HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

Horizon Deadline 5 Responses to actions set in Issue Specific Hearing on 11 January 2019

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00194

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Appendices

List of Tables

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1 Horizon's Deadline 5 responses to actions set in Issue Specific Hearing on 11 January 2019

1.1 Introduction

1.1.1 This document contains Horizon Nuclear Power Wylfa Limited's ("Horizon") responses to actions outlined by the Hearing Action Points issued by the Examining Authority [OD-009] on 25th January 2019.

1.1.2 It also contains Horizon's responses to actions it recorded during the Issue Specific Hearing on 11th January 2019 and committed to responding to in its Deadline 4 (17 January 2019) submission [REP4-010].

1.1.3 A summary of other actions set at the Issue Specific Hearing on 11th January 2019 provided at Deadline 4 (17 January 2019) or planned for subsequent deadlines is also provided.

1.2 List of responses to actions provided at Deadline 4

1.2.1 Effects on red squirrel habitat – additional information

1.2.2 Additional clarification on radiological consequence analysis & Project flexRISK

1.2.3 Analysis of Accidental Releases: comparison with information submitted under EURATOM Article 37

1.2.4 Valley Tidal Breach Modelling

1.3 Hearing Action points

1.3.1 The below table outlines the status of responses to actions recorded by the Examining Authority in document reference OD-005.

Table 1-1 Status of actions assigned to 'Applicant'

Ref	Action	Deadline	Status
1	Submission of reptile survey data information.	Deadline 5	Provided in Appendix 1-2 of this document.
2	Submission of further information on detailed mitigation measures and how they will be secured in relation to water voles, bats and Great Crested Newts – including revised Code of Construction Practice's (CoCPs) and sub CoCPs.	Deadline 5	Summary of response provided in section 1.4.
3	Submission of Post Hearing Note (PHN) on construction/operation of monitoring for Adders and	Deadline 5	Provided in Appendix 1-3 of this document.

Ref	Action	Deadline	Status
	common lizards and the securing methodology.		
4	Revised suite of control documents to be submitted.	Deadline 5	A revised control document submission has been provided at Deadline 5. Refer to the Deadline 5 cover letter for further information.
5	Submission of note on additional detail on the mitigation for S.7 Habitats loss.	Deadline 4	Provided in Appendix 1-4 of this document.
6	Provide background academic research papers to IACC and the Examination.	Deadline 4	Responded at Deadline 4 (17 January 2019) in REP4-010 Appendix 1-1.
7	Chough: • Addendum to 2018 Chough Baseline Report to be referenced with the ES in revised new Schedule 18 of draft Development Consent Order(dDCO). • Revisit Chough mitigation during construction in relation to phasing of landscape works (temporary and permanent). • Note on how Chough mitigation in relation to breeding season would be secured through the ecological clerk of works.	Deadline 5	Chough addendum provided at Deadline 3 (18 December 2018) reference REP3-046. Further response provided in section 1.4 of this document.
8	Note on: • Operation of Ecological Clerk of Works(ECW) and possible Wylfa Head warden – including level of power and authority the ECW team would have.	Deadline 4	Summary of response provided in section 1.4.

Ref	Action	Deadline	Status
	• Barn Owl roost – securing mitigation. • Protection of Dame Sylvia Crowe woodland mound buffer zones - mitigation and response.		
9	Provision of further detail on protection of sensitive sites/species to be provided in revised CoCPs.	Deadline 5	Summary of response provided in section 1.4.
10	Confirmation that new guidance on pollution prevention (NRW-GPP5) has been followed and secured.	Deadline 5	Summary of response provided in section 1.4.
11	Discussion on monitoring and active management plan at Esgair Gemlyn.	Deadline 5	Update provided in section 1.4. Full response at Deadline 6 (19 February 2019).
12	Submission on use of marine disposal site for rock on the basis of pre-disposal surveys and micro- siting – subject to consideration of the marine licence by NRW.	Deadline 5	Summary of response provided in section 1.4.
13	Submission of further work on robust monitoring and adaptive management regime in relation to possible sediment build up on Esgair Gemlyn during construction and operation.	Deadline 5	Update provided in section 1.4. Full response at Deadline 6 (19 February 2019).
14	Technical note on construction/removal/remediation of the causeway – construction/removal method statement, monitoring, management and securing.	Deadline 5	Provided in Appendix 1-5 of this document.
15	Submission of revised Shoreline Protection and Management Works in Marine Works CoCP.	Deadline 5	Revised Marine Works CoCP provided in Deadline 5 submission along with a revised

Ref	Action	Deadline	Status
			Construction Method Statement.
16	Qualitative update on potential impacts of climate change in relation to UK Climate Projections 2018 and the 2017 UK Climate Change Risk assessment; including monitoring and managing mitigation and adaptation in conjunction with NRW.	Deadline 5	Provided in Appendix 1-6 of this document.
18	Provision of response to NRW's request for more information in relation to flood risk assessment at Dalar Hir. In relation to: • blockages; • spine road; • location of single parking space and • changing field levels.	Deadline 5	Provided in Appendices 1-7 and 1-8 of this document.
21	Technical note on tidal flooding potential at Valley.	Deadline 4	Responded at Deadline 4 (17 January 2019) in REP4-010 Appendix 1-4.
22	Submission on Wylfa Newydd Development Area (WNDA) Site flood risk in relation to Afon Cafnan.	Deadline 6	Horizon plan to respond at Deadline 6 (19 February 2019).
23	Submission of revised phasing strategy.	Deadline 4	Provided at Deadline 4 (17 January 2019). Clean version reference REP4-014 and track change version reference REP4-015.
24	Submission of revised Design and Access Statement volumes 3 and 4.	Deadline 4	The Design and Access Statement comes in 3 volumes (1-3). Volumes 2&3 were amended but all 3 volumes

Ref	Action	Deadline	Status
			provided at Deadline 4 (17 January 2019) for completeness. References: Volume 1: REP4-016 Volume 2: REP4-017 Volume 3 Part 1: REP4-018 Volume 3 Part 2: REP4-019
25	Working drafts of drainage strategies and flood mitigation plans for Dalar Hir and the two proposed ecological compensation sites to be provided to NRW, IACC and the eNGOs.	Deadline 4	We will provide a note outlining proposed flood risk measures relating to the Afon Cafnan at Deadline 6 (19 February 2019). We believe this action should not have been assigned to Dalar Hir.
26	Provision of Dalar Hir flood risk blockage modelling.	Deadline 5	Provided in Appendix 1-9 of this document.
28	Provision of technical note in relation to waste discharge levels into Cemaes Bay.	Deadline 5	Provided in Appendix 1-10 of this document.
29	Note on flexRISK methodology.	Deadline 4	Responded at Deadline 4 (17 January 2019) in REP4-010 Appendix 1-2.
30	Note as to whether additional, complementary and further information referred to in European Commission opinion on the analysis of accidental releases has been included in D2 response.	Deadline 4	Responded at Deadline 4 (17 January 2019) in REP4-010 Appendix 1-3.

Ref	Action	Deadline	Status
31	Submission of three further change requests relating to shift patterns, HGV deliveries and Main Site working hours.	Deadline 4	Provided at Deadline 4 (17 January 2019); references: Worker Shift Patterns: REP4-011, Working Hours: REP4-012, HGV Delivery Window: REP4-013.
32	Submission of revised Mitigation Route Map.	Deadline 6	This is planned for Deadline 6 (19 February 2019), further to control document updates at Deadline 5 (12 February 2019).
33	Submission of internal document on contractual obligations.	Deadline 5	Horizon is unclear as to what information this action is requesting and ask that further information be provided so that a response can be submitted into examination.
34	Submission of updated visual diagram of how control documents relate to each other and to other documents.	Deadline 5	Provided in Appendix 1-11 of this document.

1.4 Additional detail on action responses

Action 2

1.4.2 Horizon can confirm that our approach to this has has remained consistent , it has always been to minimise duplication with other consents, permits and licenses. An additional column has now been added to the NRW SOCG to identify such overlaps and provide clear-cross referencing to these other regimes. All these mitigation licenses are legally binding and Horizon is committed to obtaining these licenses; therefore it is unnecessary to replicate the content of such licenses in our control documents such as the CoCPs.

1.4.3 The following are excerpts from the Wylfa Newydd COCP provided as part of Horizon's Deadline 5 (12 February 2019) submission.

1.4.4 Para 2.2.9- where separate UK legislation will govern specific mitigation measures, those measures have not been duplicated within this Wylfa Newydd CoCP and the sub-CoCPs, for example a European Protected Species Mitigation Licence (EPSML)

1.4.5 Para 11.1.8 - The specific details of mitigation measures and working methods would be detailed within each licence application, which are legally binding documents. As set out in paragraph 2.2.9, the content of protected species licence applications is not duplicated in the sub-CoCPs to keep these documents concise, and to avoid unnecessary repetition.

1.4.6 Following a call with NRW on the 4th February, there appears to be agreement that the licensable mitigation measures would be secured through the grant of a relevant protected species licence and therefore securing this mitigation through the CoCP(s) is not considered necessary. The Statement of Common Ground (SoCG) with NRW will be updated accordingly.

Action 7

1.4.7 The following mitigation measures related to monitoring Chough behaviour and habitats are reflected in the revised documentation submitted at Deadline 5 (12 February 2019):

1.4.8 Public access on Wylfa Head is managed to minimise adverse effects on sensitive habitats and species, in particular chough (Landscape and Habitat Management Strategy (LHMS) [REP02-039].

1.4.9 Monitoring will be undertaken of species translocations, habitat creation and work undertaken as part of a protected species licences to assess the efficacy of mitigation provided (including chough habitat management). Monitoring commitments will be undertaken in line with the requirements of the relevant protected species licence. (LHMS, Deadline 5 (12 February 2019)).

1.4.10 Monitoring of chough foraging behaviour will be undertaken during the breeding and non-breeding season on areas of optimal chough foraging habitat within the Wylfa Newydd Development Area. (LHMS, Deadline 5 (12 February 2019)).

1.4.11 The role of Ecological Clerk of Works (ECOWs) has been further defined (WN CoCP, Main Power Station Site sub-CoCP, Deadline 5 (12 February 2019)). The Warden for ecologically sensitive areas such as Wylfa Head i.e. the Chough Habitat is secured by the draft s.106 agreement, the Workforce Management Strategy (to be submitted at Deadline 5 (12 February 2019))

1.4.12 It is understood that a recurring issue relating to Chough is the timing of construction works, primarily in relation to final form and habitat creation on various mounds, notably Mound A. There is more detail around the timing of works in the Phasing Strategy (REP04-014) and chapter A2 of the ES, and Horizon is not able to provide more detail at this stage.

1.4.13 Horizon confirmed during the Issue Specific Hearing how it would ensure that construction traffic/machinery would not encroach into sensitive receptors stating:

1.4.14 Many areas will have existing boundaries walls/fencing etc that will provide segregation from vehicle movements. Where there no natural boundaries exist, Horizon will ensure that as a minimum a 1m high post and single wire fence will be constructed to delineate the restricted area and ensure that workers and plant operators are aware of the requirement not to encroach into these designated areas.

1.4.15 Where trees are subject to an existing preservation order these will be delineated using "Heras" type fencing in line with industry best practise.

Action 8

1.4.16 The role of ECOWs (including the level of power and the authority the ECW team would have) has been enhanced – measure #439 (secured by Wylfa Newydd COCP, submitted at Deadline 5 (12 February 2019)).

1.4.17 Wardening of the Wyla Head in particular has been included and enhanced in the Main Power Station Site sub-COCP.

1.4.18 Four barn owl nesting boxes will be provided prior to construction activities affecting those roosts to mitigate the possible effects of disturbance to breeding roosts. Occasional barn owl roosts that will be lost at Tyddyn-Gele and The Firs will be replaced through the provision of two barn owl boxes. Pre-demolition inspections of the non-breeding barn owl roosts at Tyddyn-Gele and The Firs would be undertaken by an ECoW. A further two barn owl boxes will be provided to mitigate possible disturbance to roosts at Caerdegog Isaf and Cafnan Farm. Annual monitoring of each nesting box will be undertaken during the construction period.

1.4.19 Nest box provision and annual monitoring is secured through the Main Power Station Site sub-CoCP.

1.4.20 Protection of Dame Sylvia Crowe woodland mound buffer zones – please refer to Horizon's response to Further Written Question reference Q2.0.9.

Action 9

1.4.21 This issue of minimising duplication with other consents, permits and licenses has already been addressed as a response to Action 2.

1.4.22 The role of Ecological Clerk of Works (ECoWs) has now been significantly strengthened (WN CoCP, Main Power Station Site sub-CoCP, Deadline 5 (12 February 2019)) to cover practicalities of their role, powers to intervene if necessary and how they might fit in the Horizon organisational structure.

Action 10

1.4.23 This has been reflected in the update to Wylfa Newydd COCP submitted at Deadline 5 (12 February 2019).

Actions 11 and 13

1.4.24 Horizon met with Natural Resources Wales (NRW) on 4th February 2019 to discuss an outline monitoring and mitigation plan for Esgair Gemlyn. Horizon will now prepare a plan for submission into examination at Deadline 6 (19 February 2019) and continue to consult with NRW on the monitoring. It will also consult with NRW and the eNGOs on possible mitigation solutions post DCO consent and through Marine Licencing.

Action 12

1.4.25 The following text is included in the Marine Works sub-CoCP as part of Horizon's Deadline 5 (12 February 2019) submission.

1.4.26 Where practicable, disposal of sediment will take place within the central area of the Disposal Site to mitigate any effects beyond the Disposal Site boundary. Rock material will be deposited within a micro-sited area of the Disposal Site, which will be determined by benthic surveys within 12 months of intended disposal activities.

1.5 Summary of Deadline 5 responses to actions recorded by Horizon

References to Sea Level Rise and Climate Changes in the DCO application

1.5.2 Provides a response to the request for further information by the Examining Authority for further details on the locations within the DCO application to references where climate change, including sea level rise, is assessed.

1.6 Action responses planned for subsequent Examination Deadlines

1.6.1 There are no additional responses to action planned for subsequent examination deadlines over and above those detailed in section 1.3 of this document.

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Appendix 1-1 References to Sea Level Rise and Climate Changes in the DCO Application

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00202

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1 Introduction

1.1 Purpose of this report

1.1.1 This report provides a response to a request for further information by the Examining Authority at Issue Specific Hearing 5 on Biodiversity (Coastal Change, Climate Change, Transboundary Impacts) on 11th January 2019.

1.1.2 The Examining Authority required further details on the locations within the DCO application to references where climate change, including sea level rise, is assessed.

1.2 Scope of this report

1.2.1 This report presents a summary of climate change discussion and assessment locations within the DCO application. The information is presented in a tabular format, indicating the relevant document and reference, followed by a brief description of what is discussed and in what sections. Where relevant, links to other documents are also identified.

1.2.2 The focus of the information presented is the climate change scenarios considered, the assessment of effects and the identification of mitigation. The contribution of the Wylfa Newydd DCO Project to reducing climate change is not covered in this document.

2 DCO application Climate Change References

Table 2-1 DCO application references to climate change and sea level rise

Document ID	Document	Reference
APP-050	5.2 Shadow Habitats Regulations Assessment Report (Part 1 of 2)	Climate change is described where it is relevant in each chapter. Changes to discharges into Cemlyn Lagoon are presented in Table 7.8
APP-127	6.4.8 ES Volume D - WNDA Development D8 - Surface water and groundwater	The evolution of the baseline due to climate change is discussed for surface water in Section 8.3.112, including on flows in watercourses during drier summers and its subsequent effect on flora and fauna and on other uses. Reference is also made to effects on water presented in the FCA [APP-150 to APP-157]. The evolution of the baseline due to climate change is discussed for geomorphology in Section 8.3.113 and for groundwater in Section 8.3.114. Assessments draw upon the assessment of climate change impacts on the quantity of water available that are presented in the Surface Water and Ground Water Modelling Results Appendices [APP-160 to APP-166].
APP-128	6.4.9 ES Volume D - WNDA Development D9 - Terrestrial and freshwater ecology	The evolution of the baseline, including the effects of climate change on habitats, is discussed in Sections 9.3.134 and 9.3.136.
APP-131	6.4.12 ES Volume D - WNDA Development D12 - Coastal processes and coastal geomorphology	Climate change effects on sea level rise, increased frequency and intensity of storms and increased wave height are discussed. The evolution of the baseline is presented in Sections 12.3.115 to 12.3.135. The impact of climate change on Esgair Gemlyn is discussed in Sections 12.5.81 and 12.5.122.
APP-132	6.4.13 ES Volume D - WNDA Development D13 - The marine environment	Climate change effects on sea level rise, increased frequency and intensity of storms and increased wave height are discussed. Also discussed is the effect of increased sea temperatures.

Document ID	Document	Reference
		Evolution of the baseline is presented in Sections 13.3.245 to 13.3.250, including the potential effects of habitat loss, the effects on fish migration, species distribution and spawning times. The effects on sea temperature from climate change have been modelled as part of the impact assessment [APP-229].
APP-145	6.4.26 ES Volume D - WNDA Development App D8-1 - Surface Water Baseline Report	The evolution of the baseline due to climate change is presented in Section 6.2.
APP-147	6.4.28 ES Volume D - WNDA Development App D8-3 - Groundwater Baseline Report (Part 1 of 3)	The evolution of the baseline due to climate change is presented in Section 9.2.
APP-150	6.4.29 ES Volume D - WNDA Development App D8-4 - Flood Consequence Assessment (Part 1 of 8)	The Flood Consequences Assessment (FCA) describes the baseline risk of flooding from tidal, fluvial, pluvial and groundwater sources. Climate change effects on sea levels, river flows and rainfall intensity at 2020 is included in the baseline to reflect the projected start of the project construction period, whilst the same effects are considered at 2087 for operational assessments and at 2187 for decommissioning assessment. A discussion of tidal flood risk during construction is presented in Section 8.1 and in operation in Section 9.1, including the effects of climate change on sea levels and wave heights. Predicted fluvial and pluvial flood depths at key locations during construction and operation are presented in Sections 8.2 and 9.2 respectively, including the effects of climate change on river flows and rainfall intensity. The effects of climate change on tidal and on fluvial and pluvial during decommissioning are presented in Sections 10.1 and 10.2 respectively. The FCA draws upon an evidence base presented in Appendices [APP-150 to

Document ID	Document	Reference
		APP-157] that present detailed information on hydrological changes and on modelled outputs, including from wave modelling reports providing detail on sea level rises and wave heights off shore and near shore in relation to climate change scenarios.
APP-166	6.4.32 ES Volume D - WNDA Development App D8-7 - Surface water and groundwater modelling results (Part 7 of 7)	Climate change allowances used for pluvial and fluvial modelling are described in Appendix E to the FCA. Further information is presented in this document on the effect of climate change scenarios on groundwater and stream flows. The information presented here was used in the assessment presented in [APP-127].
APP-167	6.4.33 ES Volume D - WNDA Development App D8-8 - Summary of preliminary design for construction surface water drainage	The preliminary drainage design presented in this document utilises climate change increases on rainfall intensity set out by NRW and the Welsh Government as part of its design criteria. This is covered in Section 1.2.3.
APP-246	6.5.8 ES Volume E - Off-Site Power Station Facilities: AECC ESL and MEEG E8 - Surface water and groundwater	Evolution of the baseline due to climate change is presented in Section 8.3.53.
APP-254	6.5.16 ES Volume E - Off-Site Power Station Facilities: AECC ESL and MEEG App E8-1 - MEEG/AECC/ESL - Flood Consequence Assessment	Section 4 presents the drainage strategy for this site and how it deals with climate change impacts on rainfall intensity. Section 5.3 presents the modelling undertaken, whilst Section 6.4 presents the results of pluvial modelling, including the effects of climate change, on the construction and operational phases respectively. Further details are provided in the FCA Appendices.
APP-273	6.6.8 ES Volume F - Park and Ride F8 - Surface water and groundwater	Evolution of the baseline due to climate change is presented in Section 8.3.47 to 8.3.51.

Document ID	Document	Reference
APP-281	6.6.16 ES Volume F - Park and Ride App F8-1 - Dalar Hir - Flood Consequence Assessment	Section 4.3 presents the drainage strategy for this site and how it deals with climate change impacts on rainfall intensity. Section 5.3 presents the modelling undertaken, whilst Section 6.4 presents the results of pluvial modelling, including the effects of climate change, on the construction and operational phases respectively. Further details are provided in the FCA Appendices. Note, an FCA Addendum was submitted at Deadline 2 [REP2-372], which describes a revision to hydrology, including the assessment of climate change over the lifetime of the development.
APP-311	6.7.8 ES Volume G - A5025 Off-line Highway Improvements G8 - Surface water and groundwater	Evolution of the baseline due to climate change is presented in Section 8.3.199. Climate change impacts on flood risk are incorporated into the discussion on each Section of Off-line Highway Improvements and have been taken into account in the design of the scheme layout and associated infrastructure. Sections 8.5.44 to 8.5.47 present impacts on flood risk within Section 1. Sections 8.5.61 to 8.5.66 present impacts on flood risk within Section 3. Section 8.5.85 comments on impacts on flood risk within Section 5. Sections 8.5.96 to 8.5.98 present impacts on flood risk within Section 7.
APP-323	6.7.20 ES Volume G - A5025 Off-line Highway Improvements App G8-1 - A5025 Off-line Highway Improvements - Flood Consequence Assessment	Modelling and climate change allowances are presented in Section 5.4. Tables throughout the document present baseline results in comparison to with scheme results with an allowance for climate change.
APP-362	6.8.8 ES Volume H - Logistics Centre H8 -	Evolution of the baseline due to climate change is presented in Section 8.3.37.

Document ID	Document	Reference
	Surface water and groundwater	
APP-370	6.8.16 ES Volume H - Logistics Centre App H8-1 - Logistics Centre - Flood Consequence Assessment	Section 4.3 presents the drainage strategy for this site and how it deals with climate change impacts on rainfall intensity. Section 6.4 presents the results of the assessment, including the effects of climate change. Further details are provided in the FCA Appendices.
APP-408	8.2.2 Design and Access Statement - Volume 2 - Power Station Site	Section 2.1.62 noted that climate change has been factored into both Volume 2 of the DAS and the Landscape and Habitat Management Strategy (LHMS) [Updated at Deadline 5 (12 February 2019)] by application of the modelling presented in APP-150 to APP-157.
APP-409	8.2.3 Design and Access Statement - Volume 3 - Associated Developments and Off-Site Power Station Facilities (Part 1 of 2)	Section 5.8 of Appendix 1.1 indicates how climate change has been incorporated into the design of the Off-site Power Station Facilities. Section 5.8 of Appendix 1.2 indicates how climate change has been incorporated into the design of the Site Campus.
APP-410	8.2.3 Design and Access Statement - Volume 3 - Associated Developments and Off-Site Power Station Facilities (Part 2 of 2)	Section 5.8 of Appendix 1.3 indicates how climate change has been incorporated into the design of the Park and Ride. Section 5.8 of Appendix 1.4 indicates how climate change has been incorporated into the design of the Logistics Centre. Section 5.8 of Appendix 1.5 indicates how climate change has been incorporated into the design of the A5025 Off-line Highway Improvements.
APP-426	8.17 Sustainability Statement	The sustainability statement presents details in Figure 5-1 on design measures and on construction/operational commitments in response to climate change.

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Appendix 1-2 Horizon's Response to an Additional Information Request - Reptiles

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00195

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1 Issue Specific Hearing - Biodiversity

1.1 Request for additional information

1.1.1 During the Issue Specific Hearing on biodiversity, held on Friday 11 January, IACC referred to an issue it had raised in its Local Impact Report (LIR) Chapter 17: Wylfa Newydd Development Area [REP2-077] relating to reptiles. In paragraph 5.4.5 of the LIR, IACC requests that the annual reptile survey reports which inform the Reptile Technical Summary Report [APP-177] are provided for their review.

1.1.2 Horizon is therefore submitting the following documents into Examination:

- 210623-02/REP/012. Reptile baseline survey report. 2010-2011.
- 210623-02/REP/039. Reptile baseline survey report. 2012.
- W202.01-S5-PAC-REP-00022. Reptile baseline survey report. 2013.

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Appendix 1-1 - Reptile Survey Report 2010-11

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00196

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Horizon Nuclear Power Wylfa Ltd

Wylfa New Nuclear Power Station

Report on Reptile Surveys 2010 & 2011

210623-02/REP/012

Issue | 5 December 2012

Job number 210623-02

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Document Verification

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Job title		Wylfa New Nuclear Power Station			**Job number** 210623-02
Document title		Report on Reptile Surveys 2010 & 2011			**File reference**
Document ref		210623-02/REP/012			
Revision	**Date**	**Filename**	Report template.docx		
Draft 1	15 Dec 2011	**Description**	First draft		
			Prepared by	Checked by	Approved by
		Name	Chris Hall	Kate Williamson	Sam Dyer
		Signature			
Issue	5 Dec 2012	**Filename**	210623-02-REP-012 Reptile Survey Report 2010-11.docx		
		Description			
			Prepared by	Checked by	Approved by
		Name	CEP	Pete Wells	Peter Hulson
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document Verification with Document	✓

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Executive Summary

The Cambrian Ecological Partnership, (C.E.P.) were commissioned by Arup to undertake a suite of reptile surveys for a proposed new nuclear power station at Wylfa, Anglesey.

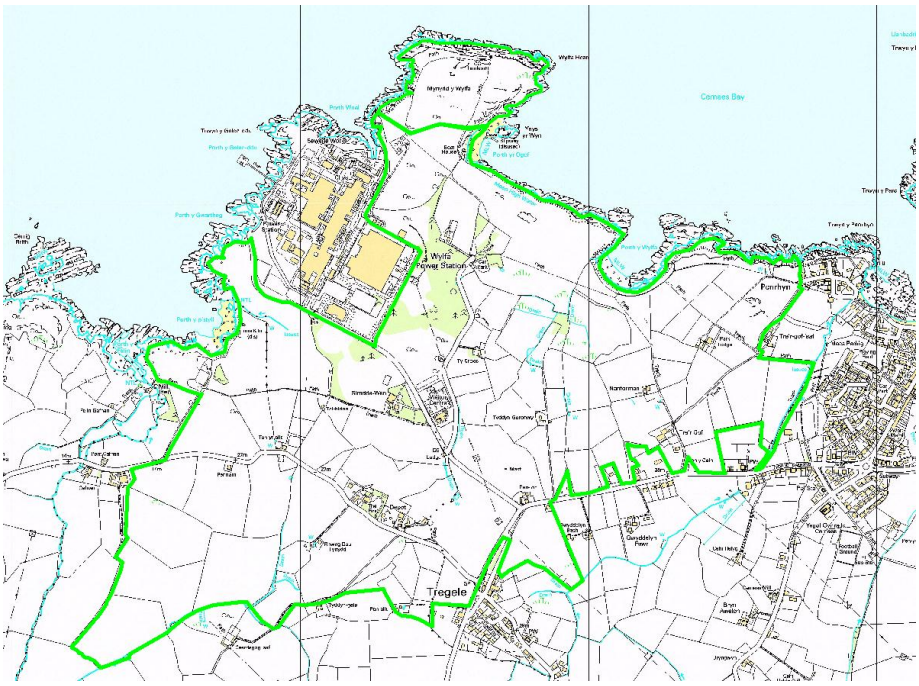
A series of decommissioning surveys carried out by RSK Carter Ltd in 2008 had revealed the presence of adders; (*Vipera beris*) on the site. The results of these surveys are shown in Figure 6. A data search (NBN Gateway) revealed the presence of slow worm; (*Anguis fragilis*), common lizard; (*Lacerta vivipara*) and grass snake; (*Natrix natrix*) on Anglesey. Consultation with Countryside Council for Wales, (CCW) revealed that this latter species appears to be only present at very low density.

The 2010 surveys revealed the continued presence of adders on the bank to the rear of the existing power station. (See Figure 5) No other reptile species were recorded during 2010 although the presence of common toads; (*Bufo bufo*) was confirmed with this species also using the refugia. (See Figure7).

The 2011 surveys revealed adders to still be present on the embankment behind the power station with additional records from the coastal area near the boat house and on the edge of the gorse strip along the stone wall leading to the coast. (See Figure 8).

Should reptile habitat be lost or damaged, there could be a requirement for the exclusion and translocation of animals, habitat creation and the restoration of habitat post-construction combined with a sympathetic habitat management regime.

Figure 1: Location of Survey Area



1 Methodology

For the first phase of the reptile surveys carried out in 2010 a total of 89 carpet tile refugia were positioned within the survey area. Tiles with a black backing were chosen as these would have the most appropriate thermal properties for use by basking reptiles which being ectothermic require the warmth of the sun to attain a functional body temperature.

The sites were chosen to sample the various potential reptile habitats within the survey area to complement the previous decommissioning surveys. This included the areas where adders had been recorded during the decommissioning surveys. The location of the refugia is shown in Figure 2. It was then intended to relocate the refugia during 2011 to concentrate on areas where reptiles had been recorded in an attempt to assess population densities.

The refugia were checked on five occasions between May & September in both 2010 and 2011 when the animals would be expected to be active. The surveys also included a visual search for any reptiles that may be active or basking away from the refugia. Surveys were timed to coincide with the first sunny periods of the survey days to increase the chance of locating basking animals.

For the second phase of the surveys carried out in 2011, Wylfa Head was included within the survey boundary. The carpet tiles were re-distributed, removing them from areas which had failed to record reptile presence, and re-positioning them in areas where reptiles had been recorded and on Wylfa Head LNR, Figure 3. The survey area was split into 10 discrete survey sections, see Figures 4 and 5. In addition to this, 50 tiles of bitumen roofing felt measuring 50cm x 50cm were deployed throughout the surveyed area - often in close proximity to carpet tiles to confirm the effectiveness of the survey methodology. 10 half sheets of corrugated metal sheeting were also deployed within some of the highest potential adder habitat to increase the ability of the survey to assess the adder population size. Figure 6 shows the distribution of refugia in the additional area on Wylfa Head.

Non-target species such as amphibians utilising the refugia were also recorded during the surveys.

2 Survey Limitations

Carpet tiles may not have been the most appropriate material to use as refugia during the 2010 surveys. There was however a specific instruction to use carpet tiles for health and safety reasons. Research has revealed that corrugated metal sheeting is the most effective material for snakes, (Edgar et al 2010) followed by roofing felt and corrugated bitumen sheeting.

During the 2011 surveys, a combination of carpet tiles, roofing felt and corrugated metal sheeting were used.

Figure 2: Location of Refugia 2010

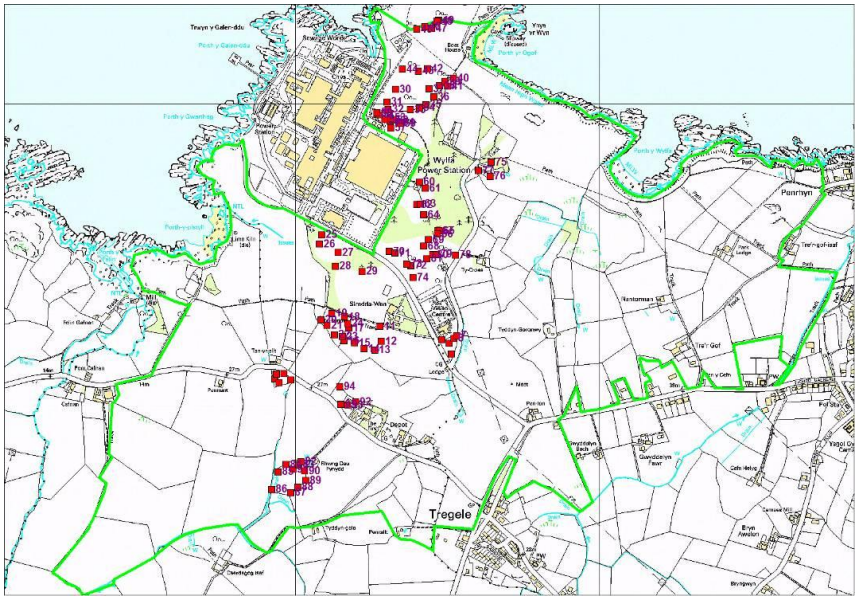


Figure 3: Location of Refugia 2011

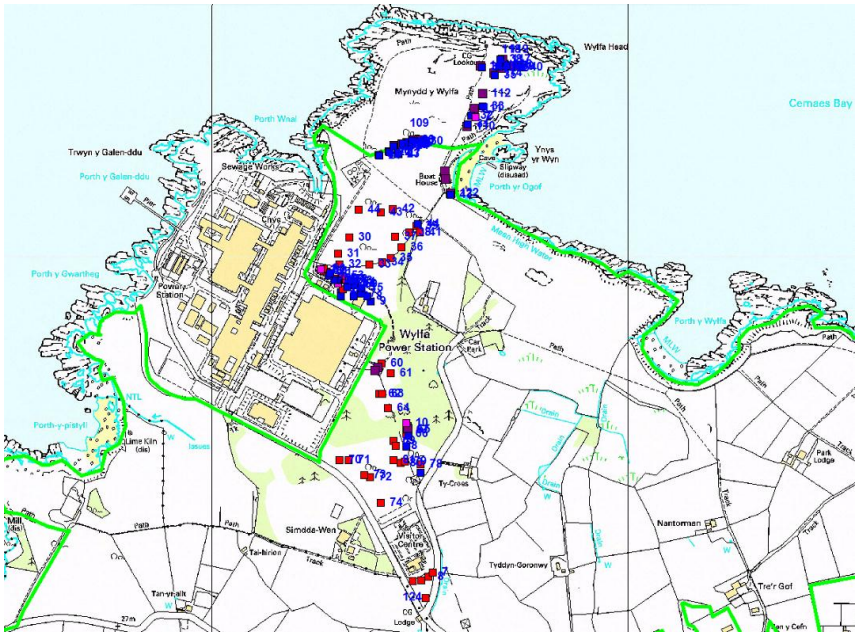


Figure 4: North Transect Habitat Areas 2010

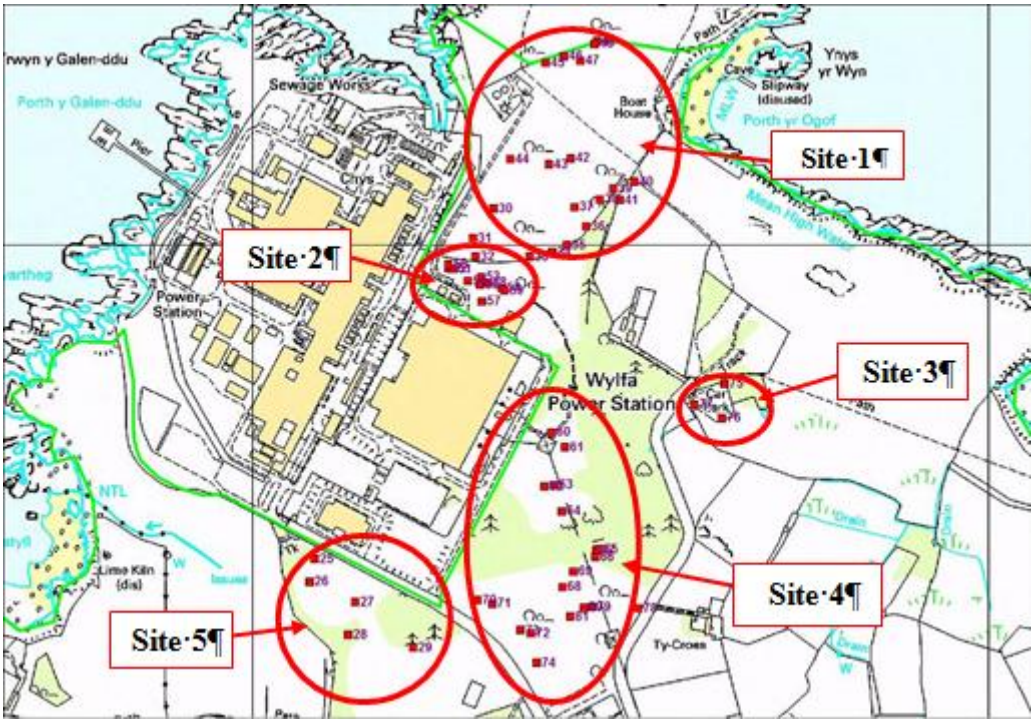


Figure 5: South Transect Habitat Areas 2010

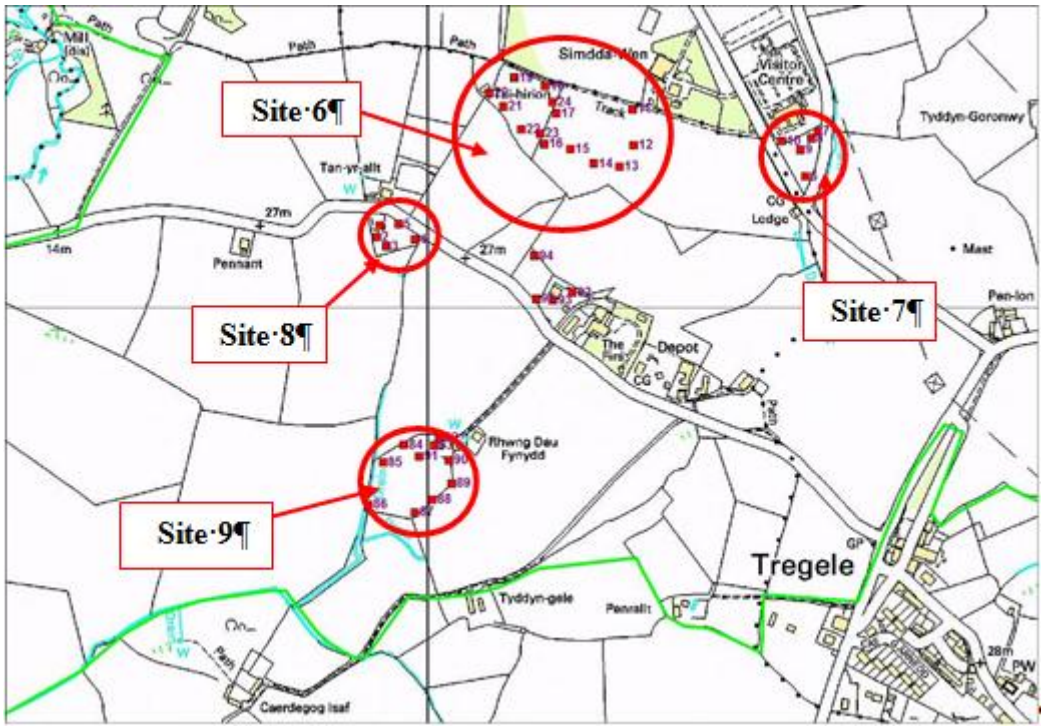
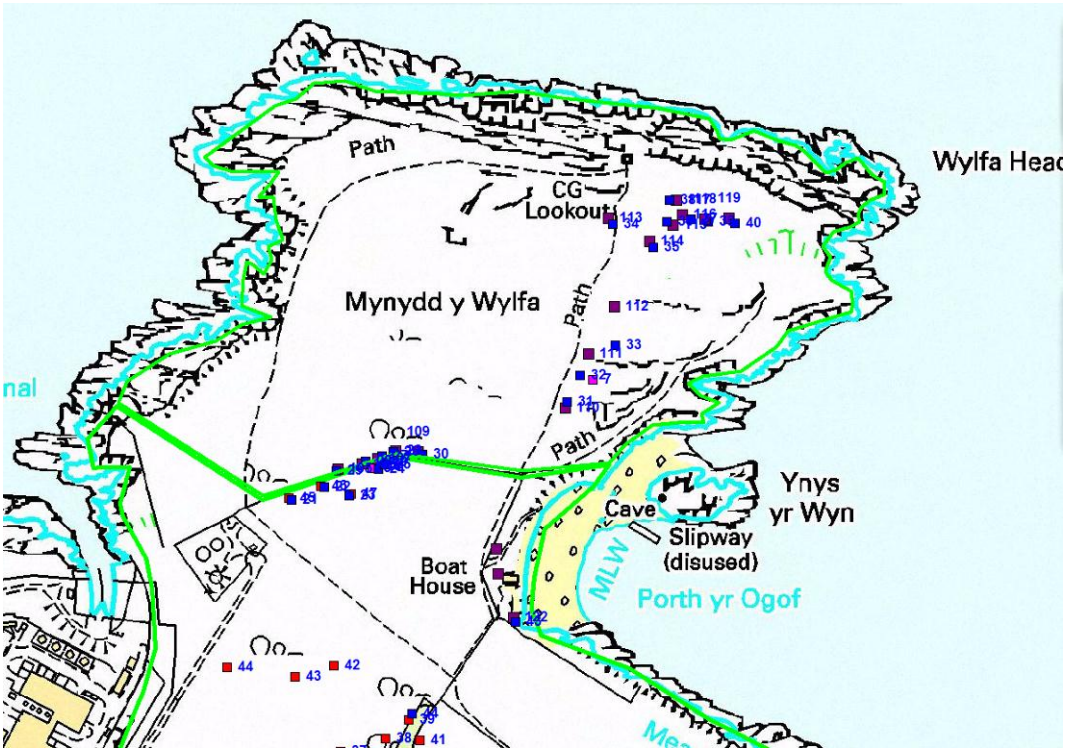


Figure 6: Additional Survey Areas 2011 - Wylfa Head, Site 10



3 Site Description

Site 1

Site 1 is an area of grazed grassland dotted with stands of gorse; (*Ulex europaeus*) and fringed on the southern and eastern boundaries with dense bramble; (*Rubus fruticosus*).

Site 2

Site 2 is a sunny embankment to the rear of the existing power station dominated by cocksfoot; (*Dactylis glomerata*) and dotted with gorse and bramble. There is also a dense stand of sea buckthorn; (*Hippophae rhamnoides*) at the eastern end of this area. This area is un-grazed.

Site 3

Site 3 is the area surrounding the 'Manor Car Park' which is an open scrubby area dominated by bramble and cocks foot with numerous opportunities for basking.

Site 4

Site 4 is the nature reserve where the refugia have been located in more open, sunny areas between the gorse and on the south-facing woodland edge.

Site 5

Site 5 encompasses the surroundings of the sports field where the refugia have been positioned in sunny positions in rough grassland on the edge of the coniferous planting.

Site 6

Site 6 comprises predominantly of a wetland area dominated by soft rush; (*Juncus effusus*) and the drier field in the vicinity of the barn, Tal Hirion which is dominated by cocks foot. There is a dense hedge of gorse, bramble and hawthorn; (*Crataegus monogyna*) surrounding Site 6. There has been no grazing on this site since the commencement of the surveys which has resulted in the habitats becoming increasing more densely vegetated.

Site 7

Site 7 is an open sunny location to the immediate south of the Visitor Centre. Although the vegetation is predominantly cocks foot, this area is under active management which controls the length and density of the vegetation.

Site 8

Site 8 is an area of increasing scrub and ruderal vegetation density opposite Tan yr Allt which now has no active management. There are however open, sunny areas suitable for basking.

Site 9

Site 9 is the field directly below Rhwng Dau Fynydd which has recently developed a dense growth of cocks-foot although some grazing by sheep has since been introduced in November 2010. There is a ditch at the lower end of the field

which is bounded by a dense hedge of hawthorn, gorse, bramble and blackthorn; (*Prunus spinosa*).

Site 10 Wylfa Head

The habitat on Wylfa Head is a combination of grazed grassland and coastal heath with areas of dense bracken and gorse.

4 Results

Reptiles 2010

Adders were recorded on two separate occasions in Site 2, the bank to the rear of the existing power station. The first was on 17th June when an individual adult snake was sighted actively hunting in the long grass. The second was on 18th August when an adult and a juvenile were recorded. Again the animals were active and were not utilising the refugia. The presence of the juvenile confirms breeding at this location.

No reptiles of any species were recorded at any other locations

Above: Adder recorded on 18th August 2010

Non-Target Species 2010

Common toads; (*Bufo bufo*) were recorded on 18th August 2010 under four separate refugia. A juvenile was found under No 33 and a very large adult under No 37, both in Site 1. Two juveniles were recorded under No 60 and one adult and one juvenile under No 66 and a further juvenile under No 74. All of these refugia are in the Nature Trail Site 4.

Palmate newts; (*Triturus helveticus*) were also recorded on the site during previous surveys for great crested newts; (*Triturus cristatus*). (Walsh, J. 2010).

Reptiles 2011

8th April 2011

On 8th April the carpet tile refugia were distributed throughout the new target area. Although not an official survey reptiles were recorded during this process. One large adult male adder was recorded in the coastal scrub above the boathouse at SH 35580 94141 and a smaller female at SH 35355 93908 on the bank behind the power station.

19th May 2011

On 19th May a further 50 roofing felt refugia and 10 sheets of corrugated metal sheeting were added to the survey area. The location of these refugia is shown in Figure 4. During this process two adders, one adult male and one juvenile female were recorded under one of the original carpet tiles (No 59) at SH 35332 93908. This record of a juvenile confirms continued breeding on this site.

9th June 2011

On 9th June the reptile survey revealed an adult female adder to be present under refugium No 59 on the bank behind the existing power station and an adult male hunting near the dense gorse along the stone wall near the sewage plant at SH 35405 94248.

Above: The adult male and juvenile female adder recorded on 19th May 2011.

Above: Adult female adder under Tile No 59 on 9th June 2011

7th July 2011

The reptile survey of 7th July was negative but common toads were found under refugia on the edge of the woodland adjacent to the access road to the power station.

4th August 2011

On 4th August a very large female adder was found, again on the bank behind the existing power station under refugium No 59. At nearly 60cm in length this was a previously unrecorded animal.

During this survey toads were again found under refugia on the woodland edge adjacent to the access road to the power station.

2nd September 2011

No reptiles were recorded during the survey of 2nd September.

One common frog; (Rana temporaria) was found under a refugium adjacent to the visitor centre. This is the first time this species has been recorded during the surveys.

Above: Large female adder recorded on 4th August

Figure 7: Location of adder records 2008

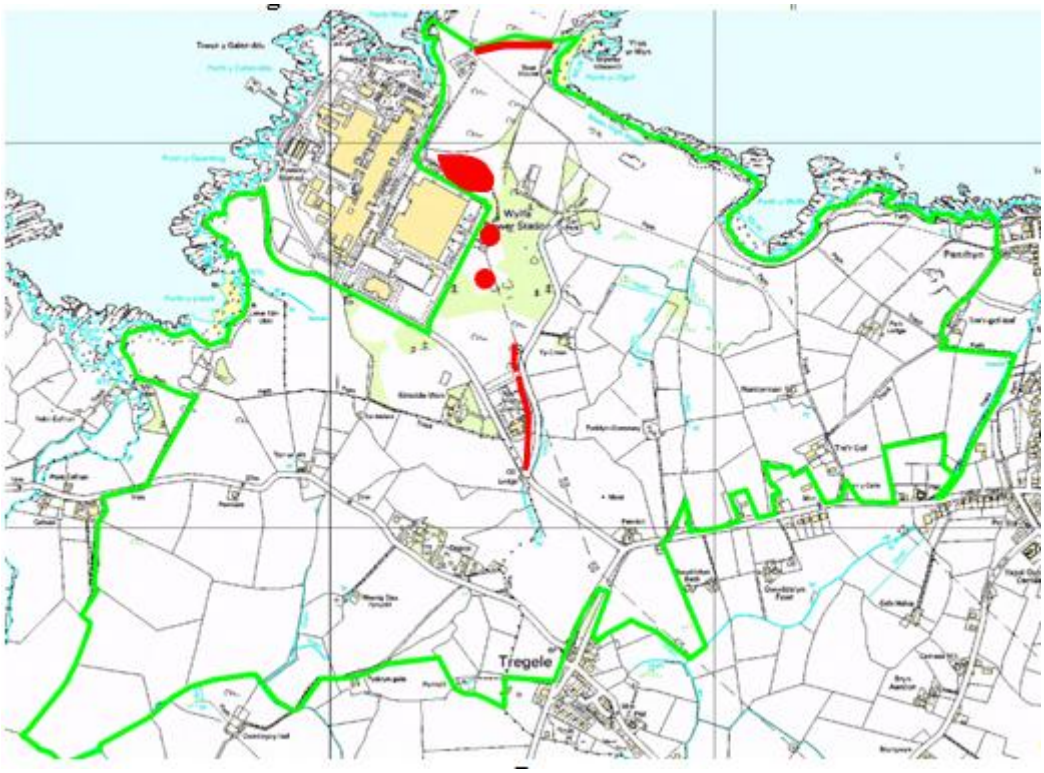


Figure 8: Location of adder records 2010

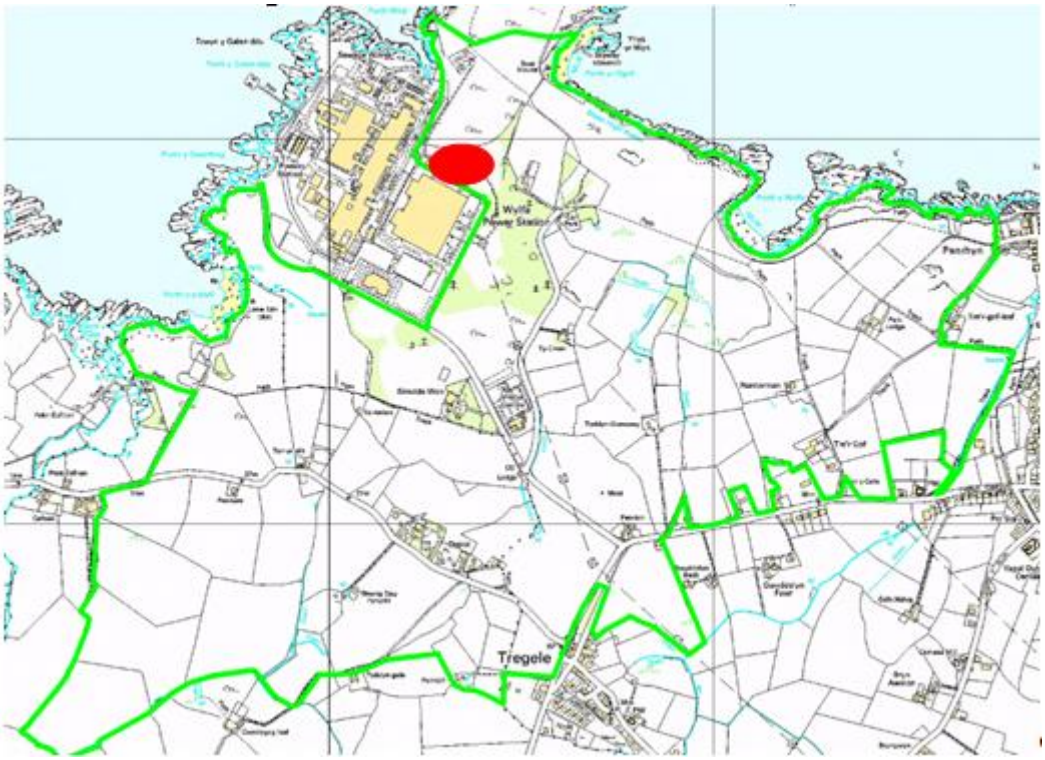
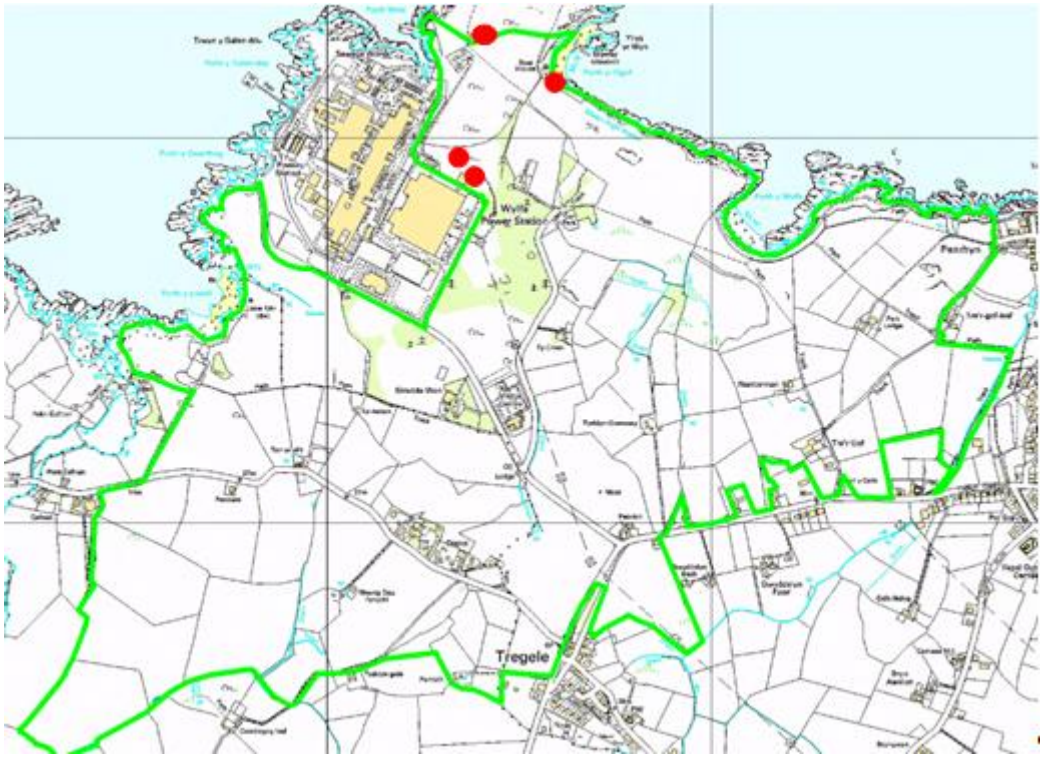
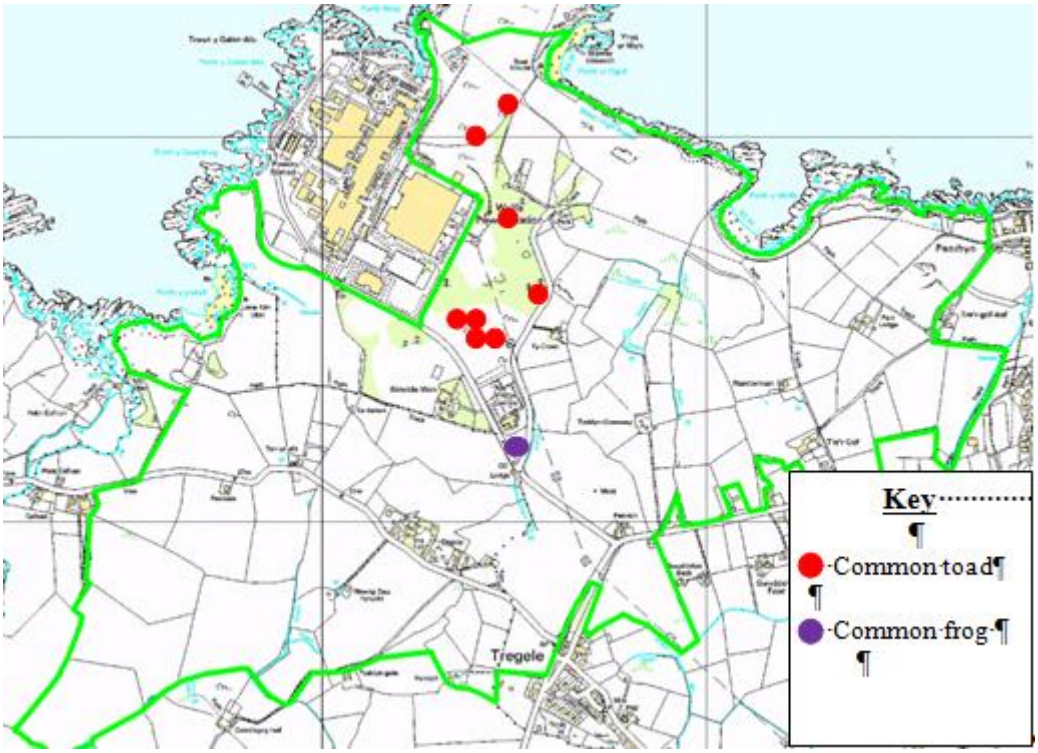


Figure 9: Location of adder records 2011



Above: Common toad found under refugia in Site 4 (2010)

Figure 10: Location of common toad & frog records 2010 & 2011



5 Habitat Evaluation

Site 1

Although adders were recorded on Site 1 during the decommissioning survey, the potential of this area to support a robust population of this species is limited by heavy grazing of the improved grassland which dominates the habitat. This grazing will be a limiting factor with regards to potential prey biomass. This area is however relatively open giving plenty of opportunities for basking and there is cover in the form of dense gorse in some areas combined with bramble on the eastern boundary. The stone wall on the northern boundary offers a safe location for hibernation and opportunities for basking. It was in the vicinity of this wall that adders were recorded during the 2008 surveys and in the latest surveys of 2011.

Site 2

Site 2 could be described as optimal adder habitat. The area is un-grazed which will encourage a greater prey biomass of small mammals and the bank has a south-facing aspect providing ideal basking opportunities. There is also good cover in the form of bramble, gorse and sea buckthorn and rocky areas for basking.

Site 3

Site 3 is a combination of scrub and areas of rough grass in a sunny location providing opportunities for basking and hunting. The car park is surrounded by stone walls which could potentially be used for hibernation. This habitat is suitable for adders, slow worms and common lizards. Due to the close proximity of the wetland of the Tre'r Gof SSSI, there is also the potential for grass snakes to be present.

Site 4

Site 4 is a combination of dense gorse with rocky outcrops and open areas for basking at the northern end of the site. This area is also un-grazed and represents optimal adder habitat. Towards the southern end, the site is dominated by broadleaved plantation with a coniferous stand to the west. These habitats could be described as sub-optimal although there is the potential for adders and slow worms to be present on the woodland edges. The potential of this area to support reptiles will however progressively diminish as the trees increase in size, reducing ground temperatures and basking opportunities.

Site 5

Site 5 has a very open aspect giving ample opportunities for basking. The sports field in the centre of the site is however closely mown and consequently limited in its potential to support reptiles which would also be susceptible to fatalities from machinery. The woodland edges and less intensively managed areas of grassland where the refugia were located do however have the potential to support a limited population of slow worms.

Site 6

Site 6 comprises two distinct habitats. The predominantly wetland area, dominated by soft rush has the potential to support an amphibian population

which would in turn provide prey for grass snakes. The drier field to the west is dominated by cocks-foot and at the time of the planning of the 2010 survey was deemed to be potential slow worm habitat. The removal of grazing and all active management from this area however has resulted in a very dense growth of vegetation leaving very little opportunity for basking. This part of Site 6 is probably now largely unsuitable for reptile occupation with the exception of areas immediately adjacent to the access track where vegetation is less dense.

Site 7

Site 7 is an un-grazed, open sunny location to the immediate south of the Visitor Centre in which adders were recorded during the decommissioning surveys. This area is actively managed with periodic strimming of the grass which could be an inhibiting factor with regards to constant adder occupation. Keeping the grass short will certainly reduce prey biomass and the use of machinery could also result in snake fatalities. This area is sub-optimal adder habitat although there is still the potential for slow worms to be present.

Site 8

During the planning of the 2010 surveys Site 8 was deemed to be suitable slow worm habitat being a patchwork of scrub and rough grassland. The habitat however has no active management and has declined throughout the year. The open, sunny areas which were suitable for basking are rapidly becoming over-grown and the habitat is now considered sub-optimal.

Site 9

Site 9 in the field directly below Rhwng Dau Fynydd was originally considered potential slow worm and grass snake habitat being a combination of rough grass and wetland. The removal of all active management of the site throughout the summer months however saw a rapid change in the habitat with dense tussocks of cocks-foot developing in the drier areas of the field. The result of this growth is that basking opportunities are now very limited and this could now be considered sub-optimal slow worm habitat. The wetter areas of the field which are dominated by soft rush have been less affected by the removal of grazing and the site still has the potential to support grass snakes.

Site 10, Wylfa Head

The potential of the habitats on Wylfa Head to support a robust population of adders is also limited by periodic heavy grazing. This grazing will be a limiting factor with regards to potential prey biomass. This area is however relatively open giving plenty of opportunities for basking and there is cover in the form of dense gorse and bracken. The stone wall on the southern boundary offers a safe location for hibernation.

6 Conclusions

It is concluded from the results of the 2008 decommissioning surveys, combined with the 2010 and 2011 surveys that it is possible that both slow worms and grass snakes are absent from the site. Consultation with CCW strongly suggests that although grass snakes are present on Anglesey, their population density is very low.

It is also possible that slow worms are absent due to past management regimes where most areas were either grazed or actively managed. What appeared to be potential slow worm habitat during the planning of the 2010 surveys could be due to the transitional stage of the vegetation which has now developed further into habitats too dense for animals to efficiently bask to raise body temperatures to an acceptable level.

Adders would appear currently to be the only reptile present on this site although a precautionary approach with regards to other species would be prudent. The adders also appear to have a restricted range and also a limited population, a conclusion reached in the population estimates following the decommissioning surveys.

7 Legal Implications

7.1 Reptiles

General Implications

All British reptiles are protected under 'Schedule 5' of the Wildlife & Countryside Act 1981 (as amended). This legislation protects reptiles from deliberate killing, injury or unlicensed trade.

The adder is a 'Priority BAP Species' and therefore receives protection under 'Section 42' of the NERC Act. Under this legislation all 'Competent Authorities' have an obligation to give consideration to the species on this list in all of their activities, including planning issues.

Specific Implications

Provided that the mitigation measures detailed in this report are adhered to, reasonable steps will have been taken to prevent the killing or injuring of reptiles and there will be no legal implications with regards to their presence.

7.2 Amphibians

The palmate newt, smooth newt, common frog and common toad are all listed on Schedule 5 of the Wildlife and Countryside Act 1981, but are protected (section 9[5]) only with respect to trade (prohibition of sale and advertising for sale, etc.). Hence these species are not legally protected from development, although other considerations may be taken into account.

The common toad is a 'Priority BAP Species' and therefore also receives protection under 'Section 42' of the NERC Act. Under this legislation all 'Competent Authorities' have an obligation to give consideration to the species on this list in all of their activities, including planning issues.

8 Mitigation Principles

8.1 Reptiles

Current Recommendations

It would seem futile at this stage to alter current management regimes throughout the site to encourage reptiles when a significant area of habitat will be altered. This would seem more applicable to apply in the post-construction restoration and habitat management plan.

Enabling Works

It is recommended that during any enabling works that take place in areas where either reptiles have been recorded, or where the habitat is still suitable for reptiles, that precautionary measures are applied. Prior to work commencing the area should first be thoroughly searched for reptiles by a suitably experienced ecologist. The work may also need to be supervised if this is deemed necessary by the ecologist.

Construction Phase

Where active reptile habitat is to be lost a full exclusion of reptiles must be undertaken prior to work commencing. This will require the following strategy to be implemented.

- The habitat to be lost must be surrounded by reptile fencing.
- Refugia should be distributed throughout the fenced area and should be checked for the presence of reptiles a minimum of seven times between May and September.
- All reptiles found should be safely removed to a previously identified receptor site.
- The receptor site will be identified in advance of any animals being moved and will be surveyed to establish its suitability.
- To cope with the eventuality of there being considerably more reptiles present than previously identified, the receptor site will be of an appropriate size.
- To cope with the eventuality of other species being present, receptor sites with the appropriate habitat for these species will also be identified prior to the removal of any animals from the site.
- A detailed record of all animals removed and the site to which they were translocated will be kept and included in a final report.
- On completion of the seven monthly checks of refugia and reptile removal, a thorough search of the site will be carried out by the ecologists. This will cover any loose material which may be harbouring remaining reptiles. Any animals found during this process will also be removed to the receptor site.
- Once it is established beyond reasonable doubt that the site is reptile free, the habitat clearance can then take place.

Where potential reptile hibernation habitat is to be lost, such as stone walls, the following strategy should be implemented.

- The removal of the habitat should take place during the summer months when the animals would be expected to be active.
- The removal of the habitat should be supervised by a suitably experienced ecologist.
- Any animals found during the supervised habitat removal should be translocated to a previously identified suitable receptor site.

Where reptile habitat is to be retained, there is still the potential for reptile fatalities from the movement of machinery due to animals straying into construction areas. The following strategy is therefore recommended to prevent this from occurring.

- The existing habitat should be fenced to keep the animals in a place of safety.
- The area fenced should be greater than the current habitat to allow for population expansion during the construction period.
- An appropriate habitat management regime should be introduced to the enclosed area.
- It should also be ensured that all of the reptile's habitat requirements are met within the enclosed area. There is a possibility that features such as hibernacula may need to be provided.

Post Construction Site Restoration

If any reptile habitat has been lost during the construction phase, new habitat should be created during the site restoration. Attention should also be paid to future habitat connectivity.

A long term monitoring scheme should then be implemented in order to assess any impact on the reptile population and to assess the success of any habitat enhancement or creation work. This work should also aim to identify any minor amendments required in the site management plan.

8.2 Amphibians

Enabling Works

Although no significant impact on amphibians is anticipated during the enabling works, it would be prudent for site personnel to be made aware of the potential sensitivity of water bodies during the spawning period and measures taken to avoid pollution or undue disturbance.

Construction Phase

If any ponds utilised by spawning amphibians are to be lost as a result of the construction phase, this should take place outside the spawning season to avoid fatalities of breeding adults. Where possible, work should take place in late summer to allow the current years young to leave the aquatic habitats.

Post Construction Site Restoration

To replace any amphibian spawning habitat lost during the construction phase, it is recommended that a series of new ponds are excavated during the site restoration phase. Ideally the new ponds should be distributed throughout the site and linked by suitable terrestrial habitat. Their siting should be agreed with a qualified ecologist.

9 References

Edgar, P. Foster, J. & Baker, J. (2010) Reptile Management Handbook. Amphibian & Reptile Conservation, Bournemouth.

RSK Carter Ecological Ltd - Wylfa Power Station Part Two, Section 12: Ecology & Baseline Survey Results

Walsh, J. (2010) Great crested newt survey report on behalf of ARUP.

Appendix A

Survey Weather Conditions 2011

A1 Survey Weather Conditions 2011

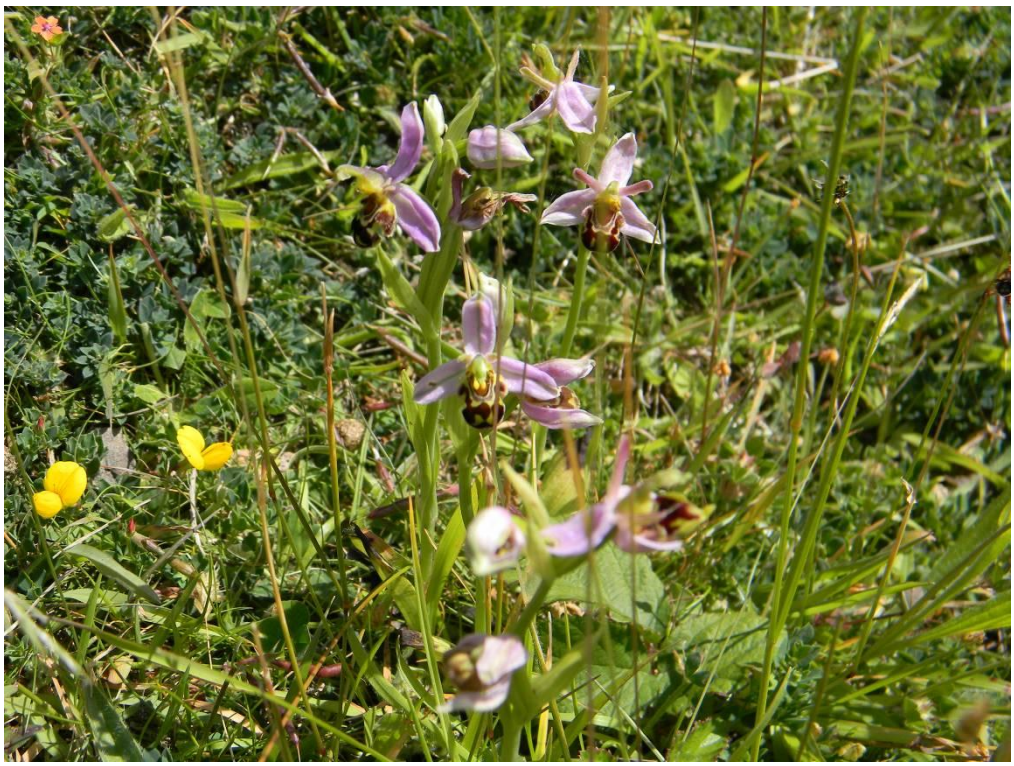
Date	Start Time	Finish Time	Temperature	Cloud Cover
04.5.10	9.00	12.15	Variable between 10 OC & 14 OC	30% - sunny intervals
17.6.10	8.30	12.00	15OC	50%
05.7.10	9.00	12.00	Variable between 14 OC & 18 OC	40%
18.8.10	9.30	13.00	21OC	75% with sunny intervals
09.9.10	10.00	14.00	18OC	10%
19.5.11	10.30	15.45	Variable between 12 OC & 15 OC	20% with warm sunny intervals
9.6.11	11.00	15.00	Variable between 11OC & 16OC	25% with warm sunny intervals
7.7.11	10.00	13.00	17 OC	60%
4.8.11	13.00	17.00	19 OC	40%
2.9.11	10.15	14.30	15 OC	70% with sunny intervals

Appendix B

Incidental Records

B1 Incidental Records

Bee orchids; (Ophrys apifera) were discovered on the bank behind the existing power station during the survey of 9th June 2011.



HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

Appendix 1-2 - Reptile Survey Report 2012

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00197

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Horizon Nuclear Power Wylfa Ltd

Wylfa New Nuclear Power Station

Reptile Survey Report 2012

210623-02/REP/039

Issue | 15 February 2013

Job number 210623-02

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Document Verification

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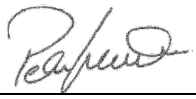
Job title		Wylfa New Nuclear Power Station			**Job number** 210623-02
Document title		Reptile Survey Report 2012			**File reference**
Document ref		210623-02/REP/039			
Revision	**Date**	**Filename**	210623-02-rep-039 reptile Survey Report 2012.docx		
Draft 1	22 Jan 2013	**Description**	First draft		
			Prepared by	Checked by	Approved by
		Name	Chris Hall	Kate Williamson	Sam Dyer
		Signature			
Draft 2	10 Feb 2013	**Filename**	210623-02-rep-039 reptile Survey Report 2012.docx		
		Description			
			Prepared by	Checked by	Approved by
		Name	Pete Wells	Austin Brown	Peter Hulson
		Signature			
Issue	15 Feb 2013	**Filename**	Reptile Survey Report 15_02_2012 ISSUE TO HNP.docx		
		Description			
			Prepared by	Checked by	Approved by
		Name	Pete Wells	Austin Brown	Peter Hulson
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document Verification with Document	✓

Contents

1 Introduction

Ove Arup & Partners Ltd was commission by Horizon Nuclear Power Wylfa Ltd (HNP) to undertake baseline ecological surveys of the Strategic Search Area (SSA) for a new nuclear power station at Wylfa on Anglesey. The survey area includes land surrounding the SSA due to the requirements for landscaping and the earthworks surplus that will be generated during the construction of new reactors.

Initial surveys were undertaken in 2009, and for most species have been repeated on an annual basis. This report documents the results of the reptile surveys undertaken during 2012 which were conducted by the Cambrian Ecological Partnership (C.E.P.) on behalf of Arup. The report also provides recommendations for an outline mitigation strategy that might be required to facilitate development of the new power station.

A series of decommissioning surveys carried out by RSK Carter Ltd in 2008 for the existing power station had revealed the presence of adder (*Vipera beris*) in close proximity to the existing station. Surveys undertaken for HNP during 2010 and 2011 also recorded the presence of adder in this location. A data search (NBN Gateway) revealed the presence of slow worm (*Anguis fragilis*), common lizard (*Lacerta vivipara*) and grass snake (*Natrix natrix*) on Anglesey.

The survey area covered during 2012 has been extended to include additional areas not surveyed during the previous two years. The survey areas are shown on Drawing 210623-02/39/01 in appendices to this report.

2 Methodology

Due to the large scale of the survey area, the approach to surveys has been to target the areas of highest quality habitat, namely species rich grassland, gorse scrub, coastal areas, woodland glades and wet marshy areas.

This survey repeats the surveys that have been undertaken in previous years although due to changes in the boundary of the survey area, some areas were being surveyed for the first time.

The reptile survey sites used in previous years (2010 and 2011) were chosen to sample the various potential reptile habitats within the survey area to complement the previous decommissioning surveys in 2009. This included the areas where adders had been recorded during the decommissioning surveys.

The 2012 survey included the majority of these sites and areas of suitable habitats identified in the enlarged survey area. The survey was undertaken in accordance with the advice provided in Froglife Advice Sheet 10 (Froglife 1999). A combination of roofing felt, carpet tiles and corrugated metal sheets were distributed within potential reptile habitat at a minimum density of five tiles per hectare. Froglife (1999) recommends densities of between five and ten refugia per hectare for the purposes of surveys, but that this is increased for detailed surveys. Research has revealed that corrugated metal sheeting is the most effective material for snakes (Edgar et al 2010) followed by roofing felt and corrugated bitumen sheeting. A combination of materials was used in order to ensure other species such as lizards and slow worms were also recorded.

The location of the survey areas and indicative locations of refugia are shown on Drawing 210623-02/039/01. Survey areas 3, 5, 8 and 9 were removed from the survey. Although these areas appear to support suitable habitat for reptiles, surveys over the previous two years have not yielded any positive results. It was therefore decided to redistribute refugia in other areas to sample suitable habitats elsewhere within the extended survey area. The area covered within site 4 was reduced to reflect prime habitat located along the nature trail and “glade” located beneath the power lines within the woodland block. The number of refugia used per site were as follows:

- Site 1: 40 Tiles and 3 Tins
- Site 2: 27 Tiles and 3 Tins
- Site 4: 13 Tiles and 1 Tins
- Site 6: 15 Tiles and 2 Tins
- Site 7: 5 Tiles and 1 Tins
- Site 10: 20 Tiles and 2 Tins
- Site 11: 8 Tiles
- Site 12 East: 28 Tiles
- Site 12 West: 15 Tiles and 5 Tins
- Site 13: 10 Tiles and 3 Tins

- Site 14: 20 Tiles

Non-target species such as amphibians utilising the refugia were also recorded during the surveys.

The refugia were checked on five occasions at monthly intervals from May to September 2012 as agreed for the previous surveys. The weather conditions during each of the surveys are shown in Table 1 in appendices to this report.

2.1 Survey Limitations

Carpet tiles may not have been the most appropriate material to use as refugia during the 2010 surveys. There was however a specific instruction from HNP and the owners of the existing power station to use carpet tiles for health and safety reasons. Research has revealed that corrugated metal sheeting is the most effective material for snakes, (Edgar *et al* 2010) followed by roofing felt and corrugated bitumen sheeting.

During the 2011 & 2012 surveys, a combination of carpet tiles, roofing felt and corrugated metal sheeting were used

3 Results

3.1 Site Description

3.1.1 Site 1

Site 1 is an area of grazed grassland dotted with stands of gorse (*Ulex europaeus*) and fringed on the southern and eastern boundaries with dense bramble (*Rubus fruticosus*). Grazing by sheep is normally undertaken in later summer and during the winter. Vegetation surveys have shown this area to comprise of a mosaic of species rich grassland plant communities, although in some areas the species composition is reduced.

Adders were recorded on Site 1 during the decommissioning survey, although the potential of this area to support a robust population of this species is limited by heavy grazing of the grassland which dominates the habitat. This grazing will be a limiting factor with regards to potential prey biomass. This area is however relatively open giving plenty of opportunities for basking and there is cover in the form of dense gorse in some areas combined with bramble on the eastern boundary. The stone wall on the northern boundary offers a safe location for hibernation and opportunities for basking. It was in the vicinity of this wall that adders were recorded during the 2008 surveys and in the latest surveys of 2011.

Plate 1 Aerial view of Sites 1 and 2 from Google Earth.

3.1.2 Site 2

Site 2 is an embankment to the rear of the existing power station dominated by cock's foot (*Dactylis glomerata*) with considerable gorse and bramble. The embankment forms part of Dame Sylvia Crowe's Mound with a viewing platform at the top of the mound. To the north is site 1 and to the east is an area of coniferous plantation which forms a visual screen between the power station and the town of Cemaes. The southern and western sides of this site are marked by the access track running around the substation building out to the sewage treatment works. This area is un-grazed and as a result the amount of scrub is increasing at the expense of the more open MG1[1] grassland.

Site 2 could be described as optimal adder habitat. The area is un-grazed which will encourage a greater prey biomass of small mammals and the bank has a south-facing aspect providing ideal basking opportunities. There is also good cover in the form of bramble, gorse and sea buckthorn and rocky areas for basking.

3.1.3 Site 4

Site 4 is located within the area of woodland plantations to the east of the existing power station and substation building. The area is over sailed by the high voltage overhead lines which create a glade within the woodland. Gorse scrub has colonised this area with the exception of the footpath running through the area as part of the nature trail.

[1] National Vegetation Classification Plant Community MG1 *Arrhenatherum elatius* grassland.

These habitats could be described as sub-optimal although there is the potential for adders and slow worms to be present on the woodland edges. The potential of this area to support reptiles will however progressively diminish as the trees increase in size, reducing ground temperatures and basking opportunities.

3.1.4 Site 6

Site 6 comprises predominantly of a wetland area dominated by soft rush; (*Juncus effusus*) and the drier field which is dominated by cock's foot in the vicinity of the barn Tal Hirion. There is a dense field boundary comprising a wall with gorse, bramble and hawthorn (*Crataegus monogyna*) surrounding Site 6. There has been no grazing on this site since the commencement of the surveys which has resulted in the habitats becoming increasing more densely vegetated.

Site 6 comprises two distinct habitats. The predominantly wetland area, dominated by soft rush has the potential to support an amphibian population which would in turn provide prey for grass snakes. The drier field to the west is dominated by cock's foot and was included in the initial 2010 surveys as potential slow worm habitat. The removal of grazing and all active management from this area however has resulted in a very dense growth of vegetation leaving very little opportunity for basking. This part of Site 6 is probably now largely unsuitable for reptile occupation with the exception of areas immediately adjacent to the access track where vegetation is less dense.

3.1.5 Site 7

Site 7 is an open sunny location to the immediate south of the Visitor Centre. Although the vegetation is predominantly cock's foot, this area is under active management which controls the length and density of the vegetation.

Adder were recorded in this area during the surveys in 2008 for the decommissioning of the existing power station. This area is actively managed with periodic strimming of the grass which could be an inhibiting factor with regards to constant adder occupation. Keeping the grass short will certainly reduce prey biomass and the use of machinery could also result in snake fatalities. This area is sub-optimal adder habitat although there is still the potential for slow worms to be present.

3.1.6 Site 10 Wylfa Head

The habitat on Wylfa Head is a combination of grazed grassland and coastal heath with areas of dense bracken and gorse. The western half of the headland lacks the areas of gorse and bracken, probably due to the effects of salt spray. The majority of the gorse and bracken in located on the eastern side and along the stone wall that separates the headland from the adjoining areas.

The potential of the habitats on Site 10 to support a robust population of adders is also limited by periodic heavy grazing. This grazing will be a limiting factor with regards to potential prey biomass. These areas are however relatively open giving plenty of opportunities for basking and there is cover in the form of dense gorse and bracken. The stone wall on the southern boundary of Site 10 and the walls in the vicinity of Felin Cafnan offer safe locations for hibernation.

3.1.7 Site 11

Site 11 is a small wetland area dominated by bulrush (*Typha latifolia*) located within a field of improved grassland. The grassland is grazed and has also been cut for hay or silage. The bulrush swamp is considered to provide good quality habitat for grass snake, although this species is known to be rare on Anglesey. However with the exception of the surrounding field boundaries this site is not considered suitable for other reptile species.

3.1.8 Site 12

Site 12 consists of a mosaic of gorse, coastal heath and species rich MG5 grassland. The western section of this site is located on the National Trust owned headland of Trwyn Pencarreg. The mosaic of heather, areas of wet grassland and rock outcrops provides very high quality habitat for reptiles.

The adjoining fields comprise MG5 species rich grassland with field boundaries of walls and fences with gorse scrub. The potential of these grassland habitats to support a robust population of adders is also limited by periodic heavy grazing. The area is however relatively open giving plenty of opportunities for basking and there is cover in the form of dense gorse and bracken. The stone walls in the vicinity of Felin Cafnan offer safe locations for hibernation.

3.1.9 Site 13

This site is located in the area immediately to the south of the existing power station. The habitats present include dry and wet grassland along with areas of gorse and a small rock outcrop. In addition there is the coastal fringe including the shingle beach. These habitats are considered suitable for reptiles although heavy winter grazing of the fields removes are large amount of the taller vegetation.

3.1.10 Site 14

Site 14 is a former horse pasture located adjacent to Caerdegog Isaf. The site comprises poor semi improved grassland with an area of trees and blocks of scrub. The northern edge of this site is formed by the stream flowing from the Cae Gwyn SSSI in the south. The site is separated from this stream by a fence line with bramble scrub. A small ditch and is present within the site that drains from a spring in to the stream. Site 14 has limited potential to support reptiles, again due to grazing although grazing pressure is not so heavy on the site and has now been removed.

3.1.11 Site 15

Site 15 is the coastal fringe extending east from Wylfa Head toward Cemaes. It comprises a thin band of coastal grassland, with areas of scrub and bracken. The field adjacent to Porth y Ogof was species rich but has been sown with rye grass (*Lolium perenne*). Within this field are a number of low rock outcrops with more diverse grassland and gorse.

Further to the east the fields are more improved, however a network of low stone walls near to Park Lodge would provide basking areas for reptile species. Although gorse and scrub patches exist, the liner area suffered greatly from habitat fragmentation

and exposure to harsher weather conditions and overall is therefore though to be of low potential to reptiles.

3.2 Survey Results

No reptiles were recorded during either the May or June 2012 surveys. A single male adder was recorded in the July survey at the western end of Dame Sylvia Crowe's Mound within Site 2 at the location shown on Drawing 210623-02/39/02. One common lizard was recorded basking on the top of refugia in the same area during the August survey. This is the first recording of a common lizard within the surveys that have been undertaken for the proposed new power station.

No reptiles were recorded during the September survey.

4 Conclusions

The results have shown that adder remain present within the area immediately to the north of the substation building where they have previously be recorded for the decommissioning and HNP surveys. In addition the presence of common lizard has now been confirmed within the survey area at Reptile site 2 where adder have been recorded.

Both of these species were only recorded on one visit out of the five undertaken and it would therefore appear that they are present in low numbers or that there are sufficient suitable basking areas that reptiles are not encouraged to use the refugia.

Sites 1 and 2 remain the most suitable habitat and the only areas where reptiles have been found. Adder were found in site 7 in 2008 but have not been recorded in this site during any of the survey from 2010 to 2012. The habitats within the additional areas added for the 2012 surveys have limited potential to support reptiles due to higher grazing pressures. While the wetland of Site 11 has some potential to support reptiles and is particularly suitable for grass snakes, this potential is limited by the heavy grazing of the surrounding habitats. Site 15 has isolated patches of gorse and scrub but due to the fragmented nature and level of exposure, it is considered to be of low potential for reptiles.

Habitats present within the survey area are also suitable to support slow worm and grass snake. Grass snake are known to be present on Anglesey but at very low population densities, based on consultation with the Countryside Council for Wales. While it cannot be concluded that these two species are definitely absent from the survey area, it is consider likely. However a precautionary approach should be adopted to take in to account their potential presence.

There is the potential for reptiles to be present in many of the suitable habitats within the site, although at very low population densities. This should be confirmed by undertaking more intensive population estimate studies involving a greater number of visits during the active period from April to September. It is recommend that these surveys should be undertaken in 2013 to provide greater information on the size of populations present and to inform the mitigation strategy in relation to reducing the potential effects of construction on reptile populations.

5 Legal Implications and Policy

All British reptiles are protected under 'Schedule 5' of the Wildlife & Countryside Act 1981 (as amended). This legislation protects reptiles from killing, injury or unlicensed trade.

Adder, grass snake, common lizard and slow worm are all included on the list of species considered to be of importance to the conservation of biodiversity in Wales[2]. They are also listed as priority species listed under the UK Biodiversity Framework[3]. The presence of adder and common lizard would therefore be a material consideration in the determination of any planning consents for development within the survey area.

6 Mitigation Principles

It is assumed that prior to the commencement of construction, a phase of enabling and major earthworks will need to be undertaken. This is likely to entail the removal of vegetation and should therefore be preceded by various species mitigation works as part of an ecological facilitation phase.

During this mitigation phase, it will be necessary to undertake reptile translocations to reduce the risk of reptiles being present at the start of the earthworks phase and thereby reducing the risk of injury or death of animals.

Prior to the translocation exercise it will be necessary to establish in greater detail the size of the populations of adder and common lizard within the area of the proposed development. Following this, work areas with known populations or high potential to support reptiles based on the habitats suitability, that will be affected during construction works should be fenced off using an appropriately designed fence to prevent reptiles escaping from these areas.

The fencing should be installed under the supervision of an Ecological Clerk of Works. Once fenced off refugia should be distributed within these areas to facilitate the capturing of reptiles so that they can be removed to a suitable receptor site outside of the area required for construction.

Each area would then need to be checked on a daily basis either until a minimum period has elapsed without reptiles being recorded or until a number of clear days when no reptiles are recorded. The length of the minimum period required would be determined by the results of the population density surveys within that area, as a larger population would need a longer minimum period as shown in Table 2 below. The translocation work would need to be completed during the active period for reptiles to avoid disrupting them during hibernation, which may affect their survival.

[2] Lists of Species and Habitats published in response to the requirements of Section 42 of the Natural Environment and Rural Communities Act 2006.
[3] JNCC and Defra (on behalf of the Four Countries' Biodiversity Group). 2012. *UK Post-2010 Biodiversity Framework*. July 2012

Table 2 Minimum effort required for reptile translocation taken from HGBI (1998)

Species	Population size	Refugia density per hectare	Minimum trapping days
	High >100/ha	100	90 suitable days
	Medium >50/ha	100	70 suitable days
Slow worm	Low <50/ha	50	60 suitable days
	High >80/ha	100	90 suitable days
	Medium >40/ha	100	70 suitable days
Common Lizard	Low <20/ha	50	60 suitable days
	High >4/ha	100	120 suitable days
	Medium 2 - 4/ha	100	100 suitable days
Adder	Low <2/ha	50	60 suitable days
	High >4/ha	100	90 suitable days
	Medium 2 - 4/ha	100	70 suitable days
Grass snake	Low <2/ha	50	60 suitable days

The capturing of reptiles can be accelerated through the use of habitat manipulation techniques to encourage animals to use the refugia and enhance the capture rates. This would entail the clearing of certain habitats and the removal of potential hibernacula such as stone walls and loose rock piles. This should only be undertaken under the supervision and direction of an ecological clerk of works.

It may be necessary to undertake habitat enhancement works within any receptor sites chosen in order to increase the carrying capacity of the area and ensure the survival of translocated animals. This is likely to entail the construction of hibernacula to provide suitable areas for reptiles to hibernate in. these would comprise areas of buried rocks and wood to provide moist crevices with stable winter temperatures. The hibernacula would normally be covered with turf to prevent the ingress of rainwater.

References

[1] Edgar, P. Foster, J. & Baker, J. (2010) Reptile Management Handbook. Amphibian & Reptile Conservation, Bournemouth.

[2] RSK Carter Ecological Ltd - Wylfa Power Station Part Two, Section 12: Ecology & Baseline Survey Results

[3] Walsh, J. (2010) Great crested newt survey report on behalf of ARUP.

[4] Froglife (1999) Reptile Survey: an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife Advice Sheet 10.

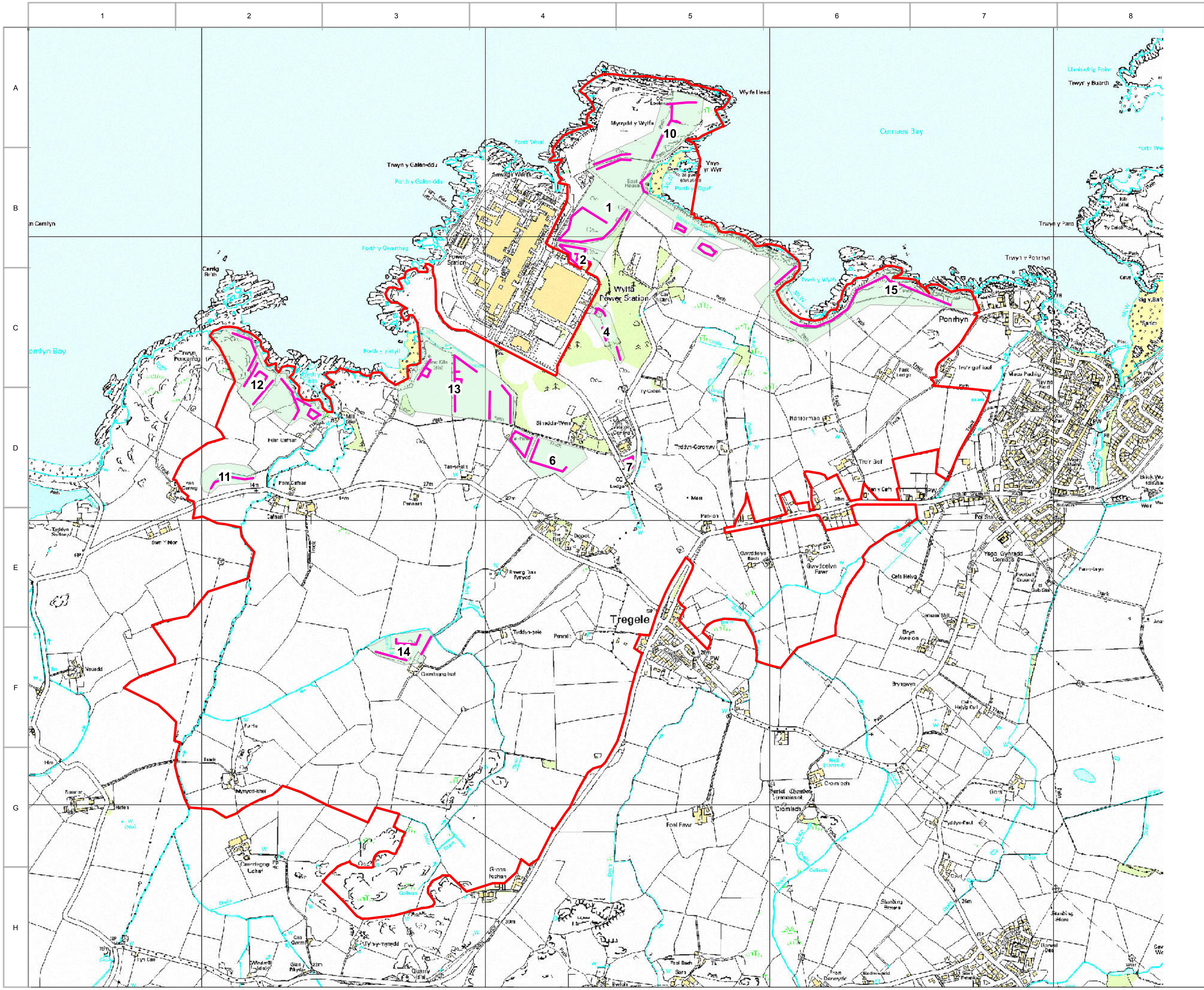
[5] Herptofauna Groups of Britain and Ireland (1998). Evaluating local mitigation/translocation programmes: Maintaining best practice and lawful standards. HGBI advisory notes for Amphibians and Reptile Groups.

Tables

Table 1 Weather Conditions During Surveys

Date	Start Time	Finish Time	Temperature	Cloud Cover
04.5.10	9.00	12.15	Variable between 10 °C & 14 °C	30% - sunny intervals
17.6.10	8.30	12.00	15°C	50%
05.7.10	9.00	12.00	Variable between 14 °C & 18 °C	40%
18.8.10	9.30	13.00	21°C	75% with sunny intervals
09.9.10	10.00	14.00	18°C	10%
19.5.11	10.30	15.45	Variable between 12 °C & 15 °C	20% with warm sunny intervals
9.6.11	11.00	15.00	Variable between 11°C & 16°C	25% with warm sunny intervals
7.7.11	10.00	13.00	17 °C	60%
4.8.11	13.00	17.00	19 °C	40%
2.9.11	10.15	14.30	15 °C	70% with sunny intervals
11.5.12	10.15	13.50	Variable between 12ºC & 14ºC	50% with sunny intervals.
12.6.12	11.15	14.45	25ºC	0%
26.7.12	10.00	13.00	Variable between 15ºC and 19ºC	10%
14.8.12			Variable between 17ºC & 14ºC	80% with sunny intervals
17.9.12	14.14	17.45	16ºC	70%

Drawings



Legend

- 2012 survey area
- Approximate locations of refugia
- Reptile survey sites 2012

PJWe	PW	30-01-13	PH	0
Drawn	Checked	Date	Approved	Rev

HORIZON
NUCLEAR POWER

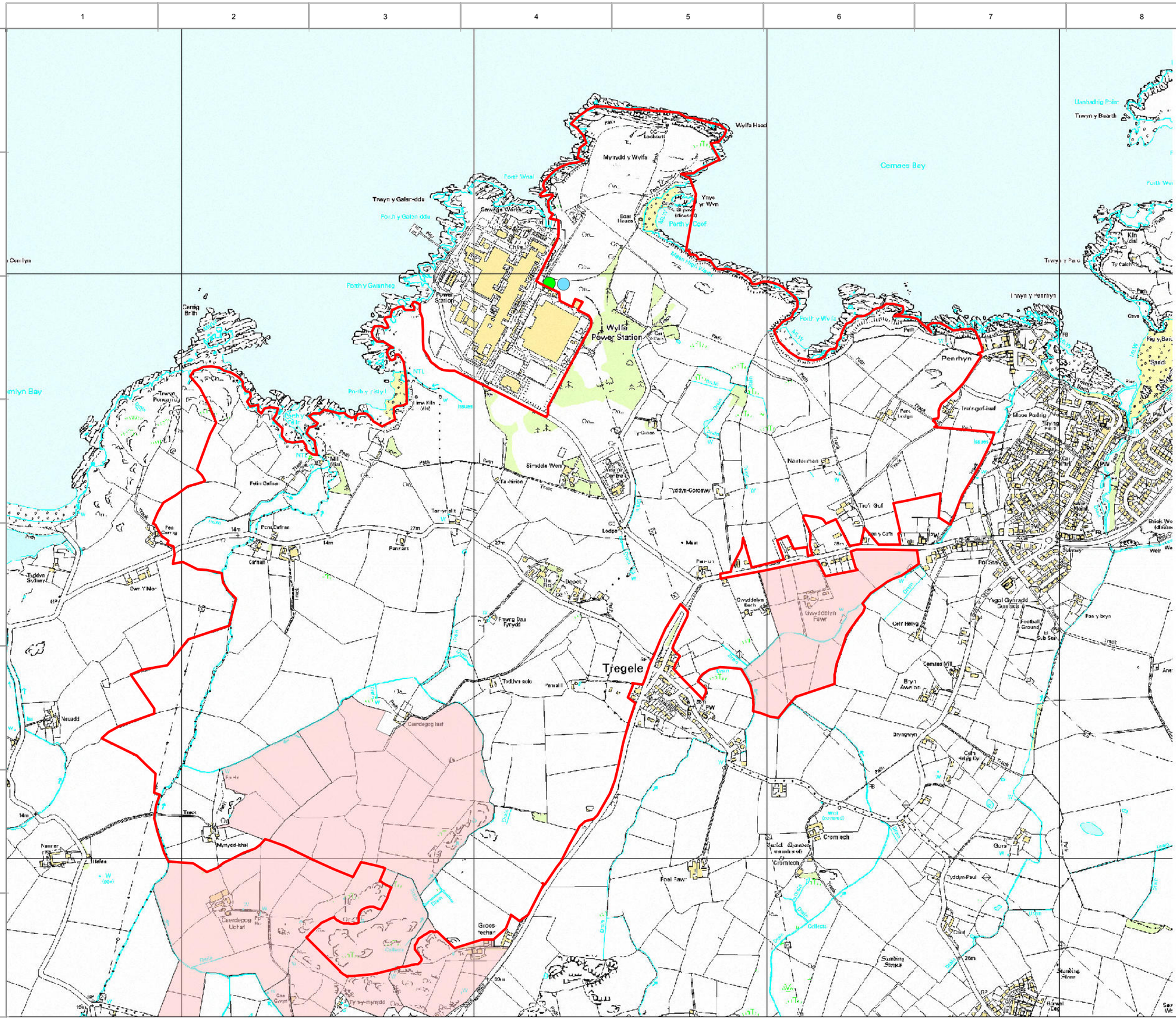
5210 Valiant Court
Gloucester Business Park
Delta Way
Gloucester GL3 4FE Tel:08453 006816

Size of original	Scale of original
A3	1:12,500

Site
Wylfa New Nuclear Power Station

Title
Reptile Survey Areas

Drawing number
210623-02/39/01



Legend

- 2012 survey area
- Adder
- Common lizard
- No access permission

PJWe	PW	30-01-13	PH	0
Drawn	Checked	Date	Approved	Rev

HORIZON NUCLEAR POWER

5210 Valiant Court
Gloucester Business Park
Delta Way
Gloucester GL3 4FE Tel:08453 006816

Size of original	Scale of original
A3	1:12,500

Site
Wylfa New Nuclear Power Station

Title
Reptile Survey Results

Drawing number
210623-02/39/02

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HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

Appendix 1-3 - Reptile Baseline Survey Report 2013

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00198

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Horizon Nuclear Power (Wylfa) Ltd

Consultancy Report: Reptiles Baseline Surveys 2013

January 2014

Chris Hall and Jonathan Jackson

Document Number: B1496000/WP6-2/R008
Horizon Ref: W202.01-S5-PAC-REP-00022
Document Date: January 2014
Version: 1

JACOBS

Document Control Sheet

BPP 04 F8
version 16 Oct 2013

Project:	Wylfa Power Station		
Client:	Horizon Nuclear Power (Wylfa) Ltd.	**Project Number:**	B1496000
Document Title:	Reptile Baseline Surveys Report 2013		
Ref. No:	B1496000/WP6-2/R008		

	Originated by	**Checked by**	**Reviewed by**
ORIGINAL	NAME **Chris Hall/Jonathan Jackson**	NAME **Adrian Hutchings**	NAME **Adrian Hutchings**
Approved by	NAME **Robert Bromley**	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**	INITIALS
DATE		**Document status**	

REVISION	NAME	NAME	NAME
Approved by	NAME	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**	INITIALS
DATE		**Document status**	

Executive Summary

Horizon Nuclear Power (Wylfa) Ltd (Horizon) is proposing to make an application for a Development Consent Order (DCO) to build a new nuclear power station on land identified in the draft National Policy Statement (NPS) EN-6 at Wylfa, Anglesey.

Jacobs UK Ltd (Jacobs) was commissioned to collect baseline data to inform the various applications, assessments and permits that will be submitted for approval to construct and operate the station.

Baseline surveys were carried out in 2013 by Cambrian Ecological Partnership (CEP) on Jacob's behalf with the aim of collecting data on the local reptile population within the survey area. The survey area comprised all land within the NPS site boundary where access was available.

Previous survey work carried out in 2008 (RSK, 2008) recorded the presence of adder (*Vipera berus*) on the site. A data search also showed that slow worm (*Anguis fragilis*), common lizard (*Lacerta vivipara*) and grass snake (*Natrix natrix*) have all previously been recorded on the island of Anglesey. Consultation with Countryside Council for Wales, (CCW) revealed that this latter species appears to be only present at very low density.

Surveys in 2010-2012 (summarised in Arup, 2012) also recorded adder and common lizard. These were found on the bank to the rear of the existing power station and on areas of the coast close to Wylfa Head.

The surveys carried out in 2013 revealed adders to still be present on the embankment behind the power station. Adders were also recorded adjacent to the Visitor Centre with one individual on a rocky outcrop on the Nature Trail to the west of the existing power station. Common lizards were recorded in two locations during the surveys. These were recorded on the embankment behind the power station and on the coastal zone near Felin Cafnan. A common lizard was also recorded as an incidental sighting near to the Tre'r Gof SSSI.

The results show that there are several small populations of adder and common lizard within the survey area which are fairly widespread. There may be other populations present within the survey area that were not detected due to the low density of animals present.

The widely spread and low density reptile populations are important due to the legal protection status afforded to individual animals, but also in the context of the metapopulations present. Small populations are much more vulnerable to stochastic extinction events making the reptile community within the survey area very fragile and potentially non-viable in the long term.

The recommendations of this report are to increase the scope of the reptile survey to include areas of suitable habitat within the 500 m buffer of the NPS site. This will provide information regarding the context of the populations of the NPS site within the local environment. It will also provide valuable information regarding the use of suitable habitat in the buffer zone as potential mitigation for reptile populations as a result of future development.

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Contents

1 Introduction

1.1 Overview

Horizon Nuclear Power (Wylfa) Ltd. (Horizon) is proposing to make an application for a Development Consent Order (DCO) to build a new nuclear power station on land identified in the draft National Policy Statement (NPS) EN-6 at Wylfa, Anglesey.

The development will consist of a power station incorporating nuclear reactors; construction stage areas and facilities, including a marine offloading facility (MOLF); infrastructure and ancillary facilities associated with the operation of a nuclear power station site, including cooling water infrastructure; electricity transmission infrastructure; interim waste storage facilities; access roads; and, landscape and biodiversity initiatives and mitigation measures.

Jacobs UK Ltd (Jacobs) was commissioned by Horizon to undertake a full ecological survey programme within the vicinity of the proposed nuclear power station development at Wylfa. This work has included the gathering of baseline data to inform the various applications, assessments and permits that will be submitted for approval to construct and operate the station.

This report details the results of reptile surveys undertaken in 2013 by Cambrian Ecological Partnership (CEP) on behalf of Jacobs.

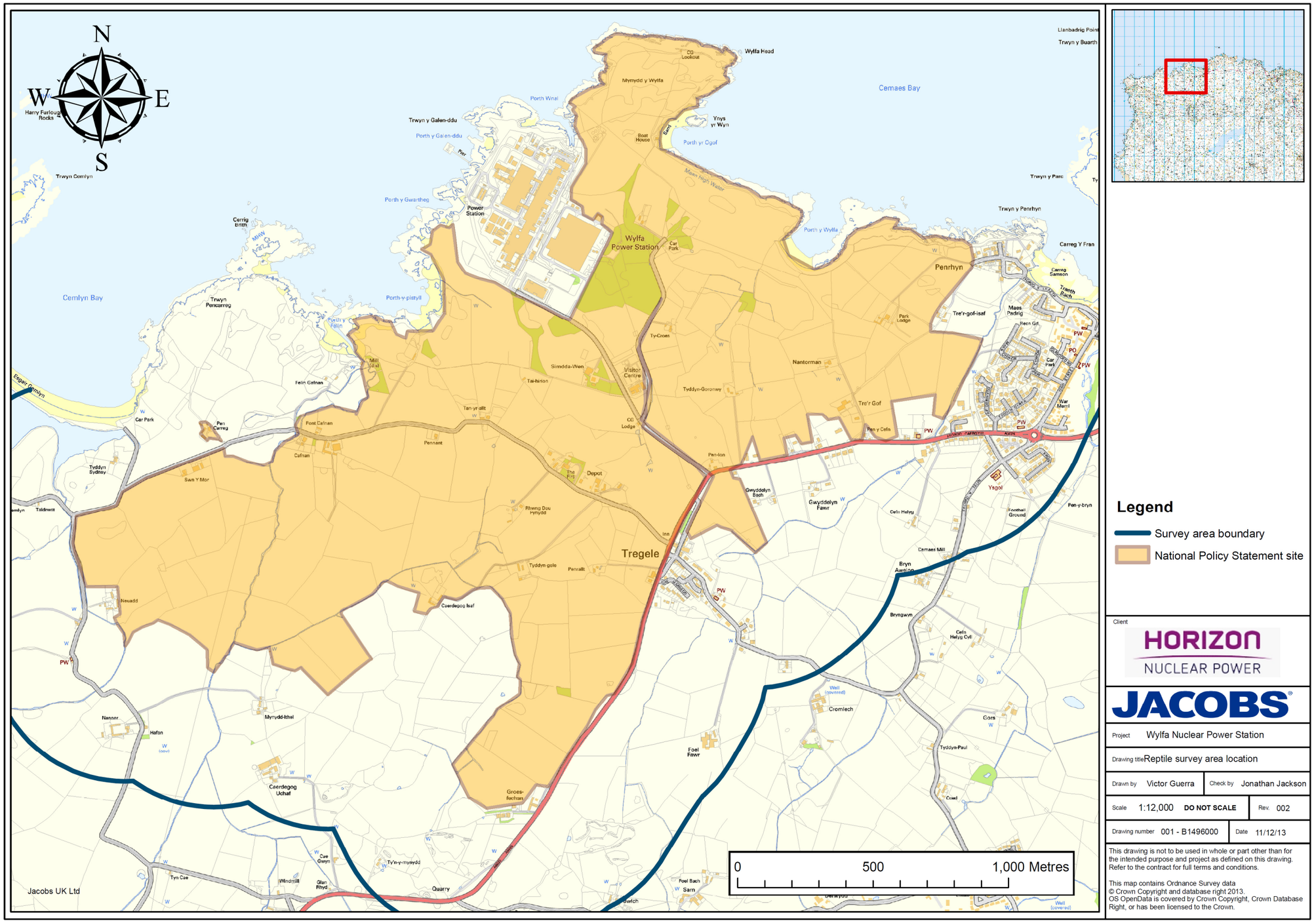
1.2 Site Description

The NPS site at Wylfa is located between the bays of Cemlyn and Cemaes on the northern tip of the Isle of Anglesey. The survey area comprised the NPS site and accessible areas of a 500 m buffer zone around the boundary of the NPS site. This is shown in Figure 1. The land proposed for the development covers an area of approximately 232 ha and largely comprises coastal grassland and agricultural land. The site includes the headland south of Mynydd-y-Wylfa local nature reserve and extends eastwards towards the western outskirts of the village of Cemaes, south to the A5025 and the village of Tregele and west to the Porth-y-pistyll inlet.

There is one designated site for nature conservation within the NPS site and one site adjacent; Tre'r Gof and Cae Gwyn Sites of Special Scientific Interest (SSSI) respectively. The development site is also within 1 km of Cemlyn Bay Special Area of Conservation (SAC) and the Ynys Feurig, the Skerries and Cemlyn Bay Special Protection Area (SPA) and SSSI.

Tre'r Gof is a small basin mire adjacent to the existing nuclear power station site, west of Cemaes. The area receives mineral-enriched waters from the surrounding boulder clay leading to the development of a diverse flora, and it is the botanical interest that provides the reason for the designation of the site as a SSSI.

Cae Gwyn is located in the south of the development site to the west of Llanfechell. The site comprises two wetland areas separated by an outcrop of rock with heathland vegetation. The southern wetland is confined by a rock basin and is dominated by bogmoss *Spagnum* spp. and a wide variety of common wetland herbs. The northern wetland has a different flora containing denser areas of willow *Salix* spp. and common reed *Phragmites commuis*.



Legend

- Survey area boundary
- National Policy Statement site

Client: HORIZON NUCLEAR POWER

JACOBS

Project	Wylfa Nuclear Power Station
Drawing title	Reptile survey area location
Drawn by: Victor Guerra	Check by: Jonathan Jackson
Scale: 1:12,000 DO NOT SCALE	Rev. 002
Drawing number: 001 - B1496000	Date: 11/12/13

Figure 1: Survey area comprising land within the NPS site boundary

1.3 Study Aims and Objectives

As part of the various applications and consents required for the power station and associated developments, a requirement for further temporal and spatial data relating to the presence of reptiles within the NPS site was identified.

The specific aims of the surveys were to;

- Determine the presence or likely absence of reptiles in the survey area;
- Evaluate the results in the context of previous reptile surveys that have been carried out in the survey area; and,
- Inform the need for further survey work.

1.4 Previous work

Previous surveys of reptiles were carried out in 2008 by RSK as part of the decommissioning works of the existing power station which recorded populations of adder in areas of suitable habitat (RSK, 2008).

In 2010 and 2012, Arup carried out additional reptile surveys within the NPS site boundary, including areas previously surveyed by RSK. These surveys found populations of common lizard in addition to previously recorded adder populations (Arup, 2012).

1.5 Legislation

All reptiles receive protection under the Wildlife and Countryside Act 1981 (as amended) and the Countryside and Rights of Way (CRoW) Act 2000 making it illegal to intentionally injure or kill these animals.

The adder also receives protection under 'Section 42' of the Natural Environment and Rural Communities Act in Wales (NERC). Under this legislation all 'Competent Authorities' have an obligation to give consideration to the species on this list in all of their activities, including planning issues.

2 Methodology

Areas of habitat with the potential to support reptiles were first identified using the Phase 1 habitat map taken from the Phase 1 Habitat Survey Report (Walsh, 2009) and then visited to confirm suitability. Surveys of these areas were then carried out using artificial refugia.

The survey methodology provides reptiles with artificial basking sites and cover called refugia. Reptiles are ectothermic meaning that they cannot control their body temperature internally and therefore need to gain heat from external sources in order to survive. Artificial refugia such as roofing felt tiles or metal sheets can be attractive to reptiles as they heat up more quickly than the surrounding environment, offering ideal conditions for reptiles to absorb heat.

The survey methodology used a range of materials to offer a variety of refugia for reptiles to utilise.

In 2013 a combination of three types of artificial refugia were used:

- 50 cm x 50 cm carpet tiles with black backing;
- 50 cm x 50 cm bitumen roofing felt tiles; and,
- 80 cm x 150 cm sheets of corrugated metal.

There were originally 17 areas identified as suitable habitat for reptiles within the survey area, as informed by the Phase 1 Habitat survey (Walsh, 2009). Full habitat descriptions are provided in Section 3, and the locations of the survey areas are provided in Figure 2, Figure 3 and Figure 4 (below). Areas 3, 5, 8 and 9 were excluded based on previous year's results and/or changes in habitat.

Artificial refugia were distributed at an approximate density of 5-10 per hectare following methodologies described within the 'Herpetofauna Workers Handbook' (JNCC, 2010).

10 survey visits were completed within each survey area in 2013. Four surveys were undertaken during May, one in June, one in July and a further four between August - September.

Where possible the surveys were carried out in optimal conditions, *i.e.* between 8 and 18°C, with minimal wind and little or no precipitation. Surveys were timed to coincide with the first sunny periods of the day to increase the chance of locating basking animals. During each survey, any animals seen basking on top of refugia were recorded and each tile was carefully lifted, recording any reptiles underneath. Non-target species such as amphibians utilising the refugia were also recorded during the surveys.

The surveys also included a visual search for any reptiles that may be active or basking in surrounding habitat.

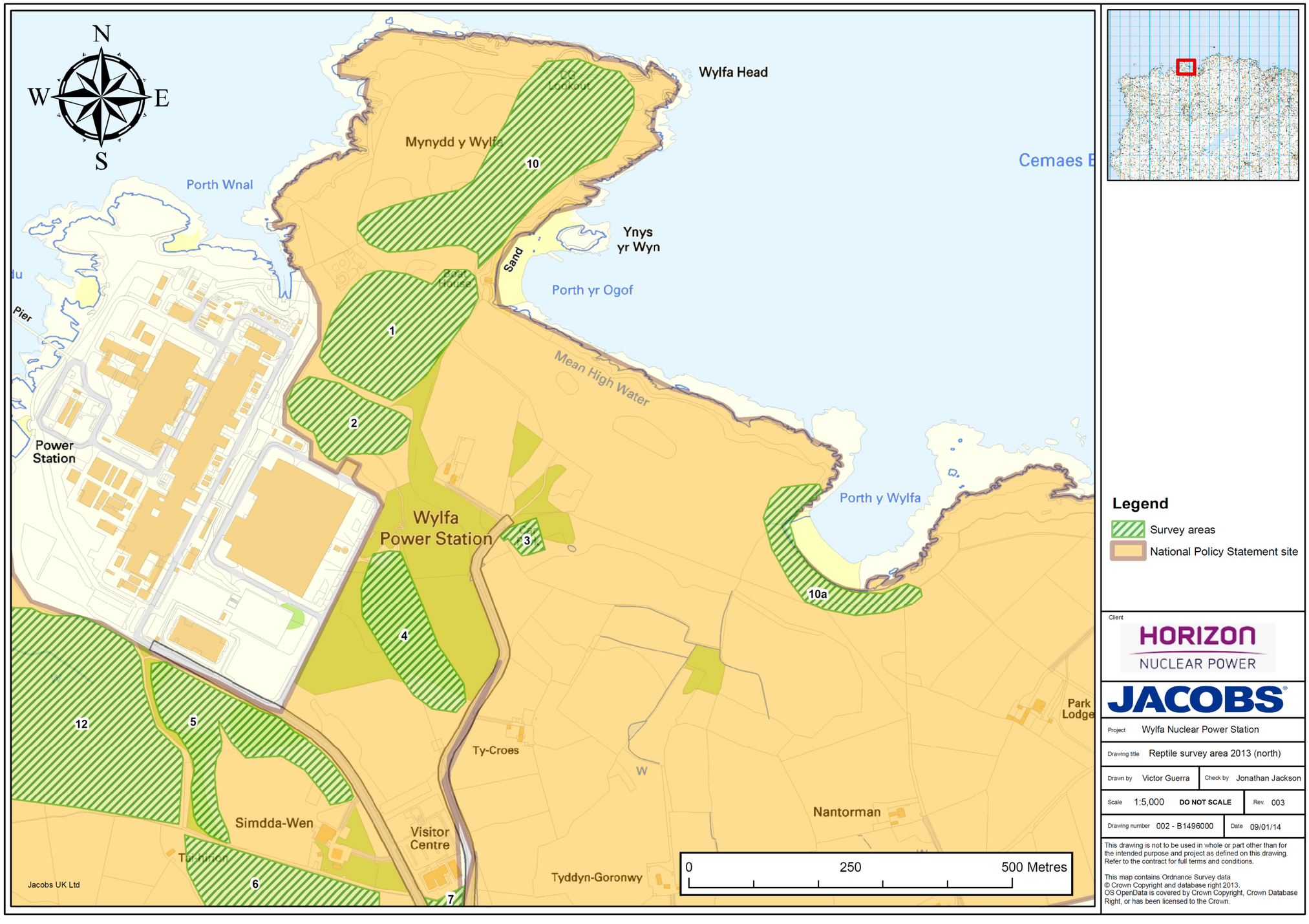


Figure 2: Reptile survey areas 1, 2, 3, 4, 5, 6, 7, 10 and 10a

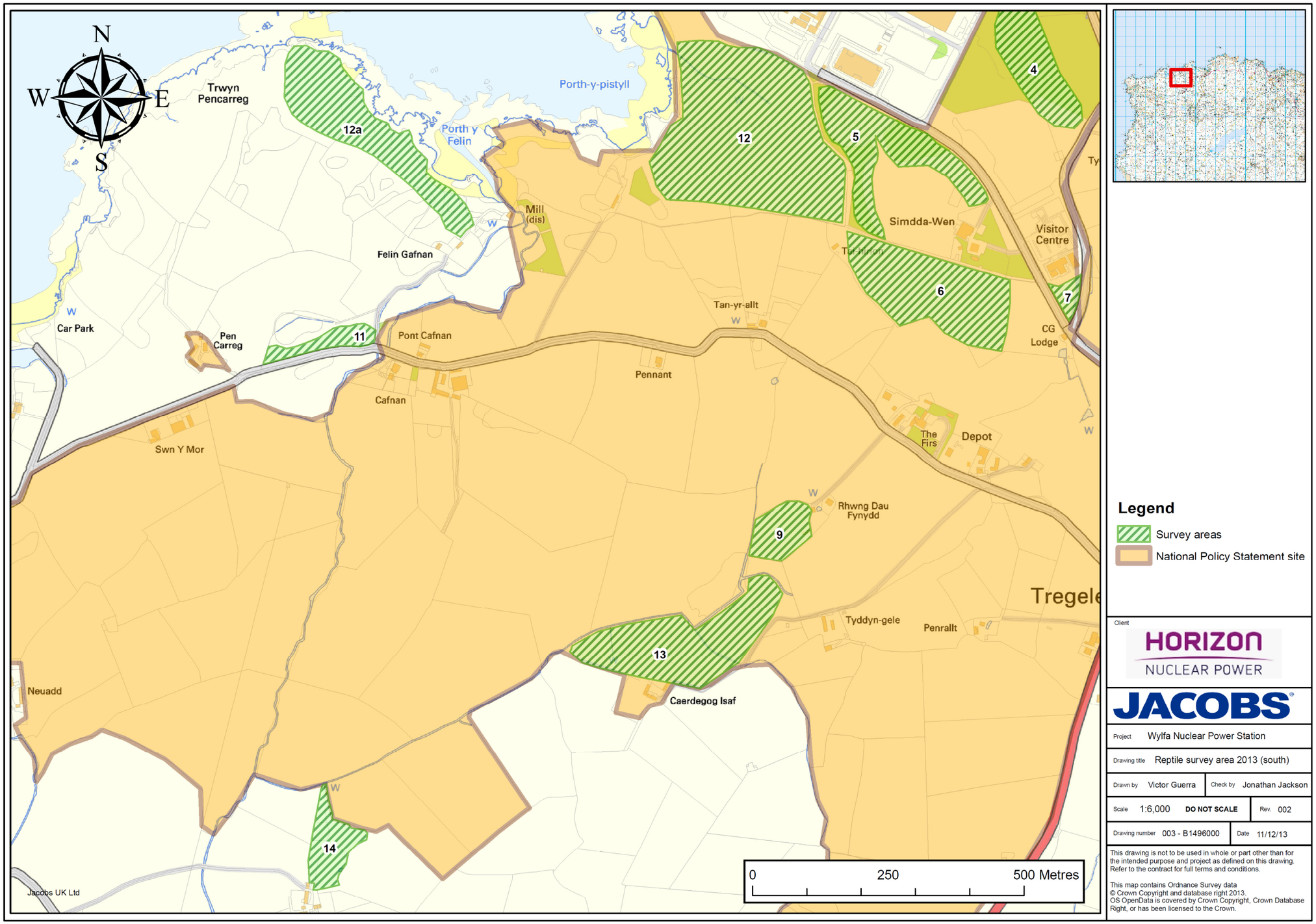


Figure 3: Reptile survey areas 6, 9, 11, 12, 12a, 13 and 14

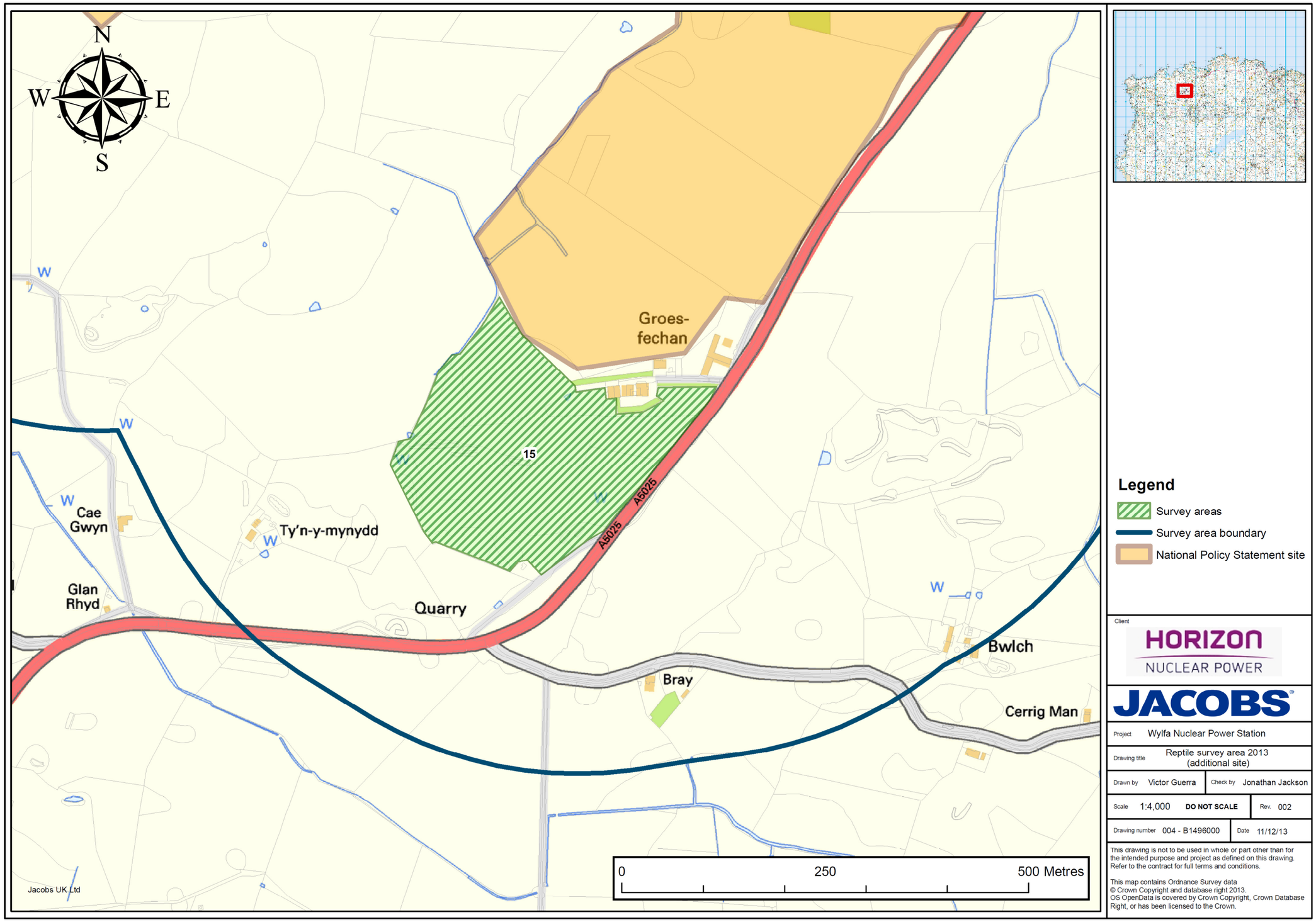


Figure 4: Reptile survey area 15

2.1 Survey limitations

During four of the surveys, the temperature was above 18ºC which is outside of the recommended guidelines. The guidelines for maximum temperatures are based on the properties of reptile physiology and in high enough air temperatures reptiles do not need to bask to heat up and are therefore less likely to be encountered using refugia. While reptiles would have been active in temperatures above 18°C they would not have utilised artificial refugia and would have been difficult to observe and record. There is therefore the potential for reptiles to have been under recorded during these four surveys.

3 Results

3.1 Habitat evaluation

3.1.1 Site 1

This area was relatively open giving plenty of opportunities for basking and there is cover in the form of dense gorse in some areas combined with bramble on the eastern boundary. The stone wall on the northern boundary offered a safe location for hibernation and opportunities for basking and it was in the vicinity of this wall that adders were recorded during previous surveys. However, although adders were recorded on this site during the decommissioning survey, the potential of this area to support a robust population is thought to have been reduced by heavy grazing of the improved grassland, which limited the potential presence of prey species such as small mammals.

3.1.2 Site 2

Site 2 was un-grazed, with good cover from bramble gorse and sea buckthorn and a south facing aspect and rocky areas providing ideal basking opportunities, making this area optimal reptile habitat.

3.1.3 Site 3

Site 3 was an area surrounding the car park near the Tre'r Gof SSSI. The area was small and heavily grazed, making it unsuitable reptile habitat which was therefore not surveyed.

3.1.4 Site 4

Site 4 represents optimal adder habitat and was made up of a combination of dense gorse with rocky outcrops and un-grazed open areas suitable for basking at the northern end of the site. Towards the southern end, the site was dominated by broadleaved plantation with a coniferous stand to the west. These southern habitats could be described as sub-optimal, although there was potential for adders and slow worms to be present on the woodland edges. The potential of this area to support reptiles will however progressively diminish as the trees increase in size, increasing the amount of shade and reducing basking opportunities.

3.1.5 Site 5

Site 5 had a very open aspect that would provide ample opportunities for basking. However, the suitability of this site to support reptiles was severely limited by the intensive management of the habitats which would be likely to result in fatalities from mowing machinery and impoverished prey biomass. This site was considered unsuitable for reptiles and was not surveyed.

3.1.6 Site 6

Site 6 comprised two distinct habitats. The predominantly wetland area, dominated by soft rush had the potential to support an amphibian population which would in turn provide prey for grass snakes. The drier field to the west was dominated by cocks-foot and had previously been identified as potential slow worm habitat. The

removal of grazing and all active management from this area however had resulted in a very dense growth of vegetation leaving very little opportunity for basking. This part of Site 6 was probably now largely unsuitable for reptile occupation with the exception of areas immediately adjacent to the access track where vegetation was less dense.

3.1.7 Site 7

Site 7 was an un-grazed, open location to the immediate south of the Visitor Centre in which adders were recorded during the decommissioning surveys (RSK, 2008). This area was actively managed with periodic strimming of the grass which could be an inhibiting factor with regards to constant adder occupation. Keeping the grass short will certainly reduce prey biomass and the use of machinery could also result in snake fatalities. This area was therefore considered sub-optimal reptile habitat.

3.1.8 Site 8

During previous survey planning, Site 8 was deemed to be suitable reptile habitat, being a patchwork of scrub and rough grassland. The habitat however has had no active management and has declined in suitability over time as habitat has become overgrown. The area is now considered unsuitable to support reptiles and was not surveyed.

3.1.9 Site 9

Site 9 in the field directly below Rhwng Dau Fynydd was originally considered potential slow worm and grass snake habitat being a combination of rough grass and wetland. However, the removal of all active management of the site throughout the summer months saw a rapid change in the habitat composition, with dense tussocks of cocks-foot developing in the drier areas of the field. The result of this growth is that basking opportunities are now very limited making the habitat unsuitable to support reptiles. This area was therefore not surveyed.

3.1.10 Site 10a

Although Site 10a had the potential to support reptiles, this was limited by the fragmented nature of the habitat. This site is bordered by sea and heavily grazed pasture.

3.1.11 Site 10, 12 & 12a

The potential of the habitats on Site 10, and Sites 12 & 12a to support a robust population of reptiles was limited by the introduction of a large number of cattle to Site 12 in August 2013, which resulted in heavy grazing and disturbance rendering the habitat generally unsuitable for reptile occupation. Refugia placed in this area were subject to trampling from cattle and were therefore removed.

3.1.12 Site 11

Site 11 was initially assessed as having the potential to support reptiles. However, a change in management regime to mowing and grazing reduced the quality of the habitat for reptiles, making the area unsuitable for survey. Refugia were placed in the area but were damaged by mowing in August 2013 and were not replaced.

3.1.13 Site 13

Site 13 has limited potential to support reptiles, again due to heavy grazing by a combination of sheep and alpacas.

3.1.14 Site 14

Site 14 has limited potential to support reptiles due to heavy grazing by horses.

3.1.15 Site 15

This additional land adjacent to the Cae Gwyn SSSI was judged to offer excellent basking opportunities on rocky outcrops, along with good cover from gorse patches and scrub. The nearby SSSI also offers excellent amphibian, invertebrate and small mammal prey.

3.2 Refugia surveys

The results from the surveys are shown in Table 1. The survey weather conditions are shown in Appendix A. The results are presented using the following key (for example Vb 1JF = one juvenile female adder):

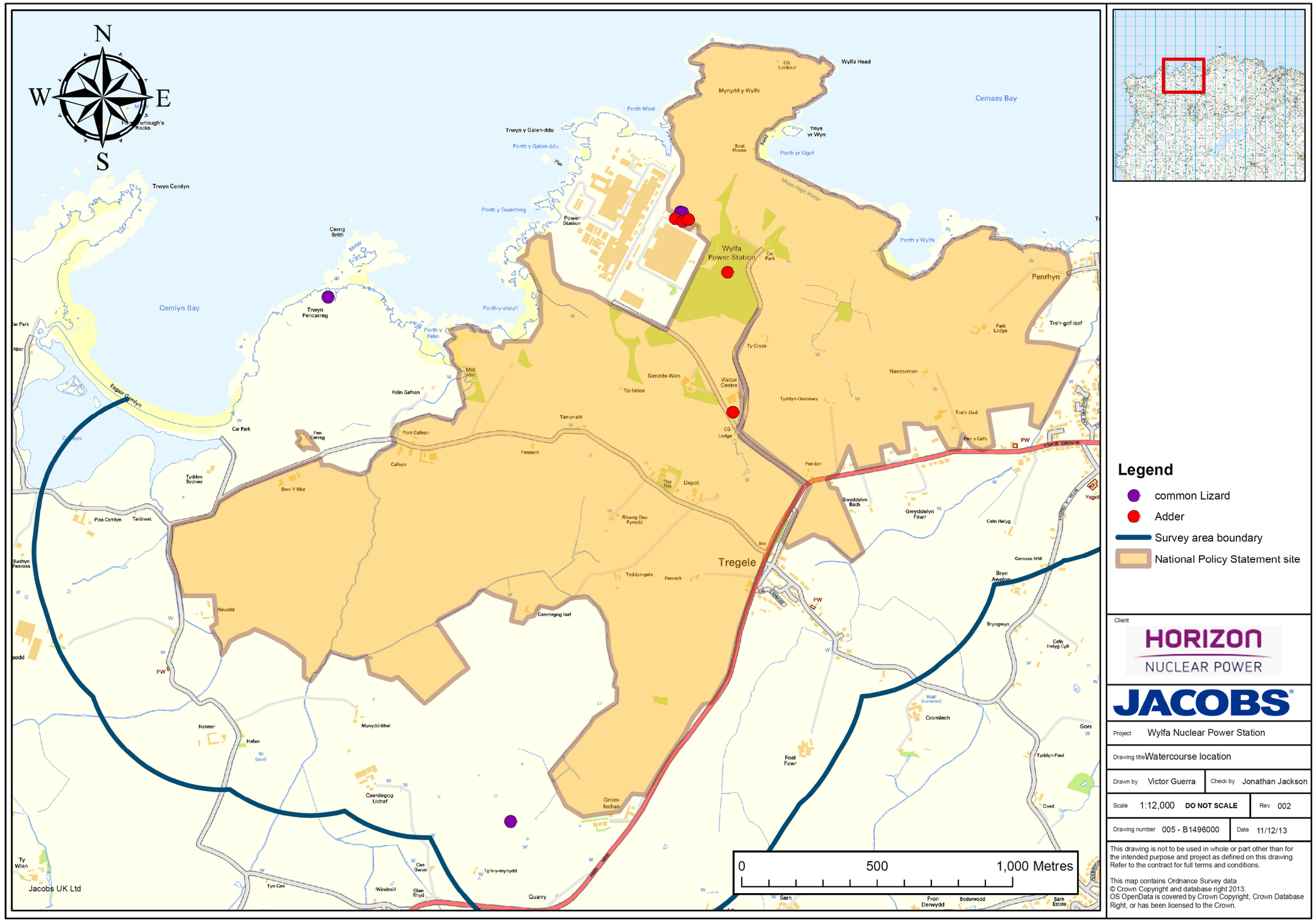
Vb - Adder *Vipera berus*
Lv - Common lizard *Lacerta vivipara*
A - Adult
J - Juvenile
F - Female
M - Male
O - No reptiles recorded
N/A - Not surveyed
- – Refugia destroyed and not replaced

Grid references for all reptiles recorded are provided in Table 3, Appendix A.

Table 1: Table of results

Site No.	Habitat description	1 02/05	2 07/05	3 13/05	4 29/05	5 17/06	6 01/07	7 20/08	8 29/08	9 05/09	10 18/09
1	An area of grazed grassland dotted with stands of gorse; (*Ulex europaeus*) and fringed on the southern and eastern boundaries with dense bramble; (*Rubus fruticosus*).	0	0	0	0	0	0	0	0	0	0
2	An embankment to the rear of the existing power station dominated by cocksfoot; (*Dactylis glomerata*) and dotted with gorse and bramble. There was also a dense stand of sea buckthorn; (*Hippophae rhamnoides*) at the eastern end of this area. This area was un-grazed.	Vb 1JF Lv 1AF	Vb 3AF 2AM Lv 1	Vb 1JF	Vb 2JF 2AF	Vb 1JM	0	Vb 2AF	Vb 1JF	Vb 1AF 1JF	Vb 1JF
4	Nature reserve where the refugia have been located in more open, sunny areas between the gorse and on the south facing woodland edge.	0	0	0	0	0	0	Vb 1JF	0	0	0
6	Comprised predominantly a wetland area dominated by soft rush; (*Juncus effusus*) and the drier field in the vicinity of the barn, Tal Hirion, which was dominated by cocks foot. There was a dense hedge of gorse, bramble and hawthorn; (*Crataegus monogyna*) surrounding Site 6. There has been no grazing on this site since the commencement of the surveys which has resulted in the habitats becoming increasing more densely vegetated.	0	0	0	0	0	0	0	0	0	0

Site No.	Habitat description	1 02/05	2 07/05	3 13/05	4 29/05	5 17/06	6 01/07	7 20/08	8 29/08	9 05/09	10 18/09
7	An open location to the immediate south of the Visitor Centre. Although the vegetation was predominantly cocks foot, this area was under active management which controls the length and density of the vegetation.	0	Vb 2AF	Vb 2AF	Vb 2JF	Vb 1AF 1JF	0	Vb 1AF	Vb 1AF	0	0
10 &10a	A combination of grazed grassland and coastal heath with areas of dense bracken and gorse. This habitat extended in a narrow strip along the coast in an easterly direction.	0	0	0	0	0	0	0	0	0	0
11	A small wetland area located within a field of heavily managed, improved grassland.	0	0	0	0	0	0	-	-	-	-
12	A mosaic of gorse scrub and heavily grazed coastal grassland.	0	0	0	0	0	0	-	-	-	-
12a	A mosaic of gorse scrub and heavily grazed coastal grassland.	Lv 1	Lv 1	Lv 1	0	0	0	0	0	0	0
13	Primarily an extension of Site 9 and extended into an area of gorse scrub and grazed pasture with a small wetland area behind Caerdegog Isaf. In this case the grazing was previously by horses but more recently a few sheep and alpaca had been present.	0	0	0	0	0	0	0	0	0	0
14	A patchwork of grazed agricultural land and gorse scrub at Mynydd Ithel.	0	0	0	0	0	0	0	0	0	0
15	An additional area adjacent to the Cae Gwyn SSSI surveyed on a single occasion. The land included some unimproved and semi-improved areas, with occasional gorse scrub and rocky areas	0	0	0	0	Lv 1	0	0	0	0	0



Legend

- common Lizard
- Adder
- Survey area boundary
- National Policy Statement site

Client: HORIZON NUCLEAR POWER

JACOBS

Project	Wylfa Nuclear Power Station
Drawing title	Watercourse location
Drawn by: Victor Guerra	Check by: Jonathan Jackson
Scale: 1:12,000 DO NOT SCALE	Rev. 002
Drawing number: 005 - B1496000	Date: 11/12/13

This drawing is not to be used in whole or part other than for the intended purpose and project as defined on this drawing. Refer to the contract for full terms and conditions.

Figure 5: Reptile records location map

3.3 Summary of results

The surveys showed that there are 13 areas of habitat that have the potential to support commoner reptiles (adder, common lizard, grass snake and slow worm). Populations of adder and common lizard were found in five of the 13 areas. These comprised:

- Three low populations of common lizard; and,
- Three low populations of adder.

No grass snake or slow worm were found during any of the surveys.

4 Discussion

The results of the 2008 decommissioning surveys, combined with the surveys undertaken by CEP since 2010, indicate that that grass snakes are absent from the site. Consultation with the Countryside Council for Wales (now Natural Resources Wales) strongly suggests that although grass snakes are present on Anglesey, their population density is very low (Pers. Comm. with Dr Liz Howe NRW). This is further substantiated by the lack of any records of grass snake or slow worm provided by the North Wales Environmental Information Service in a data search of biological records within 2.5 km of the centre of the site (COFNOD, 2013).

It is also possible that slow worms are absent due to past management regimes where most areas were either grazed or actively managed. What appeared to be potential slow worm habitat during the planning of the surveys could have been due to the transitional stage of the vegetation which has now developed further into habitats too dense for animals to efficiently bask to raise body temperatures to an active level. The fact that no slow worms have been recorded during these surveys adds weight to the suggestion that this species is absent

Adders, originally thought to be the only reptiles present, appear to have a restricted range and also a limited population. The results from 2013 do however give cause for optimism with this species found in areas where it had not been recorded since 2008.

Common lizard was only recorded on one occasion (Arup, 2012) prior to the 2013 surveys where an individual was recorded three times in May at two locations with further incidental records in August near the Tre'r Gof SSSI; this suggests that the species could be fairly widespread but present at a very low density.

The adder and common lizard data suggest that where they are found they exist at very low population densities. Small populations can be hard to record using refugia surveys as reptiles may be very widely spaced. This results in refuges being put down that reptiles may never find as they are outside of their normal ranges. This could results in false negatives and reptiles not being recorded despite being present but in very low numbers. The effects of surveying for small populations can be minimised by using an increased density of refugia per hectare. This is discussed further in Section 5.

5 Conclusions and Recommendations

The habitat assessment found that four sites suitable for reptiles in previous year's surveys were reassessed as being unsuitable for reptiles. This highlights the dynamic nature of the survey area, and although no suitable areas were added to previous year's assessment, the likelihood is that some areas may become suitable for reptiles and will become populated if there is connectivity to existing populations nearby. Any future reptile surveys of the site should therefore make new habitat assessments to determine where reptile surveys need to be carried out.

The results show that there are low populations of adder and common lizard within the survey area. These were found in five areas only, representing 38% of the 13 total number of suitable sites within the survey area. However, as discussed above it is likely that there are other areas with reptiles present that were not recorded to the low numbers of animals present. Any future reptile surveys within the survey area should also have an increased density of refugia as this may help to minimise the impacts of surveying for low density populations in general.

It is considered likely that grass snake and slow worm are absent from the survey area, as supported by the survey results and brief background data search.

The reptile populations on the island of Anglesey as a whole are unknown. It is therefore difficult to contextualise these results. However, the populations are low and scattered rendering them more susceptible to extinction. Populations that are present are therefore not only important due to the legislative protection that each animal has, but also as constituent parts within what appears to be an isolated and fragile local community.

6 References

Arup, (2012), *Reptile Survey Report 2012*, unpublished report to Horizon Nuclear Power Wylfa Ltd

COFNOD, (2013), unpublished data search of all biological records within 2.5 km of the centre of the NPS site provided to Jacobs, December 2013

Gent, T. & Gibson, S., (2003), *Herpetofauna Workers manual*, JNCC

RSK Carter Ecological Ltd, (2008), *Wylfa Power Station Part Two, Section 12: Ecology & Baseline Survey Results*

Walsh, J., (2009), *Phase 1 & Protected Species Survey*, Report on Behalf of ARUP

Appendix A Survey weather conditions

Table 2: Survey weather conditions

Date	Temperature °C	Notes
02/05/13	16	0% No wind
07/05/13	19	10%.Light breeze
13/05/13	18	80%. Light breeze
29/05/13	17	0% cloud and light breeze
17/06/13	20.1	20% and light breeze
01/07/13	20	10% cloud, warm and light breeze
10/07/13	23.9	0% cloud and light breeze
20/08/13	22.9	10% cloud and light breeze
29/08/113	17.9	20% cloud and light breeze
05/09/13	14.9	100% cloud, moderate breeze
18/09/13	16.2	50% cloud, moderate breeze

Table 3: Grid references for reptile records

Date	Results	Site No	Grid Reference
2nd May	♀ Adder (Juvenile) ♀ Common lizard Common lizard	Site 2 Site 2 Site 12a	SH 35327 93923 SH 35295 93928 SH 33997 93636
7th May	♀ Adder x 3 ♂ Adder x 2 Common lizard ♀ Adder x 2	Site 2 Site 2 Site 2 Site 7	SH 35327 93923 SH 35327 93923 SH 35295 93928 SH 35492 93208
13th May	♀ Adder (Juvenile) ♀ Adder x 2 Common lizard	Site 2 Site 7 Site 12a	SH 35327 93923 SH 35492 93208 SH 33997 93636
29th May	♀ Adder (Juvenile) ♀ Adder x 2 ♀ Adder x2 (Juvenile)	Site 2 Site 2 Site 7	SH 35280 93926 SH 35327 93923 SH 35492 93208
17th June	♂ Adder (Juvenile) ♀ Adder x2 (1xJuvenile)	Site 2 Site 7	SH 35327 93923 SH 35492 93208
1st July	Common lizard	Site 15	SH 34671 91692
10th July	♀ Adder x 2	Site 2	SH 35327 93923
20th August	♀ Adder x 2 ♀ Adder ♂ Adder (Juvenile)	Site 2 Site 7 Site 4	SH 35327 93923 SH 35492 93208 SH 35472 93728
29th August	♀ Adder (Juvenile) ♀ Adder	Site 2 Site 7	SH 35327 93923 SH 35492 93208
5th September	♀ Adder (Juvenile) ♀ Adder	Site 2 Site 2	SH 35307 93916 SH 35327 93923
18th September	♂ Adder (Juvenile)	Site 2	SH 35327 93923

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HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

Appendix 1-3 Horizon's Response to Request for Additional Information - Reptile Monitoring Approach

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00207

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Contents

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1 Issue Specific Hearing - Biodiversity

1.1 Request for additional information

1.1.1 During the Issue Specific Hearing on biodiversity, held on Friday 11 January, IACC addressed an issue it had raised in its Local Impact Report (LIR) Chapter 17: Wylfa Newydd Development Area [REP2-077] relating to reptiles. In paragraph 5.2.18 of the LIR, IACC states it would require a programme of monitoring of the reptile population during construction and the establishment and ongoing management of the provisions of the Landscape and Habitat Management Strategy (LHMS).

1.1.2 The LHMS has been updated by Horizon and submitted into Examination at Deadline 5 (12 February 2019). The provisions of this document (section 7.2) include that:

- monitoring is undertaken of species translocations [including reptile translocation], to assess the efficacy of the mitigation provided;
- management schemes will seek to ensure the reptile receptor site and notable wildlife enhancement site, the latter being available as contingency site for the reptile receptor site, provide suitable habitats for reptiles which have been displaced / translocated until new habitats have been created on the landform surrounding the Power Station Site; and,
- management schemes will seek to ensure that the landscape and habitats are regularly monitored to assess efficacy of management and inform management reviews.

1.1.3 Monitoring of the presence of reptiles within the reptile receptor site would be undertaken on an annual basis throughout the period of its lease by Horizon (until 2032). This would follow published good practice guidance such as Sewell et al. (2013)[1].

1.1.4 The LHMS design principles include the creation and, where possible, retention and enhancement of the following habitats which will provide suitable reptile foraging and refuge areas:

- coarse-sward / species-rich grassland;
- marshy/wet grassland and fen;
- coastal heath/grassland mosaic;
- field boundaries, including hedges and cloddiau; and,
- woodland and scrub edge habitat.

[1] Sewell, D., Griffiths, R. A., Beebee, T. J. C., Foster, J., and Wilkinson, J.W. 2013. *Survey protocols for the British herpetofauna.* Version 1.0.

1.1.5 Figure 6-22 of the LHMS illustrates how the provision of these habitats would create strong links to the Reptile Receptor Site, Notable Wildlife Enhancement Site, and reptile hotspots at Trwyn Pencarreg and Wylfa Head.

1.1.6 The LHMS commits to monitoring the creation of these habitats through new planting throughout its establishment period, quarterly for a five year period after implementation, followed by annual inspections for a second five year period. This would ensure the planting successfully establishes and achieves its intended mitigation function. Should any failure in habitat establishment be identified, replacement planting would be provided during the first available planting season.

1.1.7 To determine the progress of reptile species in recolonising the Wylfa Newydd Development Area as the habitats described above become established, presence/absence surveys would be undertaken on an annual basis along the key corridors (field boundary habitats; tree and scrub edges) linking reptile hotspots into the wider site. These surveys would follow published good practice guidance such as Sewell et al. (2013), and would occur for both the five year planting establishment period, and the following five year inspection period.

1.1.8 Longer term monitoring of habitats and species will be set out in the Landscape and Habitat Management Schemes which will be prepared in accordance with the principles described in the LHMS and agreed with IACC in accordance with WN11 in the Draft Development Consent Order [REP2-020].

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Appendix 1-4 Section 7 Habitat Information

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00228

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1 Section 7 Habitat Information

1.1 Introduction

1.1.1 Isle of Anglesey County Council (IACC), as part of its Local Impact Report on the Wylfa Newydd Development Area, make the following statement regarding priority habitats as listed in accordance with Section 7 of the Environment (Wales) Act 2016:

1.1.2 Paragraph 5.4.4: Horizon's conclusion regarding effects on habitats is summarised in Para. 9.5.136 of ES Volume D – WNDA Development D9 as being: "…medium in the medium-term. As the habitat permanently lost under the footprint of permanent infrastructure mainly comprises low quality grassland, and the provisions of the Habitat Management Strategy would mitigate habitat losses in the long-term through the creation of habitats of higher biodiversity value, the medium magnitude of change is not expected to affect the integrity of terrestrial habitats. As such, a minor adverse effect due to habitat loss, fragmentation or modification is predicted". Whilst IACC would agree that much of the site is low ecological value agricultural land, the baseline habitat data are not presented in a manner that allows this assessment to be easily tested. In particular, the areas of each [Section 7] habitat that will be permanently or temporarily lost are not stated, and nor is the timescale over which any effects will be offset by the [Landscape and Habitat Management Strategy (LHMS)]. This information was requested at a meeting on [17 October 2018] but has not yet been forthcoming. IACC believes that the applicant needs to clearly identify the [Section 7] habitats present at the site; the amounts permanently lost and temporarily lost; the net gain predicted as a result of the LHMS; and the timescales over which these gains will be realised. This should cross-reference the NVC survey as far as possible to specifically identify the rarer and higher value [Section 7] habitats, and commitments for replacing these. This will allow the assessments in the EcIA to be tested now and through long-term monitoring of the LHMS delivery.

1.1.3 The objective of this memo is to provide information to address the issues raised by IACC.

1.1.4 The information in table 1 below provides area / length figures for habitat loss as a result of the Wylfa Newydd Development, classified under the Phase 1 Habitat classification system and their equivalent Section 7 priority habitat type. Table 2 is taken from the Landscape and Habitat Management Strategy, a revised version of which was submitted into Examination at Deadline 5 (12 February 2019), showing the broad habitat types which will be created under its provisions, and the equivalent Section 7 priority habitat types. Where possible, National Vegetation Classification (NVC) categories have been provided as indicative objectives for the broad habitat type.

Table 1-1 Habitat loss within the Wylfa Newydd Development Area

Phase 1 Habitat	Equivalent Section 7 priority habitat	Area / length lost
Broadleaved parkland	Wood pasture and parkland	0.20ha
Broadleaved plantation	Lowland mixed deciduous woodland	1.58ha
Mixed plantation woodland	Lowland mixed deciduous woodland	1.02ha
Coastal/Maritime Grassland	Coastal and floodplain grazing marsh	0.29ha
Inland mine	Lowland fen	0.16ha
Mire Fen	Lowland fen	0.29ha
Marsh/marshy grassland	Purple moorgrass and rush pasture	4.01ha
Natural rock exposure	Inland rock outcrop	0.57ha
Semi-improved neutral grassland	Lowland meadows	21.87ha
Standing water	Ponds	0.07ha
Defunct Species-poor Hedge Intact Species-poor Hedge Species-poor Hedge with tree	Hedgerow	11.3km

Table 1-2 Habitat loss within the Wylfa Newydd Development Area

Proposed habitat type	Equivalent Section 7 priority habitat	NVC community	Area (ha) or Length (km) created
Woodland and scrub	Lowland mixed deciduous woodland Wet woodland	Not specified	25ha
Coarse sward / species-rich grassland	Lowland meadows	Primarily MG5	120ha
Close sward species-rich grassland	Lowland meadows	MC8, MC9 and MC10 NVC communities	25ha
Coastal heath/grassland mosaic	Lowland heathland	Primarily a mosaic of H8 and U4	15ha
Marshy grassland	Lowland fens Purple moorgrass and rush pastures Reedbeds	Primarily M23	15ha
Ponds (additional to sediment ponds)	Ponds	Not specified	9 no.
Planted hedgerows and cloddiau	Hedgerows	Not specified	10km

1.1.5 In terms of timescales for the loss and creation of habitats described above, clearance of above ground structures followed by vegetation and topsoil strip, form part of the site preparation and clearance of the Wylfa Newydd DCO Project and would be one of the first activities undertaken as part of construction. The timing of this, together with the creation of habitats described in Table 2 above, as part of the LHMS provision, is outlined in chapter A2 of the Environmental Statement [APP-056], and the Phasing Strategy document [REP4-014].

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Appendix 1-5 Causeway Removal and Pollution Prevention

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00200

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1 Technical clarification regarding causeway removal and pollution prevention

1.1 Background

1.1.1 This technical note contains Horizon Nuclear Power Wylfa Limited's ("Horizon's") response to actions set by the Examining Authority during the Issue Specific Hearing on 10 January 2019.

1.1.2 The Examining Authority requested clarification on the removal of the temporary causeway and associated pollution prevention. (Horizon has also addressed the possibility of environmental incidents during construction period where the causeway shall be in continuous use).

1.1.3 This technical note sets out Horizon's position on this matter.

1.2 Technical response

Causeway removal

1.2.1 The temporary causeway will be removed after completion of the construction of the MOLF and western breakwater and following removal of the outer cofferdam area.

1.2.2 The majority of the temporary causeway cross section which will comprise rock fill will be removed by a 360-degree mechanical excavator working off the temporary causeway structure. As the removal excavation progresses and as it gets to a level immediately above the 200-300mm protective layer of geotextile/sand/gravel/type 6F material placed above the shoreline surface the excavation technique shall change. This will utilise a suction excavation technique, lorry mounted that is capable of removing the material sizes used in the construction of the temporary causeway protective layer. This type of equipment is commonly used in excavations around sensitive services/operational pipework/structures to eliminate any risk of damage caused by mechanical excavation techniques.

1.2.3 Material will be removed to shore and managed in line with the Horizon's waste management hierarchy and associated procedures as secured in Section 9 of the Wylfa Newydd DCO Project Code of Construction Practice (CoCP) [REP2-031] and Section 9 of the Marine Works sub-CoCP [REP2-033]. All geogrid or terram sheeting will be recovered during excavation and either recycled or disposed of in accordance with Horizon's waste management procedures.

1.2.4 This technique is expected to leave the substrate free from loose material and habitat restoration will then begin.

Pollution prevention

1.2.5 The Wylfa Newydd DCO Project CoCP [REP2-031] sets out Horizon's overarching approach to protecting water resources from pollution. In summary Horizon will:

- comply with relevant legislation (including, but not limited to, the Water Resources Act 1991, the Environmental Permitting Regulations 2016 and the Land Drainage Act 1991 (as amended)).
- will implement working methods to protect watercourses and marine environment from pollution using appropriate control measures and resources to manage the risk of spills and accidents.
- will take measures to prevent the deposition of silt or other material arising from work operations. The measures will accord with the principles set out in industry guidelines, including Guidance for Pollution Prevention: *Works and maintenance in or near or water: GPP 5* [RD1]. In addition, relevant guidance including the following PPGs and GPPs will be followed, including:
  - PPG1: Understanding Your Environmental Responsibilities – Good Environmental Practices [RD2];
  - GPP 2: Above ground oil storage tanks [RD3]
  - PPG6: Working at construction and demolition sites [RD4];
  - GPP 13: Vehicle washing and cleaning [RD5];
  - GPP 20: Dewatering underground ducts and chambers [RD6];
  - GPP 21: Pollution Incident Response Plans [RD7]; and
  - PPG 26: Safe storage – Drums and intermediate bulk containers [RD8].

1.2.6 Horizon's management of construction activities will be updated by the Environment Agency's GPPs, as they are made available.

2 References

Table 1-1 Schedule of references

ID	Reference
RD1	Northern Ireland Environment Agency, Scottish Environment Protection Agency and Natural Resources Wales. 2017. *Guidance for Pollution Prevention: Works and maintenance in or near water: GPP 5*. Cardiff. Natural Resources Wales.
RD2	Environment Agency, Scottish Environment Protection Agency and Northern Ireland Environment Agency. 2013. *PPG1: Understanding Your Environmental Responsibilities – Good Environmental Practices*. Bristol: Environment Agency.
RD3	Northern Ireland Environment Agency, Scottish Environment Protection Agency and Natural Resources Wales. 2018. *GPP 2: Above ground oil storage tanks*. Cardiff: Natural Resources Wales.
RD4	Environment Agency, Scottish Environment Protection Agency and Northern Ireland Environment Agency. 2012. *Working at construction and demolition sites: PPG 6*. 2nd Edition. Bristol: Environment Agency.
RD5	Northern Ireland Environment Agency, Scottish Environment Protection Agency and Natural Resources Wales. 2017. *GPP 13: Vehicle washing and cleaning.* Cardiff: Natural Resources Wales.
RD6	Northern Ireland Environment Agency, Scottish Environment Protection Agency and Natural Resources Wales. 2018. *GPP 20: Dewatering of underground ducts and chambers*. Cardiff: Natural Resources Wales.
RD7	Northern Ireland Environment Agency, Scottish Environment Protection Agency and Natural Resources Wales. 2017. *GPP 21: Pollution Incident Response Plans*. Cardiff: Natural Resources Wales.
RD8	Environment Agency, Scottish Environment Protection Agency and Northern Ireland Environment Agency. 2011. *Safe storage – Drums and intermediate bulk containers: PPG 26*. Bristol: Environment Agency.

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HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

Appendix 1-6 UKCP18 Climate Change Projection and the Wylfa Newydd Project

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00201

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1 Introduction

1.1 Purpose of this report

1.1.1 This report provides a response to a request for further information by the Examining Authority at Issue Specific Hearing 5 on Biodiversity (Coastal Change, Climate Change, Transboundary Impacts) on 11th January 2019.

1.1.2 In light of the recently published UK Climate Projections 2018 (UKCP18, 26th November 2018) and guidance in Section 4.8.6 of the Overarching National Policy Statement (NPS) on Energy (EN-1), the Examining Authority required to know how these latest climate change projections would affect the Wylfa Newydd DCO Project.

1.2 Scope of this report

1.2.1 This report presents a qualitative assessment of the climate projections and how they relate to the Wylfa Newydd DCO Project and the assessments presented within the DCO application.

1.2.2 The assessments and modelling presented in the DCO application utilised the UKCP09 climate projections, as these were the only climate projections that were available at the time that the DCO application was submitted. Use of UKCP09 kept all modelling of the effects of potential climate change consistent.

1.2.3 This report will present the information that is currently available from the UKCP18 climate projections and will present this, where possible, alongside that used within the DCO application assessments to show how they compare. Finally, as no UKCP18 climate projections have been taken forward to be remodelled, partly because the data available from UKCP18 output does not yet include a full data set (for example it doesn't include sea surface temperature, which is required to confirm/calculate the surface heat flux coefficients used in the wave model), a qualitative assessment of the effects of the latest climate projections is made.

2 UK Climate Projections 2018

2.1 Background to UKCP18

2.1.1 UK Climate Projections is a climate analysis tool designed to enable government departments, regulators and business understand the potential impacts of updated climate change projections and to ensure that policy, guidance and resilience planning is appropriately tailored.

2.1.2 UKCP18 uses the latest climate science to provide updated climate change projections out to 2100 in the UK, providing probabilistic projections over land at various scales alongside updated sea-level rise and storm surge projections for the marine environment.

2.1.3 UKCP18 uses new emissions scenarios relative to those previously available from UKCP09. These emissions scenarios, called Representative Concentration Pathways (RCPs) are the emission scenarios used in the Intergovernmental Panel on Climate Change's latest 5th assessment report.

2.1.4 RCPs specify the concentrations of greenhouse gases that would result in target amounts of radiative forcing at the top of the atmosphere by 2100, relative to pre-industrial levels, and four forcing levels have been used: 2.6, 4.5, 6.0 and 8.5 watts per square meter (W/m^2), to create the four scenarios considered by UKCP18; RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5.

2.1.5 Further information is available in UKCP18 Guidance: UKCP18 for UKCP09 users, which is presented in Appendix A, however, an illustration of the temperature changes associated with each of these scenarios is summarised in Table 2-1, below.

Table 2-1 Increases in global mean surface temperatures (˚C) by 2081-2100

RCP	Increase in global mean surface temperatures (˚C) by 2081-2100 Best estimate (5 to 95% range)
RCP2.6	1.6 (0.9 to 2.3)
RCP4.5	2.4 (1.7 to 3.2)
RCP6.0	2.8 (2.0 to 3.7)
RCP8.5	4.3 (3.2 to 5.4)

2.1.6 Further information is available from the UK Climate Projections website (https://www.metoffice.gov.uk/research/collaboration/ukcp), though one important item to note in the context of this report is that the UKCP09 H++ scenario, has not been updated as it is still considered a useful, plausible but unlikely high-end sea-level pathway for decision making.

2.1.7 It should also be noted that there will continue to be updates provided via the UKCP18 website as more information is produced and published. This will include further updates for higher sea-level rise scenarios, along with further information on high impact events such as localised heavy rainfall in summer.

2.2 Data availability

2.2.1 Data is available from either the UKCP18 User Interface or via a CEDA Catalogue. The data currently available can be summarised as:

Marine Projections

- Mean sea level projections, RCP2.6, RCP4.5 and RCP 8.5, 2007 to 2100
- Exploratory sea level projections, RCP2.6, RCP4.5 and RCP 8.5, 2007 to 2300
- Storm surge trends, RCP8.5, 2007 to 2100

Land Projections

- Probabilistic projections at 25km, RCP2.6, RCP4.5, RCP6.0 and RCP 8.5, 1961 to 2100
- Regional projections at 12km, RCP8.5, 1981 to 2080
- Variables include:
  - Cloud cover
  - Precipitation
  - Radiation (total downward short wave flux)
  - Radiation (net long wave)
  - Relative humidity
  - Sea level pressure
  - Specific humidity
  - Temperature (maximum, mean, minimum)
  - Wind speed (Regional projections of wind speed, eastwards windspeed and northward windspeed)
- Timesteps include:
  - Probabilistic projections: Monthly, Seasonal, Annual, 20/30-year, means
  - Regional projections: Daily, Monthly, Seasonal, Annual, 20/30-year, means

2.3 UKCP18 Summaries

2.3.1 The following presents a summary of the key results of the UKCP18 climate projections, based on available factsheets and data analysis.

Precipitation

2.3.2 Observations have indicated a slight increase in UK winter precipitation in recent decades. The projections show a clear shift to higher probability levels of dry summers and they suggest the likelihood of wet summers reduces only slightly. There is a larger increase in winter precipitation over southern and

central England and some coastal region, particularly in in the north and Scotland.

2.3.3 In Anglesey, winter rainfall changes are as indicated below (scenario, mean (10% to 90%) for 2080 to 2099:

- RCP8.5, 10% (0% to 30%)
- RCP6.0, 10% (-10% to 30%)
- RCP4.5, 10% (-10% to 20%)
- RCP2.6, 0% (-10% to 10%)

2.3.4 In Anglesey, summer rainfall changes are as indicated below (scenario, mean (10% to 90%) for 2080 to 2099:

- RCP8.5, -40% (-70% to -10%)
- RCP6.0, -30% (-50% to -10%)
- RCP4.5, -30% (-50% to 0%)
- RCP2.6, -20% (-40% to 0%)

2.3.5 No information is currently available on high-impact rainfall events.

Sea Level Rise and Storm Surge

2.3.6 Sea levels have risen through the 21st century and will continue to do so. UKCP18 presents new sea level projections that follow IPCC 5th assessment approach for contributions from thermal expansion, glaciers and small ice caps, land storage and some of the ice-sheet contributions. They are consistently larger than those presented under the UKCP09 projections. Based on exploratory results to 2300, sea levels are predicted to continue to increase beyond 2100, even with large reductions in greenhouse gases. There was no evidence for significant changes in future storm surges.

2.3.7 A range of sea level changes for Holyhead, the nearest UK tidal gauge, are indicated below. The data presented is for 2100 and is relative to 1981 to 2000 averages (scenario, mean (5% to 95%):

- RCP8.5, 0.624m (0.388m to 0.973m)
- RCP4.5, 0.406m (0.237m to 0.673m)
- RCP2.6, 0.309m (0.163m to 0.550m)

2.3.8 Predicted return periods for still water levels at Holyhead in 2090 is presented in Figure 2-1 and in 2190 in Figure 2-2, below, for each of the above scenarios.

Figure 2-1 Projected mean still water return levels (m AOD) at Holyhead in 2090, with 5th and 95th percentile

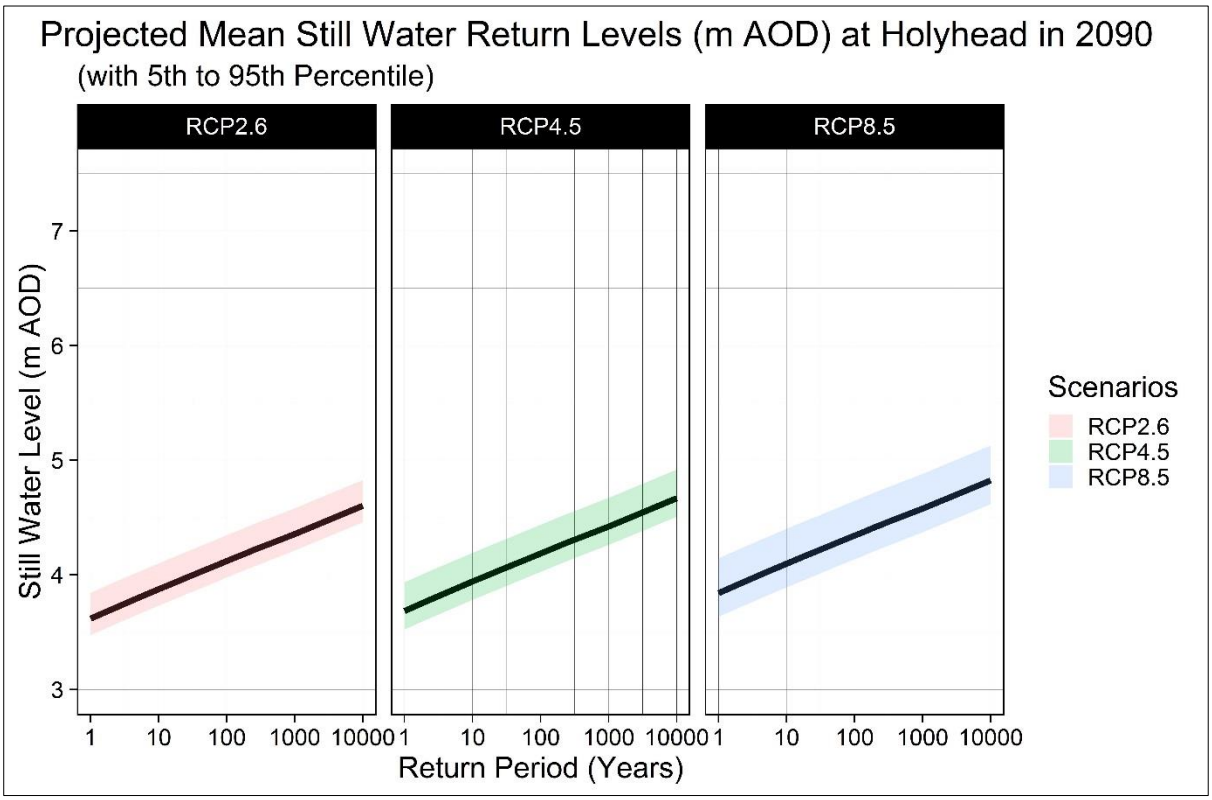
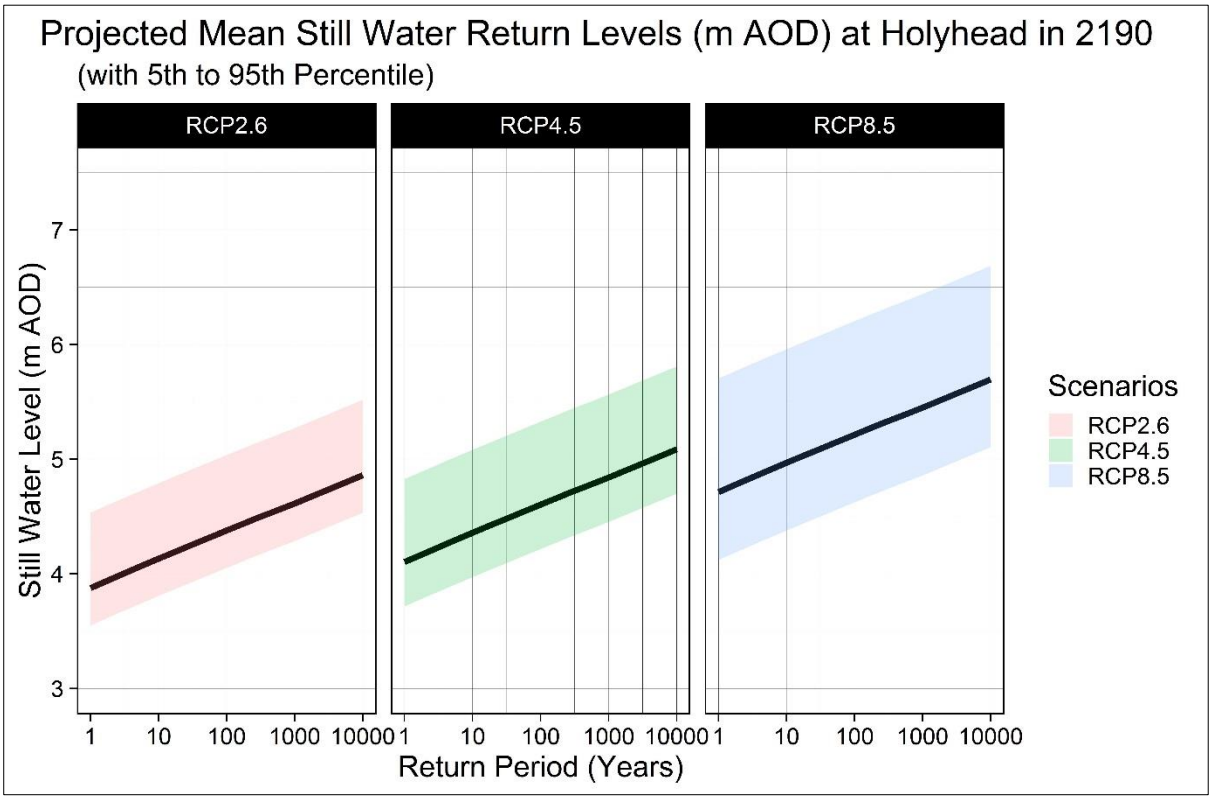


Figure 2-2 Projected mean still water return levels (m AOD) at Holyhead in 2190, with 5th and 95th percentile



2.3.9 It is worth noting that the UKCP18 factsheet on sea level rise and storm surge indicated that substantial additional sea level rise associated primarily with dynamic ice discharge from the West Antarctic Ice Sheet could not be ruled out. As indicated above, the estimate for low probability, high impact range for sea level rise around the UK to 2100 (H++ scenario from UKCP09) is still a reasonably plausible high-end scenario based on current interpretation of the evidence.

Temperature

2.3.10 There has been an overall annual warming in the UK in recent decades. The projected trends for UKCP18 are similar over land to those predicted by UKCP09 with a move towards warmer, wetter winters and hotter, drier summers.

2.3.11 In Anglesey, mean winter temperature changes are as indicated below (mean (10% to 90%) for 2080 to 2099:

- RCP8.5, 3˚ (1˚ to 5˚)
- RCP6.0, 2˚ (0˚ to 3˚)
- RCP4.5, 1˚ (0˚ to 3˚)
- RCP2.6, 1˚ (-1˚ to 2˚)

2.3.12 In Anglesey, mean summer temperature changes are as indicated below (mean (10% to 90%) for 2080 to 2099:

- RCP8.5, 4˚ (2˚ to 6˚)
- RCP6.0, 3˚ (1˚ to 5˚)
- RCP4.5, 2˚ (0˚ to 4˚)
- RCP2.6, 1˚ (0˚ to 3˚)

Wind

2.3.13 There have been no compelling trends in storminess (defined by maximum gust speeds) in the UK over the last four decades. Global projections suggest that there may be an increase in near surface wind speeds over the UK in the second half of the 21st century during winter, which is linked to an increase in the frequency of winter storms.

3 Climate change in the DCO application

3.1 Climate change considerations in the DCO application

3.1.1 It is a requirement of the Overarching National Policy Statement (NPS) for Energy (EN-1) that applicants must consider the impacts of climate change when planning the location, design, build, operation and, where appropriate, decommissioning of new energy infrastructure (Section 4.8.5).

3.1.2 The design of the Power Station has considered climate change up to 2183, which is the functional end of life. The design must be resilient from the outset, as a Nuclear Site Licence will not be granted without confirmation that the design can withstand highly conservative predictions of the effects of climate change. Indeed, it is a requirement of EN-1 that the applicant demonstrate the following:

- That there are not features of the design of new energy infrastructure critical to its operation which may be seriously affected by more radical changes to the climate beyond that projected in the latest set of UK climate projections, taking account of the latest credible scientific evidence on, for example, sea level rise (for example by referring to additional maximum credible scenarios – i.e. from the Intergovernmental Panel on Climate Change or EA) and that necessary action can be taken to ensure the operation of the infrastructure over its estimated lifetime;
- Where energy infrastructure has safety critical elements … the applicant should apply the high emissions scenario (high impact, low likelihood) to those elements. Although the likelihood of this scenario is thought to be low, it is appropriate to take a more risk-averse approach with elements of infrastructure which are critical to the safety of its operation.
- If any adaptation measures give rise to consequential impacts (for example on flooding, water resources or coastal change) the IPC (now the Examining Authority) should consider the impact of the latter in relation to the application as a whole and the impacts guidance set out in Part 5 of EN-1.

3.1.3 With respect to the DCO application as submitted, climate change has been considered in the following documents using the information from UKCP09, which was available at the time of the preparation of the DCO application.

3.1.4 The Sustainability Statement [APP-426] accompanying the application for development consent outlines the design measures that have been incorporated with regards to climate change adaptation.

3.1.5 The following elements of the design are examples of where climate change has been considered:

- Cooling water system (including breakwater (if used) design);
  - Rise in sea temperature;

  - Sea level rise (including tide and surge effects);
  - Change in flora and fauna;
- Site drainage;
  - Increase in precipitation (including hail);
- Building design;
  - Increase in precipitation – including snow loading;
  - Changes in wind speed; and
  - Increase in lightning.

3.1.6 For relevant ES chapters the potential effects of the Wylfa Newydd DCO Project on the environment have been assessed in the context of a changing climate. Where appropriate, topic chapters provide a description of the evolution of the baseline and the predicted effects of climate change. This allowed the potential effects of the Wylfa Newydd DCO Project to be considered in combination with the effects of climate change.

3.1.7 Climate change allowances are included in the Flood Consequences Assessments for all sites [Wylfa Newydd Development Area APP-150, Off-Site Power Station Facilities APP-254, Park and Ride APP-281, A5025 Off-line Highways Improvements APP-323 and Logistics Centre APP-370] via increased rainfall intensity for drainage design and attenuation, via increased flood flows for fluvial flood risk where modelling has been undertaken, and via sea level rise where there has been a tidal flood risk. Where modelling was undertaken, reasonably foreseeable and credible maximum scenarios were considered.

3.1.8 The wave modelling appendix, D12-3 [APP-218] considers the reasonably foreseeable future (2087) baseline scenario, which reflects precautionary values for climate change conditions of sea level rise and increases in storm events recommended within UKCP09 and Welsh government guidance

3.1.9 UKCP09 projections have been used in the marine modelling. Modelling outputs show a ‘reasonably foreseeable’ future sea level rise from 2008 to 2023, to 2087 and to 2187 with no additional allowance for surge. However, it is recognised that there is continuing uncertainty with respect to sea level rise.

4 Comparisons between UKCP18 and UKCP09

4.1.1 Direct comparisons cannot be made between the following climate change parameters:

- Projections of rainfall intensity during short-duration rainfall events – The pluvial flood risk modelling and drainage design undertaken to inform the FCA requires this information to inform rainfall profiles, however, this is not yet available via UKCP18. UKCP09 information indicates that rainfall intensity is likely to increase, and these values remain the best available at the present time.
- Changes in river flows are not yet defined by UKCP18 – Predictions of monthly, seasonal and annual precipitation is available; however, this has not yet been converted into river flow changes through rainfall-runoff modelling. UKCP09 information indicates that rainfall intensity is likely to increase, and these values remain the best available at the present time. The Environment Agency has undertaken a quick assessment of the impacts of UKCP18 in England on river flows, which indicate that high flows become higher and low flows become lower. UKCP18 peak flows are slightly higher than UKCP09 peak flows. The same might be expected in Wales and Anglesey on the basis of the changes in precipitation noted in Section 2.3.3 and 2.3.4.
- Wave height information is not currently available via UKCP18 and therefore cannot be directly compared with that assessed in the DCO application as submitted. Wind, which is a factor in the development of waves, is predicted to increase over land during the latter half of the 21st century and as such it can be assumed that this may be linked to an increase in wave height in the same period.
- Sea temperature information is not yet available via UKCP18. Sea surface temperature is an element that influences the cooling water system design and the wave modelling.

4.1.2 Indirect comparisons can be made between sea level projections used in the assessment and UKCP18 projections of sea level rise, bearing in mind that the emissions scenarios considered have changed between UKCP09 and UKCP18.

4.1.3 Sea level rise projections used in the Wylfa Newydd Development Area FCA [APP-150] (presented in Table D8-4-6) cover a range of sea level projections that were derived for the Wylfa Newydd Main Site Wave Modelling Report [APP-218] by hazard assessments. The projections presented in the FCA include Present Day (2023), reasonably foreseeable projects for 2087 and 2187 and credible maximum projections for the same dates.

4.1.4 Section 3.1 of the Wave Modelling Report indicates that the reasonably foreseeable scenarios used were originally based on the 95% projections for the medium emissions scenario of UKCP09, however, this was updated to

reflect more recent (2016) guidance from Welsh Government with slightly higher projections of sea level rise[1].

4.1.5 The credible maximum allowance used was based on the H++ approach of UKCP09, which, as noted above, has not been updated as it is still considered a useful, plausible but unlikely high-end sea-level pathway for decision making.

4.1.6 Reasonably foreseeable future sea level increases from 2008 to 2023, to 2087 and to 2187 of 0.05m, 0.67m and 2.12m, respectively were considered.

4.1.7 Section 2.3.7 of this report indicates that the 95th percentile UKCP18 sea level increases for Holyhead at 2100 relative to 1981 to 2000 averages for the RCP4.5 scenario is 0.673m. This is marginally higher than the UKCP09 medium emissions scenario and the 0.67m proposed by the Welsh Government for this epoch. Such a subtle change is not considered to alter the conclusion of the assessments presented in the DCO application.

4.1.8 No information is currently available for 2190 for comparison with the 2187 prediction used in the DCO application.

4.1.9 At present and based on the information that is available from UKCP18, Horizon's assessment is that there will be no notable changes in the assessments presented in the DCO application and therefore no requirement for further resilience measures or adaptation. This position is consistent with the Met Office's view that "*results in the latest set of climate projections are broadly consistent with UKCP09*" and that "*UKCP18 sea level rise is projected to be higher than in UKCP09, but this increase has already been factored into current adaptation planning.*"[2].

[1] Welsh Government (2016). Flood consequence assessments: Climate change allowances.

[2] https://www.metoffice.gov.uk/binaries/content/assets/mohippo/pdf/ukcp18/ukcp18-headline-findings.pdf

5 Conclusions

5.1.1 The latest UK Climate Projections were published in November 2018 and included the latest information on a number of climate variables. Of the information made available by UKCP18, most can only be compared qualitatively, as there are elements missing that make it impossible to relate back to the assessments undertaken to support the DCO application. The conclusions of that qualitative assessment are that:

- Rainfall intensity is likely to increase, however UKCP09 values remain the best available at the present time;
- Peak river flows are slightly higher than UKCP09 peak flows, based on Environment Agency assessments in England. The same might be expected in Wales and Anglesey on the basis of the changes in precipitation noted in Section 2.3.3 and 2.3.4. Until detailed predictions are available, UKCP09 values remain the best available at the present time; and
- Wave height information is not available, however, based on predicted slight increases in wind speed in the second half of the 21st century, wave heights are expected to increase, albeit the degree to which there is an increase cannot yet be quantified.

5.1.2 Reasonably foreseeable sea level rise projections can be indirectly compared to those presented in the earlier UKCP09 climate projections that were used in the assessments that support the DCO application. Up to 2090 these are not dissimilar to those used to support the DCO application and as a result, the overall conclusions of the DCO application, where it demonstrates resilience to these reasonable foreseeable scenarios, remain appropriate in demonstrating that the Wylfa Newydd DCO Project meets the requirements of EN-1 and specifically Sections 4.8.5, 4.8.6, 4.8.8 and 4.8.11. No information is available within the UKCP18 data on timeframes up to 2190.

5.1.3 In addition to the above, UKCP18 information indicates that H++ scenarios, which were used in wave modelling and subsequently tidal elements of the flood consequences assessments, as well as for fluvial and pluvial flood risk modelling of credible maximum scenarios, remain suitable as high-end and plausible but unlikely scenario. As a result, the overall conclusions of the DCO application, where it demonstrates resilience to the H++ scenario, remain appropriate in demonstrating that the Wylfa Newydd DCO Project meets the requirements of EN-1 and specifically Sections 4.8.5, 4.8.6, 4.8.8 and 4.8.11.

5.1.4 Overall, Horizon considers that the information available from UKCP18 at present does not sufficiently differ from UKCP09 projections used within the study, to indicate that further resilience or adaptation mitigation is required. This is consistent with the Met Office's view that "*results in the latest set of climate projections are broadly consistent with UKCP09*" and that "*UKCP18 sea level rise is projected to be higher than in UKCP09, but this increase has already been factored into current adaptation planning.*"[2].

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WYLFA NEWYDD

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Appendix A - UKCP18 Guidance: UKCP18 for UKCP09 users

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00227

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UKCP18 Guidance: UKCP18 for UKCP09 users

This document is for those who are familiar with the products available for UKCP09. It summarises the main similarities and differences in the UKCP09 and UKCP18 products. If you require information on the differences in the results, please refer to the Science Overview Report, Land Projections Science Report and Marine Projections Science Report available from the UKCP18 website.

The document explains:

1 What is happening to the UKCP09 website, User Interface and User Interface

The current UKCP09 site will be available from the launch of UKCP18 until the end of December 2018 from: http://ukclimateprojections-ukcp09.metoffice.gov.uk. At the end of December 2018, the current service providing UKCP09 will close. The UKCP09 website will then be available in an archived format only and the underlying UKCP09 data available from the Centre for Environmental Data Analysis (CEDA) catalogue. After December 2018, there will be no further updates to material on the UKCP09 website and no further access to the UKCP09 helpdesk or User Interface. If you have previously run jobs in the UKCP09 User

Interface, please make sure you save them to an offline location before the end of December.
In their place will be the UKCP18 web pages (https://ukclimateprojections.metoffice.gov.uk), UKCP18 User Interface (https://ukclimateprojections-ui.metoffice.gov.uk) and Helpdesk (see UKCP18 web pages).

2 Which emissions scenarios are used in UKCP18

UKCP18 uses new emissions scenarios, called Representative Concentration Pathways (RCPs). RCPs are the emissions scenarios used in the Intergovernmental Panel on Climate Change's latest 5th assessment report. UKCP09 used the SRES (Special Report on Emissions Scenarios) emissions scenarios which were reported on in the IPCC's 4th assessment report. RCPs specify the concentrations of greenhouse gases that would result in target amounts of radiative forcing at the top of the atmosphere by 2100, relative to pre-industrial levels. Four forcing levels have been set: 2.6, 4.5, 6.0 and 8.5 W/m2. These create four RCPs that are used in UKCP18; RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5.
The global mean temperature increase associated with each RCP is shown in Table 1.

RCP	Increase in global mean surface temperature (°C) by 2081-2100	Most similar SRES scenario (in terms of temperature)
RCP2.6	1.6 (0.9-2.3)	None
RCP4.5	2.4 (1.7-3.2)	SRES B1 (low emissions scenario in UKCP09)
RCP6.0	2.8 (2.0-3.7)	SRES B2 (between the low and medium emission scenarios in UKCP09)
RCP8.5	4.3 (3.2-5.4)	SRES A1F1 (high emissions scenario in UKCP09)

Table **1**: The increase in global mean surface temperature averaged over 2081-2100 compared to the pre-industrial period (average between 1850-1900) for the RCPs (best estimate, 5-95% range) and the most similar SRES scenario in terms of global mean temperature. Based on Table 12.3 of IPCC (2013).

The UKCP18 probabilistic projections include SRES A1B so that you can directly compare them with the UKCP09 probabilistic projections. For further information on RCPs, please see UKCP18 Guidance on Representative Concentration Pathways and the box in the Science Overview Report.

3 Which data products have been updated and which are new

A summary of the products that were available in UKCP09 is compared to similar UKCP18 products in Table 1. Products that are new in UKCP18 are written in bold.

Product	UKCP09	UKCP18
Observations	5km 25km in rotated pole grid* to match probabilistic projections Administrative regions and river basins	5km 25km in Ordnance Survey's British National Grid+ to match probabilistic projections **Countries**, administrative regions and river basins 12km and 60km in in Ordnance Survey's British National Grid+ to match global and regional projections
	Daily, monthly, long-term averages No daily precipitation	Daily, monthly, long-term averages **Daily precipitation**
Probabilistic projections	25km in rotated pole grid* Administrative regions and river basins	25km in Ordnance Survey's British National Grid+ **Countries**, administrative regions and river basins
	Monthly, seasonal, annual	Same
	30-year averages	30-year averages and **monthly time series**
	SRESB2 (low) SRESA1B (medium) SRESA1FI (high)	SRESA1B RCP2.6, RCP4.5, RCP6.0, RCP8.5
	10,000 samples	**3,000** samples
Spatially-coherent climate model data	25km in rotated pole grid* Daily time series	**60km global projections (daily+)** 12km regional projections over Europe (daily+) **2.2km regional projections over UK (sub-daily+)**
Spatially coherent projections	25km in rotated pole grid* 30-year averages	No longer available. Replaced by spatially coherent • **60km global projections** • 12km regional projections over Europe • **2.2km regional projections over UK** • **60km derived projections over UK**
Weather generator	Daily and hourly	No longer available. Replaced by • Daily data from global and regional models • Sub-daily data from 2.2km regional projections
Marine Projections	Time-mean sea level to 2100	Time-mean sea level to 2100 **Exploratory time-mean sea level to 2300**
	H++	Not updated but are still valid
	Storm-surge trend	Best estimate is for zero storm-surge trend, see **Extreme still water return levels**
		Case studies

Table 2 Summary of characteristics of UKCP09 and UKCP18 products. New items are in bold. *The rotated pole grid is the coordinate system used in UKCP09 +See Ordnance Survey (2018) for further details.

The additional components of the UKCP18 land projections mentioned in Table 2 are:

- **Global projections** - a set of 28 climate futures at 60km grid resolution, showing how the 21st Century climate may evolve under the high emission scenario RCP8.5. It incorporates 15 members of the Met Office Hadley Centre model, HadGEM3-GC3.05 (PPE-15), and 13 other climate models selected from the climate models that informed the Intergovernmental Panel on Climate Change's 5th Assessment Report (CMIP5-13);
- **Regional projections** - a set of 12 high resolution projections at 12km downscaled from the PPE-15 over the UK and Europe. At a later date, a further set of 10 projections at 2.2km over the UK will be made available.
- **Derived projections** - a set of climate futures for the UK at 60km grid resolution for RCP2.6 and a global warming level of 2°C and 4°C.

4 The rotated-pole grid and Ordnance Survey's British National Grid

In UKCP09, the probabilistic projections were provided in the same co-ordinate system as the climate model, i.e. rotated-pole. This has proved to be difficult for those users who are more familiar with the Ordnance Survey's British National Grid co-ordinate system (OSGB). In UKCP18, we provide the data in both OSGB (which requires post-processing involving interpolation) as well as the original climate model's coordinate system where appropriate. See guidance on data availability, access and formats for further details.

5 Why there is no weather generator

UKCP09 provided a Weather Generator which is a tool for providing long synthetic series of daily climate variables. This was used for risk analysis of impacts that depend upon the sequence of weather conditions (e.g. river flows and plant growth). It also provided a convenient tool for statistical analysis of the joint effects of multiple climate variables. A Weather Generator has not been provided in UKCP18. If you are interested in the effects sequences of events and multiple variables, data is available from the regional and the derived projections.

In UKCP18, we have chosen to provide data from a physically-based modelling system that can be better evaluated against real world observations rather than the statistical approach of the weather generator.

6 Why the baseline period 1981-2000 is used

The UKCP18 science reports, key messages, maps and graphs use a different baseline period from UKCP09. UKCP18 uses a 20-year baseline period of 1981-2000, as opposed to the 1961-1990 baseline period in UKCP09. This is to maintain consistency across UKCP18 products where due to computational constraints, the high resolution 2.2km projections will only be available for 20-year time periods (a baseline of 1981-2000 and future periods of 2021-2040 and 2061-2080). Note that you can obtain results for other baselines (1961-1990 and 1981-2010) from the UKCP18 User Interface.

7 Where can the data be downloaded and what formats are available

There are two main ways to download the data: the UKCP18 User Interface and the CEDA Data Catalogue. The UKCP18 User Interface is designed for those who need quick access to data through a graphical user interface. At present, **only UK data** is available from the interface**.** The UK region has been extracted from the global 60km and European 12km model. Data for the UK region is available from the user interface in comma-separated value files that can be used in software such Microsoft EXCEL and also as netCDF format.

The CEDA Data Catalogue is designed for those who are familiar with coding and handling large climate datasets. It hosts all UKCP18 datasets in netCDF format. See the guidance on data availability, access and formats for more detail (Fung et al, 2018).

8 The methodology used for the probabilistic projections

The methods used to produce the probabilistic projections are similar to those used in UKCP09. We have updated them using additional climate models (e.g. Met Office Hadley Centre and CMIP5 earth system models) as well as more recent observations. The probabilistic projections in UKCP18 are presented at the monthly, seasonal and annual time steps, whereas their UKCP09 counterparts were only available for 30-year average changes. You can find a detailed description of the method in section 2.2 of Murphy et al (2018).

9 Why H++ has not been updated

Our summary interpretation of the recent evidence is that the H++ scenario of UKCP09 can still be considered a useful plausible but unlikely high-end sea level pathway for decision-making. It should not be considered a theoretical maximum rate of sea-level rise. The scientific community will further update the potential for higher sea-level rise scenarios in the

coming months but this is likely to be in a different format to the previous scenario, reflecting an emerging need for tailored high-end scenarios for different users. Details will be provided on the UKCP18 website when available.

10 Why the administration and river basin regions are different from those used in UKCP09

In UKCP09, the shapefiles for the administration and river basin regions were not freely available as they required a licence. To make it easier to share and use the shapefiles, we have created the administration and river basin region as well as country shapefiles from open-source datasets. The shapefiles are available with an Open Government Licence. The main differences between UKCP09 and UKCP18 administration region shapefiles are in Scotland where Eastern, Western and Northern Scotland are based on aggregating regions from OS Boundary Line. There are also some small changes to river basins which are based on the European Environment Agency's European river catchments. Further details can be found in the UKCP18 guidance on data availability, access and formats.

11 Why there is no wind speed and relative humidity for the probabilistic projections

For the probabilistic projections, all variables were checked for credibility by comparing them against the suite of global climate model simulations used in their construction. For relative humidity and near-surface wind speed, the tails of the probability distribution often showed outcomes beyond the most extreme of the climate model responses. This is contrary to one of the key assumptions in the methodology and so these variables were rejected. More details are provided in Appendix C of the Land Projections Science Report.

Please cite this document as:
Fung F and Gawith M (2018). "UKCP18 for UKCP09 Users", UKCP18 Guidance. Met Office Hadley Centre, Exeter.

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HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

Appendix 1-7 Clarifications regarding Park and Ride Flood Risk

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00203

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Contents

Appendices

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1 Park and Ride Flood Risk Clarifications

1.1 Introduction

1.1.1 This technical note contains Horizon Nuclear Power Wylfa Limited's ("Horizon's") response to actions set by the Examining Authority during the Issue Specific Hearing on 10 January 2019.

1.1.2 This document concerns the Park and Ride facility at Dalar Hir (Park and Ride). Specifically, clarification is provided on the following, as requested by National Resources Wales (NRW) and Isle of Anglesey County Council (IACC):

- the proposed levels of the flood attenuation areas in relation to the existing topographical levels of the site;
- the potential flooding of the Park and Ride spine road; and
- the identified flooded parking area at the Park and Ride.

1.1.3 A further clarification was also requested on the assessment of blockages to the culvert on Nant Dalar Hir beneath the A5 and A55. This is dealt with through a separate Technical Note to be submitted at Deadline 5 (12 February 2019).

1.1.4 This document provides clarifications on the Dalar Hir FCA Addendum, which was submitted at Deadline 2 (4 December 2018) [REP2-372].

1.2 Topographical conditions of the site

1.2.1 Figure 1 presents the existing ground levels within the site and indicates the ground level differences between the two proposed flood attenuation areas and the existing topographical levels at their proposed location. There is a maximum level difference of 2.14m and 1.97m at the two areas. These maximum differences relate to high points within each area, as indicated in Figure 1.

1.3 Potential flooding of the spine road

1.3.1 Figure 2 shows the flood outline of the 1 in 100 year storm plus 15% allowance for climate change overlain onto the Park and Ride site. As shown on Figure 2, the spine road does not flood, as flood water is contained within the flood attenuation areas and the spine road is higher than the simulated flood level. The proposed minimum elevation of the spine road is 16.3m AOD.

1.4 Identified flooding of the parking area

1.4.1 Figure 2 shows that the extent of the 1 in 100 year flood plus 15% allowance for climate change encroaches onto 2 car park spaces in the southwest corner of car park 1 and also affects three spaces in the north west corner of Car Park 5. However, a comparison of the proposed level of this area of Car

Park 1 (16.45m AOD) and the predicted 1% AEP with climate change flood level (16.25m AOD) indicates that no car park spaces are at risk of flooding.

1.4.2 The flood risk shown to these car parking spaces, as indicated by the flood outlines in Figure 2, has been investigated and found to be the result of an incorrect interpolation of the car park levels from point topographical data in these two areas. The effect of this is that in these two areas the flood extents do not effectively represent the fact that the car park levels are higher than the flood level. The effect of these interpolation issues on predicted flood levels is negligible and would not affect the conclusion that the car park levels are above predicted flood levels and therefore not at risk from flooding.

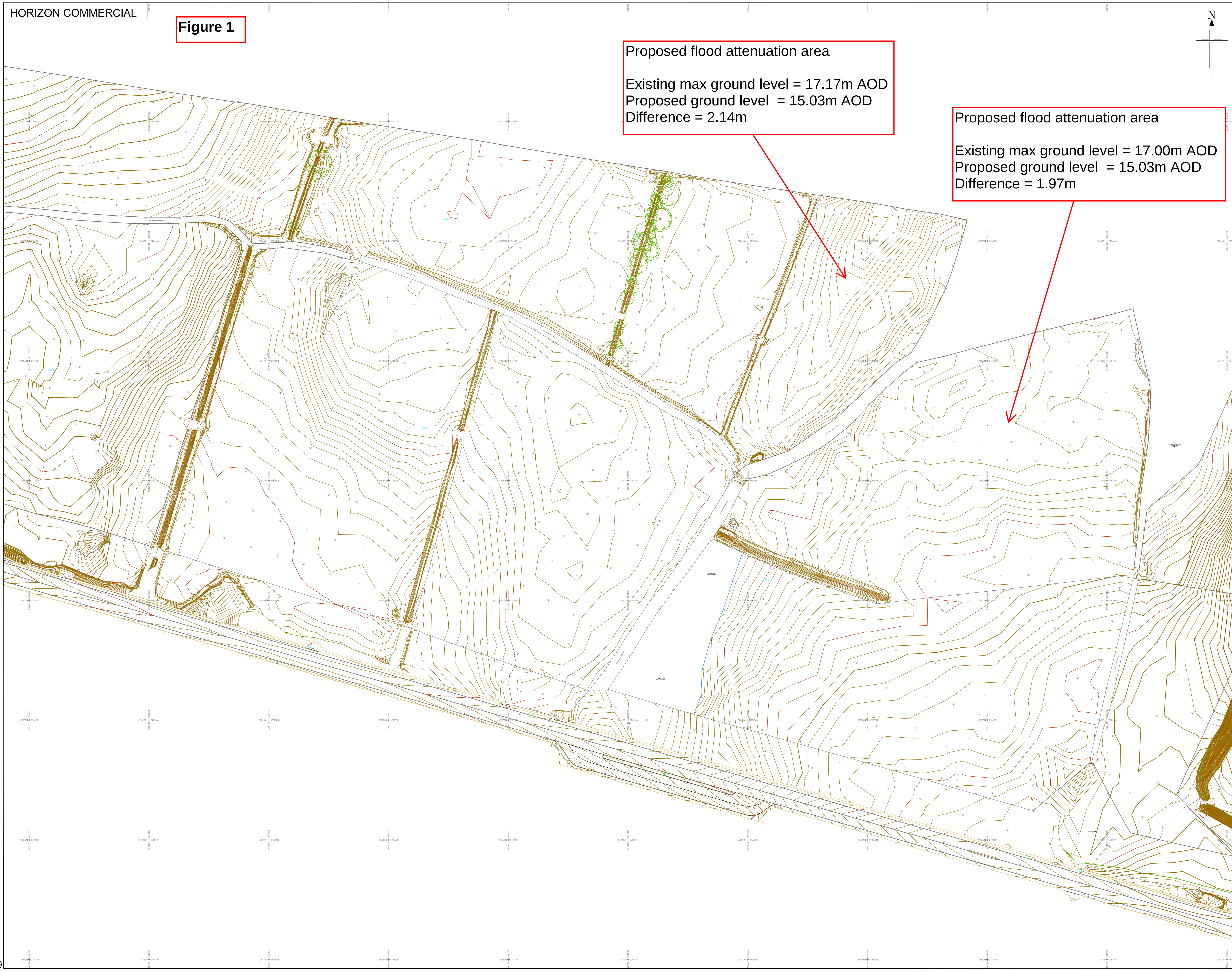
1.4.3 Considering that all car park areas and all other proposed infrastructure within the Park and Ride at Dalar Hir will be above predicted 1% AEP plus climate change flood levels, it is concluded that the proposals will be fully compliant with TAN15.

1.4.4 As indicated in Section 1.1.3, an additional Technical Note has been prepared on the effects of blockage of culverts at the site. That document also concludes that compliance with TAN15 is maintained when the effects of blockage are considered.

Appendix 1-1 Figure 1

HORIZON COMMERCIAL

Figure 1



ANNOTATIONS:

AV	Air Valve	RE	Rodding Eye
BH	Borehole	RNP	Road Name Plate
BL	Bed Level	RP	Reflector Post
Bol	Bollard	RS	Road sign
OSBM	Bench Mark	SAP	Sapling
BS	Bus Stop	SF	Soffit Level
BT	Telcom IC	Slt	Salt Box
Br	Stay Wire	ST	Stop Tap
Cbx	Control Box	SV	Sluice Valve
Culv	Culvert	Tap	Water Tap
CL	Cover Level	TCB	Telephone Call Box
CTV	Cable TV	TS	Traffic Signal
DP	Down Pipe	TL	Traffic Light
Dr	Drain cover	Thl	Threshold Level
Ebx	Electric Box	TM	Traffic Master
EC	Electric Cover	TP	Telegraph Pole
EP	Electric Pole	CCTV	CCTV Camera
PY	Electric Pylon	Gvp	Vent Pipe
ER	Earthing Rod	W	Water Cover
FH	Fire Hydrant	WE	Well
FL	Flood Light	WL	Water Level
FS	Flag Staff	WM	Water Meter
Gas	Gas Manhole	WO	Wash Out
Gt	Gate Post		
G	Gully		
GV	Gas Valve		
IC	Inspection Cover		
IL	Invert Level		
Jbx	Junction Box		
KO	Kerb Outlet		
KI	Kerb Inlet		
LB	Litter Bin		
LC	Light Column		
LP	Lamp Post		
MH	Manhole		
Mkr	Marker Post		
MP	Mile Post		
MS	Mile Stone		
NB	Notice Board		
Pi	Pipe		
PM	Parking Meter		
P	Post		
PU	Pump		
PZ	Piezometer		

FENCE TYPES:

CBF	Close Boarded Fence
IRF	Iron Railings Fence
PWF	Post & Wire Fence
PRF	Post & Rail Fence
BWF	Barbed Wire Fence
PCLF	Post & Chain Link Fence

WALL TYPES:

AB	Abutment Wall
BW	Brick Wall
SW	Stone wall
DSW	Dry Stone Wall
RTW	Retaining Wall
CW	Concrete Wall

SYMBOLS:

Building, Open Building, Gate, Bottom of Bank, Ditch, Fence, Foliage Line, Hedge (width varies), Kerb, Overhead Line, Road Edge (no kerb), Rock Outcrop, Top of Bank, Track Edge, Verge, Wall, Tree (spread varies), Bush (spread varies), + (value) (Spot Level), name value (Survey Station)

Notes:

Survey Control Coordination Method:

A Leica AX1230 SmartRover GPS Receiver was used to coordinate all survey control points to Ordnance Survey National Grid (OSGB36) following TSA guidelines.

Three minute observations were taken on each control point, twice; over a 20 minute time period in order to record data using different satellite configurations. The mean of the 2 observations were used as final coordinates.

Transformation:

In order to be able to use National Grid for topographical surveying purposes, the scale factor inherent within these coordinates has to be removed and transformed onto a local gird. This is done via the following calculation.

(NG - LGO)/LSF)+LGO = LG

Where:
NG are the National Grid coordinates obtained via GPS observations.
LGO is the local grid origin.
LSF is the local scale factor for the centre of the site - Obtained from the OS Excel Spreadsheet (http://gps.ordnancesurvey.co.uk/convert.asp)
LG are the coordinates in local grid (Scale Factor = 1)

Local Grid Origin = 232899.563, 378427.391
Scale Factor = 0.999944031

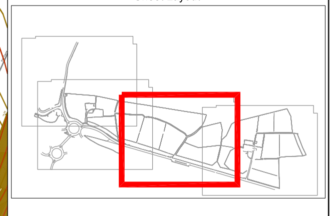
Transformation between survey grids - All survey data was recorded and processed using local grid coordinates and scale factor 1. In order to produce drawings in National Grid the survey has to be translated and scaled by two know points, this was carried out within LSS using the points below. These points were also used to calculate the local scale factor at the mid point between them.

P200
NG - E: 232470.918, N: 378706.805
LG - E: 232470.894, N: 378706.821
P208
NG - E: 233328.208, N: 378147.978
LG - E: 233328.232, N: 378147.962

Survey Stations

Name	Easting (m)	Northing (m)	Level (m)
P200	232470.894	378706.821	19.476
P201	232433.680	378526.748	18.660
P202	232463.548	378411.079	21.939
P203	232553.200	378408.544	21.723
P204	232668.799	378338.698	18.765
P205	232866.638	378280.360	15.704
P206	233015.239	378227.475	16.711
P207	233188.397	378187.125	18.420
P208	233328.232	378147.962	18.929

Sheet Layout



Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
3.0	28.07.16	Updated to Include south roundabout	SP	NJH	NJH	LM
2.0	21.06.16	Updated to Include Carriageway Survey	SP	NJH	NJH	LM
1.0	15.04.16	Final Revision	SP	NJH	NMB	LM

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Client
HORIZON NUCLEAR POWER

Project
Associated Development Sites
Dalar Hir

Drawing title
3d Topographical Survey
Sheet 3 of 4

Drawing status
FINAL

Scale	1:500 @ A0	DO NOT SCALE
Jacobs No.	60PO8049	
Client no.	WN016-JAC-OS-DRG-00020	

Drawing number: 60PO8049/JAC/TOPO/DRG/00003 — Rev 2.0

Appendix 1-2 Figure 2

NOT PROTECTIVELY MARKED

Car Park Area 4

Car Park Area 1

Car Park Area 5

A5 Holyhead Road

Exit

B

Cut

Legend

- Road surface
- Footway / pedestrian route surface
- Permeable road surface
- Proposed building footprint
- Retained vegetation
- Soft landscaping
- Existing watercourse / drainage ditch
- Proposed drainage basin cutting location
- Security fence (1.8m paladin type)
- Existing stone wall
- Pedestrian crossing
- Internal bus stops
- Public bus stops
- Minibus parking
- Motor bike parking
- Accessible parking
- Flood outline (1% AEP + 15% climate change

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Apprv'd
0.1	01/02/2019	ISSUED FOR COMMENT	RL	RA	PR

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Project

WYLFA NEWYDD

Drawing Title

Modelled 1% AEP Flood Extent, Car Park 1 and Car Park 5

Security Status

NOT PROTECTIVELY MARKED

Scale	NTS	Sheet(s)	1 of 1

Drawing Number

60PO8081-JAC-FASS-DRG-00001

Rev 0.1

Appendix 1-8 Technical note on A5025 flooding (Llanfachraeth)

HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

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Appendix 1-8 Technical Note on A5025 Flooding (Llanfachraeth)

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00205

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Contents

Appendices

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1 Introduction

1.1 Purpose of this report

1.1.1 This report provides a response to a request for further information by the Examining Authority at Issue Specific Hearing 5 on Biodiversity (Coastal Change, Climate Change, Transboundary Impacts) on 11th January 2019.

1.1.2 Further details were requested on the flood risk associated with the Afon Alaw and Afon Llywenan at Pont-Yr-Arw, specifically in relation to the further consideration of compensatory storage to offset the impacts of flooding at this location.

1.2 Scope of this report

1.2.1 The assessments presented in ES Volume G - A5025 Off-line Highway Improvements G8 - Surface water and groundwater [APP-311] and in the Off-line Highway Improvements - Flood Consequence Assessment [APP-323] present the baseline and with-scheme impacts on flooding without mitigation. The Draft DCO concluded that it was not possible to mitigate the impact on flood risk at this location and indicated that discussion with the landowner were ongoing as to the acceptability of these impacts.

1.2.2 This report briefly summarises the results of an assessment of compensatory storage options within the Order Limits at the proposed viaduct crossing of the Afon Alaw and Afon Llywenan at Pont-Yr-Arw. Full details of the assessment can be found in Appendix 2-1.

1.2.3 No further information on the outcome of negotiations with the landowner are presented, as these have not been concluded.

2 Additional assessment at Llanfachraeth

2.1 Methodology

2.1.1 In summary, having identified that the proposed scheme without mitigation resulted in an increase in flood level, and therefore impact on agricultural land, at this location, efforts were made to identify and test potential options to mitigate these effects.

2.1.2 Initially, the baseline and with-scheme models were compared to identify the impact on the floodplain, indicating that there was a direct loss of floodplain storage as a result of the viaducts embankments and piers (Section 2.1, Appendix 2-1).

2.1.3 Options were then developed for three compensatory storage scenarios that differed in the compensatory storage provided by virtue of the slope adopted for the back face of excavation into the floodplain on the northern side of these watercourses (Sections 2.2 and 2.3, Appendix 2-1). These were subsequently refined to two key options (Option 1 and Option 2) through preliminary checks on the volume of storage provided (Section 2.3 and Section 3, Appendix 2-1).

2.1.4 Tests of the compensatory storage were then undertaken to assess their effectiveness, in terms of compensating for the direct loss of floodplain storage and in terms of reducing the effects of reduced conveyance on flood levels upstream of the proposed viaduct (Section 5, Appendix 2-1).

2.1.5 Section 6 of Appendix 2-1 presents consideration of the pros and cons of alternative options relative to Options 1 and 2.

2.2 Conceptual design

2.2.1 The conceptual design of the flood compensatory storage area is such that lateral excavation into the northern edge of the floodplain, immediately upstream of the proposed viaduct, is proposed, combined with a degree of lowering (approx. 1m), to provide sufficient storage to off-set the volume directly lost by the presence of the proposed viaduct's embankments within the floodplain.

2.2.2 The extent of the potential area is limited by the steepness of the floodplain at this point, the need to provide compensatory storage at a specific level, the need to limit the steepness of the back face of the storage area and the limits imposed by the availability of space within the order limits, though as will be seen the sensitivity to this latter requirement was also tested.

2.2.3 Two options were tested within the hydraulic model; Option 1 with a back face slope of 1:2 (V:H) and a storage area that extended beyond the Order Limits, and Option 2 with a back face slope of 1:1 (V:H) and a storage area that remained within the Order Limits.

2.3 Model results

2.3.1 Model results are presented in Section 5 of Appendix 2-1. The model results indicate that there remains a small incremental increase in flood extent and in flood depth for both Options 1 and 2 relative to the baseline.

2.3.2 In comparison to the unmitigated with-scheme scenario, there is a benefit from both Options 1 and 2 that results in a lessening of the flood extent and depth increases, however, as indicated in Figures 7.23 and 7.25 in Appendix 2-1, there remain small increases in extent and depth (0.05m to 0.1m) relative to the baseline indicating that neither option is sufficient to offset.

2.4 Conclusions

2.4.1 The conclusion of the additional assessment undertaken is that compensatory storage is not a sufficiently effective measure in isolation to offset impacts on flood extent and flood level upstream of the proposed Afon Alaw Viaduct as a result of reductions in floodplain storage and conveyance.

2.4.2 Compensatory storage, whether within the Order Limits or extending out, does provide some benefit, however, it is marginal relative to the impact of the proposed scheme without any mitigation.

2.4.3 Additional options, discussed in Section 6 of Appendix 2-1, would be expected to have significant cost and/or environmental impacts relative to a no mitigation option and Options 1 and 2.

2.4.4 As indicated in the ISH on January 11th, Horizon's current position is that mitigation of these flood impacts is either ineffective or undesirable because of the constraints noted in Section 6 of Appendix 2-1. As such Horizon is currently in negotiation with the landowner on the acceptability of flood risk impacts.

Appendix 2-1 Llanfachraeth Floodplain Compensation Modelling

Document Issue Record

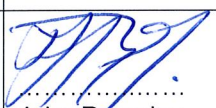
Document Title: Llanfachraeth Compensatory Storage – Hydraulic Modelling (input to Defensive Brief 16)

Document Number: 207672-0015-AA40-TLN-0001

Project Reference: 35989-51

Purpose of Issue: Final

Security Class: NOT PROTECTIVELY MARKED

Issue	Description of Amendment	Originator / Author	Checker	Approver	Date
1	Draft	Bidur Ghimire	Francesca Hurt	John Rampley-Clarke	02-08-18
1	Final	 ..... Bidur Ghimire	 ..... Francesca Hurt	 ..... John Rampley-Clarke	09-11-18

Previous issues of this document shall be destroyed or marked **SUPERSEDED**

Technical note:
Llanfachraeth Floodplain Compensation modelling (Ref: 207672-0015-AA40-TLN-0001)

1. Introduction

The DCO application for Wylfa Newydd project comprises a number of associated development sites including the A5025 bypass at Llanfachraeth. The proposal includes a viaduct crossing of the Afon Alaw and its tributary the Afon Llywenan immediately upstream of their confluence. The viaduct crossing proposed is east of the existing A5025 crossing of the Afon Alaw at Pont-Yr-Arw.

This technical note outlines the hydraulic modelling task carried out for Task Sheet 15 [PO 498788], as part of supporting documents for Defensive Brief 16 [Item 3]. The previous hydraulic modelling report (Doc ref: *207017-0000-AA40-RPT-0004_v3 Llanfachreath Report Jan2018*) acknowledged that the proposed bypass viaduct will result in a constriction of flow and loss of floodplain storage, resulting in an increase in flood risk upstream of the proposed crossing. The primary cause of this impact is the northern earth embankment which encroaches into the floodplain. To compensate for the lost floodplain volume, new compensatory floodplain storage needs to be provided to match the volume lost. Ideally the storage would look to offset the impacts of impeded conveyance, but space restrictions within the DCO Order Limits do not provide space for any additional storage over and above direct volume replacement. This technical note presents the data, calculations, methodology and results of the modelling work carried out for the proposed compensatory storage arrangement to compensate for the floodplain storage loss. The note (in Section 6) provides a summary of the possible mitigation measures which for further consideration to mitigate the residual increase in flood risk associated with marginally impeded conveyance. The conveyance mitigation measures have not been modelled or developed to concept design level, they are presented as possible options for further consideration.. The technical note is structured as follows:

- **Section 1: Introduction**
- **Section 2: Methodology** – describing the method deployed to calculate the required volumes of compensatory storage
- **Section 3: Conceptual design of compensatory storage area** – outlining the three iterations of the conceptual design to provide the required storage
- **Section 4: Model run detail** – providing details of the model simulations developed to test the concept design.
- **Section 5: Model run results** – presenting the results of the model simulations
- **Section 6: Residual risks and mitigation measures –** sets out possible options to mitigate the residual increase in risk associated with impeded conveyance.

1.1 Overview

The loss of floodplain storage volume should be compensated, as the model results in the DCO modelling report (Doc ref: *207017-0000-AA40-RPT-0004_v3 Llanfachreath Report Jan2018*) indicate that without it there is an increase in flood risk upstream. The intention of the compensatory arrangement for the floodplain

storage loss is to ensure the natural flood storage is maintained in the developed scenario with minimal or negligible impact on the existing flood dynamics in the vicinity of the proposed viaduct bypass and elsewhere. It is also helpful in understanding the scale of the impact due to floodplain encroachment and constrictions in the channels resulting from the proposed development. The main objective of this task is to provide the compensatory arrangement consisting of a flood storage area to compensate for the lost floodplain volume.. Sections 3 through to 5 describe the process of developing the conceptual design of the compensatory storage arrangements, the representation of the conceptual design in the hydraulic model and the results of that modelling respectively. Section 5 concludes that the conceptual design (configured within the DCO Order Limits) is capable of re-providing the lost floodplain volume associated with the embankments. However, the modelling results indicate that the replacement of compensatory floodplain storage on a like for like basis with that lost is not sufficient to fully mitigate the impacts of the proposed highway crossing. This is because the proposed development both results in a loss of floodplain storage, but also it impedes flood flow conveyance. Section 6 of the note therefore considers possible additional mitigation measures for further consideration to mitigate the residual increases in flood risk.

1.2 Data and assumptions

This section details the data inputs and assumptions underpinning the subsequent conceptual designs and modelling.

i. The same LiDAR data that was used in previous 1D/2D modelling studies (Doc ref: *207017-0000-AA40-RPT-0004_v3 Llanfachreath Report Jan2018*) was used along with the proposed development drawings/maps to calculate the floodplain storage loss due to proposed viaduct embankment footprint and piers that support viaduct. For the development scenario, viaduct piers were modelled as blocks that constrict flow depending upon the proportion of blocked areas within the TUFLOW model 3m by 3m grid (Doc ref: *WN02.05-ACM-SCH-018 and Llanfachraeth bypass modelling approach and F100 results.pdf*). To be consistent with previous studies (Doc ref: *207017-0000-AA40-RPT-0004_v3 Llanfachreath Report Jan2018*) and design, the existing model set up has not been changed.

ii. Floodplain storage loss calculation was based on the levels corresponding to a modelled fluvial event 1:100 year plus 30% climate change allowance. The inflow hydrology is assumed to be the same as reported in the hydraulic modelling report (Doc ref: *207017-0000-AA40-RPT-0004_v3 Llanfachreath Report Jan2018*).

iii. It is assumed that any land within the DCO Order Limit is available for consideration in this assessment.

iv. The existing baseline model results for the fluvial 1:100 year AEP plus 30% climate change event have been used for calculations and comparison. No new baseline modelling works will be carried out to define the baseline water levels from those presented in the January 2018 report submitted as part of the DCO.

v. Compensatory storage is being proposed to mitigate the fluvial event only.

vi. The downstream tidal boundary is the future predicted mean highwater spring (MHWS) level corresponding to 2114 AD.

vii. Compensation is being designed on a volume for volume basis, its effectiveness has been checked through modelling. A more rigorous level for level method was not deemed to be required as the loss and compensation are taking place within the same range of elevations (see Table 2.1 and Figure 5.1 Temporal variation of water level (right) at observation points (left) for Option 1).

2. Methodology

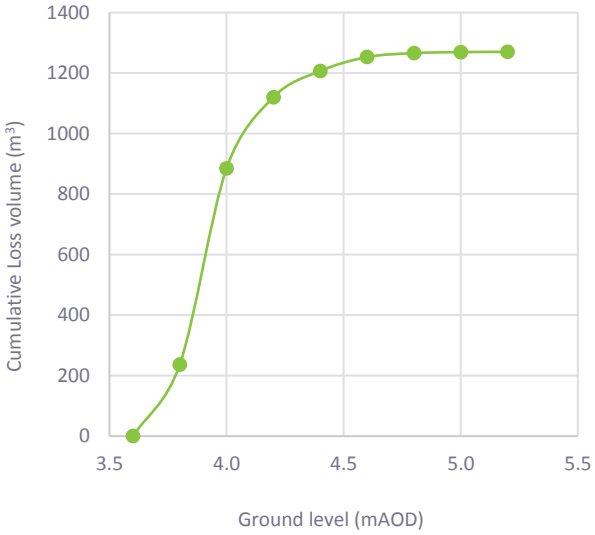
This section provides a methodology that was carried out to assess the adequacy of the compensatory volume, configuration of the compensatory storage area and the mode of hydraulic model run adopted to arrive at an iterative modelling approach.

2.1 Definition of lost floodplain volume

The volume of lost floodplain under the viaduct embankments has been confirmed and verified as 1270m^3 in the 1:100 year AEP event plus 30% climate change. This is consistent with the previously reported value. The loss of storage for this hydrological event has been found to occur between 3.6mAOD and 5.2mAOD. Table 2.1 below shows the volumetric loss at vertical intervals.

Table 2.1 Lost Floodplain Volume

Level below the value	Volume loss	Cumulative loss	Explanation
(mAOD)	m^3	m^3	A chart showing level-wise cumulative storage loss
3.6	0.0	0.0	
3.8	235.9	235.9	
4.0	649.4	885.2	
4.2	234.9	1120.2	
4.4	86.8	1206.9	
4.6	46.0	1252.9	
4.8	12.9	1265.8	
5.0	3.5	1269.4	
5.2	0.6	1270.0	



As can be seen from Table 2.1, the major portion of volume loss occurs between 3.6mAOD and 4.5mAOD. A conceptual compensation storage design was carried out to accommodate this lost volume. Section 3 gives the detail of the compensatory storage area.

2.2 Land suitability and selection for compensatory arrangement

i. The available land for such compensatory arrangement were based on DCO Limit and Land Parcel maps supplied by Horizon (Doc ref: *Horizon_DCO_OrderLimits20180301.shp; WN0902-HZDCO-LPN-DRG-00008*).

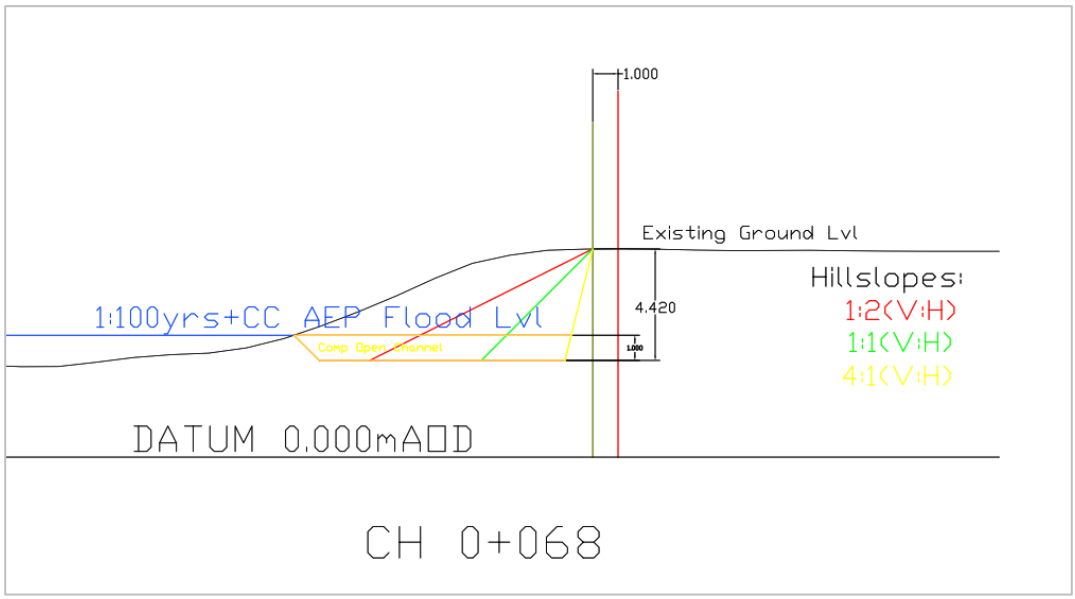
ii. An outline of the 1:100 year AEP plus 30% climate change flood extent was used to identify the available areas suitable for compensation storage. The search criteria were that the area should be outside of the 1:100 year AEP plus 30% climate change flood extent, adjacent to the floodplain to ensure hydraulic connectivity and within the redline boundary. Three areas of varying size (1400m^2, 270m^2 and 260m^2) were identified as suitable[1] for compensatory arrangements.

iii. The largest of the three available areas, situated on the eastern side of the northern embankment (yellow shaded area in attached Figure 3.1 and Figure 3.2) was chosen for the assessment. The other two areas were discounted as although these small areas can be used to augment the volume, they do not have the potential to contribute significantly to the flood storage compensation.

2.3 Description of compensatory arrangements

For the conceptual design of the compensatory arrangement consisting of a storage area and associated open channel hydraulic connections to the main Afon Alaw channel, a number of potential options were considered. Preliminary calculations were carried out for a range of storage area configurations with respect to excavation slope and depths. Figure 2.1 shows various cut hillslopes (i.e. backslopes) that were considered in the calculation.

Figure 2.1 Various slope configurations for compensatory arrangement



Please note: The vertical red line represents the boundary of the DCO Order limits, there is a 1m offset from the boundary to the crest of the excavated slope in all examples.

Preliminary calculations showed that a slope of 1:1 and 1:2 was not sufficiently steep to provide adequate storage in the available area for excavation. But, with some hard engineering measures it could be possible to implement a 4:1 (V:H) backslope to provide enough compensation volume (please see Table 2.3).

[1] Suitable in terms of ground elevations, in that they were not currently floodplain. No other technical, engineering, geotechnical or consideration of underlying services have been factored into the conceptual design.

Table 2.3: Preliminary calculation for checking adequacy

Option	Backside slope (V:H)	Excavation depth (m) below FWL*	Compensation volume available(m^3)	Available compensation volume	Remark
Option 1	1:2	1.0	679.3	not enough	Needs extra land beyond DCO Order Limits
Option 2	1:1	1.0	1078.2	not enough	Capacity can be increased with deeper excavation
Option 3	4:1	1.0	1309.4	Enough	Retaining walls would most likely be required in this example.

* FWL: Flood water level (mAOD)

To provide the required volume, in Option 1 (e.g. with a 1:2 backslope) an increase in spatial extent is required to retain the 1m depth of excavation below the peak water level. An expanded area was developed and this results in an increased footprint beyond the extent of the DOC Order Limits. This option was not discontinued as HNP advised, during a conference call on 22 June 2018, that this should be pursued alongside HNP entering into discussions with landowners.

Option 2 with a backslope of 1:1 retained and considered further. It is noted that the potential for some slope stability measures may be required in this option, but these requirements are not considered at this conceptual stage.

Option 3 with the steepest backslope of 4:1 option was not considered further owing to the likely requirement for hard engineering to provide slope stability.

3. Conceptual design of compensatory storage area

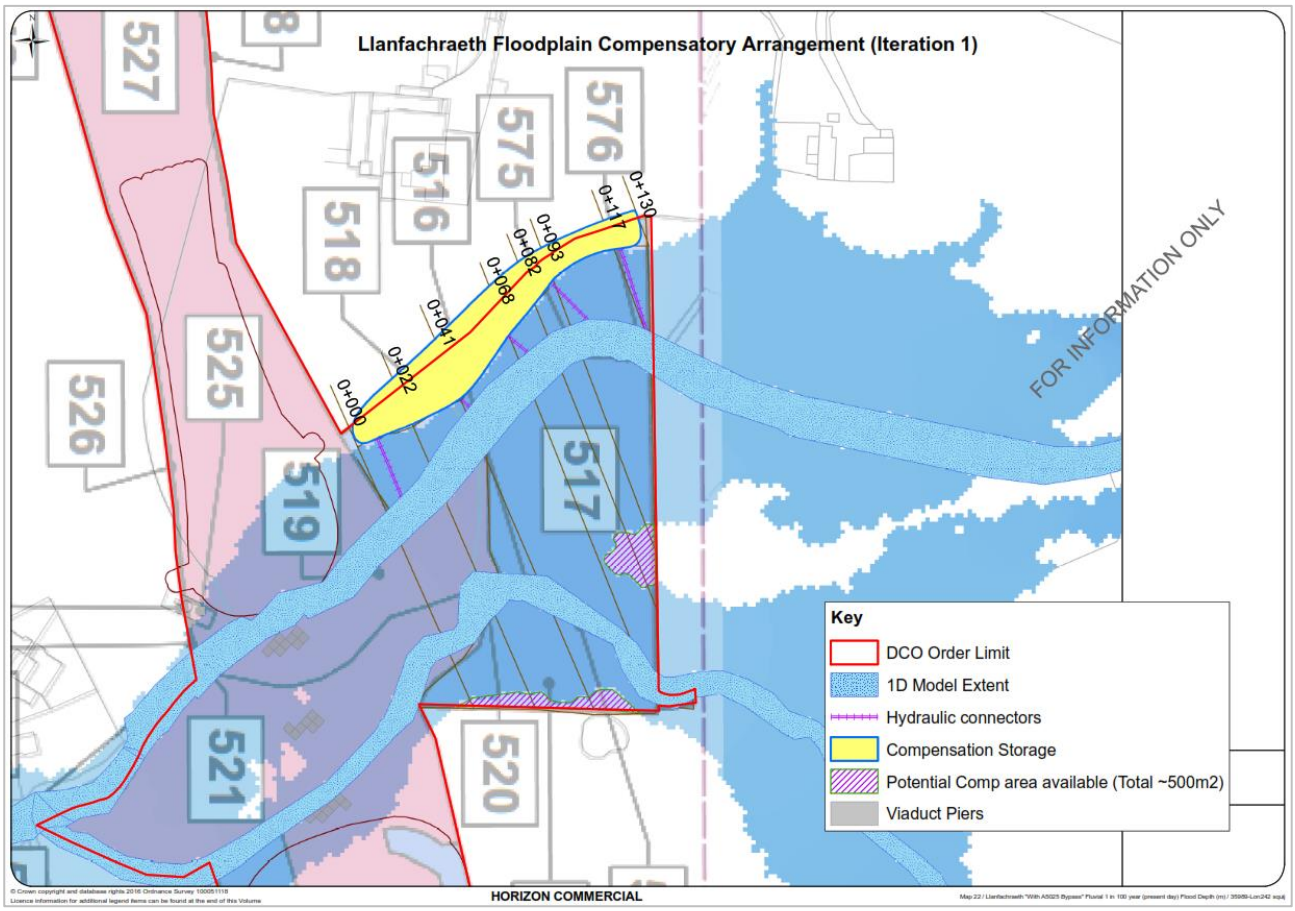
The existing 'with bypass' model that was produced for to support the DCO flood risk assessment (Doc ref: *207017-0000-AA40-RPT-0004_v3 Llanfachreath Report Jan2018*) was modified to include the proposed storage area and hydraulic connections. For both options, only the 2D model has been updated, the 1D model component remained unaltered. The details of the update for modelling are given in subsequent sections.

Topographical cross sections at eight chainage lines from 0+000 to 0+130 were extracted (see Figure 3.1 and Figure 3.2). Using the extracted ground topography, the storage area geometry has been proposed. Using the extracted cross sections, calculations for the available compensation volume was done assuming an open channel earthen trapezoidal section in CAD environment. An offset of 1m inside from the boundary was assumed to allow for any fences or retaining structures. The details of these features will be finalised during the detailed design phase.

3.1 Option 1

Option 1 represents a compensation storage arrangement assuming a 1:2 (V:H) backslope and limiting the depth of excavation about 1.0m below flood water level as deeper excavation would impart poor slope instability. An additional distance to acquire extra land outside of DCO Order Limits as shown in Figure 3.1.

Figure 3.1 Compensation area (Option 1)



Model run results for this Option are given in section 5.1.

3.2 Option 2

To accommodate the compensatory storage area within the DCO Order Limits, it was agreed to keep the excavation backslope at 1:1, recognising that some slope stability measures and associated geotechnical engineering may be required to stabilise the backslope of the excavation. The HNP confirmed agreement to pursue this concept design during a conference call on 22 June 2018. The compensatory arrangements pertaining to Option 2 are presented in Figure 3.2.

Figure 3.2 Compensation area (Option 2)

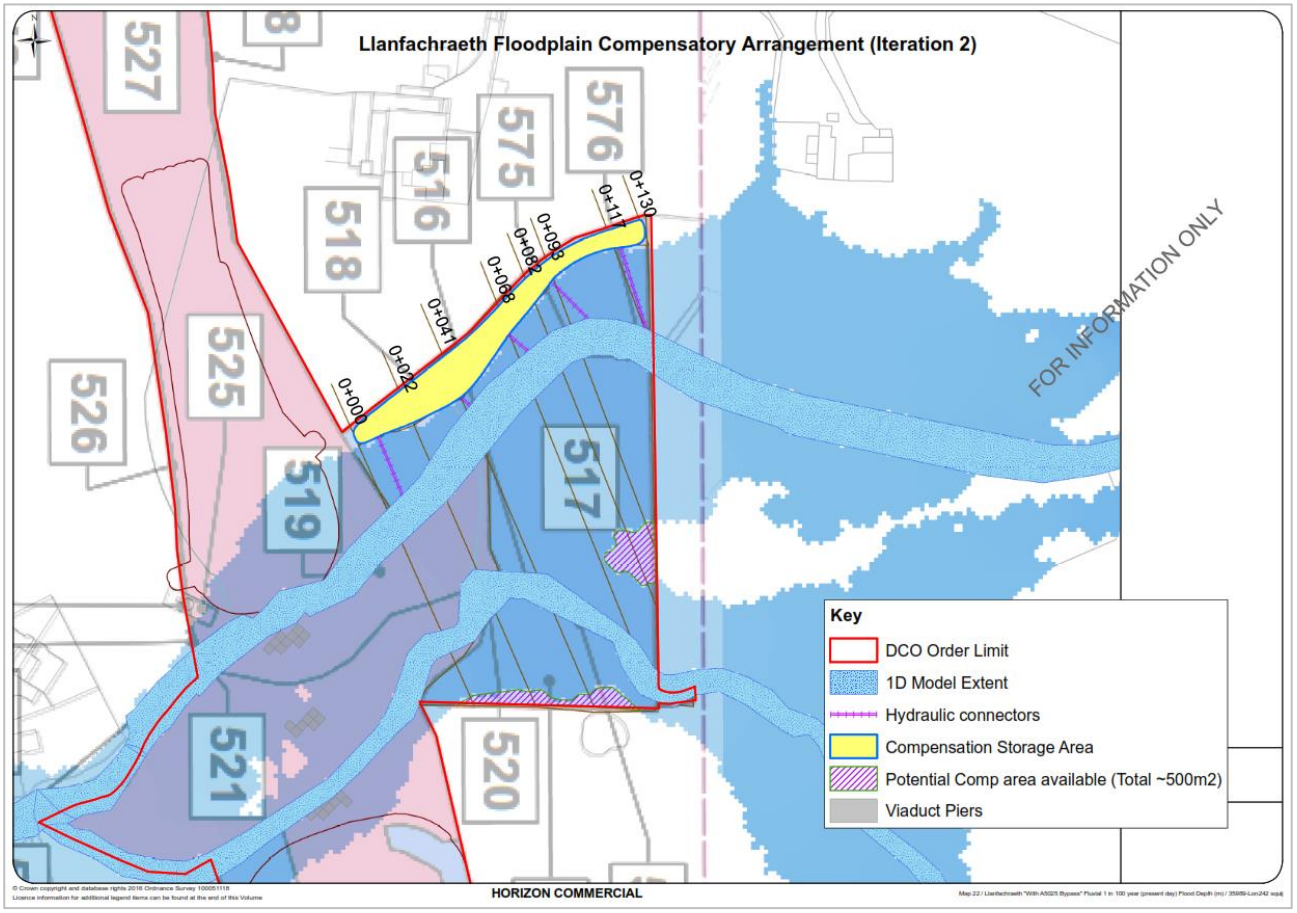


Table 3.1 Compensation volume calculation

Chainage	Cross-section area*, m2	Average area, m2	Length, m	Volume, m3
CH 0+000	5.49	-	-	-
CH 0+022	12.22	8.86	21.0	186.0
CH 0+041	18.1	15.16	19.6	297.5
CH 0+068	9.3	13.70	27.6	378.4
CH 0+082	7.33	8.32	13.5	112.1
CH 0+093	4.875	6.10	10.6	64.9
CH 0+117	3.652	4.26	24.8	105.7
CH 0+130	6.1	4.88	13.5	65.6
			Total =	1210.0

*Ref : Green outline in '*Compensation open ditch v3.dwg*'

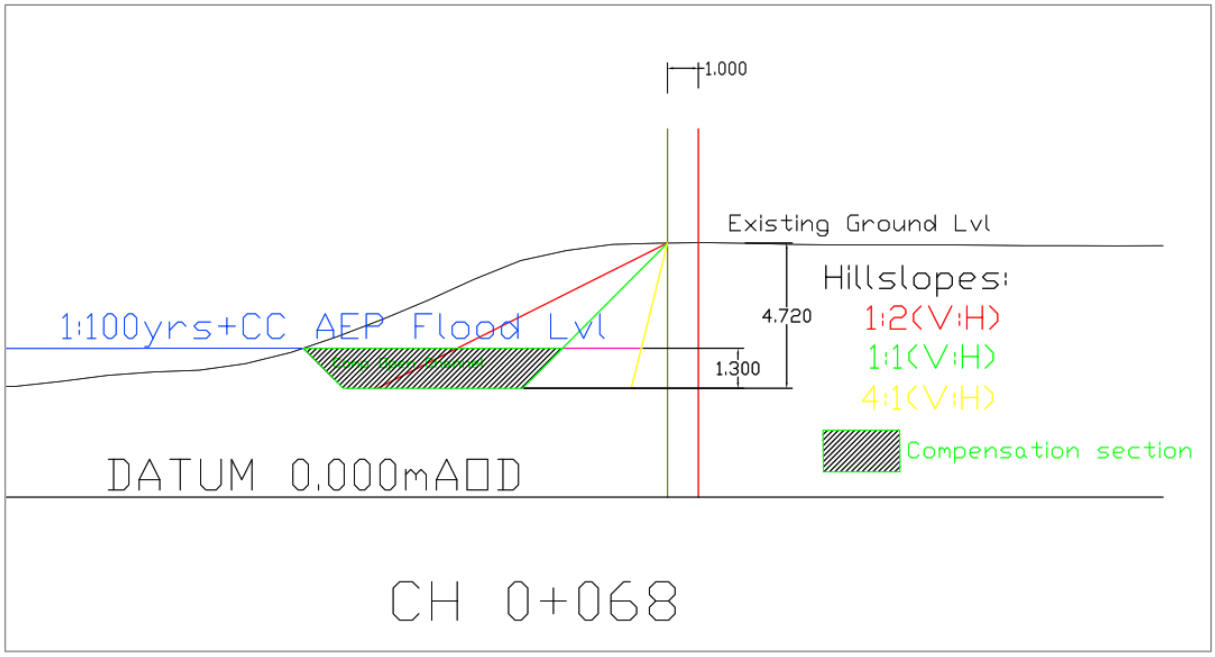
Table 3.1 Compensation volume calculation presents a breakdown of the calculation to check the adequacy of the concept excavation (cross section by cross section) in Option 2. The cross sections are

displayed on Figure 3.2 and are derived based on LiDAR. In this calculation an average depth of 1.3m below the flood water level (FWL) has been considered. Model run results for this option are given in section 5.1.

An additional 60.0 m^3 storage volume will be available from open channel hydraulic connectors that connect the storage area with its parent floodplain. There are also two areas (hatched areas with a total 500 m^2 shown in Figure 3.2 and Figure 3.3) from which it can be gained approximately 100m^3 volume as a surplus compensation.

A representative cross section of the compensatory storage area (for chainage 0+068) is given in Figure 3.3 Proposed Open Channel floodplain compensation configuration (cross section) for Option 2 to show indicative depths of excavations and size of the compensation area. As the arrangement with 1:1 backslope and excavation depth 1.3m below flood water surface elevation provides the required compensatory volume, it has been considered as the preferred option and is thought to be an optimum arrangement. All cross-section geometries are provided in Appendix A.

Figure 3.3 Proposed Open Channel floodplain compensation configuration (cross section)



3.3 Comparison of Options

A summary of the two options discussed in above sections are presented here for comparison. In both option model runs; the required compensation volume has been provided by means of storage area and connecting open channels. A total length of about 50m channel (as measured from CAD files) is required to connect to its floodplain. The connecting channel is assumed to be a trapezoidal channel with effective width 1.5m and providing a depth of about 0.8m for compensatory storage resulting in a total of 60m^3 volume. A comparative summary of both the compensatory arrangements is given in Table 3.2 Comparative Summary for Option 1 and Option 2.

Table 3.2 Comparative Summary for Option 1 and Option 2

Particular	Option 1	Option 2	Additional Information
Areal extent	Extends beyond current DCO Limit	Accommodated within current DCO Limit	
Average depth of excavation below 1:100CC Flood Water Level	1.0 m	1.3m	
Compensation storage area bed level	3.65 to 3.90 mAOD	3.45 to 3.60 mAOD	
Average depth of excavation below 1:100CC Flood Water Level	1.0m	1.3m	
Excavation backslope (V:H)	1:2	1:1	
Typical backslope cut vertical height	4.42m AOD	4.72m AOD	
Area of compensation storage area (on the east side of northern embankment)	1926 m^2	1246 m^2	
Hydraulic Connectors (length)	50m	50m	
Compensation volume achievement method	From storage area = 1309 m^3	From storage area = 1210 m^3 + 60 m^3 from connecting channels	
Additional area available	500m^2	500m^2	on southern side of proposed viaduct

4. Model run detail

The model from the January 2018 DCO modelling report has been updated with the compensatory arrangements as described in Section 3.2. Only the 2D component of the model has been updated with respect to topography and roughness for both the options considered. The 1D component of the model has not been altered. Changes have not been made to the hydrology that was reported in the January DCO modelling Report. Hydrological event corresponding to fluvial 1:100 years AEP+CC climate change (30%) has been supplied to the coupled 1D-2D model. Tidal boundary condition has been supplied as mean high water spring (MHWS) level corresponding to 2114 AD epoch. Further detail of the model inputs and run events are shown in Table 4.1 Compensation volume calculation.

Table 4.1 Compensation volume calculation

Option detail	Model run events and details of Input files
Option 1 Backslope 1:2 With additional land area beyond DCO Limit	► Fluvial event:- 1:100 year +CC AEP climate change (30), Tidal event:- MWHS (2114) ► Llan_Base_035.dat ► Llan_Base_022_bypass_iter1.tgc

Option detail	Model run events and details of Input files
	► Llan_Base_023_F100CC_MHWS(2114)_bypassFPC.tcf
	Main changes:- ► Compensation area topo layer: 2d_zsh_Llan_Comp_001.MIF ► Compensation area material layer: 2d_mat_Llan_FPC_pond.MIF ► Monitoring points layer: 2d_po_Llan_002.MIF
Option 2 Backslope 1:1 Within supplied DCO Limit	► Fluvial:- 1:100 year +CC AEP climate change (30), Tidal:- MWHS (2114) ► Llan_Base_035.dat ► Llan_Base_022_bypass_iter2.tgc ► LLAN_Base_023_F100CC_MHWS(2114)_bypassFPC_iter2.tcf
	Main changes:- ► Compensation area topo layer: 2d_zsh_Llan_Comp_002.MIF ► Compensation area material layer: 2d_mat_Llan_FPC_pond_002.mif ► Monitoring points layer: 2d_po_Llan_003.MIF

4.1 Hydraulic connections

Hydraulic connectors are provided in the concept design to connect compensation area to the parent floodplain. These connectors are represented as open channel sections with 1.5m bed width and serve as a means to pass water to the storage during flood event and to release water to its parent floodplain during the recession of the flood.

4.2 Monitoring points

It is necessary to check whether the storage is working as envisaged or not. Five points (points 14, 15, 16, 17 and 18) have been added to assess the temporal variation of water levels in the compensation storage area (see Figure 5.1 and Figure 5.2).

5. Model run results

Results from the model runs are presented in map and graph forms to describe the effectiveness of conceptual compensatory storage design. Flood inundation maps showing flood depths are presented and corresponding depth difference maps are presented in this section. Charts showing temporal variation of water surface elevations in the compensation storage area are also presented to assess the effectiveness of the arrangements. The output maps have been supplied as separate high-resolution pdf files in Appendices B and C as indicated below. Figure number and titles of output maps are listed here for completeness.

Output maps provided in Appendices:

APPENDIX B:

B.1 Inundation maps for 'baseline' and 'with development'

- Figure 7.20 A5025 Llanfachraeth baseline peak fluvial depth 1:100 year AEP climate change (30%) (Re-produced for comparison)
- Figure 7.21 A5025 Llanfachraeth 'with bypass' peak fluvial depth 1:100 year AEP climate change (30%) (Re-produced for comparison)

B.2 Inundation and depth difference maps (For Option 1 i.e. with backslope 1:2 (V:H) and storage area beyond DCO Order Limit)

- Figure 7.22 A5025 Llanfachraeth 'with bypass and floodplain compensation' (Option 1) peak fluvial depth 1:100 year AEP climate change (30%)
- Figure 7.23 A5025 Llanfachraeth 'with bypass and floodplain compensation' (Option 1) Depth Difference for 1:100 year AEP climate change (30%) with baseline

APPENDIX C: Inundation and depth difference maps (For Option 2 i.e. with backslope 1:1 (V:H) and storage area within DCO Order Limit)

- Figure 7.24 A5025 Llanfachraeth 'with bypass and floodplain compensation' (Option 2) peak fluvial depth 1:100 year AEP climate change (30%)
- Figure 7.25 A5025 Llanfachraeth 'with bypass and floodplain compensation' (Option 2) Depth Difference for 1:100 year AEP climate change (30%) with baseline

5.1 Discussion of the results

In this section, comparison of results are made based upon inundation depth maps and depth difference maps for Option 1 and Option 2 presented above.

When compared with the baseline results, Option 1 results show a small increment in the inundation extent and it also shows an increase in flood water depth immediate upstream of the proposed viaduct (see Figures 7.20 and 7.23 of Appendix A)

Similarly, when compared with the baseline results, Option 2 results show a slight increment in the inundation area and also an increment in depth at a range higher than they were in Option 1. (see Figures 7.20 and 7.25 in Appendices)

Thus, depth difference maps in Appendices B and C from Option 1 and Option 2 show that there is an increase in flood depth in upstream area compared to baseline scenario. A separate quick assessment (not reported here) on the depth differences and inundation extents show that there is a noticeable benefit of providing the compensatory storage areas resulting in lessened inundation extent and reduced depth than in the 'with development' only scenario i.e. without compensatory storage area. The model results show the flow constriction impeded from the proposed viaduct offsets the benefit from the provision of compensation storage area. The increase in depth is in a range of 5cm to 10cm at location immediate upstream of the viaduct. There is also some decrease in flood depth downstream of the viaduct. Most of the upstream area show an increase in 1cm to 5cm in range. The extent and depth difference for both options seem similar with negligible difference (See Figures 7.23 and 7.25 in Appendices).

A temporal variation of water depth at five monitoring points inside the storage area show the effectiveness of the compensatory storage area in storing water during flood event and releasing it when the flood

recesses. Figure 5.1 and Figure 5.2 show such depth versus time graphs at indicated model observation locations. Considering all the factors such as available land within DCO Limits, compensation arrangement and its effectiveness and benefit from storage with respect to channel conveyance, Option 2, where the compensation storage area was accommodated within the DCO Limit, was considered to be the preferred option.

Figure 5.1 Temporal variation of water level (right) at observation points (left) for Option 1

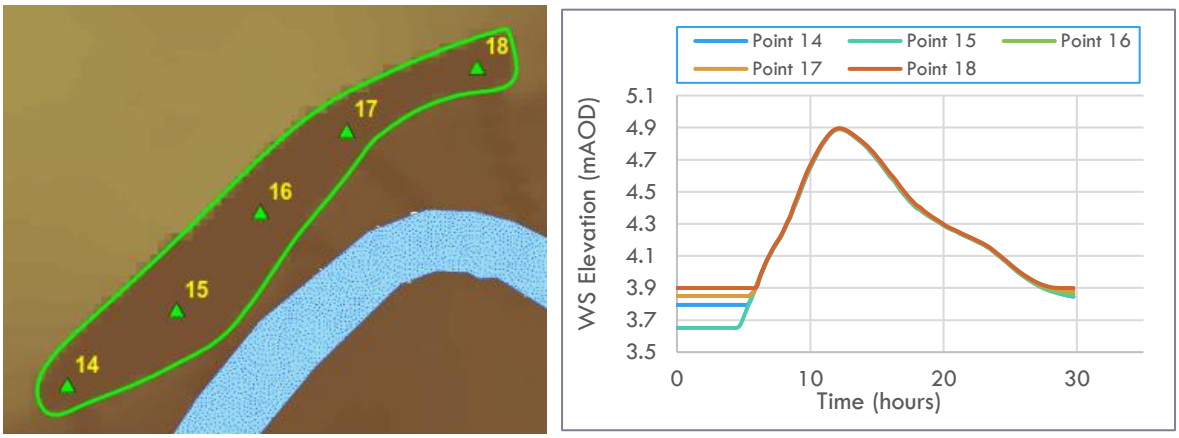
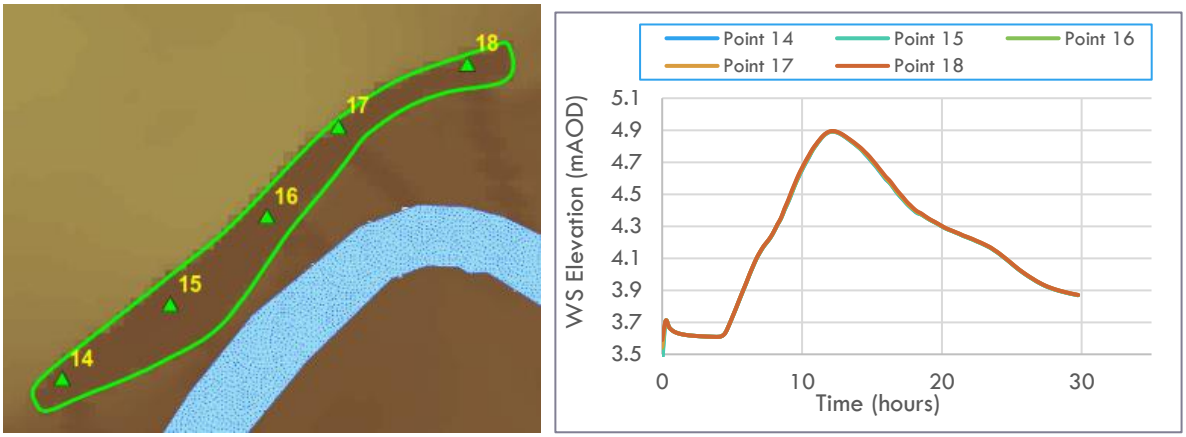


Figure 5.2 Temporal variation of water level (right) at observation points (left) for Option 2



6. Possible additional mitigation measures

The compensatory arrangement as modelled provides a match for the lost floodplain volume, however it cannot completely revert to the baseline condition of flood risk. There remains a residual increase in flood risk resulting from the proposed highway crossing. The flow constriction caused by the viaduct has an impact on upstream flood levels which cannot be mitigated for in the compensatory storage areas, as can be seen from depth difference maps presented in section 5.1. Thus, in addition to the compensatory arrangement as described above, the following potential measures for enhancing conveyance between the

embankments have been developed at a high level and remain draft considerations at the time of the release of this note. These options have not been developed to concept design nor have they been modelled to quantify effectiveness as this is beyond the scope of this study. The intention was to discuss the residual impacts and then enlist the potential measures (see Table 6.1 Potential conveyance enhancement measures).

Table 6.1 Potential conveyance enhancement measures

SN	Option	Conveyance/ Objective	Pros	Cons	Constructability
1	Widen the distance between the embankments and increase the span of the viaduct	Increases the conveyance corridor and reduce encroachment into the floodplain	May offset the residual increase in flood risk upstream by increasing conveyance potential.	Cost implication, due to increase of bridge span	May complicate the DCO process as it may not be possible within existing Order Limits
2	Channel bed profiling to streamline flow around piers	Streamlines the flow and reduces turbulence and hence improves conveyance	Reduces turbulence, reduces scouring, improves the conveyance and may offset the residual increase in flood risk upstream	High uncertainty in the geomorphological regime in the long run. WFD implications	Potentially not difficult to construct and could can be synchronised with the pier construction
3	Reduce the number of bridge piers	Improves conveyance resulting from more flow area	May offset the residual increase in flood risk upstream by increasing conveyance potential.	May add cost resulting from increased span widths.	Other than cost, this is potentially not overly onerous from a consenting perspective, providing a reduction in piers does not constitute a material change.
5	Insertion of culverts under viaduct embankments	Pipe culvert especially under the northern embankment have the potential to act to convey flood waters in high flow conditions.	May offset the residual increase in flood risk upstream by increasing conveyance potential.	Regular maintenance and removal of debris may need to be considered. Potential resistance to this option from NRW	Potentially challenging to demonstrate long term effectiveness owing to maintenance requirements and potential for NRW resistance.

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Management systems

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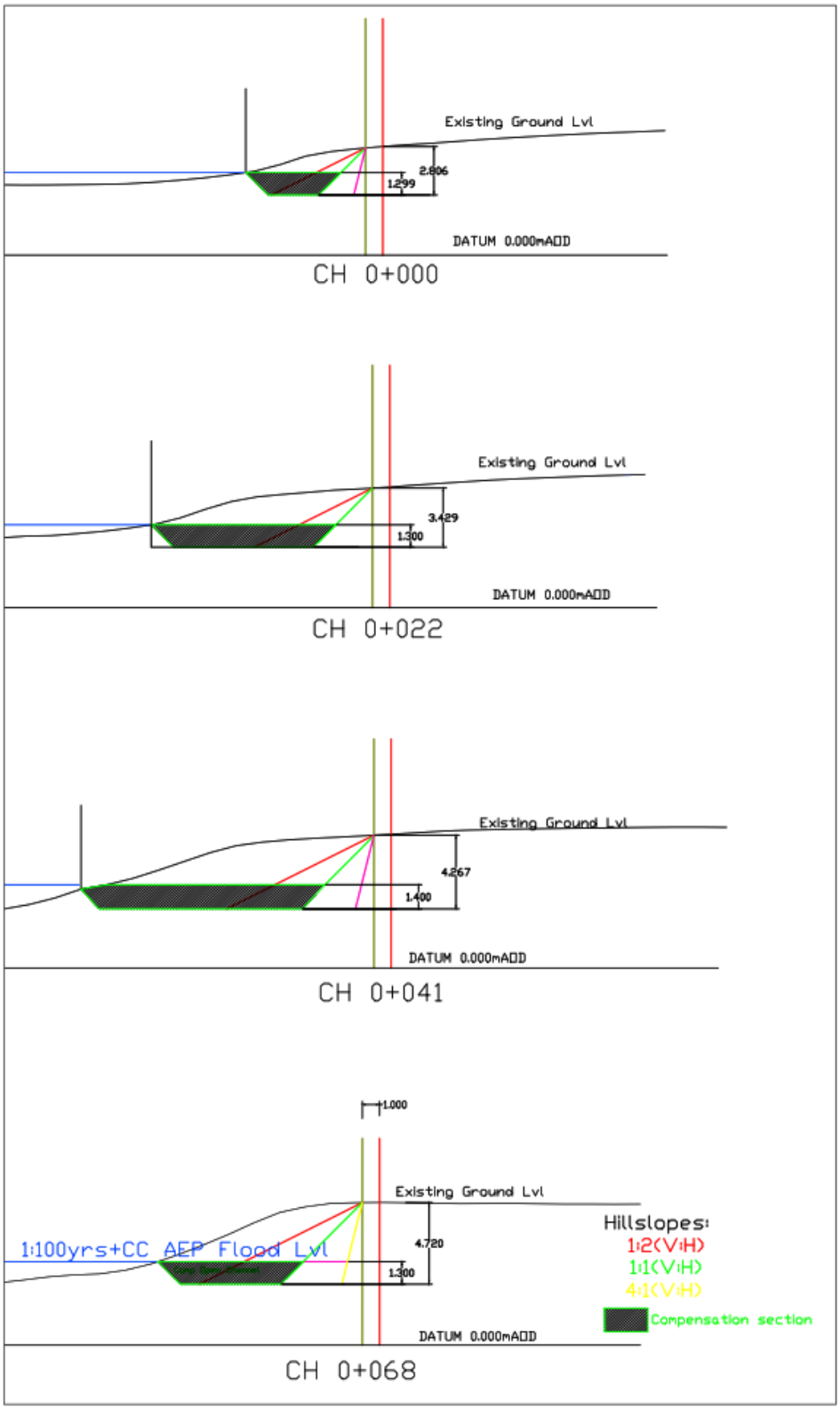
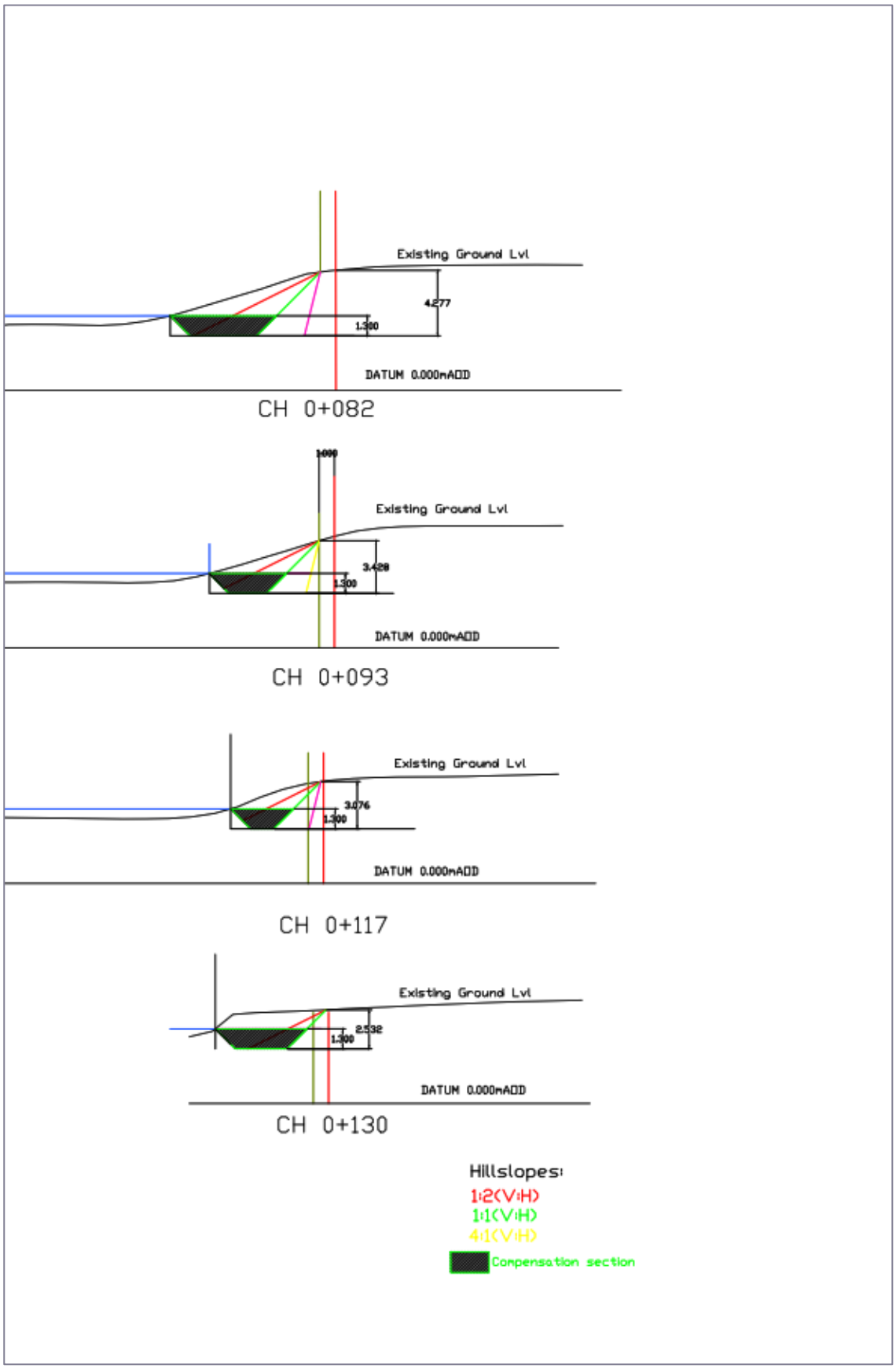
Appendix A Cross Sections (Option 2)




Existing Ground Lvl
4.277
1.300
DATUM 0.000mAOD
CH 0+082
1.000
Existing Ground Lvl
3.428
1.300
DATUM 0.000mAOD
CH 0+093
Existing Ground Lvl
3.076
1.300
DATUM 0.000mAOD
CH 0+117
Existing Ground Lvl
2.532
1.300
DATUM 0.000mAOD
CH 0+130
Hillslopes:
1:2(V:H)
1:1(V:H)
4:1(V:H)
Compensation section

Appendix B Inundation and depth difference maps

Figure 7.20 to Figure 7.23

231700 231800 231900 232000

382300 382200

N

0+000 0+022 0+041 0+068 0+082 0+093 0+117 0+130

527 518 575 576 517 519 525 522 521 515 514 516 513

Key

- DCO limit
- Land parcel
- 1D model extent
- Viaduct pier
- Embankment outline
- Cross section line
- OS Mastermap

Peak flood depth (m)
Baseline
Combined fluvial and tidal climate change

- < 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 20 40 60 m

Scale at A3: 1:1,000

Wylfa Newydd
DCO
Hydraulic Modelling

Figure 7.20
A5025 Llanfachraeth baseline peak fluvial depth 1:100 year AEP climate change (30%) (Re-produced for comparison)

August 2018

wood.

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231700 231800 231900 232000

382300 382200

N

0+000 0+022 0+041 0+068 0+082 0+093 0+117 0+130

527 525 522 521 519 518 517 516 515 514 513 576 575

Key

- DCO limit
- Land parcel
- 1D model extent
- Viaduct pier
- Embankment outline
- Cross section line
- OS Mastermap

Peak flood depth (m)
With bypass
Combined fluvial and tidal climate change

- < 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 20 40 60 m

Scale at A3: 1:1,000

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DCO
Hydraulic Modelling

Figure 7.21
A5025 Llanfachraeth 'with bypass' peak fluvial depth 1:100 year AEP climate change (30%) (Re-produced for comparison)

August 2018

wood.

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231700
231800
231900
232000
382300
382200
N
0+130
0+117
0+093
0+082
0+068
0+041
0+022
0+000
527
518
575
576
517
519
525
515
522
521
514
516
513
Key
DCO limit
Land parcel
1D model extent
Viaduct pier
Results point
Hydraulic connector
Embankment outline
Cross section line
Compensation storage area (Option 1)
Potential compensation area only (Area = 500m²)
OS Mastermap
Peak flood depth (m)
With bypass and floodplain compensation (Option 1)
Combined fluvial and tidal climate change
< 0.05
0.05 - 0.10
0.10 - 0.25
0.25 - 0.50
0.50 - 0.75
0.75 - 1.00
1.00 - 1.50
1.50 - 2.00
> 2.00
0
20
40
60 m
Scale at A3: 1:1,000

Wylfa Newydd
DCO
Hydraulic Modelling
Figure 7.22
A5025 Llanfachraeth 'with bypass and floodplain compensation' (Option 1) peak fluvial depth 1:100 year AEP climate change (30%)
August 2018
wood.
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231700 231800 231900 232000

382300 382200

0+130 0+117 0+093 0+082 0+068 0+041 0+022 0+000

527 525 522 521 519 518 517 516 515 514 513 576 575

Key

- DCO limit
- Land parcel
- 1D model extent
- Viaduct pier
- Results point
- Hydraulic connector
- Embankment outline
- Cross section line
- Compensation storage area (Option 1)
- OS Mastermap

Peak flood depth difference (m) for 1:100 year AEP fluvial climate change (30%)

- < -0.1
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 to -0.005
- No Change
- 0.005 - 0.01
- 0.01 - 0.05
- 0.05 - 0.1
- > 0.1

0 20 40 60 m

Scale at A3: 1:1,000

Wylfa Newydd
DCO
Hydraulic Modelling

Figure 7.23
A5025 Llanfachraeth 'with bypass and floodplain compensation' (Option 1) depth difference for 1:100 year AEP climate change (30%)

August 2018

wood.

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Appendix C Inundation and depth difference maps (Option 2)

Figure 7.24 and Figure 7.25

231700
231800
231900
232000
382300
382200

0+000
0+022
0+041
0+068
0+082
0+093
0+117
0+130

527
525
522
521
519
518
517
516
515
514
513
576
575

Key

- DCO limit
- Land parcel
- 1D model extent
- Viaduct pier
- Results point
- Hydraulic connector
- Embankment outline
- Cross section line
- Compensation storage area (Option 2)
- Potential compensation area only (Area = 500m²)
- OS Mastermap

Peak flood depth (m)
With bypass and floodplain compensation (Option 2)
Combined fluvial and tidal climate change

- < 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 20 40 60 m
Scale at A3: 1:1,000

Wylfa Newydd
DCO
Hydraulic Modelling

Figure 7.24
A5025 Llanfachraeth 'with bypass and floodplain compensation' (Option 2) peak fluvial depth 1:100 year AEP climate change (30%)

August 2018

wood.

231700
231800
231900
232000
382300
382200
N
0+000
0+022
0+041
0+068
0+082
0+093
0+117
0+130
517
518
519
513
514
515
516
521
522
525
527
575
576
Key
DCO limit
Land parcel
1D model extent
Viaduct pier
Results point
Hydraulic connector
Embankment outline
Cross section line
Compensation storage area (Option 2)
OS Mastermap
Peak flood depth difference (m) for 1:100 year AEP fluvial climate change (30%)
< -0.1
-0.1 to -0.05
-0.05 to -0.01
-0.01 to -0.005
No Change
0.005 - 0.01
0.01 - 0.05
0.05 - 0.1
> 0.1
0
20
40
60 m
Scale at A3: 1:1,000

Wylfa Newydd
DCO
Hydraulic Modelling
Figure 7.25
A5025 Llanfachraeth 'with bypass and floodplain compensation' (Option 2) depth difference for 1:100 year AEP climate change (30%)
August 2018
wood.
R:\Projects\35989 Wlyfa NNB Modelling\Design\Drawings (E&I created)\Task51_A5025\35989-Lon648.mxd Originator: jacqui.parkin

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WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

Appendix 1-9 Updated Modelling to Include the Possible Blockage of Culverts within Dalar Hir

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00204

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Contents

Appendices

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1 Introduction

1.1 Purpose of this report

1.1.1 This report provides a response to a request for further information by the Examining Authority at Issue Specific Hearing (ISH) 5 on Biodiversity (Coastal Change, Climate Change, Transboundary Impacts) on 11th January 2019.

1.1.2 The request for further information by the Examining Authority followed an indication by Natural Resources Wales (NRW) that it felt that the lack of blockage modelling at the Dalar Hir Park and Ride site was a gap within the FCA Addendum [REP2-372] that needed to be addressed.

1.2 Scope of this report

1.2.1 This report presents the results of blockage modelling at the Dalar Hir Park and Ride that has recently completed by Horizon in response to the Examining Authority's request.

1.2.2 This report will describe the approach taken to defining the degree of blockage to be assessed, the assessment of blockage itself and the results of the blockage assessment. To ensure full comparison, blockage analysis for both the baseline and with-scheme scenarios are presented. Finally, the implications of blockage are considered in light of the design of the Dalar Hir Park and Ride within the DCO application and any implications for the FCA Addendum.

2 Blockage Assessment

2.1 TAN15 Requirements

2.1.1 Appendix 1 of TAN15 *Development and Flood Risk* notes in Section B paragraph A1.6 (*Assessing flood consequences*) states that:

> *When assessing the consequences of flooding associated with a proposed development it is important to recognise that during extreme flood events the landscape often changes physically. Rivers can change their course, trees can be uprooted and along with other debris can be swept down the river systems. Such debris can sometimes cause a damming effect on bridges, hedgerows, fence-lines and at the entrance to culverts. While this may in itself cause flooding upstream it can also lead to surge flows when those hedgerows, fence-lines or bridges give way under the pressure of the retained flood water. Therefore, although this is usually a matter for pragmatic judgement, consideration should be given to the possibility of flooding caused by blockage and particular attention given to the flooding consequences of such blockage on the development.*

2.1.2 Item 17 of paragraph A1.17 also states that '*all potential sources of flooding to include potential blockages'* should be comprehensively presented within the FCA, noting later in paragraph A2.3 that blockage might be caused by a lack of maintenance within watercourses and culverts.

2.1.3 It is within this context that NRW wanted to see the results of blockage analysis at the proposed Dalar Hir Park and Ride site, particularly in light of the sensitivity identified in the FCA Addendum. NRW's concern was not with the risk of debris generated from outside of the site, but more specifically with that which might be generated within the site.

2.2 Approach taken to Blockage Assessment

2.2.1 Blockage had been omitted from the FCA Addendum, as the site was to be manned on a 24hr basis and there would therefore be an inspection and maintenance regime, to include the watercourse and culverts, such that the risk of blockage was considered low.

Degree of Blockage

2.2.2 Rather than assess a range of blockage scenarios within the site, and overthink the potential sources and types of debris that might be generated, a simple but highly conservative approach has been taken whereby a 100% blockage of the culverts on Nant Dalar Hir has been applied to existing hydraulic models.

2.2.3 This degree of blockage has been applied to both the baseline, i.e. undeveloped, scenario in addition to the proposed with-scheme model scenario.

2.2.4 Provision of a 100% scenario will provide an upper envelope for the risk profile within the site both before and after development and allow comparison of the residual risks to the site at baseline and following development.

Assessment of Blockage

2.2.5 The assessment of the blockage simply applied the above blockage amount to the culvert beneath the A5 on Nant Dalar Hir.

2.2.6 The baseline and with-scheme models were run with a blockage scenario for the 1% AEP event with a 15% allowance for climate change, which is the same hydrology that was used within the modelling that supported the FCA Addendum. The model was run for the full duration of the hydrograph, to ensure that there was no underestimation because of missing the tail of the hydrograph. No other changes were applied.

3 Blockage Assessment Results

3.1 Modelling Results

3.1.1 The tables below present the predicted water levels at three key Model Output (MO) Points within the site. The MO Points selected are identified below (described from upstream to downstream) and they are illustrated in Figure 4.1b, taken from Appendix F8-1-3 from the original FCA for the Dalar Hir Park and Ride [APP-281].

1. DALA12 – This MO Point is located on the northern boundary of the site, immediately adjacent to one of the flood attenuation areas.
2. DALA21 – This MO Point is located along the southern boundary of the site, just upstream of the culverts beneath the A5/A55. It is representative of the flood levels within the site and the flood risk posed to the car parks and spine road.
3. DALA26 – This MO Point is located immediately downstream of the site in land between the A55 and A5. This area was shown to benefit from the flood mitigation proposed for the scheme, indicating that there was a reduced risk to the A5 and A55, and its selection will demonstrate that this is maintained under a blockage scenario.

Baseline Scenario

3.1.2 Table 3-1 presents flood levels at the key MO Points described above in the baseline (undeveloped) scenario. As can be seen from the predicted flood levels under a blockage scenario, blockage of the A5 culvert results in higher flood levels within the site that have reached a constant level of 16.48m AOD. There would appear to be a key flow mechanism created from the site over the A5 into the land between the A5 and A55, which results in flood levels equalising with those within the site itself.

3.1.3 Levels downstream, although not shown in Table 3-1, reduce by approximately 0.05m as a result of the increased storage of flood water within the site. Baseline flood extent and depths under the 1% AEP event are presented in Figure 6.57 within Appendix 4-1. Note, where minor encroachment is indicated within Car Park 1, this is a result of interpolation between points within the hydraulic model that does not materially affect the flood levels within the site.

Table 3-1 Predicted free flow and with blockage flood levels, baseline scenario

Location	Flood Levels, 1% AEP (m AOD)		Difference (m)
	Free flow	100% Blockage	
DALA12	16.28	16.48	+0.20
DALA21	16.20	16.48	+0.28
DALA26	15.58	16.48	+0.90

With-development Scenario

3.1.4 Table 3-2 presents predicted flood levels for a 100% blockage scenario at the key MO Points described above in the with-scheme (developed) scenario and compares them to the baseline. As can be seen from predicted flood levels in Table 3-2, under a blockage scenario under the proposed scheme there is a reduction of 0.05m within the site relative to the baseline under the same scenario.

3.1.5 Based on the flat flood levels between DALA25 and DALA12, the with-scheme blockage scenario exhibits the same flow mechanism from the site over the A5 into the land between the A5 and A55, which results in flood levels equalising with those within the site itself.

3.1.6 With-scheme flood extent and depths under the 1% AEP event are presented in Figure 6.58 within Appendix 4-2. Note, where minor encroachment is indicated within Car Park 1, this is a result of interpolation between points within the hydraulic model that does not materially affect the flood levels within the site.

Table 3-2 Comparison of blockage flood levels, baseline versus with-scheme scenario

Location	Flood Levels, 1% AEP (m AOD)		Difference (m)
	Baseline, 100% Blockage	With-scheme, 100% Blockage	
DALA12	16.48	16.43	-0.05
DALA21	16.48	16.43	-0.05
DALA26	16.48	16.43	-0.05

3.2 Implications for Flood Risk

3.2.1 Further development of the design at Dalar Hir to mitigate the flood risk has been carried out which includes the provision of flood attenuation areas and the raising of levels at Car Park 1 (central, within the site) and Car Park 5 (south east corner of the site) to at least 16.45m AOD. Similarly, the spine road will be raised to at least the same level, and so will remain free from flooding under this residual risk scenario. These measures will be incorporated in the ES Addendum to be submitted at Deadline 6 (19 February 2019).

3.2.2 There will remain a need to inspect and maintain the culverts beneath the A5 and A55, to minimise the risk of blockage and so avoid the potential for the effects of blockage to manifest themselves within the site.

3.2.3 As a result of the development of the design at Dalar Hir, and as the site will remain free from flooding and will not increase flood risk elsewhere, the proposals are considered to be compliant with TAN15.

4 Conclusions

4.1.1 Blockage modelling has been undertaken at the proposed Dalar Hir Park and Ride site in response to a request by the Examining Authority at an Issue Specific Hearing on 11th January 2019.

4.1.2 A 100% blockage scenario was assessed to provide an upper range to the simulated flood risk envelope within the site. The results of the blockage assessment for both the baseline and with-scheme scenarios indicates that blockage results in both an increase in flood levels within the site, but also a flattening that extends to the land south of the A5 but not extending as far as the A55.

4.1.3 This pattern of flooding suggests that the storage within the site has been utilised and that flood water has spilled into the land immediately southwards. In effect, the capacity of the site has been reached and it would be unlikely that flood levels would increase much further in the event that higher flows were experienced under similar circumstances.

4.1.4 Predicted flood levels in this scenario reach 16.43m AOD when the scheme is in place. Proposed minimum levels of Car Park 1 and Car Park 5 are 16.45m AOD, which suggests that in the event of a blockage, which is considered a residual flood risk, the site would remain essentially flood free.

4.1.5 There remain minor benefits elsewhere as a result of the proposed scheme. Because the site will remain free from flooding and will not increase flood risk elsewhere, the proposals are considered to be compliant with TAN15.

Appendix 4-1 Baseline flood risk with blockage

232000
233000
234000
379000
378000
N
Bodowyr
Tre-Angharad
A55
Bryn Elen
Pant Y Fedwen
Llanfihangel yn Nhowyn
DALA82
DALA71
DALA81
DALA84
DALA72
DALA83
DALA85
DALA73
DALA86
DALA46
DALA48
DALA47
DALA45
DALA49
DALA33
DALA35
DALA3
DALA36
DALA37
DALA4
DALA41
DALA34
DALA11
DALA12
DALA5
DALA15
DALA39
DALA9
DALA40
DALA13
DALA50
DALA18
DALA25
DALA42
DALA22
DALA24
DALA2
DALA7
DALA27
DALA6
DALA44
DALA23
DALA43
DALA28
DALA29
DALA30
DALA88
DALA74
DALA87
DALA90
DALA75
DALA89
DALA91

Key

Peak flood depth (m)
Base case
100% Blockage Culvert A55
1:100 year AEP fluvial
Climate change (0%)

- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

Notes:
The depths represent the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Model run date: 25/01/2019
Corresponding data:
35989-C1459_Base case
_Task_70_Fluvial_F100cc0pc.xlsx

0 100 200 300 400 m
Scale at A3

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Figure 6.57
Dalar Hir base case peak fluvial flood depth 1:100 year AEP plus climate change (0%), 100% Blockage A55 Culvert

January 2019 35989_Lon663i1 ghimb

file: \\atl5-fs7.global.amec.com\shared2\Projects\35989 Wylfa NNB Modelling\Design\Task70_DHirBlockage\Civ_A55_Blockage\GIS\35989-70_lon663_Fig6.57_BlockageBase_100cc00pc.mxd

Appendix 4-2 With-scheme flood risk with blockage

232000
233000
234000
379000
378000
N
Bodowyr
Tre-Angharad
A55
Bryn Elen
Pant Y Fedwen
Llanfihangel yn Nhowyn
DALA82
DALA71
DALA81
DALA84
DALA72
DALA83
DALA73
DALA85
DALA86
DALA46
DALA48
DALA47
DALA45
DALA49
DALA3
DALA35
DALA33
DALA36
DALA41
DALA34
DALA37
DALA4
DALA11
DALA12
DALA38
DALA39
DALA9
DALA40
DALA14
DALA13
DALA50
DALA18
DALA25
DALA42
DALA22
DALA24
DALA2
DALA7
DALA27
DALA6
DALA44
DALA26
DALA43
DALA28
DALA30
DALA88
DALA74
DALA87
DALA90
DALA75
DALA89
DALA91

Key

Peak flood depth (m)
With Dev Mitigation Option-1A
100 % Blockage Culvert A55
1:100 year AEP fluvial
Climate change (0%)

- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00
- Model boundary
- 1D Model Domain
- Site Boundary
- Results Point
- Results Line
- OS Mapping

Notes:
The depths represent the maximum depth achieved. The flood prediction does not represent a moment in time as maximum depths can be achieved at different times.

Model run date: 25/01/2019
Corresponding data:
35989-C1460_Dev_Mit-1A
_Task_70_Fluvial_F100cc0pc.xlsx

0 100 200 300 400 m
Scale at A3

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Figure 6.58
Dalar Hir development & Mitigation Option-1A peak fluvial flood depth 1:100 year AEP plus climate change (0%), 100% Blockage A55 Culvert

January 2019 35989_Lon664i1 ghimb

NOT PROTECTIVELY MARKED

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Appendix 1-10 Supplementary Sewage (Bacteria) Modelling for the Wylfa Newydd Project

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00199

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1 Supplementary sewage (bacteria) modelling for the Wylfa Newydd DCO Project

1.1 Background

1.1.1 This technical note contains Horizon Nuclear Power Wylfa Limited's ("Horizon's") response to actions set by the Examining Authority during the Issue Specific Hearing on 10 January 2019.

1.1.2 The Examining Authority requested further information on the effect of sewage on Cemaes Bathing Water following a request from Natural Resource Wales (NRW) through their Written Representation [REP2-325].

1.1.3 This technical note provides a summary of the supplementary work undertaken since the DCO application to address NRW's concerns.

1.1.4 The discharges of treated sewage effluent from the western breakwater is the subject of an application for a water discharge activity which NWR are currently determining PAN-002428.

1.2 Information provided in the DCO application

1.2.1 Chapter D13 [APP-132] of the Environmental Statement included particle tracking modelling results and assessment of two sewage effluent discharges proposed during the construction phase of the Wylfa Newydd DCO Project. Assessments included assessing the potential effects on the Cemaes Bathing Water.

1.2.2 One outfall was located at the northern end of the western breakwater, and the other to the west of Wylfa Head (known as the Site Campus outfall). The modelling was based on a continuous discharge (18.5l/s) from each of the outfalls of secondary treated (no disinfection) effluent with a mean bacterial concentration of 3 x 10^6 Colony Forming Units (CFU)/100ml. The model was run over a typical spring-neap-spring tidal cycle, and undertaken using a worst-case approach, i.e. without the influence of wind or waves in the model.

1.2.3 The combined model results for each of the outfalls predicted that there would be a cumulative increase of 29.3CFU/100ml (11.8CFU/100ml from the outfall at the northern end of the western breakwater and 17.5CFU/100ml from the outfall west of Wylfa Head).

1.2.4 Drawing upon the worst-case modelling output, the assessment of potential effects predicted that the sewage effluent would quickly disperse to background levels within the marine environment. It was predicted that the magnitude of change would be negligible and that the discharges would not result in a significant increase in Escherichia coli (E.coli) and Intestinal enterococci (I.enterococci) reaching the Cemaes Bathing Water.

1.2.5 It was therefore considered that there would be a negligible effect on EU-designated bathing waters through changes in water quality from the discharge of treated sewage effluent during construction.

1.3 Supplementary information

1.3.1 Horizon has continued to engage with NRW, through the DCO examination and Environmental Permitting, to further assess the potential risk to the Cemaes Bathing Water as a result of the Wylfa Newydd DCO Project and in-combination with the existing Dwr Cymru – Welsh Water (DCWW) discharge.

1.3.2 This report provides the output of additional detailed numerical modelling (advection dispersion modelling) undertaken in order to assess the cumulative impact of the two proposed construction discharges and the DCWW discharge (combined with the Site Campus effluent) on water quality at the designated Cemaes Bathing Water, to the east of Wylfa Head.

1.3.3 For the purposes of this assessment, the Horizon Delft3D hydrodynamic model has been utilised for advection dispersion modelling rather than particle tracking modelling. The hydrodynamic model has been developed during the period 2010 to 2016, and is underpinned by an extensive bespoke marine and aerial survey dataset for the purposes of model build, calibration and validation. The model was subject to a detailed 2-stage peer review in 2016, and was subsequently applied to the assessment of cooling water thermal dispersion, Total Residual Oxidant dispersion and a range of dredging plume and coastal processes (shear stress) studies.

2 Model Background

2.1.1 The hydrodynamic and dispersion model, operating in the Delft3D software environment, represents part of the Irish Sea with a particular focus on the waters around Wylfa Head and Cemaes Bay, where model resolution was set to 23m. Further afield, the model resolution decreases to 70m and then to 350m. The model is shown in Figure 2-1 and Figure 2-2.

Figure 2-1 Horizon's Wylfa coastal model, full extent of model grids (shaded grey area representing 70m grid; and shaded blue area 350m grid)

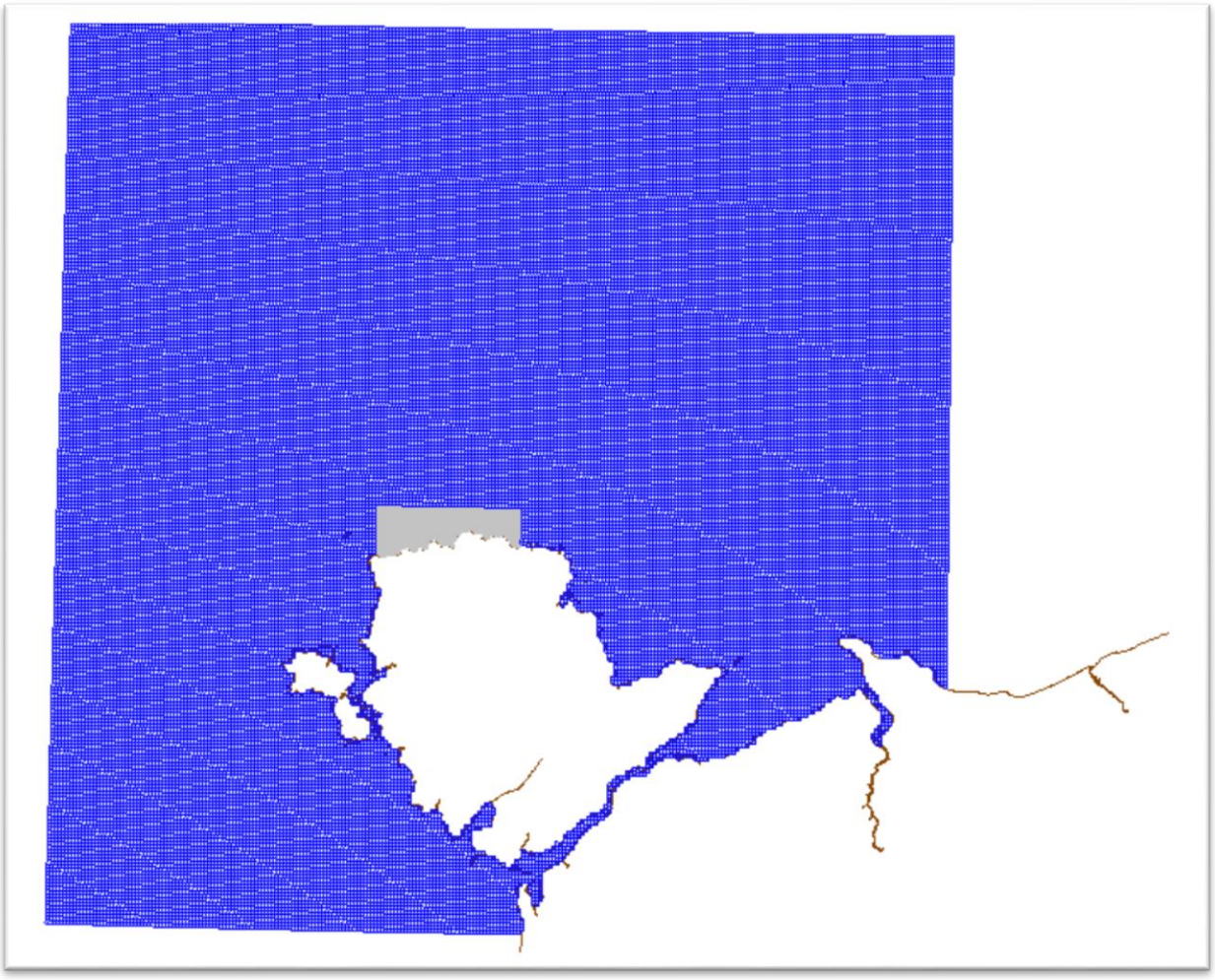
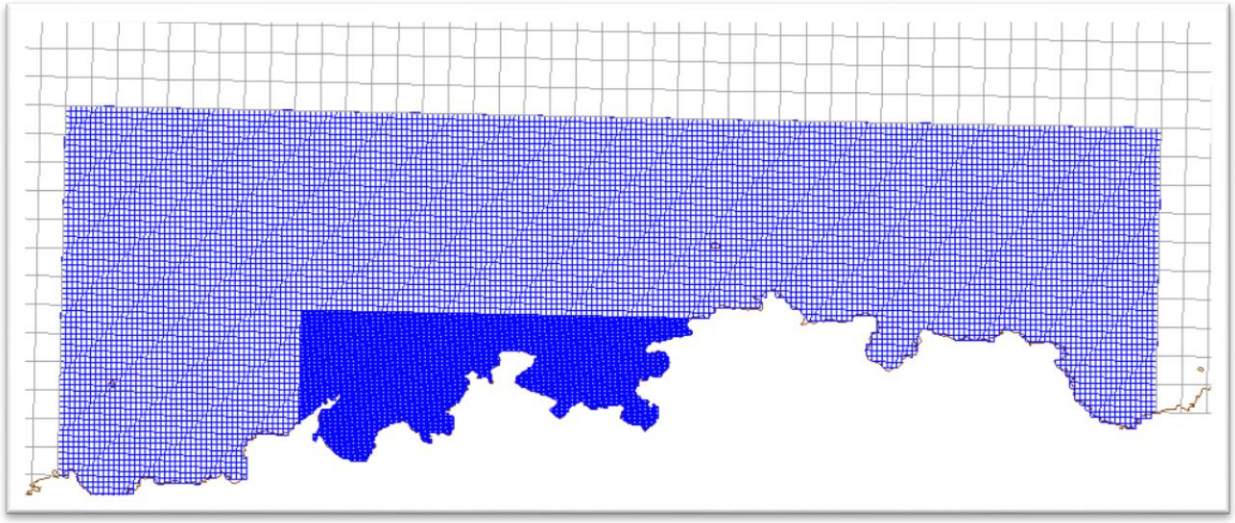


Figure 2-2 Horizon's Wylfa coastal model, zoomed in view of model grids (shaded dark blue area represents 23m grid; shaded light blue area 70m grid



2.1.2 Bathymetry for the model was obtained from existing UK Hydrographic Office survey data and from bespoke multibeam surveys of the area around the north Anglesey coast. The local multibeam survey dataset is shown in Figure 2-3 and the final model bathymetry is shown in Figure 2-4.

Figure 2-3 Horizon's bespoke multibeam bathymetry data

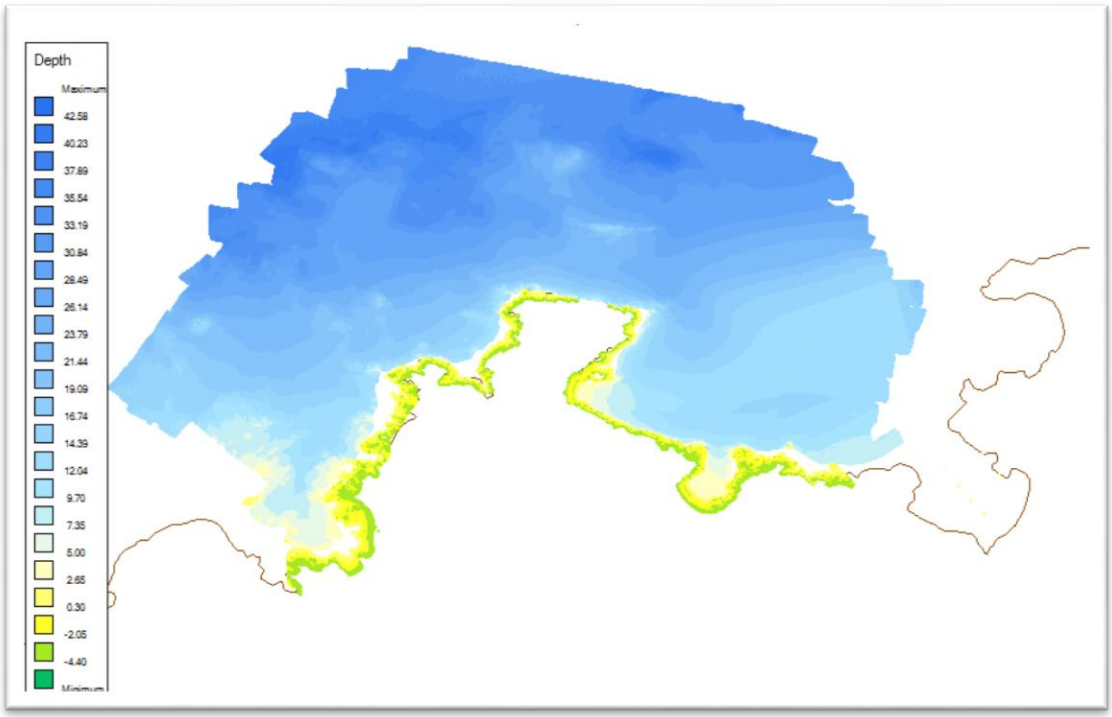
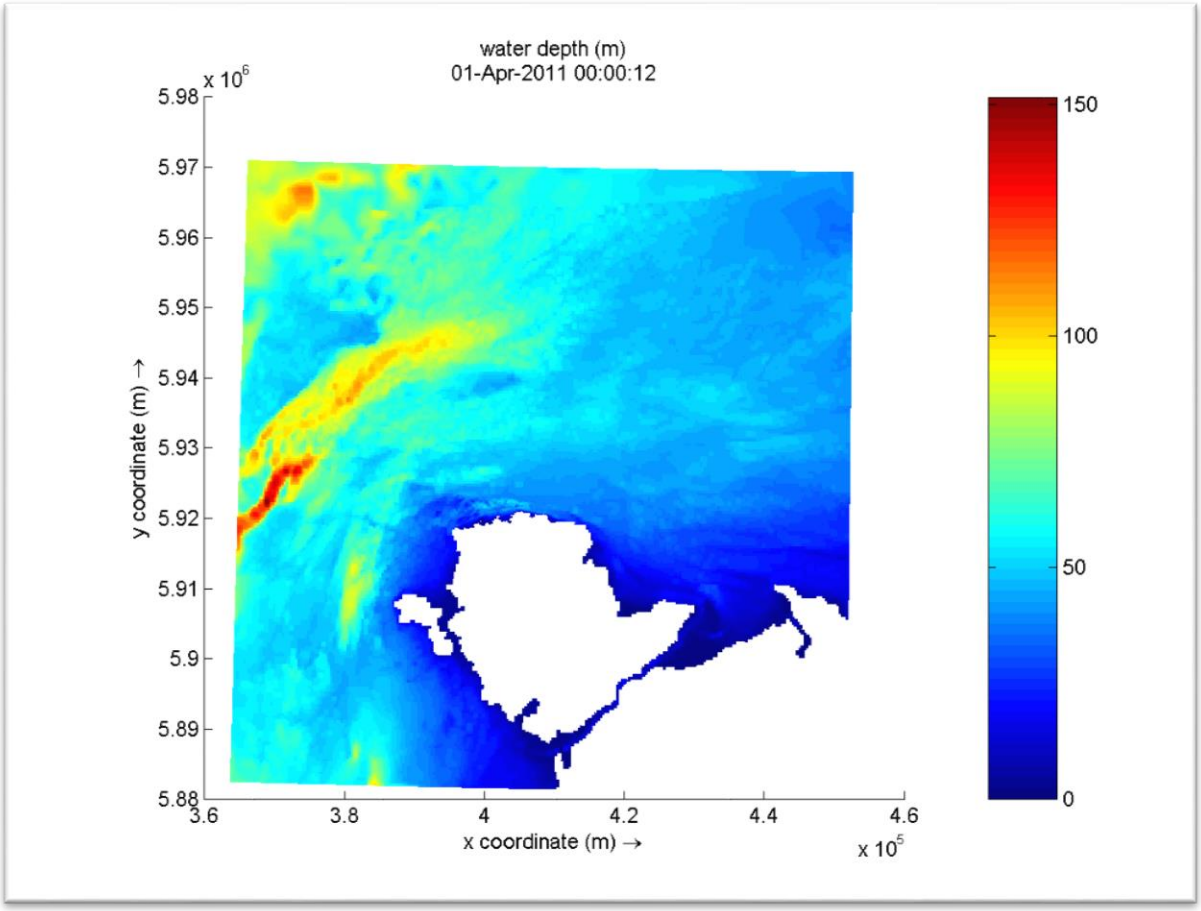
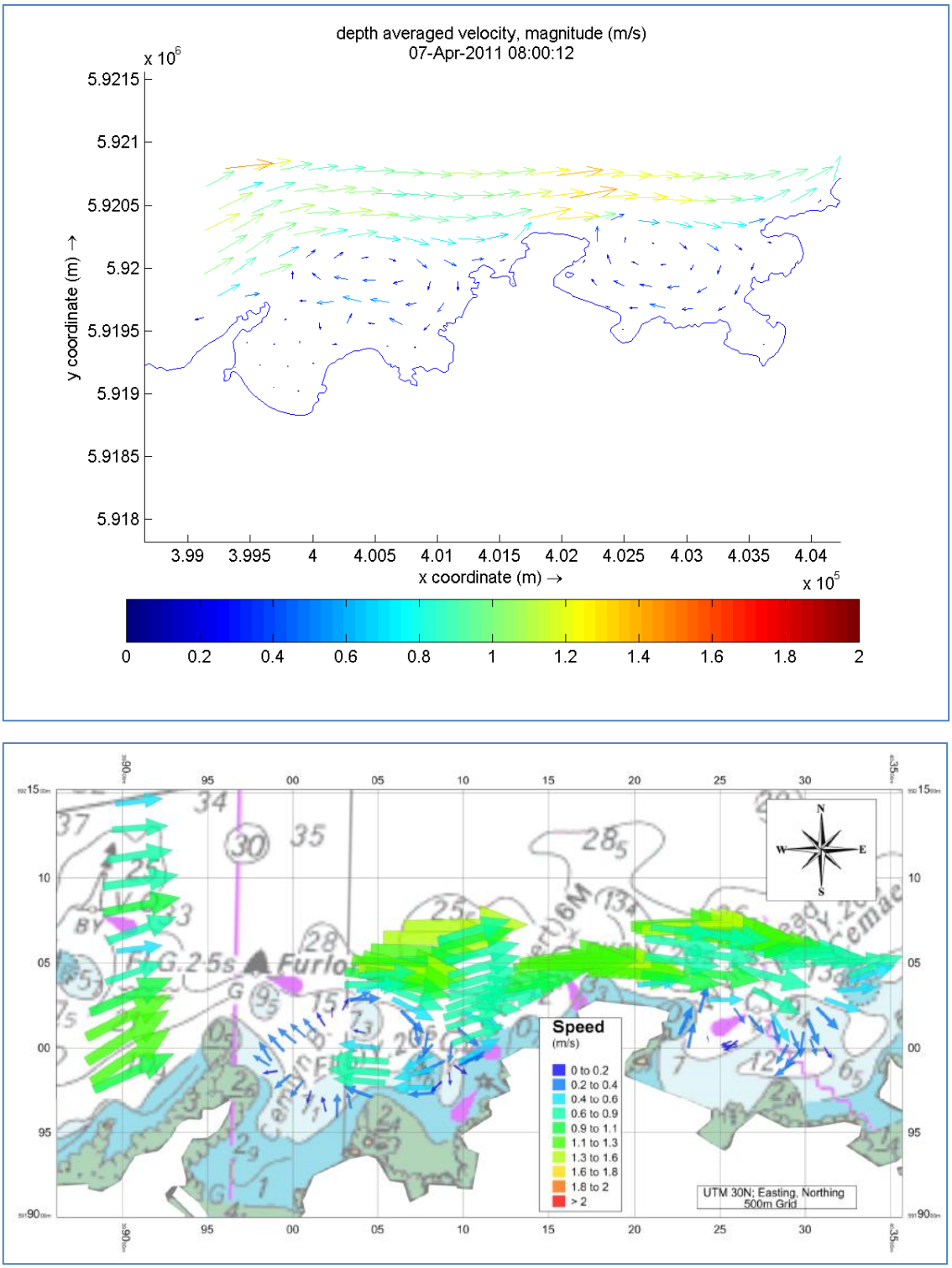


Figure 2-4 Final model bathymetry



2.1.3 An extensive model calibration process was undertaken against a wide range of survey data, including bespoke water level and current measurements around the Wylfa Head and offshore areas. The model calibrated strongly against the available water level data, and against synoptic velocity data where a complex set of gyres either side of Wylfa Head are correctly reproduced by the model. An example of this synoptic comparison is shown in Figure 2-5.

Figure 2-5 Example of synoptic comparison, model (top) and survey data (bottom)



2.1.4 A series of dye releases was undertaken to verify the model hydrodynamics and to allow for calibration of the model dispersion parameters. The robust

model performance when compared with the dye data gives confidence in the model skill in terms of both hydrodynamics and dispersion.

2.1.5 Finally, the model was calibrated against aerial thermal imagery of the (then) Existing Power Station thermal plume discharge, thus ensuring robust model performance for advection and dispersion as well as heat exchange processes.

2.1.6 The model build, calibration and validation process is described in detail in [RD1].

2.2 Model audit

2.2.1 ABP Marine Environmental Research (ABPmer) was commissioned to undertake a detailed 3rd party audit of the modelling, which it undertook in two stages [RD2]. The audit considered:

- the choice of model software;
- the model build (extents, resolution, bathymetry, boundary data);
- the model calibration (including water levels, flow velocities, dispersion); and,
- the model validation (including water levels, flow velocities, dispersion).

2.2.2 The audit process was carried out in two stages to allow for feedback between the initial findings of the process and the team developing the model. This engagement process was found by the auditors to be extremely productive, allowing improvements to be made in the demonstration of the model performance. As a result, the model was found to be Fit for Purpose for the key purpose of investigating the thermal dispersion requirements of the marine consent.

2.3 Modelling of the sewage effluents

2.3.1 The Delft3D model was configured as follows:

- western breakwater included in model simulations.
- Model run in 3D mode as per previous work.
- Three treated sewage effluent discharges modelled, namely Breakwater North (BWN), Site Campus (Campus) and DCWW, with the Site Campus and DCWW sharing the same outfall location. Outfall locations are shown in Figure 2-6. Flow rates are described in Table 2-1. As an additional sensitivity test to the location of the DCWW discharge, an alternative (“DCWW-Alt”) outfall was located approximately 50m to the north of the original location.
- E.coli and I.enterococci indicator bacteria were both included. Concentrations and die-off are described in Table 2-1.
- The model simulation time-frame was 28 days, allowing 14 days to achieve dynamic equilibrium and 14 days of a full neap-spring-neap

tide cycle for data output, which is considered sufficient to capture any variation within the typical tidal cycle.

- No wind was included for the main application model runs, however a worst case onshore wind sensitivity simulation was undertaken. The onshore wind direction was northerly, agreed with NRW on the basis that effluent would be carried around Wylfa Head by the dominant tidal flows, and then "driven" into Cemaes Bay by the northerly wind. The selected wind speed (4.7m/s, or 9.14 knots) was determined and agreed during previous hydrodynamic modelling as being the mean speed for wind from the northerly sector as recorded at RAF Valley during the period 2003 to 2012.

Figure 2-6 Modelled outfall locations

Table 2-1 Modelled effluent parameters

Discharge	Release location	Flow rate l/s	E.coli count per 100ml	E.coli T90 value (constant)	I. enterococci count per 100ml	I. enterococci T90 (constant)
Horizon - Main Site "BWN"	Tip of northern breakwater 234475 394323	18.5*	100,000	40 hours	40,000	80 hours
Horizon - Site Campus "Campus"	Wylfa head, western side 235237 394373	18.5*	100,000	40 hours	40,000	80 hours
DCWW Wylfa Head- onshore "DCWW"	Wylfa head, western side 235237 394373	18*	100,000	40 hours	40,000	80 hours
DCWW Wylfa Head- alternative "DCWW-Alt"	Wylfa head, western side 235240 394417	18*	100,000	40 hours	40,000	80 hours

** All modelled flow rates are continuous Full Flow to Treatment (FFT). FFT is the design maximum flow which may be carried through the treatment process and is significantly higher than the usual Dry Weather Flow (DWF) treated at the works. FFT has been considered in this study as a reflection of the highly conservative approach adopted throughout.*

2.4 Determination of effluent parameters

2.4.1 Robust model predictions regarding bacteria concentrations at the Cemaes Bathing Water are dependent on a number of factors, as follows:

- Sound representation of hydrodynamic flows. Calibrated and validated extensively as described above.
- Sound representation of effluent dispersion. Calibrated and validated extensively as described above.
- Correct definition of effluent parameters, namely flow rate (well defined), bacterial count and bacterial mortality.

2.4.2 The effluent parameters presented in Table 2-1 have been derived following extensive discussions between Horizon, DCWW and NRW.

Bacterial count

2.4.3 The values used are appropriate to secondary treated effluent. The values presented have been suggested by DCWW, and are based on conservative assessment of geomean values from extensive UK water industry experience underpinned by a wide range of sampling exercises described, for example, in [RD3].

2.4.4 DCWW has used similar values for modelling of other coastal secondary treated effluent discharge sites, which NRW has subsequently reviewed and approved.

Bacterial mortality

2.4.5 Bacterial mortality rates are defined in terms of T_{90}, i.e. the time taken (in hours) for the bacterial population to decrease by 90%.

2.4.6 The values applied in the current study have been developed over a number of DCWW modelling projects and were derived from the validation of models used in the recent Coastal Investigations Programme. The values were agreed by NRW as part of the Coastal Investigations Programme sign off for the modelling in each location and area. In particular, for studies along the north Wales coast, DCWW validated the models against bathing and shellfish water data using T_{90} as a variable. In these cases 40 hours for E.coli and 70 hours (*c.f.* 80 hours used in the present study) for I.enterococci gave the best fit for bathing season conditions.

2.4.7 During the course of this study, NRW requested sensitivity testing be carried out for reduced bacterial mortality rates, in-line with the generally conservative approach adopted throughout. T_{90} values for this simulation were therefore doubled to 80 hours and 160 hours for E.coli and I.enterococci respectively. It should be noted that these values are not supported by water industry experience or the scientific literature; they are simply a very conservative sensitivity test. The result of these tests are nonetheless of interest to the study.

3 Modelling Results

3.1.1 Results of the model applications and sensitivity studies are described below. Model outputs are presented in terms of timeseries of bacteria concentrations as predicted to occur at the Cemaes Bathing Water monitoring point. The actual values measured by physical sampling at this location would also include contributions from intermittent DCWW assets (storm discharges) and, significantly, diffuse inputs from the catchment, principally agriculture run-off. These inputs are not the subject of this study, which is intended purely to consider the continuous discharges identified above.

3.1.2 For context, Table 3-1 gives the regulatory standards under the revised Bathing Water Directive [RD4], by which bathing water quality is categorised.

Table 3-1 Bathing Water standards as defined in the revised Bathing Water Directive and Annexes

For coastal waters and transitional waters

	A	B	C	D	E
	Parameter	**Excellent quality**	**Good quality**	**Sufficient**	**Reference methods of analysis**
1	Intestinal enterococci (cfu/100 ml)	100 (3)	200 (3)	185 (4)	ISO 7899-1 or ISO 7899-2
2	Escherichia coli (cfu/100 ml)	250 (3)	500 (3)	500 (4)	ISO 9308-3 or ISO 9308-1

(1) Based upon a 95-percentile evaluation. See Annex II.
(2) Based upon a 90-percentile evaluation. See Annex II.
(3) Based upon a 95-percentile evaluation. See Annex II.
(4) Based upon a 90-percentile evaluation. See Annex II.

3.2 E.coli

3.2.1 Timeseries of predicted E.coli concentrations at Cemaes Bathing Water are shown in Figure 3-1. Note the y-axis scale, adjusted so that the timeseries profile can be seen clearly. It would be more usual to scale the y-axis in terms of the relevant water quality standards, and this has been done in Figure 3-2 in terms of the Excellent water quality standard for E.coli (250 CFU / 100ml). The resultant plot provides useful context.

3.2.2 Timeseries presented include the “combined” results, calculated by summing the BWN, Campus and DCWW outputs.

Figure 3-1 E.coli at Cemaes Bathing Water, full output period (top), intermediate tides (bottom)

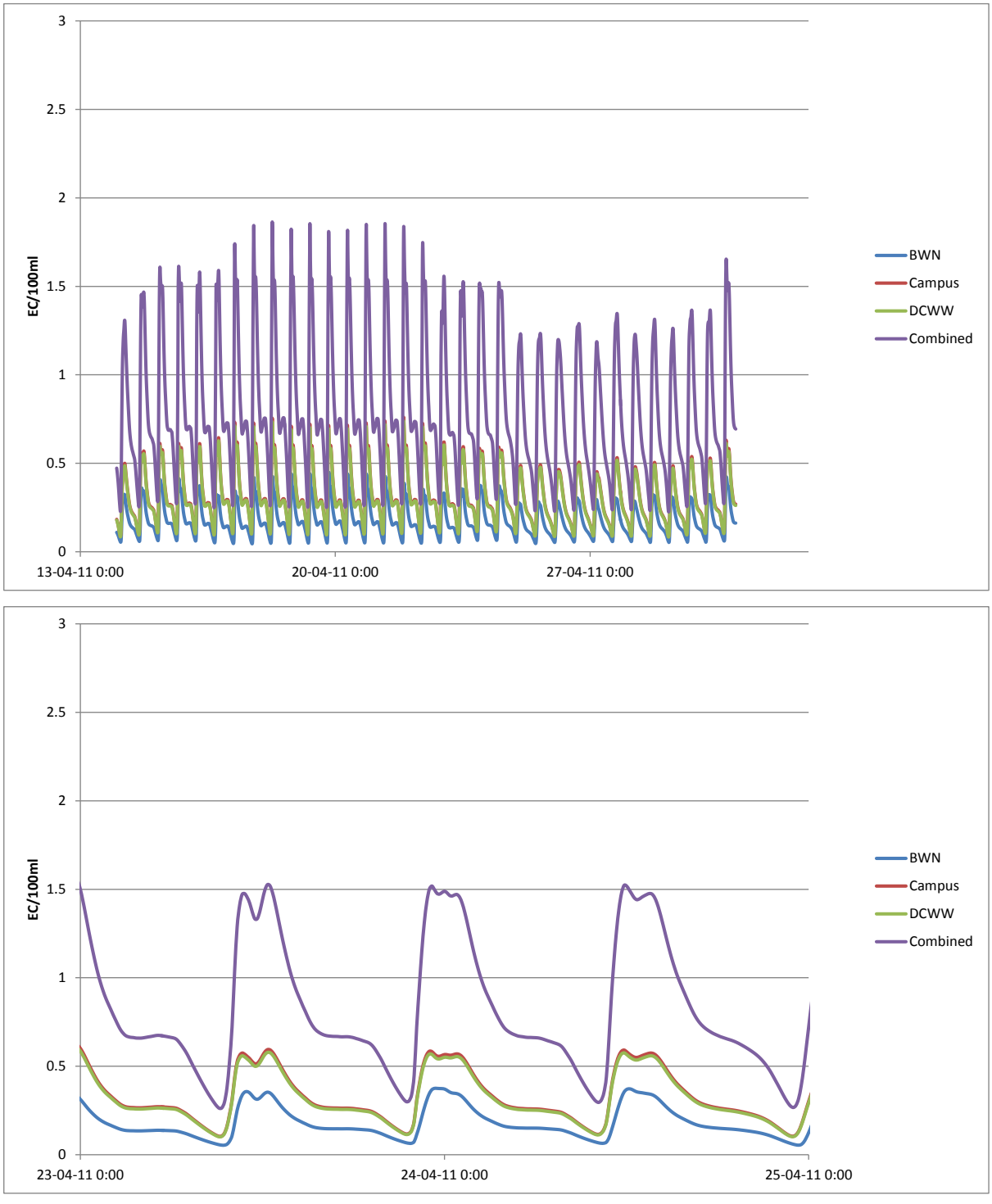
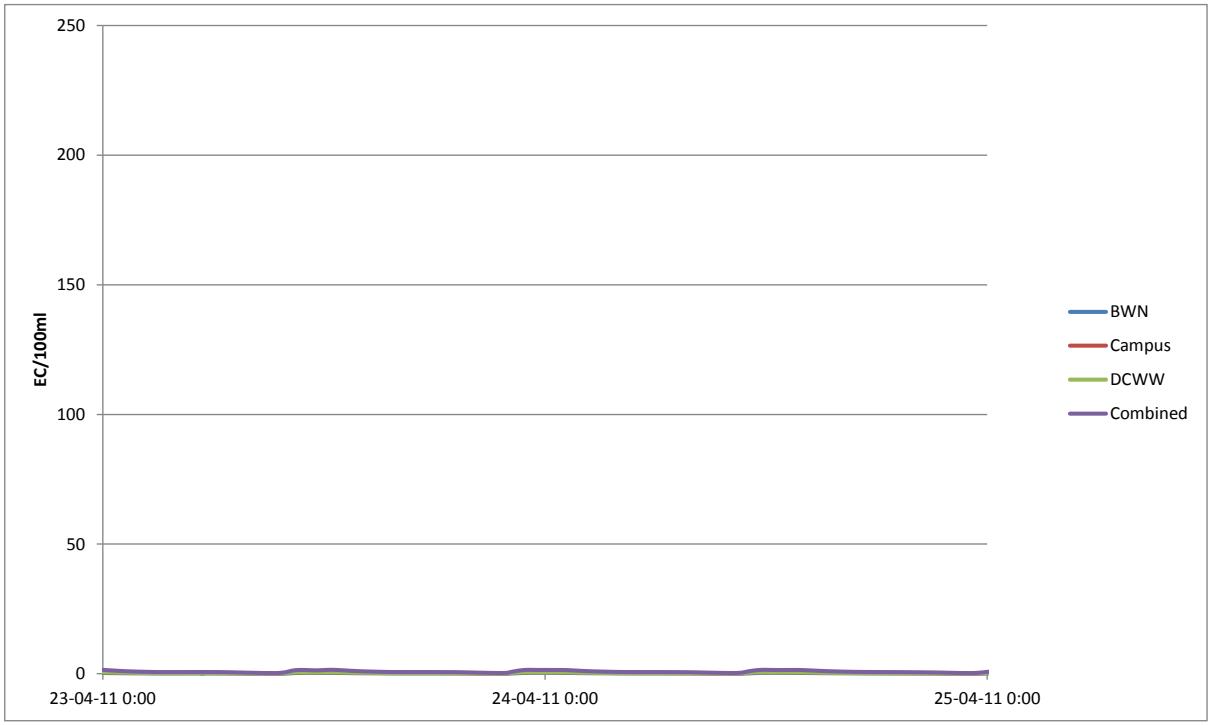


Figure 3-2 E.coli at Cemaes Bathing Water, y-axis scaled according to the rBWD Excellent water quality standard [RD4]



3.2.3 Predicted 95th percentile E.coli concentrations at Cemaes Bathing Water are as follows:

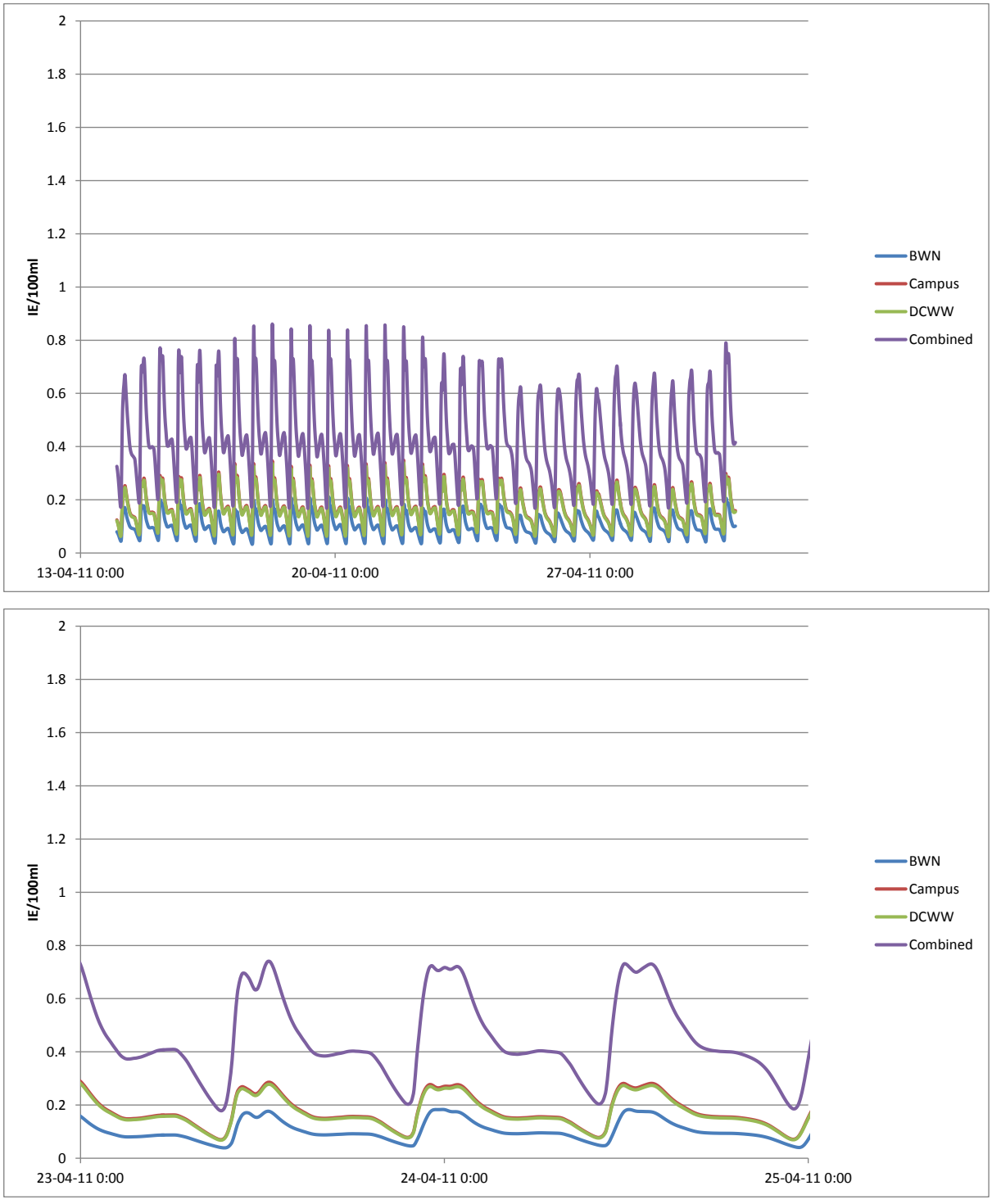
- BWN discharge – 0.35 CFU / 100ml
- Campus discharge – 0.60 CFU / 100ml
- DCWW discharge – 0.58 CFU / 100 ml
- Combined discharges – 1.53 CFU / 100ml

3.2.4 All of these values, timeseries and statistics, are very low in the context of the rBWD 95%ile standards (Excellent - 250 CFU / 100 ml; Good – 500 CFU / 100 ml) [RD4].

3.3 Intestinal enterococci

3.3.1 Timeseries of predicted I.enterococci concentrations at Cemaes Bathing Water are shown in Figure 3-3. Timeseries presented include the “combined” results, calculated by summing the BWN, Campus and DCWW outputs

Figure 3-3 I.enterococci at Cemaes Bathing Water, full output period (top), intermediate tides (bottom)



3.3.2 Predicted 95th percentile I.enterococci concentrations at Cemaes Bathing Water are as follows:

- BWN discharge – 0.17 CFU / 100ml

- Campus discharge – 0.28 CFU / 100ml
- DCWW discharge – 0.27 CFU / 100 ml
- Combined discharges – 0.72 CFU / 100ml

3.3.3 All of these values, timeseries and statistics, are very low in the context of the rBWD 95%ile standards (Excellent - 100 CFU / 100 ml; Good – 200 CFU / 100 ml) [RD4].

4 Model Sensitivity Testing

4.1.1 A range of sensitivity tests were agreed with NRW, in order to maximise confidence in, and understanding of, the model predictions. The results of the sensitivity testing are presented below.

4.2 Sensitivity testing – bacterial mortality (T_{90} values)

4.2.1 Sensitivity testing for T_{90} values, where T_{90} values were doubled to 80 hours and 160 hours for E.coli and I.enterococci, was undertaken in order to test the sensitivity of the model predictions to a very large change in the bacteria die-off rate. Results are shown in Figure 4-1 for E.coli and Figure 4-2 for I.enterococci.

Figure 4-1 E.coli at Cemaes bathing water, T90 sensitivity

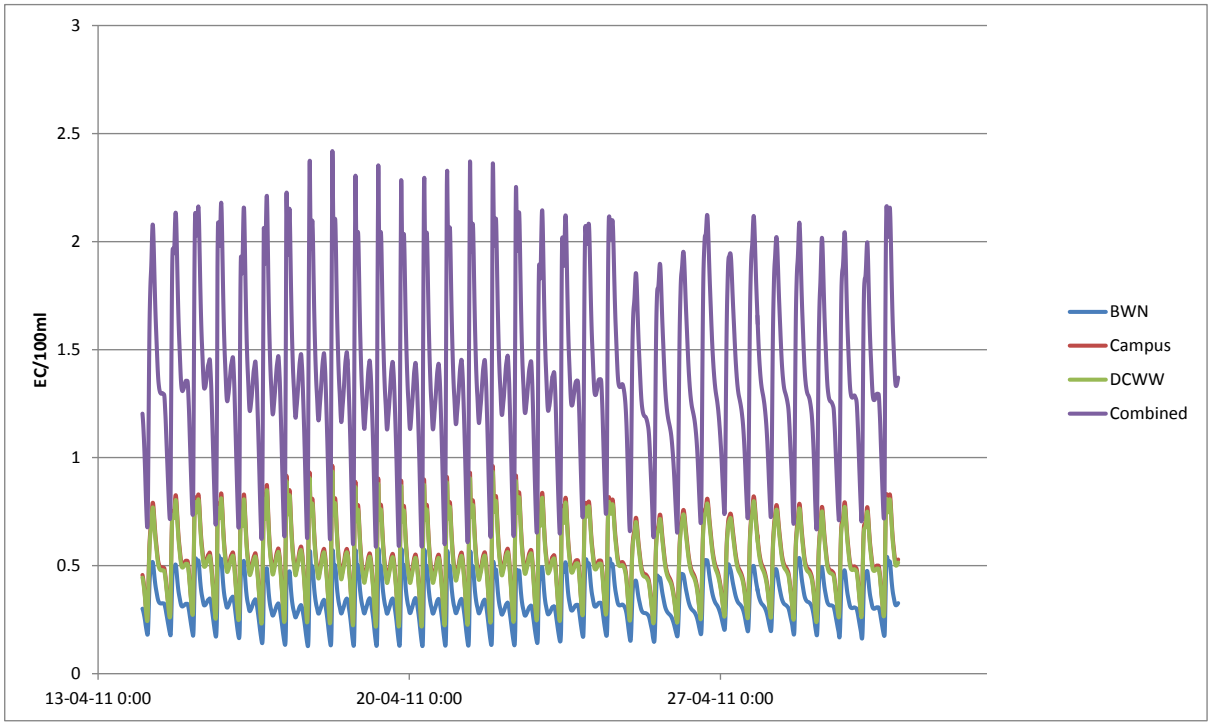
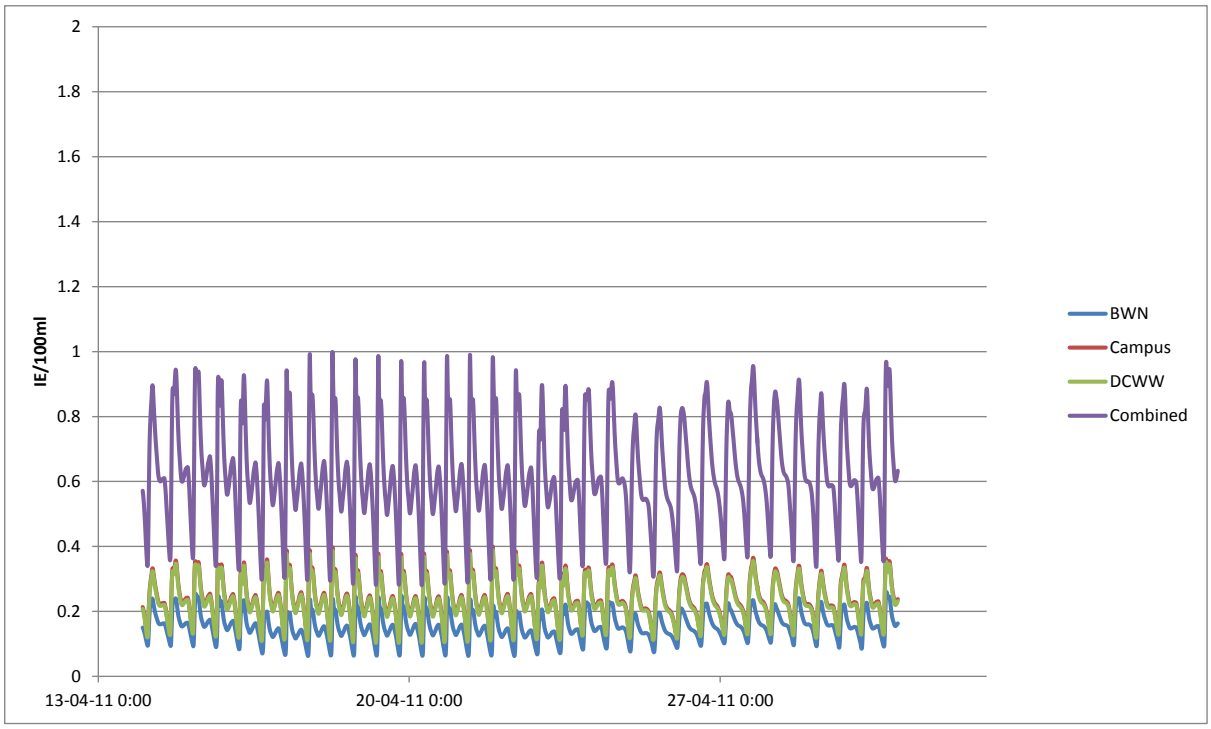


Figure 4-2 I.enterococci at Cemaes bathing water, T90 sensitivity



4.2.2 Predicted 95th percentile E.coli concentrations at Cemaes Bathing Water are as follows (original values in parentheses):

- BWN discharge – 0.51 (0.35) CFU / 100ml
- Campus discharge – 0.80 (0.60) CFU / 100ml
- DCWW discharge – 0.78 (0.58) CFU / 100 ml
- Combined discharges – 2.08 (1.53) CFU / 100ml

4.2.3 Predicted 95th percentile I.enterococci concentrations at Cemaes Bathing Water are as follows (original values in parentheses):

- BWN discharge – 0.23 (0.17) CFU / 100ml
- Campus discharge – 0.34 (0.28) CFU / 100ml
- DCWW discharge – 0.33 (0.27) CFU / 100 ml
- Combined discharges – 0.88 (0.72) CFU / 100ml

4.2.4 From the timeseries plots and statistical values, it can be seen that the increases in bacterial concentrations associated with doubling the T_{90} times are very small (<<1 CFU / 100ml in all instances) and not significant in terms of compliance with rBWD standards [RD4].

4.3 Sensitivity testing – northerly wind

4.3.1 Sensitivity testing for worst case wind conditions, whereby a continuous onshore northerly wind was applied to the model simulations. In keeping with the conservative approach adopted throughout, this simulation did not include the effect of wind generated waves, which would tend to reduce bacterial concentrations through increased dispersion and turbulent mixing. The results are presented in Figure 4-3 for E.coli and Figure 4-4 for I.enterococci.

Figure 4-3 E.coli at Cemaes Bathing Water, northerly wind sensitivity simulation

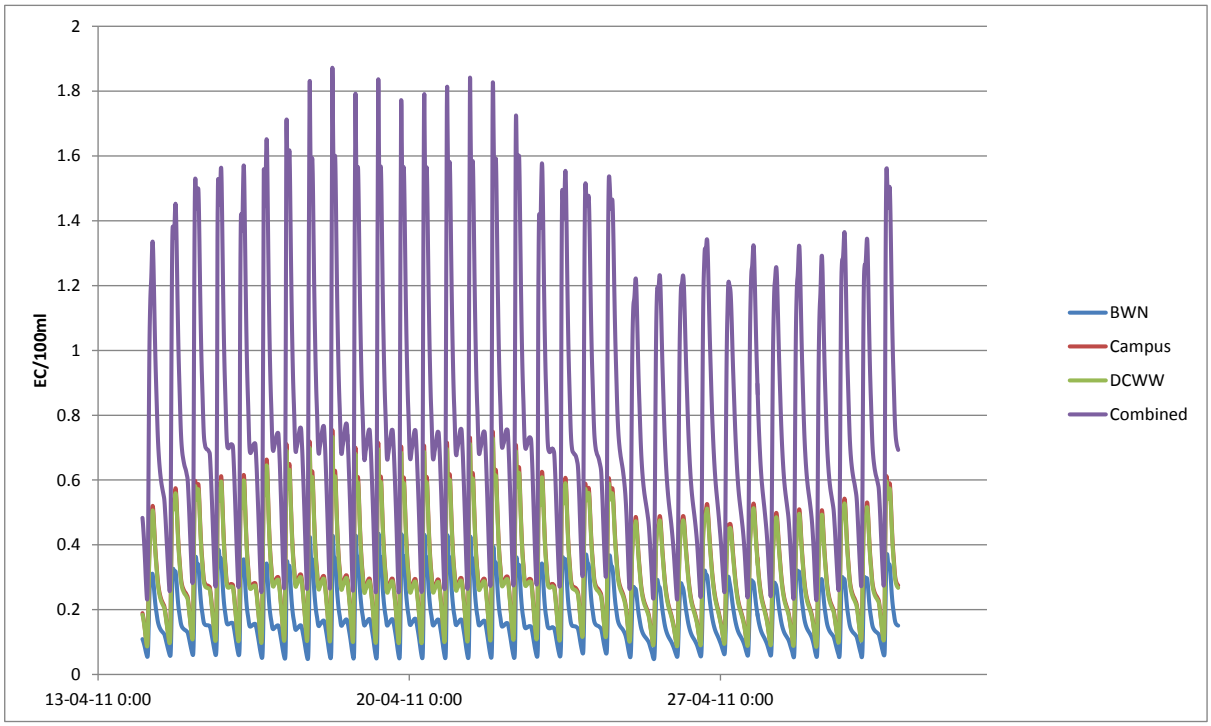
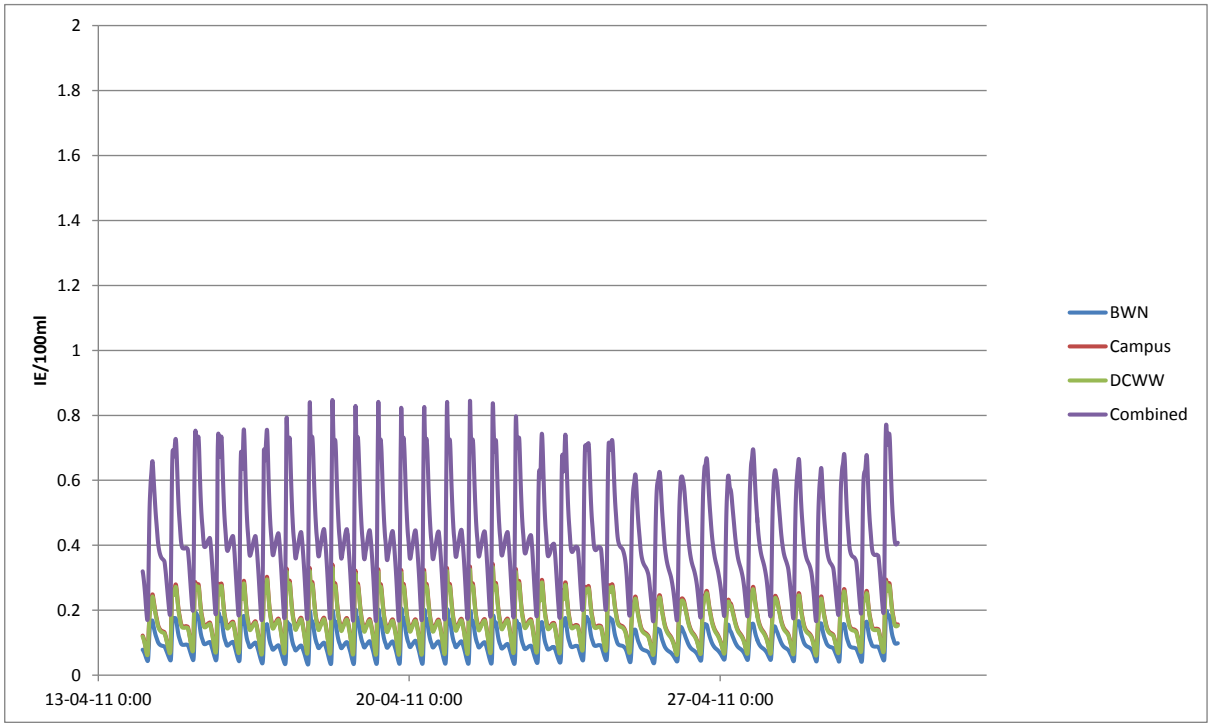


Figure 4-4 I.enterococci at Cemaes Bathing Water, northerly wind sensitivity simulation



4.3.2 Predicted 95th percentile E.coli concentrations at Cemaes Bathing Water are as follows (original values in parentheses):

- BWN discharge – 0.35 (0.35) CFU / 100ml
- Campus discharge – 0.61 (0.60) CFU / 100ml
- DCWW discharge – 0.59 (0.58) CFU / 100 ml
- Combined discharges – 1.54 (1.53) CFU / 100ml

4.3.3 Predicted 95th percentile I.enterococci concentrations at Cemaes Bathing Water are as follows (original values in parentheses):

- BWN discharge – 0.17 (0.17) CFU / 100ml
- Campus discharge – 0.28 (0.28) CFU / 100ml
- DCWW discharge – 0.27 (0.27) CFU / 100 ml
- Combined discharges – 0.72 (0.72) CFU / 100ml

4.3.4 From the above predictions, it is clear that a northerly onshore wind has a very marginal impact on bathing water quality at Cemaes, particularly when considered in the context of the rBWD standards [RD4]. This result is in line with expectation, since the water movements around Wylfa Head and past / into Cemaes Bay are dominated by tidal flows.

4.4 Sensitivity testing – location of DCWW discharge

4.4.1 Results of the sensitivity test for the alternative location of the DCWW discharge (50m to the north of the modelled "DCWW" location) are presented below in Figure 4-5 and Figure 4-6. The results are presented so as to allow direct comparison between predicted bacteria concentrations at Cemaes Bathing Water arising from the DCWW and the DCWW-Alt discharge locations.

Figure 4-5 E.coli predictions at Cemaes Bathing Water, for the DCWW and DCWW-Alt discharges locations

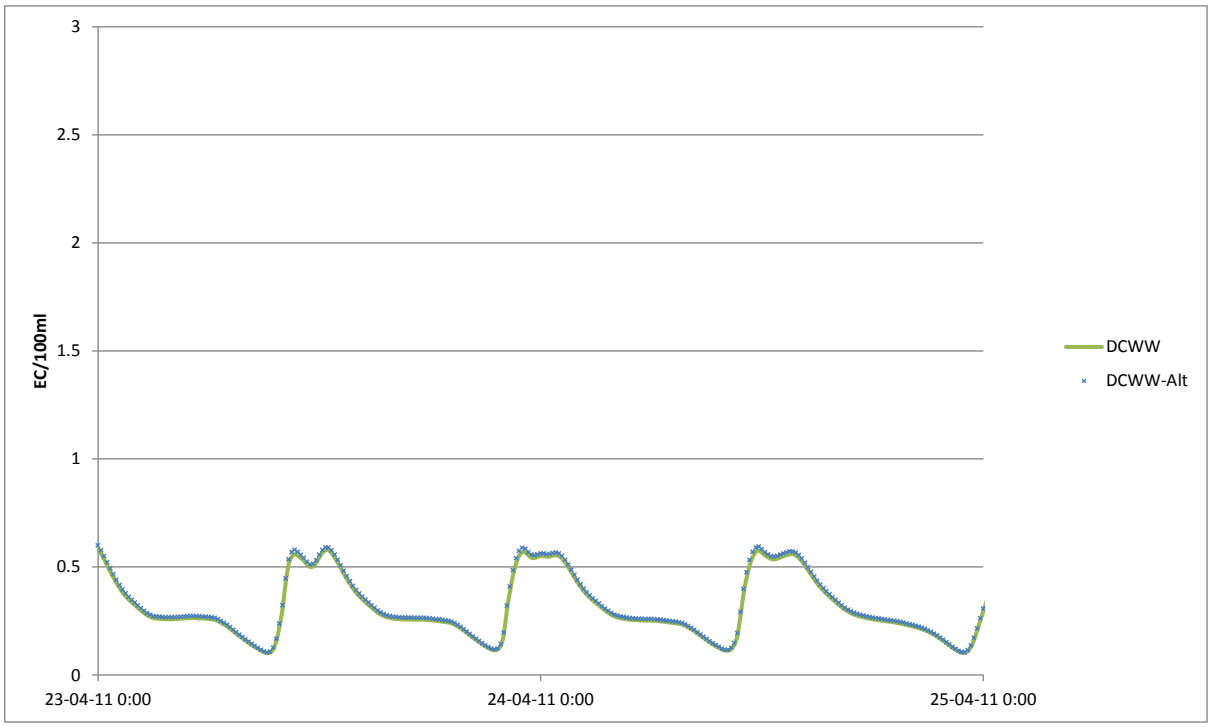
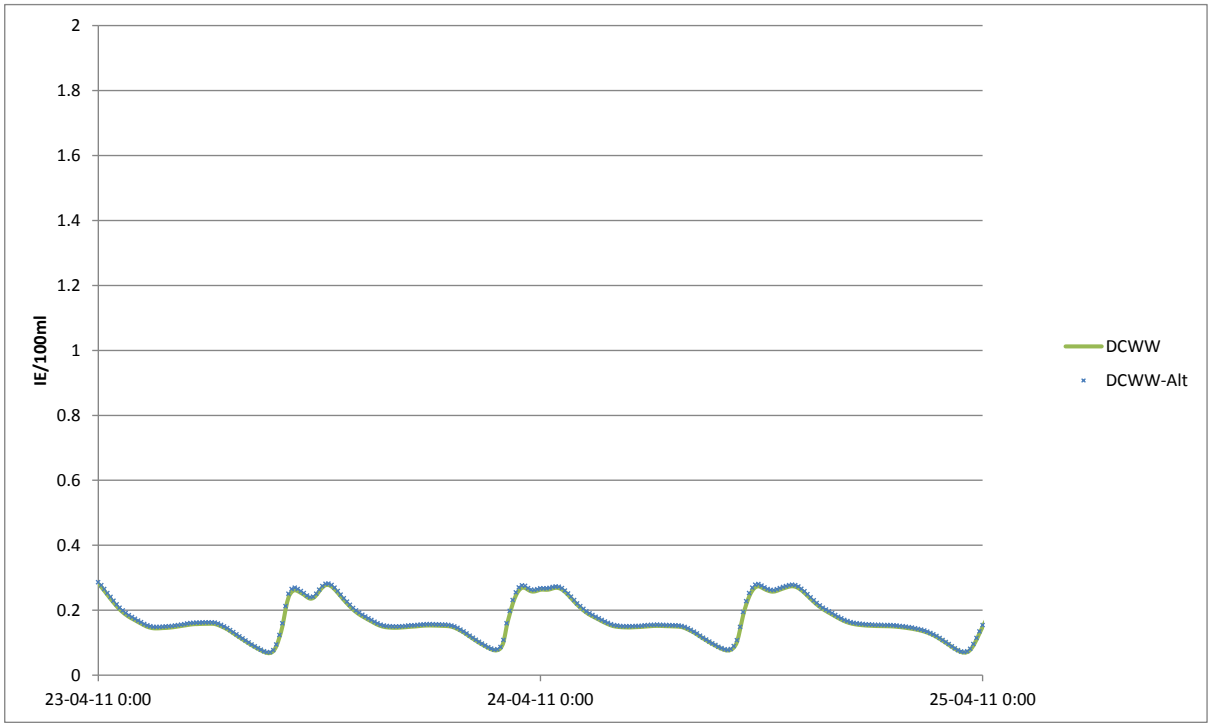


Figure 4-6 I.enterococci predictions at Cemaes Bathing Water, for the DCWW and DCWW-Alt discharges locations



4.4.2 Predicted 95th percentile E.coli concentrations at Cemaes Bathing Water are as follows:

- DCWW discharge – 0.58 CFU / 100 ml
- DCWW-Alt discharge – 0.60 CFU / 100 ml

4.4.3 Predicted 95th percentile I.enterococci concentrations at Cemaes Bathing Water are as follows:

- DCWW discharge – 0.27 CFU / 100 ml
- DCWW-Alt discharge – 0.28 CFU / 100 ml

4.4.4 From the above, it is clear that not only is the impact of the DCWW discharge on bathing water quality well below measurable limits in terms of water quality sampling, but also the effect of moving the discharge location 50m is not significant.

5 Conclusions

5.1.1 Extensive modelling has been applied to consider the impact of sewage effluents from the Wylfa Newydd DCO Project and DCWW discharges on bathing water quality at the designated Cemaes Bathing Water.

5.1.2 Modelling has previously been subject to a very extensive build, calibration and validation process, and a successful independent two-stage audit process.

5.1.3 The latest modelling, presented in this technical note, includes model input parameters based on industry measurements and scientific literature, with conservative assumptions being made where appropriate and in agreement with NRW.

5.1.4 A number of sensitivity tests have also been undertaken to give further confidence to the model predictions; in each case the sensitivity test changed the model predictions to some degree, but did not result in significant changes to the model predictions in the context of rBWD standards [RD4].

5.1.5 The predicted impact of the Breakwater North and Site Campus discharges, operating together with the DCWW discharge, is seen in the context of the revised Bathing Water Directive standards.

5.1.6 For E.coli, the 95%ile standard for Excellent bathing water quality is 250 CFU / 100ml. The combined effect of all three discharges operating at full flow to treatment is predicted to result in an increase of 1.53 CFU / 100 ml at Cemaes.

5.1.7 For I.enterococci, the 95%ile standard for Excellent bathing water quality is 100 CFU / 100ml. The combined effect of all three discharges operating at full flow to treatment is predicted to result in an increase of 0.72 CFU / 100ml at Cemaes.

5.1.8 For both E.coli and I.enterococci, the concentrations predicted by the model, even in combination, are well below measurable limits in terms of water quality sampling.

5.1.9 It is concluded that the combined effects of all three discharge will not result in an increased risk of bathing water compliance failure, and that the assessments in the DCO application (specifically the Environmental Statement and the Water Framework Directive compliance assessment) remain valid, i.e. any effects will be negligible and will not result in a deterioration of status respectively.

6 References

Table 6-1 Schedule of references

ID	Reference
RD1	Horizon (2016) - *Wylfa Hydrodynamic & Water Quality Modelling; Phase 2 Model Build, Calibration & Validation*; DCRM Ref Number: WYL-PD-PAC-REP-00015, Horizon Nuclear Power, 2016.
RD2	ABPmer (2016) - *Audit of the Wylfa Hydrodynamic Model*; ABPmer Report No. R2583P2
RD3	Kay *et al* (2007) - *Faecal indicator organism concentrations in sewage and treated effluents*; Water Res. (2007), doi:10.1016/j.watres.2007.07.036
RD4	rBWD (2006) - *Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive* 76/160/EEC

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HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

Appendix 1-11 Interrelationship between DCO Documents, Schemes and Plans

PINS Reference Number: EN010007

12 February 2019

Revision 1.0
Examination Deadline 5

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-HZDCO-PAC-REP-00206

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Contents

Appendices

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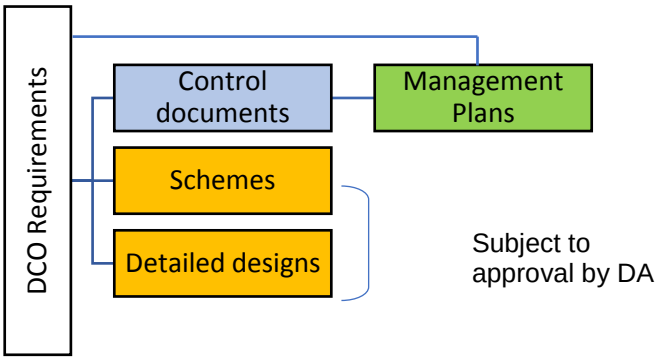
1 Interrelationship between DCO documents, schemes and plans

1.1.1 Through the DCO Requirements, the construction, maintenance and operation of the authorised development is controlled through three types of documents:

1. Post-grant Schemes
2. Control documents
3. Management Plans



1.1.2 Each of these documents, shown on the following diagram have key defining features:

Post-grant Schemes

- Required by a DCO Requirement (i.e. WN11 requires the preparation of landscape and habitat management schemes).
- Prepared by Horizon in accordance with principles or details within an identified control document or specified details in the DCO Requirement.
- Submitted to the discharging authority for approval (in consultation with a third party where relevant).
- Once granted, activities must be undertaken in accordance with the Scheme.
- Any changes must be approved by the discharging authority and cannot go beyond the scope of the ES (Sch.3, para 1(4)) (otherwise must be progressed through statutory change process).
- *Examples: Construction and Operational Lighting Schemes, Habitat Management Schemes, Decommissioning Schemes, Construction Drainage Scheme.*

Control documents

- Approved and certifed as part of the DCO itself.
- Compliance with the control document is secured through the Requirements (i.e. PW7 requires compliance with the Wylfa Newydd CoCP during construction).
- Any changes must be approved by the discharging authority and cannot go beyond the scope of the ES (Sch.3, para 1(4)) (otherwise must be progressed through statutory change process).
- *Examples: Wylfa Newydd CoCP, Workforce Management Strategy, Phasing Strategy.*

Management Plans

- *Required as part of the control documents (i.e. the Wylfa Newydd CoCP requires the preapration of CEMPs) or required by a DCO Requirement.*
- *Must be prepared in accordance with the details or principles outlined in the control document*
- *Prepared by either Horizon or the appointed construction contractor.*
- *Not subject to subsequent approvals by the discharging authority – only Horizon.*
- *Examples: Construction Traffic Management Plan; Site Waste Management Plans, Construction Environmental Management Plan, Digital Infrastructure Plan.*

Appendix 1-1 Horizon's environmental and sustainability corporate polices

Horizon's environmental and sustainability corporate policies

DCO DCO DCO DCO

CONSTRUCTION

OPERATION

DECOMMISSIONING

DCO Environmental Statement and other impact assessment reports

Securing mechanisms (DCO requirement/S106)

Phasing Strategy (PW2)
Identifies the triggers for the delivery of key Project mitigation (i.e. the Site Campus and Park and Ride Facility)

Construction Method Statement (PW3)
Identifies the proposed construction methodology to be used within the Power Station Site

Wylfa Newydd Code of Construction Practice (CoCP) (PW7)
With sub-CoCPs, contains Horizon's construction management strategies and controls relating to noise, public access, air quality and traffic etc

- **Management Plans relating to Site Waste, Construction Traffic, Handover Environmental Management and Construction Environmental Management etc** *(prepared by the Contractor in accordance with the principles in the WNCoCP for Horizon approval)*
- **Traffic Incident Management Scheme (PW7)** *(prepared by Horizon in accordance with Schedule 21 for IACC approval)*
- **Community Safety Management Scheme (PW7)** *(submitted to IACC for approval following consultation with Emergency Services)*
- **Abnormal Indivisible Load Management Scheme (WN1)** *(prepared by Horizon in accordance with Schedule 21 for IACC approval)*
- **Protest Management Scheme (WN1)** *(prepared by Horizon in accordance with Schedule 21 and submitted to IACC for approval)*

Sub-CoCPs (WN1, WN17, OPSF1, PR1, LC1, OH1)
for the Main Power Station Site, Marine Works, Off-Site Power Station Facilities, Park and Ride, A5025 Offline Highway Improvements and the Logistics Centre

- **Overarching Construction Drainage Scheme (WN1)** *(prepared by Horizon in accordance with Schedule 21 and submitted to IACC for approval)*
- **Phased construction drainage designs (WN[A])** *(prepared by Horizon in accordance with the Overarching Construction Drainage Scheme, and submitted to IACC and NRW for information)*
- **WNDA Overarching Construction Lighting Scheme (WN1)** *(prepared by Horizon in accordance with Schedule 21 for IACC approval)*
- **WNDA Phased Construction Lighting Scheme (WN[B])** *(prepared by Horizon in accordance with Overarching Construction Lighting Scheme and submitted to IPCC and NRW for information)*
- **Management Plans relating to Construction Environmental Management and Vessel Management etc** *(prepared by the Contractor in accordance with the principles in the WNCoCP for Horizon approval)*
- **Construction Lighting Scheme for LC, P&R, A5025 and OPSF** *(prepared by Horizon in accordance with Schedule 21 for IACC approval)*
- **Archaeological Mitigation Schemes for WNDA OPSF and LC** *(prepared by Horizon in accordance with Schedule 21 for IACC approval)*

Landscape and Habitat Management Strategy (Article 76) (LHMS)
outlines the design and management principles that apply to the creation and long term management of habitats and within the WNDA

- **Design of landscaping and habitat created within the WNDA during construction (WN8) and prior to operation (WN9)** *(final operational design to be in accordance with the LHMS Principles and submitted to IACC for approval within 24 months of FNC for Unit 1)*
- **Management Schemes for landscape and habitat created during construction, operation and the Ecological Compensation Sites (WN11, ECS3)** *(prepared by Horizon in accordance with the Management Principles in the LHMS and submitted to IACC for approval)*
- **Management Schemes for the Ecological Mitigation Sites (WN12–14)** *(prepared by Horizon in accordance with the Management Principles in the LHMS and submitted to IACC for approval prior to completion of works)*

Design and Access Strategy (Article 76) (DAS)
outlines the design and landscaping principles that apply to the development of detailed design drawings

- **Detailed design drawings for buildings/structures (all Works) and associated landscaping** *(prepared by Horizon in accordance with the Design and Landscaping Principles in the DAS, Approved Plans, parameters in Schedule 3 and Limits of Deviation. Submitted to IACC for approval 12 months prior to commencement)*

Workforce Management Strategy (Article 76 and PW8) (WMS)
outlines the principles that will apply to workforce and employer behaviour during construction

- **Wylfa Newyyd Code of Conduct (PW8)** *(prepared by Horizon in accordance with the principles in WMS and submitted to IACC for information)*

Decommissioning Schemes for Site Campus (WN23), Park and Ride (PR6) and Logistics Centre (LC7)
(prepared by Horizon and submitted to IACC for approval prior to the anticipated Unit 2 Commissioning Date)

Digital Infrastructure Plan (New Requirement – PW15)
(prepared by Horizon following technical assessment and submitted to the Welsh Government for information

Wylfa Newydd Code of Operational Practice (CoOP)
Contains Horizon's operational management strategies (WN10)

- **Management Plans (Operational Traffic Management etc)** *(prepared by the Contractor in accordance with the principles in the WNCoOP for Horizon approval)*
- **Operational Lighting Scheme (for WNDA – WN10)** *(prepared by Horizon in accordance with Schedule 21 for IACC approval)*

Decommissioning Scheme for the Power Station, Grid Connection and Off-site Power Station Facilities (PW10)
To be submitted 24 months after cessation notice being served under PW9

DCO DCO DCO

Other Consents, Licences and Agreements
(Environmental Permits, Nuclear Site Licence, Marine Licence etc)

Horizon's procurement and contractual arrangements
(opportunities for continual standards improvement, for example as per Horizon's ISO14001 Environmental Management System)

Control documents approved through the DCO

Required under a control document or Requirement to be prepared following grant of DCO and approved by the discharging authority

Required under a control document or Requirement to be prepared following grant of DCO and approved by Horizon