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HPC COMBUSTION ACTIVITY PERMIT VARIATION – AIR QUALITY IMPACTS ON ECOLOGICAL RECEPTORS TECHNICAL NOTE

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Hinkley Point C: Consideration of Air Quality Impacts on Ecological Receptors.

1. Introduction and Background

The Environment partnership (TEP) was originally commissioned by Bureau Veritas in 2023 to assess the impacts to ecological receptors following an air quality (AQ) assessment[1] associated with the operational phase of the Hinkley Point C (HPC) nuclear power station from emissions from fossil fuel combustion, primarily through the use of back-up diesel generators, which exist to provide power in the event that the nuclear power plant loses off-site power. The AQ assessment focused on presenting the methodology and full results for the following scenarios:

- **Scenario 1:** Commissioning (inclusive of emissions arising from ongoing construction activities). This scenario assesses all potential releases to air from the back-up generators during the commissioning of the diesel generators.
- **Scenario 2:** Routine Testing. This scenario presents the likely potential impacts to be expected as a result of the standard generator testing, which will be scheduled throughout the lifetime of the power station; and
- **Scenario 3:** Emergency Loss of Off-site Power. This scenario covers a loss of off-site power (LOOP) situation where grid connection for both reactor units is lost and the station is unable to operate under house load.

However, due to changes in the operation startup and scenarios, the data was reassessed in 2024, the results of which are updated in the following technical note.

1.1. Site Description

HPC is located in Somerset, England, adjacent to the existing power stations at Hinkley Point and approximately 12.5 km northwest of the town of Bridgwater. The existing land use around the site is primarily rural, with isolated residential properties and small villages to the east, south and west.

[1] AIR13252516 - Hinkley Point C – Air Quality Modelling report, Bureau Veritas (May 2023)

The power stations of Hinkley Point A (now decommissioned) and Hinkley Point B (soon to be decommissioned) are located to the northeast of HPC, whilst to the north of the site lies the Severn Estuary.

2. Ecological Receptors

2.1. Discrete Ecological Receptors

The predominant route by which emissions will affect land in the vicinity of the operational activities is by deposition of atmospheric emissions. Potential ecological receptors can be sensitive to the deposition of pollutants, particularly nitrogen and sulphur compounds, which can affect the character of the habitat through eutrophication and acidification.

In order to complete the permit application, the results of the air quality modelling need to be assessed for their potential impact on the ecology receptors identified within the vicinity of the HPC Site[2] . The ecology receptors are illustrated in Figure 1 and include:

- International and European[3] designated sites within a 15 km radius of HPC; and
- Nationally designated SSSI and local nature sites (including ancient woods, local wildlife sites and national and local nature reserves) within a 2 km radius of HPC.

Designated sites that meet the above criteria include:

- Severn Estuary Ramsar, Special Protection Area (SPA) and Special Area of Conservation (SAC);
- Bridgwater Bay Site of Special Scientific Interest (SSSI) and National Nature Reserve (NNR);
- Blue Anchor to Lilstock Coast SSSI;
- Somerset Wetlands National Nature Reserve (NNR); and
- The Exmoor and Quantock Oakwoods SAC.

These designated sites were used as the basis for the discrete modelled ecological receptors for the AQ assessment. See Figure 2.

The discrete ecological receptors are based on the shapefiles from Defra's MAGIC Map for the Bridgwater Bay SSSI/NNR and the Severn Estuary Ramsar/SAC/SPA. The discrete ecological receptors extend to the full spatial extent of these designations to the north and the west of HPC. To the east, the discrete receptors extend approximately 3.8 km from the HPC boundary.

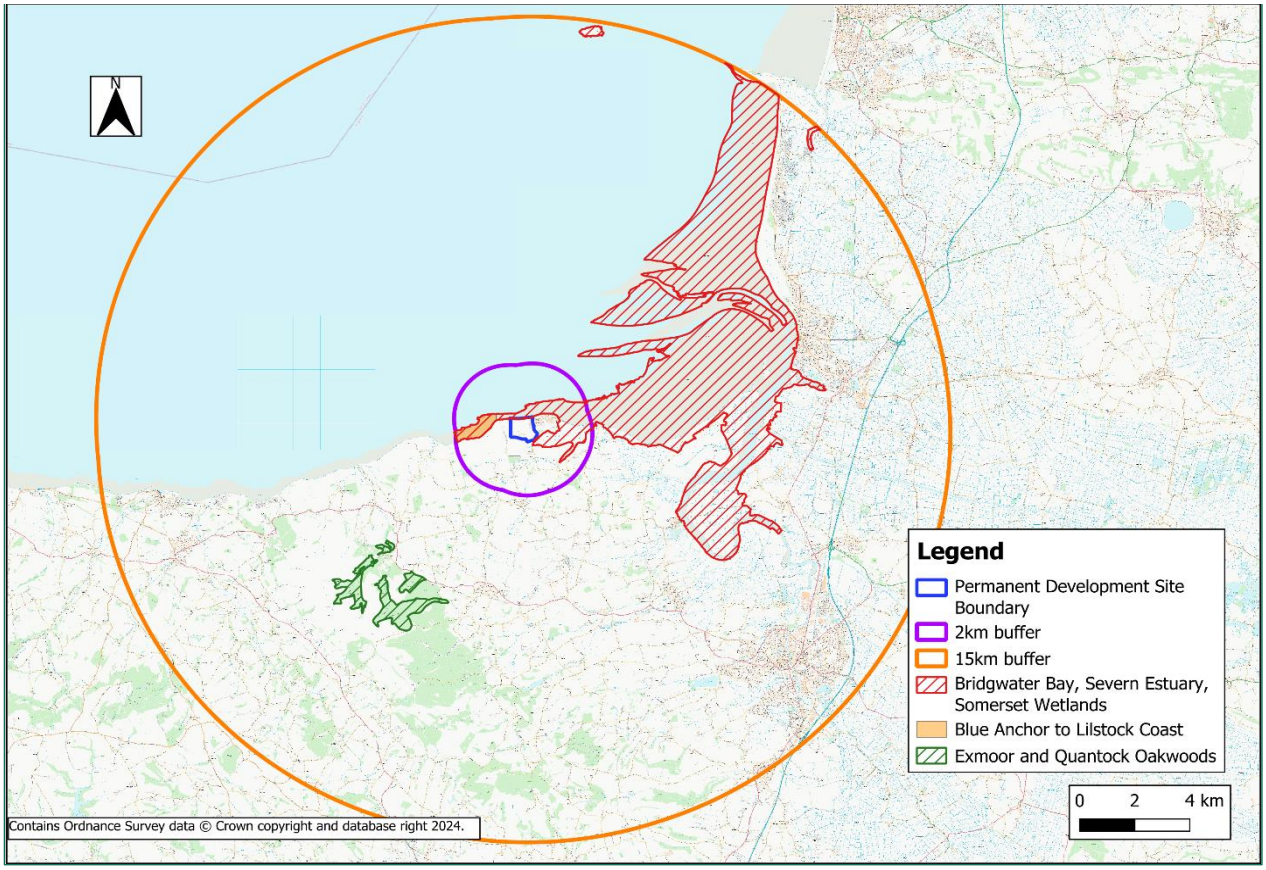
With regard to the Severn Estuary SAC designation, which extends further to the north of HPC into the water body itself, the focus of the assessment is on the mud/sand flats of the estuary, where

[2] Air risk assessment for your environmental permit (2016), Environment Agency. https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [accessed 22/06/2023]

[3] SACs and Special Protection Areas (SPAs) in the UK no longer form part of the EU's Natura 2000 ecological network. The 2019 Regulations have created a national site network on land and at sea, including both the inshore and offshore marine areas in the UK.

deposition of pollutants to land may occur. Any potential impacts from operational activities on the water body itself relate to water quality, which was outside the scope of AQ assessment.

Figure 1: Designated Ecological Receptors within 15km



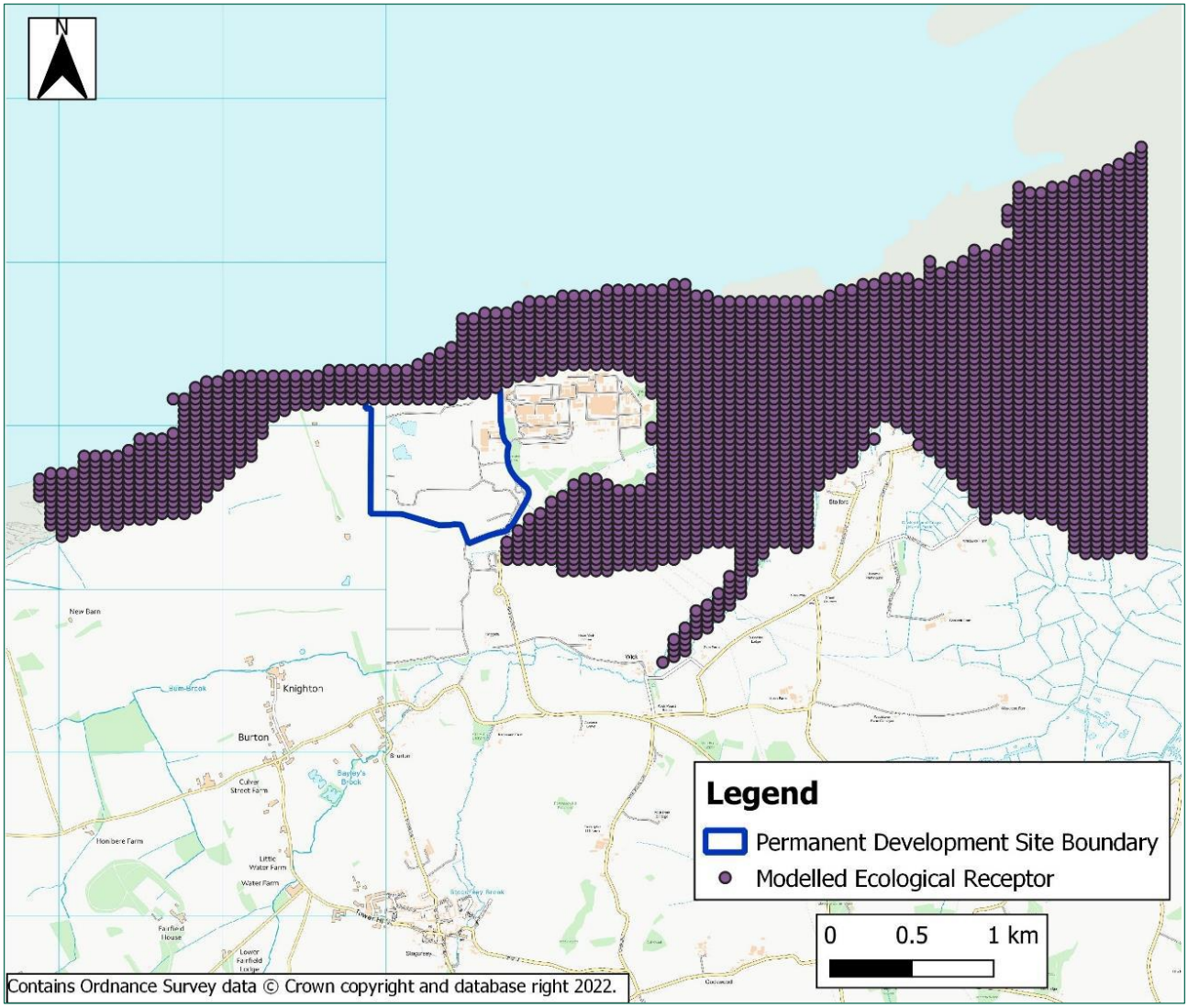
2.2. Ecological Receptors Scoped Out

Bureau Veritas concluded that there were modelled exceedances of the critical levels or critical loads at the Exmoor and Quantock Oakwoods SAC, however these were concluded as negligible being only 0.1% PC of AQAL, therefore, the SAC has not been considered further in this technical note (this is in line with the findings of the earlier HPC Habitat Regulations Assessment.[4]).

Blue Anchor to Lilstock Coast SSSI is within the study area, however, as it is designated for geological features which are not sensitive to air quality changes, it has also been excluded from this assessment.

[4] Hinkley Point C Project Report to Inform a Habitats Regulations Assessment (2011), EDF Energy

Figure 2: Discrete Ecological Receptors (image taken from BV document AIR13252516 – May 2023)



2.3. Ecological Receptors Scoped In

For the purposes of this report the following designated sites have been scoped in for further assessment (see Figure 1 for locations).

- Severn Estuary Ramsar/SPA/SAC;
- Bridgwater Bay SSSI/NNR.
- Somerset Wetlands NNR

3. Purpose of this Technical Note

This Technical Note (TN) explores the results of the Bureau Veritas air quality modelling for the Scenarios using available study data to predict physical impacts on the habitats within the ecological receptors scoped into the assessment. This assessment focusses on the effects of nitrogen and acid deposition and oxides of nitrogen (NO_x).

The Bureau Veritas air quality modelling data modelled predicted concentrations at gridded receptor locations, with a spatial resolution of 40 m. This was undertaken across the entire areas of designated sites falling into the EA's risk assessment criteria, with the exception of the subtidal area of the Severn Estuary SAC, as open sea is not susceptible to NO_x, or acid or nitrogen deposition.

4. Methods Applied

4.1. Designated Sites and Qualifying Features

The qualifying features of the designated sites or their supporting habitats were reviewed, to assess where they are located within the modelling study area. The following information sources were consulted to ascertain which qualifying features are present and their locations:

- Multi Agency Geographic Information for the Countryside (MAGIC)[5];
- Natural England SAC and SPA habitat mapping[6]; and
- The Hinkley Point C Project Report to Inform Habitats Regulations Assessment (EDF, 2011).

The potential impacts of NO_x and nitrogen and acid deposition, in terms of the physical effects and implications are reported for each qualifying feature. The Air Pollution Information System (APIS) pollution impact records for habitats, ecosystems and species were also consulted[7]. APIS only records effects and implications on habitats where it has been possible to gather evidence through research-based studies. Therefore, where relevant evidence through previous studies is not available, it was not always possible to characterise or predict impacts.

4.2. Standard methods used in Air Quality Assessment

Critical Levels and Critical Loads Relevant to the Assessment of Ecological Receptors

A summary of the relevant Air Quality Standards (AQS) and Environmental Assessment Levels (EAL) that apply NO_x and SO_2 emissions from the plant and their impact on ecological receptors are given in Table 1.

Table 1: Critical Levels of NO_x and SO_2 for Designated Sites (Severn Estuary Ramsar/SPA/SAC, Bridgwater Bay SSSI/NNR)

Pollutant:	AQS/EAL	Average Period:	Value (ug/m.3)
Oxides of Nitrogen (NO_x)	AQS	Annual Mean	30
Oxides of Nitrogen (NO_x)	EAL	Daily Mean	75
Sulphur Dioxide (SO_2)	AQS	Annual Mean	20

[5] Website: https://magic.defra.gov.uk/MagicMap.aspx (accessed 22/06/23)

[6] Magic GIS downloadable database https://magic.defra.gov.uk/MagicMap.aspx (accessed 22/06/23)

[7] http://www.apis.ac.uk/ (accessed 22/06/23)

Critical Loads (CL) – Nitrogen Deposition (Eutrophication) and Acidification

The APIS website provides specific information on the potential effects of nitrogen deposition and acid deposition on various habitats and species. The information collected from APIS and used in the assessment is presented in Table 2. Although there are a number of sensitive ecologically designated sites within the modelled area, they are all covered by both the Severn Estuary SPA/Ramsar site and Bridgwater Bay SSSI/NNR, therefore all APIS input data used within the data processing relates to the worst-case critical load data from the ecological sites. The data used is presented below.

Table 2: Critical Loads for Nitrogen and Acid Deposition.

Designated Site:	Min N-CL	N dep.	Acid dep. of N equiv.	Acid dep. of S equiv.	CLminS	CLminN	CLmaxN
	(kg/N/ha/yr)		(keq/ha/yr)				
Severn Estuary Ramsar/SPA/SAC	10	17.9	1.3	0.3	No critical load available for this feature		
Exmoor & Quantocks Oakwoods SAC	5	27.2	2.0	0.2	0.21	0.14	0.87
Bridgwater Bay SSSI	5	20.2	1.4	0.2	0.16	0.32	0.48
Somerset Wetlands NNR	5	24.4	1.7	0.3	4.00	1.07	5.07

The CLs relate to the most nitrogen (N) sensitive habitat listed for each of the designated sites. The nitrogen CL used is for common redshank (*Tringa totanus)*. The Severn Estuary SAC habitat used is pioneer, low-mid, mid-upper saltmarshes. For the Severn Estuary SPA acidity CL, common redshank (acid grassland) is stated. There are no acidity critical loads for sulphur and nitrogen for the Severn Estuary SAC. The nitrogen CL and deposition for the Bridgwater Bay SSSI fen, marsh and swamp feature is shown, and vascular plant assemblage is used for the acid deposition.

5. Evaluation of Impacts - Nitrogen Oxides (NOx)

A review of all 3 scenarios was also undertaken to assess the impacts on ecological receptors based on the longevity and depositional rates and was determined that **Scenario 3 (LOOP)** has been excluded from further evaluation which predicts a loss of off-site power (LOOP) situation where grid connection for both reactor units is lost. In this scenario all eight EDGs would operate simultaneously alongside all other on-site generators (with the exception of the UDGs and SEGs) for a minimum of 24 hours. And it is highly unlikely that loss of power from the grid would be greater than 5 days.

As the scenario will only be very short term this is unlikely to have a long-standing impact on current ecological receptors. Therefore, for the purposes of this TN only Scenario 1 and 2 will be taken forward for evaluation.

5.1. Scenario 1 - Commissioning

This scenario assesses all potential releases to air from the back-up generators during the commissioning of the generators, assuming the commissioning phase to be during a period of one calendar year. It is assumed that the commissioning of Unit 1 and Unit 2 would not occur during the same year. The following commissioning sub scenarios A/B/C for Unit 1 and Unit 2 would occur separately, not concurrently:

- Commissioning A - 56 hours testing of all EDGs operating simultaneously at 50% load.
- Commissioning B - 192 hours (8 days) testing of all EDGs operating simultaneously at 100% load; and
- Commissioning C - 192 hours (8 days) testing of all EDGs and all UDGs operating simultaneously at 100% load.

Commissioning A – Unit 1

As this is only 56 hours of testing, increases in the daily rate of nitrogen oxides (NOx) will increase considerably with the highest increase of both Process Contributions (PC) and Predicted Environmental Concentration (PEC) identified at receptor GE622 (on the northern sea wall), however, the overall annual increase in NOx is not significant with highest increases in both PC and PEC identified at receptor GE779 and GE797 (PC) and GE624 (PEC) , however it must be noted that background NOx is also very high, and above critical loading (CL) situated within agricultural land south east of the HPC which is not identified as qualifying habitat (neutral grassland) based on last condition assessment report (Natural England (NE) 2010) and immediately along the northern boundary and sea wall within the intertidal mudflats.

Commissioning A – Unit 2

Again, the same scenario as for Unit 1, the highest daily NOx rate for both PC and PEC both identified at receptor GE576 (PC and PEC), situated to the north of the HPC, with greatest annual NOx increases found at GE589 (PC), located on the estuary just to the north of HPC and GE840 (PEC) located on fields to the southeast, however once again background NOx is also significantly above critical loading.

Commissioning B – Unit 1

The highest daily rate of NOx will increase considerably during the 8-day testing period with the highest concentration at receptor GE622 (PC and PEC), with the highest increases in annual NOx identified at receptor GE779 (PC) and GE624 (PEC), however it must be noted that background NOx is also very high, and above critical loading situated within agricultural land southeast of the HPC.

Commissioning B – Unit 2

Again, highest exceedances of daily rate of both PC and PEC occur at receptor GE622, with annual high exceedances of both PC and PEC occur at receptors GE779 (PC) and GE837 (PEC).

Commissioning C – Unit 1

Again, highest exceedances of daily rate of both PC and PEC occur at receptor GE622, with annual high exceedances of both PC and PEC occur at receptors GE779 (PC) and GE624 (PEC).

Commissioning C - Unit 2

Again, highest exceedances of daily rate of both PC and PEC occur at receptor GE622, with annual exceedances of both PC and PEC occur at receptors GE779 (PC) and GE837 (PEC).

5.2. Scenario 2 – Routine Testing

This scenario presents the likely potential impacts to be expected as a result of the standard generator testing, which will be scheduled throughout the lifetime of the power station.

Highest increases in daily NO_x output PC and PEC were found at receptor GE596 (northern sea wall) with the annual increases modelled at receptor GE797 (within agricultural land to the south east of the HPC) and highest overall PEC identified at receptor GE837 (also within agricultural land to south east).

6. Evaluation of Impacts - Acid (SO_2) Deposition

An evaluation of the results from the AQ assessment has determined that exceedance of acid deposition on all ecological receptors for all scenarios is unlikely to exceed 1% of the CL, therefore no significant impact is likely on any of the qualifying features of the designated sites and will not be taken forward for further assessment within this TN.

7. Assessment of Impacts Ecological Receptors (designated sites)

7.1. Determining Qualifying Features to be Assessed for Impacts

By their very nature both the condition of international and European designated sites is underpinned by Natural England SSSI condition assessment. Qualifying features which are mobile species, such as the bird and fish species, are assessed on their vulnerability to the pollutants by assessing the impact on their supporting habitats.

Severn Estuary Ramsar, SPA and SAC

The features present within the designated sites are as follows:

- Intertidal mudflats;
- Estuary;
- Reefs (*Sabellaria* spp.);
- Qualifying bird species; and
- Intertidal mudflats.

Bridgwater Bay SSSI/NNR (including Somerset Wetlands NNR)

The following habitats are present within the SSSI:

- Littoral sediment; and
- Neutral grassland.

Bridgwater Bay now forms part of the newly acquired Somerset Wetlands NNR, which has absorbed the six reserves on the Somerset Levels and Moors and added 56% more land to the area occupied by the original NNRs which include;

- Bridgwater Bay
- Ham Wall
- Huntspill River
- Shapwick Heath
- Somerset Levels, and
- Westhay Moor

A rich variety of habitats lie within the NNR – wet grassland, saltmarsh and intertidal mudflats which are home to many diverse species. Highlights include:

- A third of the UK's bittern population, a large marsh bird of the heron family; avocets, black-and-white waders which bred in Somerset in 2012 for the first time in more than 150 years and new colonisers like the great white egret, which bred for the first time in Somerset and the UK ten years ago.
- Nineteen species of dragonflies including a 'Merited Site of National Importance' by the British Dragonfly Society.
- Round-leaved sundew – a carnivorous plant whose original habitat was the peatlands before drainage and farming.

7.2. Assessment of Qualifying Features Vulnerability to Nitrogen Deposition

The air quality modelling concluded that there are exceedances of the nitrogen deposition minimum CL at all ecological receptor locations. At all data points, the background deposition already exceeds the CL (by a minimum of 150%) without the PC. This is discussed further in the relevant sections below.

Severn Estuary Ramsar/SPA/SAC

Intertidal mudflats

The Severn Estuary adjacent to HPC contains intertidal substrate, however these are not listed as a designated feature of these Severn Estuary sites. The nearest tidal mudflats and sandflats which are designated features are 2-3 km to the north of HPC. Although the APIS database considers that mudflats are sensitive to nitrogen deposition, there are no comparable habitats with established critical load estimates available and therefore no critical loads for mudflats are listed on the APIS website.

Consequently, there is also no characterisation of any impacts of nitrogen deposition on this habitat and conclusions cannot be made regarding the impacts of the predicted deposition. However, as discussed previously, although the exceedance of the minimum CL at this location is 180%, only

0.1% of this is due to the PC, which alone is only 0.2% of the minimum CL, the rest of the exceedance being due to background deposition rate. Given the very small potential increase due to the PC, it is considered that the effects of the PC would be negligible. Furthermore, the habitat is submerged regularly and given this, it is considered unlikely that nitrogen deposition would have an adverse impact.

Estuary

The sensitivity of estuaries to nitrogen deposition is based on the presence of pioneer, low-mid, mid-upper saltmarshes. The nearest saltmarsh to HPC is approximately 2.5 km east. The exceedance of the minimum CL at this location is 180%, however only 0.1% of this is due to the PC, the rest of the exceedance is due to background deposition rate. Given the very small potential increase due to the PC, it is considered that the effects of the PC would be negligible.

Reefs

According to APIS, this habitat is not sensitive to nitrogen deposition and therefore there are no critical loads recorded for this habitat.

Qualifying Bird Species

A number of Severn Estuary SPA, Ramsar and SSSI qualifying bird species are known to utilise habitats within designated sites. Bird species are assessed in terms of their vulnerability to nitrogen deposition, by considering the habitats which support them (intertidal mudflats) which is not a qualifying feature on its own but could be identified as functionally linked land (FLL) associated with the qualifying bird species.

Although the APIS database considers that mudflats are sensitive to nitrogen deposition, there are no comparable habitats with established critical load estimates available and therefore no critical loads for mudflats are listed on the APIS website.

Consequently, there is also no characterisation of any impacts of nitrogen deposition on this habitat. The impact of nitrogen deposition on the invertebrate assemblages on which the qualifying bird species feed should also be considered, however there is no comparable data or studies to aid with this, and therefore this cannot be assessed. However, it should be noted that, given that the habitat is located within an intertidal area, which is frequently flooded by tidal movements, any nitrogen deposition will be regularly diluted and it is considered unlikely that nitrogen deposition would have an adverse impact.

Bridgwater Bay SSSI/NNR (including Somerset Wetlands NNR)

Littoral Sediment

Although the APIS database considers that mudflats are sensitive to nitrogen deposition, there are no comparable habitats with established critical load estimates available and no characterisation or conclusions of impacts of nitrogen deposition of the predicted deposition. However, as discussed

previously, given that the habitat is located within an intertidal area, which is regularly flooded by tidal movement it is considered unlikely that nitrogen deposition would have an adverse impact.

Neutral Grassland

NO_x impacts are mainly noted for lichens, mosses and liverworts, which derive their nutrients from atmospheric deposition. Direct effects from NO_x in the long term usually occur within the immediate vicinity of the emissions source. This includes changes in ground flora composition and a loss in diversity of species. At very high NO_x levels (>400 µg/m^3) visible injury can be noted in plants. The top exceedance for nitrogen deposition rates at the neutral grassland within Bridgwater Bay SSSI, to the east of HPC have been modelled for maximum 121% of critical loading for all scenarios. The PC originating from the proposal accounts for an equivalent of 0.9% of the minimum critical load, with the current background nitrogen deposition at this location accounting for 120% of the critical load.

This neutral grassland condition is assessed by Natural England as 'unfavourable, recovering' and is not a qualifying feature of the SSSI. It is also apparent that the neutral grassland adjacent to the HPC is bordered by main roads and is probably subject to agricultural activity (grazing and/or silage). Given these numbers it is unlikely that the PC would cause a change in plant composition or visible signs of plant stress such as leaf discolouration would occur. It is therefore considered that, whilst the PEC may result in a delayed recovery of the grassland condition, no significant detrimental effect on the grassland would be expected.

8. Conclusions

The evaluation identified that any increases in nitrogen deposition would not have an impact on qualifying habitats associated with both Severn Estuary Ramsar/SPA/SAC and Bridgwater Bay SSSI/NNR.

The air quality modelling concluded that there are exceedances of the nitrogen deposition minimum CL at all ecological receptor locations, due solely to the background deposition and worst-case scenario modelling (by a minimum of 150%) without the PC with only a marginal proportion attributed to proposed scenarios. Estuaries and reefs are not susceptible to nitrogen or acid deposition according to APIS. Although estuaries may be prone to vulnerability from NO_x, due to the high tidal ranges and velocity experienced in the Severn Estuary the habitat is likely to be unaffected. Similarly, for the qualifying bird species and littoral sediment, it is expected that the flushing effect of the tides within the Severn Estuary will negate any impacts of nitrogen or acid deposition and NO_x.

The neutral grassland within Bridgwater Bay SSSI/NNR would be subject to negligible levels of nitrogen deposition and as a result it is not anticipated to have a significant detrimental effect.

The NO_x impact on the neutral grassland condition is not considered to be significant and is not a qualifying feature of the SSSI. The grassland has been assessed by Natural England as 'unfavourable, recovering' (Neutral Grassland), and given the low additional nitrogen deposition rate (less than 1% critical loading), it is unlikely that the PC would cause a change in plant composition or visible signs of plant stress such as leaf discolouration.