and consulted on, off-site emergency plans for Hinkley Point, ONR stated that

> *'REPPIR19 places a duty on the lead local authority, in this case, Somerset County Council, in preparing or reviewing an off-site emergency plan, to consult a range of organisations including such other persons, bodies or authorities as the local authority considers appropriate. [reg 11(5)]. The guidance (ONR, 2019) further specifies that the local authority must ensure that all individuals or organisations identified in regulation 11(5) and anyone else with a role in delivering the off-site emergency plan are made aware of the proposals and its contents.'*

Furthermore, ONR stated that

> *'Although REPPIR19 does not explicitly state that neighbouring authorities that have jurisdiction within the outline planning zone should be consulted, in this case, it would be reasonable to expect Somerset County Council to consult any other authority should there be the possibility that those authorities may be required to undertake any actions in an emergency, or should there be a possibility that their population is affected, even if the likelihood of the event was extremely low'.*

ONR added that

> *'The local authority is also required to make available the extent of the OPZ to the public, for example by publishing a map showing the boundary of the zone on their website. However, as the planning for the OPZ is at the strategic level, it is not appropriate to pre-identify any specific protective actions for members of the public within the OPZ. This advice would be provided in the unlikely event of an emergency with consequences that extend to the OPZ. However, under the banner of strategic planning, we may expect a lead local authority to be in contact other local authorities or organisations, for example those with jurisdiction in the DEPZ or OPZ, that could be required to carry out any actions in an emergency, such as passing on information to their population. The extent of the interaction may simply inform them of any potential arrangements (even high-level plans) that they may need to put in place.'*

With regard to contact between the ONR and Somerset County Council, ONR stated that

> *'Our representatives have had a number of bilateral teleconferences with the emergency planning representatives to seek assurance of the development and publication of the revised Hinkley off-site emergency plan and public information, in accordance with the revised requirements for REPPIR19.'*

Concerning oversight of off-site emergency plans, ONR stated that

> *'In January 2020, ONR wrote to all the lead local authorities with nuclear sites in their jurisdiction clarifying various roles and responsibilities under REPPIR19. The letter stated that although ONR no longer had a statutory role in the determination process for detailed emergency planning zones, we remained committed to assisting local authorities in navigating the revised processes required by the regulation during the implementation period. The letter went on to describe how we would sample some of the assessments to provide us with an overview of how operators and local authorities are following the new processes and fulfilling their new statutory responsibilities. The letter also made it clear that ONR is not required to, and would not be performing a formal assessment of, or approving the individual DEPZs. Similarly, under either the previous or the 2019 regulations, ONR is not required to review or approve off-site emergency plans.'*

ONR added that

> *'REPPIR does not place any duty on ONR to review or approve emergency plans, however we intend to review all the off-site emergency plans including the HPB off-site emergency plan in the coming months to ascertain the level of compliance. Furthermore, if we do identify any shortfalls in the plans, these will*

be relayed to the relevant local authority and a way to rectify the issue or issues will be agreed.'

When asked for a view on the effectiveness of the scrutiny process for off-site emergency plans, ONR stated that

'We would expect the production and approval of the document to be subject to Quality Assurance arrangements, which we would expect to be in accordance with the Council's or the Local Resilience Forum's usual governance arrangements. Where there is a significant change to the plan, off-site plans should undergo a consultation period where those who need to comment are afforded the opportunity. REPPIR19 Regulation 11(5) lists the organisations that would need to be consulted on production or revision of the off-site plan'

ONR added that

'ONR has no part in the approval process but we are provided with a copy of published plans for our own information and regulatory oversight. During an inspection of the local authorities' arrangements, we would often look to check that there is appropriate consultation and collaboration.'

ONR had planned an inspection of SCC's emergency arrangements under REPPIR in March 2020 but this was postponed due to Covid-19. This inspection is now planned for 2021.

On the question of whether SCC had consulted risk management authorities in Wales during the development of off-site emergency plans for the Hinkley site in the past, SCC stated that '*there has been only limited dialogue in recent years*' between SCC Civil Contingencies Unit and the relevant risk management authorities in Wales, but SCC saw '*value in increased contact between the risk management teams on either side of the Bristol Channel going forward*' in regard to plans to start decommissioning Hinkley Point B in 2022 and the subsequent completion of Hinkley Point C.

Furthermore, SCC stated that

'Cardiff Council, Vale of Glamorgan Council, Rhondda Cynon Taf County Borough Council, Newport City Council have been referenced in the off-site planning documents since the introduction of REPPIR 01 and are sent copies of the multi-agency off-site plan following plan updates. Somerset County Council is required to update the off-site plan on a three-year schedule.'

Concerning the recent update to the off-site emergency plan for Hinkley Point B under REPPIR19, SCC stated that

'The most recent off-site plan update went live in August 2020 following the introduction of REPPIR 19 and the redetermination of the detailed emergency planning zone. Copies of the most recent plan have been sent to the authorities listed above with reference to the outline planning sections.'

In an initial reply via the Welsh Local Government Association, Cardiff Council, Rhondda Cynon Taf County Borough Council and Monmouthshire County Council have replied that they are not aware of any contact from SCC concerning Hinkley Point, at least with the departments within these local authorities that have replied so far.

Newport City Council confirmed that they had recently received a copy of SCC's revised off-site emergency plan for Hinkley Point B (August 2020 version), although there was no reference to the City Council in the plan. Newport City Council noted that the plan stated that in the event of an off-site nuclear incident at Hinkley Point B, environmental monitoring would be coordinated by Public Health England, and undertaken by the Environmental Agency, the Food Standards Agency and Water Companies with support from EDF. These activities would be undertaken beyond the outer boundary of the OPZ out to 43 km from the site, which includes Newport City Council.

Concerning the information that must be made available to the public regarding off-site nuclear emergencies, SCC stated that

> *'The Civil Contingencies Unit is finalising an update to the public information relating to off-site nuclear emergencies. In the near future, this information will be shared with all organisations mentioned in the off-site plan including those in the outline planning areas including the authorities listed above. Organisations will be asked to include the public facing information on their websites.'*

In the event of any off-site nuclear emergency SCC stated that

> *'the call-out and alerting arrangements for an off-site nuclear emergency at Hinkley Point B would include the Welsh authorities. As set out in the off-site plan, notification would be via the Ministry of Housing, Communities & Local Government (MHCLG) to the Welsh Government for onward transmission to relevant local authorities and public bodies.'*

On the issue of timing for production of off-site emergency plans, with a view to the potential timeline for such work for Hinkley Point C, the ONR stated that

> *'The lead local authority must produce an off-site emergency plan within eight months of being sent a Consequences Report and the operator cannot start working with ionising radiation before the off-site emergency plan is put into effect.'*

On the same issue, SCC stated that

> *'We would look to ONR to give a notification and direction to Somerset County Council when the C Site is required to come within the scope of the off-site planning arrangements under REPPIR 19. Somerset County Council will then carry out an update of the off-site plan to incorporate the C Site and will engage with organisations involved with the off-site plan. Our current planning assumption is that this will take place within the next 5 years.'*

5.3.2 What requirements are placed on relevant Welsh authorities and organisations in relation to preparing and maintaining plans or procedures relating to potential nuclear emergencies at Hinkley Point?

On the issue of what requirements are placed on relevant Welsh authorities and organisations in relation to preparing and maintaining plans or procedures relating to potential nuclear emergencies at Hinkley Point, the ONR stated that '*it is for Somerset County Council to prepare and maintain the off-site emergency plan and to identify and consult relevant organisations on its content.*'. ONR recalled that the guidance under the REPPIR approved code of practice §334 proposes that the lead local authority should ensure

'that the plan can be put into effect without delay when required by ensuring that prior information has been supplied in accordance with regulation 21 and by seeking confirmation, so far as reasonably practicable, from responding organisations that: (i) the necessary information, instruction and training has been provided and the necessary equipment for restricting exposure has been made available, in accordance with regulation 11(6); and (ii) any other underpinning capabilities required to implement the plan are in place and readily available.'

In asking for insight into their experience in managing the off-site emergency plan for Hinkley Point A and B, SCC stated that

'REPPIR 01 and REPPIR 19 set out expectations for training, exercising and preparedness regarding the off-site arrangements. Somerset County Council is required, with EDF to deliver a test of the off-site plan on a three-year cycle. The exercise scope and objectives are agreed in advance with ONR. ONR provide assessors to observe the tests and sign off the post -exercise reports and recommendations. The most recent test of the off-site plan was Exercise Nighthawk held in June 2018. Because the focus of the exercise was the immediate area surrounding the site and not the wider outline planning area, we did not extend an invitation to the Devon or Welsh authorities on that occasion.'

With regards to future exercises, SCC stated that

'Representatives of risk management organisations in Wales would be very welcome to attend future Level 2 (off-site plan) exercises as observers. The next Level 2 exercise for Hinkley Point B will be Exercise Dorado. This will be a modular exercise to be held as workshops across two dates in July and September 2021.'

SCC added that they are '*required to ensure that information is available to partner organisations that would have a role in the activation of the off-site plan.*', which would be delivered via circulation of the off-site plan, delivery of exercises to test the plan and delivery of briefing and awareness events prior to exercises. The exact participants in any exercise would vary with the scope of the exercise planned. SCC stated that '*The briefing event webinar for Exercise Dorado is scheduled for 9th June 2021 and representatives of the risk management organisations in Wales would be welcome to attend*'.

5.3.3 Are such authorities/organisations aware of these expectations and what has been done to meet these expectations?

When asked whether the ONR has a view on whether relevant authorities and services dedicate appropriate time and resources into training for nuclear emergencies and into raising awareness of potential emergencies with local populations, to ensure plans and procedures can be implemented effectively as necessary, the ONR stated that

'We have previously scrutinised the training arrangements for off-site nuclear emergencies as well as the provision information to members of the public within Detailed Emergency Planning zones; these are both requirements under REPPIR (both under 2001 and 2019 legislation). Of those local authorities inspected, some areas for improvement were identified in some aspects of the training and these were reported back to the local authorities. Lead (nuclear) local authorities and relevant emergency responders regularly engage at the

national level to share good practice and raise issues, specifically at the Local Authorities Nuclear Working Group (LANWG), the Blue Lights Working Group (BLWG) and the Lessons Learned Working Group (LLWG). We attend these groups to provide feedback and to gain oversight of the common issues.'

ONR added that

'To date, we have not identified any significant shortfalls in compliance with the regulations in the areas identified in your question, although we have been made aware of pressures on local authority and emergency responder resource in some areas made worst by Brexit planning and the Covid-19 response. As a result, we have offered assistance and guidance to assist local authorities continue to achieve compliance under the existing pressures.'

Monmouthshire County Council stated they were heavily involved with the off-site arrangements for Oldbury nuclear power station and also worked with partners in developing the Gwent Local Resilience Forum (GLRF) Extendibility Arrangements Plan in relation to Oldbury (GLRF 2011). The Extendibility Arrangements Plan was designed to dovetail with the Oldbury off-site emergency plan produced by South Gloucestershire County Council. The plan covered cross border command and control structures and reinforced existing arrangements to ensure response agencies in the Gwent LRF could deal with an off-site nuclear incident at Oldbury. The Plan addressed countermeasures that could be implemented and set out arrangements for warning and informing the public. Both the Oldbury off-site emergency plan and the GLRF Extendibility Arrangements Plan were formally withdrawn at the end of 2017, due to the progress of decommissioning work at Oldbury nuclear power station.

Monmouthshire County Council stated that they would be interested in gaining a greater understanding of the footprint and reference scenarios for potential off-site nuclear incidents at Hinkley Point and that they would have the basis of a template and issues that would require consideration from their previous work with Oldbury.

Newport City Council stated that as they are not within the DEPZ, no formal Hinkley Point B emergency plans have been developed. However, the City Council has existing procedures to ensure that any notification of a radiation release are managed, particularly with regards notification to Environmental Health. Newport City Council stated that they will review these procedures in light of the update from SCC.

5.4 Advice

Advice 1. On the basis of the information received from the Office for Nuclear Regulation and Somerset County Council, the Group suggests that the Welsh Government, relevant Welsh local authorities, local resilience fora and emergency services should review plans or procedures relating to potential nuclear emergencies at Hinkley Point in light of any information received from Somerset County Council to date and in particular with regard to the REPPIR19 updated off-site emergency plan that Somerset County Council has sent to the stated Welsh local authorities. Such a review should examine whether sufficient resources are available to respond as required in the event of an off-site nuclear emergency at Hinkley Point. Similar reviews may be required in relation to any other nuclear site and associated off-site emergency plan that may have implications for Wales.

Advice 2. The Group sees the benefit in establishing greater cross-border cooperation with regard to nuclear emergency preparedness in the case of Hinkley Point and the future operations at Hinkley Point C and any other cross-border situation involving a nuclear site in England or Wales. As part of this process, the Group would encourage the Welsh Government, relevant Welsh local authorities, local resilience fora and emergency services to participate, as appropriate, in Somerset County Council's next Level 2 exercise for Hinkley Point B in 2021.

Chapter 6

The use of powers by the Welsh Government and its agencies in the context of the Hinkley Point C sediment disposal at Cardiff Grounds

6.1 Background

This chapter will first, based on the Group's examination of the evidence that it has collated in considering issues arising from the past and potential disposal of radioactive sediments from the Hinkley Point C site at the Cardiff Grounds disposal site, draw out observations on the use of powers by Welsh government its agencies. It will deal with matters arising in this regard from the substantive areas of inquiry undertaken by the Group into the ecosystem resilience of the Severn Estuary; cross border systems and processes; sediment disposal; modelling and the Cardiff Grounds and the Portishead marine disposal areas; and emergency planning. These considerations will be set against the legal background of multi-dimensional complexity regarding regulatory provision for nuclear sites, encapsulating environmental and human impacts, which the Group views as being amplified in a cross-border context, where multiple administrations and their agencies and differing legal provision come into play.

The complexities that we encountered appeared and reappeared and will continue to manifest in various forms and constellations throughout the regulatory timeline for Hinkley Point C as a large complex infrastructure project, reflecting environmental, institutional, political, and societal contexts that both situate the process as a whole and contribute in diverse ways to its constituent parts. While interactions between the many actors in the multiple decision-making processes are framed by law and policy, they are fleshed out in practical terms by a range of less formal but significant documents that have been agreed between them, such as Memorandums of Understanding (MOU). The Group observes that these vary considerably in currency, approach, and detail.

The Group observed that many of the elements that we encountered are common to developments at this scale/of particular sensitivity that involving complex, interlocking regulatory concerns. In addition, the Group observed that the cross border context and devolution, as it matures, with distinctive approaches to environmental matters becoming increasingly evident and embedded in different parts of the UK, raise particular concerns which require proactive treatment to deliver sustainable decisions for the environment and people of Wales. The Group notes that in Wales, the relevant legal framing for the activities of the Welsh Government and its regulatory agencies in this area and for Welsh local government, provided by the Well-being of Future Generations Act (WFG Act) in principle provides the basis for a much more joined up approach to regulation in temporal, spatial and functional terms. In this context the WFG Act's five ways of working (namely: long term; prevention; integration; collaboration; and involvement) have a great deal to offer – but in cross-border contexts, the space to deliver on this agenda is constrained by decisions taken elsewhere, under very different legal provision.

The diagram below identifies core areas of complexity and connection in the timeline of approving and operating a nationally significant infrastructure project with cross-

border impacts. It employs a temporal approach to core elements of the applicable regulatory process (tracking through the stages: 'before' - land use planning; 'during' - subsequent regulatory approvals; and 'after' – monitoring, enforcement, and potential challenges) that apply, framed by the environmental setting, and impacts upon it and contextual recurring considerations relating to the various applicable law and policy settings.

Figure 6.1 **Key elements of planning and regulatory decisions with cross-border impacts**

Key:

Red	Before
Blue	During
Yellow	After
Green	Contextual/Recurrent

6.2 Review of evidence

6.2.1 Ecosystem Resilience Severn Estuary Environment

The Group noted in its treatment of ecosystem resilience in Chapter 1 that the Severn Estuary is subject to dense, multiple, intersecting and often overlapping, regulatory regimes with regard to pollution control and ecosystem integrity. It also noted that, despite this coverage, the ecological status of the features of interest in designated areas is largely unfavourable and that the Severn Estuary ecosystem is

therefore in need of support. These observations raise serious concerns as to the efficacy of existing protective regimes, both in regard to a precious and unique environment and to securing the stake of future generations in Wales in it, that require a long term and sustainable approach toward its regulation. The Group also notes that post-Brexit issues in regard to environmental justice provision may be relevant to ongoing decision-making around Hinkley Point C.

6.2.2 Cross Border Systems and Processes

While the Group note in Chapter 2 that the ASERA management scheme[72] provides for cross cross-border management of the Severn Estuary ecosystem, coordinating on matters of detail continues to raise challenges. The fact that the Severn Estuary falls under two discrete marine planning areas and two distinct sets of institutional arrangements also raises significant issues – the fact that systematic, publicly available cross-border concordats was envisaged in s44 of the Marine and Coastal Access Act 2009 was noted, as was the informal cross border cooperation process that represents current practice. The Group took the view that the evident good relationships across many aspects of regulating the estuary are commendable, but would benefit from a stronger institutional underpinning. The Group notes that, in the absence of overarching structural coverage the Welsh National Marine Plan[73] and the consultation draft of the South West Marine Plan[74] do allude to the need to further develop cross border arrangements.

This stakeholder review has highlighted the challenges that exist in relation to the current planning process, both in terms of the Hinkley Point C development and many other developments of varying scale.

There is a clear need to integrate the planning system more effectively on all levels from local to national and across border. This is also needed in the pre-planning, as well as planning stages, and with the permitting process more closely aligned with the planning process.

Only by integrating the planning process in terms of supporting contributions from all of the appropriate agencies involved, whether directly, or indirectly as "neighbouring", downstream or upstream, can the environmental, ecological and health impacts of such developments be considered. Without this, planning decisions by the appropriate planning authority, cannot be fully informed.

The importance of doing this in the current climate is the pressures on the existing planning authorities. Even before the COVID-19 pandemic, planning authorities had been suffering challenges including decreasing resources and capacity to set and

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[72] Association of Severn Estuary Relevant Authorities (ASERA) (2018) Severn Estuary European Marine Site Management Scheme 2018 – 2023, 63pp. Online at https://asera.org.uk/wp-content/uploads/sites/3/2018/05/Severn-Estuary-EMS-Management-Scheme-2018-2023-May-2018-2.pdf (accessed 05/03/21).

[73] Welsh Government (2020) *Wales National Marine Plan*. Online at

https://gov.wales/sites/default/files/publications/2019-11/welsh-national-marine-plan-document_0.pdf (accessed 05/03/21).

[74] Marine Management Organisation (2020) *South West Inshore and South West Offshore Marine Plan*. *Draft for consultation* January 2020. online at https://www.gov.uk/government/publications/draft-south-west-marine-plan-documents. (accessed 05/03/21).

enforce planning conditions. It has been suggested that these issues will only increase during pandemic recovery.

In addition, integration of the system is needed to ensure that relevant legislation is considered for those who will be affected by a development. In Wales, the Wellbeing of Future Generations Act specifically emphasises the importance of these broader considerations, while Planning Policy Wales 11 has embraced the principles of WFG Act to set the direction of planning for Wales for the future.

Finally, many developments, whether of local or national interests, such as HNC, have the potential to cause concern among members of the public who perceive that they will be affected by such a development. Integration is key to ensuring that the process is more transparent and that people are able to have their concerns heard and accounted for.

This is not an issue that is specific to Hinkley Point C, nor solely to England or Wales. Moving to a more integrated, transparent, and robust planning system that is fully cognisant of the responsibilities placed on it by WFG Act, can appropriate protections for our future generations be ensured.

With regard to the Hinkley Point C Development Consent Order (DCO) (2013), the Group noted that, while Welsh agencies were able to input into this decision-making process and were agreeable to the outcome, the current challenge to its terms raises concerns and observe that the decision to be taken in this regard should not weaken protections offered to the environment. The Group notes further ongoing concerns from the parallel EDF applications to dump sediment in Welsh and English governed parts of the estuary and take the view that this serves to underline the imperative need to ensure detailed cooperation in decision-making to ensure that a consistent approach is applied and that the developer's ultimate decision as to which site it will use is appropriately framed to guarantee the highest level of protection for the estuary ecosystem regardless. A fundamental issue that emerged from the Group's investigation is that decisions taken across borders can have significant implications for Welsh institutions in pursuing their obligations under Welsh law in areas concerning sustainability and the environment, where there are now significant distinctions in the applicable law between Wales and England. In the case of Hinkley Point C, while there was sustained informal cross-border discussion, the more general issue of the links between planning permission and the regulation of polluting activities is very much to the fore. This raises important cross-border issues, as planning permission granted in England not only has significant environmental ramifications for Wales but also on the ability of Welsh agencies to fulfil their statutory responsibilities under regulatory law and the WFG Act, as the range of options open for consideration are effectively curtailed by decisions taken in elsewhere. The general position is that planning decisions and pollution control decisions are 'separate but complementary'[75] and this has been confirmed in case

[75] *Currently expressed (this restates the previous approach* from Office of the Deputy Prime Minister, Planning Policy Statement 23: Planning and Pollution Control, para 10, (2004)) in Ministry of Housing, Communities and Local Government: National Planning Policy Framework (2019) (England) at para 183: '*The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the*

law (see *Gateshead MBC v Secretary of State of the Environment* [1995] Env L. R. 37). However, as a steady stream of reported case law demonstrates, this approach has not served to fully address potentially problematic confusion as to demarcation of decision-making responsibilities across agencies. This picture of how supposedly interlocking regulatory responsibilities interact in practice becomes more complex still in the context of cross border impacts and increasing distinctiveness in law and policy coverage of planning and environmental regulation between England and Wales.

6.2.3 Sediments

The Group noted in its treatment of sediments issues in Chapter 3, that issues involving nuclear activities raise high levels of public anxiety and require very careful communication to contextualise and clarify the issues and allay concerns. The Group observed that providing explicit guidance on the need to address radioactivity in applications to the MMO in sampling and monitoring plans is essential to fostering a robust regulatory process and public confidence therein.

6.2.4 Modelling and the Cardiff Grounds and the Portishead Marine Disposal Areas

Chapter 4 raises substantive concerns around Hydro-environmental Modelling Study TR186, which in the Group's view were not adequately addressed by Hydro-environmental Modelling Study TR267 and which go to their quality and fitness for purpose in permitting processes. The Group advises that, on the basis of the evidence that it has seen, modelling regarding the impact of Hinkley Point C's thermal plume and future sediment dumping activities on the Severn Estuary SAC, fish breeding grounds and on migratory fish pathways, is not sufficiently robust to fully inform decision-making. It was also noted that the dual role of Cefas as a government advisory body and simultaneously as a commercial provider of modelling to EDF raises systemic concerns. Despite assurances given, the combination of roles undertaken by Cefas, in which Cefas (advisory) appears to have reviewed the work of Cefas (commercial), goes to the credibility of the regulatory process by raising issues as to the appearance of bias and conflict of interest.

6.2.5 Emergency Planning

The report of the International Atomic Energy Agency's (IAEA) Integrated Regulatory Review Service (IRRS) mission to the UK in 2019 revealed the considerable complexity of nuclear regulation generally,[76] with regulatory endeavour fragmented across numerous UK and Devolved Government Departments and agencies. The IRRS pointed to preparation for engaging with the process as having 're-energised' cooperation among the relevant regulatory bodies and encouraged continued cooperation at this level (p9). The IRRS report is peppered with references to Memorandums of Understanding (MOU) documents, indicating that they play a

planning issues should not be revisited through the permitting regimes operated by pollution control authorities.'

[76] Report of the Integrated Regulatory Review Service (IRRS) Mission to the United Kingdom of Great Britain and Northern Ireland, Rev. 1 (April 2020) online at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/899129/irrs-report-2020-to-uk.pdf (accessed 24/02/21).

significant role in tackling fragmentation in nuclear regulation. The Group observes that local government involvement in emergency planning, not least in light of changes to relevant provisions in the 2019 Radiation Emergency Preparedness and Public Information Regulations (REPPIR19), not only adds further density to the arrangements in place for emergency planning in this area but also raises issues of capacity, resource, and communication for local authorities in this regard, which are amplified in a cross border context.

6.3 Advice

The picture that has emerged from the Group's inquiry into the sediment dumping issues associated with sediments from Hinkley Point C has proved revealing across a number of key themes namely: fit and/or fracture between regulatory and real world issues in cross-border contexts; regulatory complexity across issues, regulators, and borders; regulatory transparency; and delegation. Each of these themes raises concerns that go to the efficacy of current arrangements to allow the Welsh Government and its institutions to deliver regulation of Wales' part of the Severn Estuary in line with their obligations in Welsh law.

Regulatory fit/fracture

At base, the Hinkley Point C sediments issue raises issues of fit/fracture between regulation and real world environments as the Severn Estuary falls under both Welsh and English law and policy regimes. The Severn Estuary is a complex ecosystem, whose health requires a multi-dimensional and integrated approach to human interactions with it. Geographic and topical fragmentation of regulatory responsibility for the estuary poses challenges which (while inevitable to some degree given the range of environmental and wider sustainability concerns that require coverage and in consequence of governance arrangements that cross a border, invoking increasingly divergent legal settings) require concerted efforts in coordination to deliver the best decisions for the environment and all stakeholders.

Advice 1. The Group advises that clarity around regulatory roles and responsibilities and consideration of the ways they interact can contribute substantially to better regulation in these complex conditions which will continue to be relevant to effective governance of the Severn Estuary.

Regulatory complexity across issues

Regulatory complexity features as a consistently significant issue in the context of disposal of the Hinkley sediments. Of its many dimensions, taking environmental considerations first, Welsh law treats these issues as interlinked and would warrant adopting expansive understanding and engagement with the environmental impacts of any permitted activity, going beyond licensing to consider ecosystem vitality, as required by the Environment (Wales) Act 2016. The societal impacts of regulating large scale complex operations, such as those around Hinkley Point C, with implications across sectors and borders and central and local government, extends to the need to tailor the operation of broader decision-making structures to the particular situation in hand. The need to clarify and make readily visible the arrangements in place to facilitate multi-level, cross-agency and cross-border cooperation is clear. These are significant not only in respect of the efficacy of governance arrangements, but also in regard to fostering public confidence in the

ability of regulators to work together and in revealing the forms that their interactions will take.

Memorandums of Understanding (MOU) and other documents aimed at collaborative working already play an important but under-interrogated role in a number of contexts that are relevant to Hinkley Point C, not least inter-agency issues, e.g., between EA and NRW; and between the Health and Safety Executive (HSE), the ONR, the EA, NRW and the Scottish Environment Protection Agency (SEPA) on the Implementation of the Major Accidents (COMAH) Regulations 2015. In contexts involving complex cross-agency, cross-border, and multi-level governance issue, negotiating and adopting an overriding concordat may offer a potentially useful framing for coordinating activities in the longer term, see for example, the 2019 Coastal Concordat for England.[77]

Advice 2. It is advised that, given the importance of MOUs and other documents covering collaborative working arrangements in shaping cross-sector and cross border regulatory interactions that their role, currency, content and transparency be reviewed. They no longer function as merely technical documents to facilitate regulatory activity, having a dual purpose that also speaks to facilitating regulation in complex conditions in the public interest. It would therefore be prudent to make them more visible and subject to specific report/scrutiny by the Senedd.

- It is advised that in recognition of the fact that MOUs and other documents covering collaborative working play an important role in shaping regulatory interactions, their role should be clear and clearly communicated on signatories' websites to better inform stakeholders, including the general public, about them and their role.
- It is advised that, in addition to MOUs and other documents covering collaborative working containing a commitment to review and update, that good document hygiene should be practiced by signatories in their treatment on websites, subjecting the material to regular editing, foregrounding current iterations, ensuring direct links to coverage of substantive areas and to other relevant agencies, and archiving material that is no longer current.
- It is advised that MOUs and other documents covering collaborative working, as documents adopted in the public interest, employ clear and simple language.
- Given their variability in form, it is advisable that the precise nature and status of each MOU and documents performing similar functions should be explicitly delineated.

Advice 3. The Group advises considering, as a matter of urgency, developing a comprehensive and publicly available coastal concordat for Wales that reflects not only regulatory rationalisation (the prime driver of the English Coastal Concordat) but encapsulates the principled, distinctly Welsh approach to sustainability in the WFG Act and the Environment (Wales) Act.

[77] A coastal concordat for England (revised: December 2019) Updated 30 October 2020. Online at https://www.gov.uk/government/publications/a-coastal-concordat-for-england/a-coastal-concordat-for-england-revised-december-2019 (01/03/2021).

Regulatory complexity across borders

Cross agency working already creates considerable complexity in this area and, as devolution prompts increasingly distinctive coverage in substantive law, this constitutes an additional significant factor in the treatment of cross-border regulatory issues involving Wales.

Advice 4. The Group advises that, where there will be cross-border impacts, integration is needed to that concerns relating to the application of contextually significant Welsh law and policy, notably the Well-being of Future Generations Act and Planning Policy Wales (Edition 11)[78], are addressed at an early stage.

Advice 5. Given the inclusion of 'involvement' as one of the five ways of working in the Well-being of Future Generations Act, which at base requires the provision of good, clear, information to all stakeholders in public decision-making processes, the Welsh Government and its agencies would be advised to promote, as good practice, the inclusion of more explicit information on sampling and monitoring of radioactive substances in interactions with the Marine Management Organisation.

Advice 6. The Group notes that changes to zoning in the Radiation Emergency Preparedness and Public Information Regulations (REPPIR19) mean that there might be resource and capacity implications for Welsh local authorities arising from the Hinkley Point C development and advise the Welsh Government that supporting them as a group, through the appointment of a designated specialist officer, would greatly facilitate efficacious and coordinated engagement with emergency planning plans and processes.

Transparency

Public confidence and trust in regulatory decision-making is predicated on delivering transparency and traceability across and within decision-making processes in order to justify confidence that core administrative law requirements on, for example, lawfulness, reasonableness, and probity have been met. A further fundamental dimension of transparency lies in the ability to challenge flawed decisions. The Group notes that delay in the Environment Bill becoming law and in instituting the Office of Environmental Protection (OEP) for England is not fully addressed by the provision of the Interim Environmental Governance Secretariat (IEGS) within Defra. The latter body has limited capacity and any substantial complaints that pass its preliminary filtering activities will have to await the creation of the OEP for determination.[79]

It also appears to be the case that, pending the creation of Wales' promised independent commission for the environment[80] (WICE), the Interim Environmental

[78] Welsh Government: Planning Policy Wales (Edition 11) February 2021. Online at https://gov.wales/planning-policy-wales (accessed 08/03/21)

[79] Letter from the Secretary of State for the Environment to the Chairs of the Environment Food and Rural Affairs and the Environmental Audit Committee. Online at https://committees.parliament.uk/publications/3556/documents/34372/default/ (accessed 23/02/21)

[80] Letter from the Minister for Environment, Energy and Rural Affairs to the Chair of the Environmental Governance Stakeholder Task Group online at https://gov.wales/sites/default/files/publications/2020-11/letter-by-minister-for-environment-energy-and-rural-lesley-griffiths.pdf (accessed 23/02/21).

Protection Assessor for Wales is in an analogous position. This would amount to an effective deferral of justice should complaints need to be made in the interim, which raise questions of compliance with article 9 of the Aarhus Convention on prompt access to justice. Furthermore, it is not clear how cross border environmental justice issues, such as those that arise in the Severn Estuary, will be dealt with in the interim period and beyond, though it is noted that the already evident asymmetry in status between the (departmental) IEGS the (independent) WICE has the potential to create additional tensions, not least in terms of public expectations of environmental justice.

Advice 7. The Group advises the Welsh Government that the duration of interim arrangements be as brief as possible in order to avoid potential non-compliance with the Aarhus Convention.

Advice 8. The Group advises the Welsh Government that the relationship between the independent commission for the environment and the Office of Environmental Protection, and how they will interact on issues of cross-border concern, requires urgent attention.

While it is recognised that specialist state bodies such as Cefas, an agency of DEFRA, often host public advisory and commercial activities within their organisational structure, the Group observed that it is imperative that it is always readily apparent that these functions operate at arm's length from one another and which limb of the organisation has been involved in a particular activity. In the context of Hinkley Point C, the delineation between Cefas's public role in advising regulators and its commercial activity in undertaking consultancy for EDF was muddled and inadequate, creating confusion and raising questions as to transparency and generating adverse perceptions regarding independence.

Advice 9. It would be highly advisable that Cefas (advisory) not be used by NRW to review the work of Cefas (commercial) in regulatory processes, due to the impression of bias that this creates, noting that actual bias is not required to damage the credibility of a decision-making process, nor to raise the prospect of judicial review. In short, review processes must not only be independent, but be seen to be independent. Furthermore, as decision-makers Natural Resources Wales would be advised to require applicants to state clearly throughout any application for a permit which limb of Cefas they have engaged with.

Advice 10. For Welsh decision-makers it would be advisable to act on the view that, at a minimum, transparency requires that the following core information be readily ascertainable and clearly indicated in all relevant documentation: who is responsible for making the decision; why they are responsible for doing so; their competence to do so; and how they have reached a decision on the substance of the matter; and how the decision has given effect to the requirements of all relevant statutory framings, including the cross-cutting Well-being of Future Generations Act.

Delegation

While the Group recognises that delegation of decision-making powers is often necessary with regard to technical issues, delegation is not always concerned with such matters. The Group observes that, insofar as obligations under the WFG Act are concerned, particular considerations arise: the fact the NRW is a public body as

defined in s6(1)(e) of the WFG Act and is thus subject to legal obligations in this regard does not displace the responsibilities of the Welsh Ministers under s6(1)(a) and each in their respective roles is required in *'carrying out sustainable development*' to s3(1)(b) take '*… all reasonable steps (in exercising its functions) to meet … [defined well-being] objectives'*. Thus, where cross cutting and complex regulatory issues arise that have implications for Wales and the Welsh people, and where the efficacy of the arrangements that are in currently in place raise significant questions, the Welsh Government has a responsibility to ensure the effective pursuit of the five ways of working.

Advice 11. For the purposes of transparency and in respect of its role referred to above, it would be advisable for Welsh Government to ensure documentation and processes promote quality control in addressing whether and how all of the relevant statutory and policy framings, including the Well-being of Future Generations Act, have been considered by its agencies in their decision-making roles.

The Group observes that valuable lessons can be drawn on the use of powers by the Welsh Government and its agencies, not only to inform future engagement with the Hinkley Point C project itself, but that are also of potentially broader significance. The Group came to the view that our examination of the issues points to the advisability of developing proactive, coherent, structured, and transparent treatment of issues with cross-border impacts, linking decision-making on planning, the regulation of pollution and ecosystem concerns in the cause of sustainability. Coverage for infrastructure projects that are significant in size/sensitivity and environmental impacts would be most fit for purpose if it encapsulated conscious linkage of administrative and real-world systems: before (at planning and inter-agency cooperation stages); during (in decision-making); and after (regarding monitoring, enforcement, and potential challenges in PINS, the OEP/WICE and the Courts) decisions are made.

Chapter 7

Advice

The Group came to the view from our examination of the issues, that there are a number of problems with established processes for major infrastructure developments which could have unintended negative consequences, if not addressed, within the cross-border context. The Group welcomes the opportunity to review the current arrangements and regulatory systems around Hinkley C in order to improve environmental and transparency outcomes. This points to the advisability of developing proactive, coherent, structured, and transparent treatment of issues with cross-border impacts, linking decision-making on planning and the regulation of pollution and ecosystem concerns to ensure that the Welsh requirements of the Well-being of Future Generations (Wales) Act and the Environment (Wales) Act are taken fully into consideration.

What is contained here is our primary advice to the First Minister, based on the discussion of issues in Chapters 1-5. It should be read alongside Chapter 6, and the detailed evidence in each chapter will provide a fuller understanding.

1. General good governance (for public confidence)

Decision making

- Decision-making roles and responsibilities to be made more clear to the Welsh public, particularly whether and how all of the relevant statutory and policy framings, including the Well-being of Future Generations (Wales) Act have been considered by agencies in their decision-making roles.
- Governments should require applicants and decision-makers of major infrastructure projects to ensure adequate separation of duties and independence throughout planning stages.

Modelling and independent review

- Modelling must be of the highest level of accuracy and transparency for major infrastructure projects and should be independently reviewed with adequate separation of duties and independence throughout the planning stages.

Specific organisation advice:

- Natural Resources Wales and the Welsh Government should not engage the commercial and advisory arms of Cefas on the same project until clarity is achieved on roles and responsibilities.

2. Cross-border issues (governance)

Cross border project planning

- Any future cross-border infrastructure projects need to consider Welsh legislation and policy from a project concept stage on a project which has a direct, or substantial indirect, influence on the people or environment of

Wales. An urgent review of cross border governance issues is proposed to consider:

- Welsh legislation from the outset of a project's development
- the integrity of Severn Estuary planning across the Welsh/English border
- strengthening cross border planning including for specific agencies e.g., Office of Environmental Protection, the Planning Inspectorate and Natural Resources Wales.
- whether regulatory harmony is best delivered by Memoranda of Understanding and how such arrangements should be delivered.

3. Cross border issues (environment)

Designated sites

- Active management of all designated sites in the Severn Estuary Special Areas of Conservation should be resourced to restore and enhance the resilience of the ecosystem.

Coastal Concordat and Cross border marine planning

- Development of a comprehensive and publicly available coastal concordat that reflects England's focus on regulatory rationalisation and encapsulates the distinctly Welsh approach to sustainability in the Well-being of Future Generations (Wales) Act 2015 and the Environment (Wales) Act (2016).

Specific organisation advice:

- Welsh Government should work with the Marine Management Organisation to introduce appropriate measures to strengthen cross-border marine planning to improve when monitoring of plan effectiveness.

4. Implications of Hinkley Point C development

Impact on Severn ecosystem

The original requirements of the Hinkley Development Consent Order permissions must be upheld to avoid any significant adverse short-term or long-term effect upon the features of the Severn Estuary. In particular, there should be no weakening of the Development Consent Order requirements for an Acoustic Fish Deterrent. As outlined in Chapter 1, with predicted fish loss of 37 tonnes or 182 million fish per annum, the environmental risk is too great.

Compensatory measures

If no suitable mitigation is available, the development can then only be approved provided three tests are met:

- There are no feasible alternative solutions to the plan which are less damaging.
- There are "imperative reasons of overriding public interest" for the plan to proceed.

- Mitigation and compensatory measures are secured to ensure that the overall coherence of the network of European sites is maintained i.e., to replenish the estuary with a commensurate number and range of fish stocks.

Water abstraction best practice

- Alternative water abstraction systems should be considered to the current proposals. Closed water cooling systems, such as those using cooling pools, are now considered best practice elsewhere and considerably reduce the pressure on marine ecosystems.

Cardiff Grounds Marine Disposal Site

- In light of contradictory modelling evidence, the Welsh Government and/or Natural Resources Wales should undertake independent model studies to review the suitability of Cardiff Grounds as a marine disposal site before any further licences are granted.

Radioactivity issues

- While the Group found no evidence of increased risk to the public or the environment, stakeholders should recognise public concern regarding radioactivity and provide appropriate assurances.

Specific organisational advice:

- The Marine Management Organisation website and the Natural Resources Wales website should provide enhanced guidance for marine licencing involving radioactive substances, and
- The Welsh Government and its agencies are advised to promote more explicit information on sampling and analysis of radioactive substances in interactions with the Marine Management Organisation.

5. Emergency Planning

Emergency Planning

- The Welsh Government, relevant Welsh local authorities, local resilience fora and emergency services should review plans or procedures relating to potential nuclear emergencies at Hinkley Point or any other nuclear site that may have implications for Wales

Specialist support

- The Group notes there may be resource and capacity implications for Welsh local authorities arising from the Hinkley Point C development. The Welsh Government should support local authorities through the appointment of a designated specialist support on emergency planning.

Active engagement

- The Group encourages the Welsh Government, relevant Welsh local authorities, local resilience fora and emergency services to participate, as

appropriate, in Somerset County Council’s next Level 2 exercise for Hinkley Point B in 2021

List of received and reviewed evidence, documents and communications

In addition to the sources of information cited throughout the report, the Group received and reviewed further evidence, documents and communications. These are listed here.

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