In Parliament – Session 2022 - 2023

HS2

High Speed Rail (Crewe – Manchester)

Supplementary Environmental Statement 1 and Additional Provision 1 Environmental Statement

Volume 5: Appendix EC-016-00003

Ecology and biodiversity

Document to inform a Habitats Regulations Assessment for Rostherne Mere Ramsar site and Midland Meres and Mosses Phase 1 Ramsar site

MA01: Hough to Walley's Green

MA02: Wimboldsley to Lostock Gralam

MA03: Pickmere to Agden and Hulseheath

Q50

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Department for Transport

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1 Introduction

1.1 Purpose of report

1.1.1 There are certain ecological sites that are designated for their international importance and to which special considerations attach under the Conservation of Species and Habitats Regulations 2017 ('the Habitats Regulations')[1], either through operation of law or government policy.

1.1.2 These sites include Special Areas of Conservation (SAC) that have been designated to protect certain species and habitats; Special Protection Areas (SPA), designated to protect certain species of wild birds; and Ramsar sites designated to protect internationally important wetland areas.

1.1.3 These sites are subject to special legal protection that imposes restrictions on a 'competent authority' from granting consent permission or authorisations for any plan or project that may affect the conservation status and integrity of these designations. In the case of the hybrid Bill, the responsible competent authority is Parliament as it is the enactment of the Bill as legislation that grants consent for the hybrid Bill scheme to be undertaken.

1.1.4 The Habitats Regulations require the competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which is likely to have a significant effect on these designated sites (either alone or in-combination with other plans or projects) to make an appropriate assessment of the implications of the plan or project for potentially affected sites in view of those sites' conservation objectives.

1.1.5 There are normally two stages in the process of discharging the duties imposed by the Habitats Regulations. The first is to undertake a 'screening' exercise to determine whether there is no reasonable scientific doubt that the plan or project will be likely to have a significant effect on the site's conservation objectives. If no such likelihood is identified, the competent authority may proceed to grant consent for the plan or project in question. If, on the other hand, there remains a reasonable scientific doubt as to its effects on the integrity of the site at this stage, the competent authority must move to a second stage and undertake a more detailed assessment, commonly referred to as an 'appropriate assessment' to determine whether, having regard to any mitigation measures that are proposed to be adopted in the delivery of the scheme, there will be an adverse effect on the integrity of the site.

[1] *The Conservation of Habitats and Species Regulations 2017* (2017/1012), as amended by The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (2019/579). Her Majesty's Stationery Office, London.

1.1.6 If the appropriate assessment does not identify an adverse effect on the integrity of the site, the competent authority may proceed to grant the consent. If an adverse effect cannot be ruled out, consent can only be granted on the basis that there are: no alternative solutions; there are imperative reasons of overriding public importance for the plan or project to proceed; and appropriate compensatory measures have been secured.

1.1.7 It is Parliament as legislator (and not HS2 Ltd as the prospective developer) that is the competent authority and the body which is required to comply with the requirements of the Habitats Regulations. The purpose of this Habitats Regulations Assessment (HRA) report is, however, to provide information to Parliament, based on HS2 Ltd's assessment of the hybrid Bill scheme, in order to inform and assist Parliament in complying with its obligations under the Habitats Regulations.

1.2 Background

1.2.1 This document replaces HRA Screening Reports for two sites: Rostherne Mere Ramsar site[2] and The Midlands Meres and Mosses Phase 1 Ramsar site[3], both prepared in 2012. The rationale for pursuing a joint HRA primarily reflects the hydrological linkages between Rostherne Mere and The Mere, Mere as both lie within the same catchment, and both could be affected by the excavation of new cuttings.

1.2.2 The 2012 HRA explored ten potential route options and were also considered in the HS2 Phase 2 Appraisal of Sustainability (AoS) in 2013[4]. These identified three potential threats to both Ramsar sites, namely: impacts on both the surface and sub-surface hydrological regimes; and pollution (and similar) impacts associated with construction related activities.

1.2.3 Although the potential for these impacts varied in severity and likelihood between each route, the 2012 HRA were able to conclude that likely significant effects could be ruled out alone and in-combination, provided a range of mitigation measures were employed.

1.2.4 This new HRA is required to take account of changes in our understanding of the ecological characteristics of Rostherne Mere, and the nature and scale of anticipated impacts associated with the AP1 revised scheme. For example, between 2018 and 2022, ongoing traffic and air quality assessment identified that air pollution (in terms of the concentration of nitrogen oxides (NOx) in the atmosphere, and both nitrogen and acid deposition) from construction and operational traffic could impact both Ramsar sites. Similarly, the continued evaluation of existing hydrological data alongside new investigations carried out by HS2 Ltd

[2] Temple-ERM (2012), *HRA Screening Report for Rostherne Mere Ramsar Site*.

[3] Temple-ERM (2012), *HRA Screening Report for Midland Meres and Mosses Phase 1 Ramsar Site*.

[4] Temple-ERM (2013), *High Speed Rail: Consultation on the route from the West Midlands to Manchester, Leeds and beyond Sustainability Statement*.

has provided a greater understanding of the local hydrological regime. Both merited a re-evaluation of the previous outcomes.

1.2.5 In order to differentiate between the original scheme and the subsequent changes, the following terms are used:

- the 'original scheme' – the Bill scheme submitted to Parliament in January 2022, which was assessed in the main ES; and
- 'the AP1 revised scheme' – the original scheme as amended by the SES1 changes and AP1 amendments.

1.2.6 This report forms part of the supporting information that accompanies the High Speed Rail (Crewe – Manchester) Supplementary Environmental Statement 1 (SES1) and Additional Provision 1 Environmental Statement (AP1 ES).

1.2.7 At Rostherne Mere, the assessment of the effects of air pollution caused by the construction and operation of the original scheme is based on traffic data for the main Environmental Statement (ES)[5]. At The Mere, Mere the assessment of the effects of air pollution is based on the traffic data for the AP1 revised scheme, which updates the traffic data in this area. The traffic data in the Rostherne Mere area will be updated in a forthcoming Additional Provision Environmental Statement, with subsequent revision to this HRA.

1.2.8 In addition to Rostherne Mere and The Mere, Mere, the potential effects of air pollution arising from the AP1 revised scheme has required the preparation of a new HRA for a further component of the Midland Meres and Mosses Phase 1 Ramsar site: Wybunbury Moss SSSI (see SES1 and AP1 ES Volume 5, Appendix: EC-016-00009).

1.2.9 The new HRA also provides an opportunity to take full account of recent changes in case law and best practice guidance. For instance, it should be noted that both previous HRA pre-dated the People Over Wind[6] judgement that subsequently restricted mitigation to the appropriate assessment stage. However, information in the previous HRA that remains robust and up to date has been relied upon and used to inform the outcomes here.

1.2.10 This report has been prepared to provide all the necessary information for the competent authority to carry out an HRA under Regulation 63 of the Conservation of Habitats and Species Regulations 2017, as amended by the Conservation of Habitats and Species

[5] High Speed Two Ltd (2022), High Speed Rail (Crewe – Manchester), *Environmental Statement.* Available online at: https://www.gov.uk/government/collections/hs2-phase2b-crewe-manchester-environmental-statement.

[6] People Over Wind and Peter Sweetman v Coillte Teoranta (2018), High Court (Ireland), Case C-323/17 (also referred to as the Sweetman II judgement).

(amendment) (EU Exit) Regulations 2019[7]. It is informed by contemporary Department for Environment, Food and Rural Affairs (Defra)[8], Department for Levelling Up, Housing and Communities[9] and best practice guidance. Where relevant, it takes full account of case law including the People Over Wind and the Wealden[10] judgements, amongst others.

1.2.11 Information for both Ramsar sites is provided in this document. However, any information in the original HRA screening reports that remains robust and up to date has been relied upon and used to inform the outcomes reported here.

1.2.12 Rostherne Mere is a single, 'standalone' Ramsar site. In contrast, the Midland Meres and Mosses Phase 1 Ramsar site comprises 16, hydrologically and geographically discrete water bodies situated across Cheshire, Shropshire and beyond, each notified as individual Sites of Special Scientific Interest (SSSI).

1.2.13 For simplicity, The Mere, Mere component of the Midlands Meres and the Mosses Phase 1 Ramsar site will, hereafter, simply be referred to as The Mere, Mere. In the context of this HRA, this will apply solely to its Ramsar designation and features and not those of the underpinning SSSI of the same name, unless stipulated. Reference to the Midland Meres and Mosses Phase 1 Ramsar site will only be made when wider issues are debated.

[7] The amended regulations generally seek to retain the requirements of the 2017 Regulations but with adjustments for the UK's exit from the European Union. See Regulation 4, which also confirms that the interpretation of these Regulations as they had effect, or any guidance as it applied, before exit day, shall continue to do so.

[8] Department for Environment, Food and Rural Affairs and Natural England (2021), *Habitats regulations assessments: protecting a European site*. Available online at: https://www.gov.uk/guidance/habitats-regulations-assessments-protecting-a-european-site.

[9] Department for Levelling Up Housing and Communities and Ministry of Housing, Communities & Local Government (2019), *Planning Practice Guidance.* Available online at: https://www.gov.uk/guidance/appropriate-assessment.

[10] Wealden District Council v SS Communities and Local Government, Lewes District Council and South Downs National Park Authority (2016), High Court of Justice, Case CO/3943/2016. No EWHC 351.

2 Context

2.1 Description of the AP1 revised scheme

2.1.1 The AP1 revised scheme comprises the construction and operation of a new high speed railway between Crewe and Manchester with a connection onto the West Coast Main Line (WCML) north of Crewe. The connection to the WCML near Golborne, proposed in the original scheme, will be removed.

2.1.2 Important elements of the AP1 revised scheme are listed below in order from south to north. Names of structures are provided in full, but note that for simplicity, all future references to the Hoo Green structures will use the term 'Hoo Green cuttings', due to changes in design.

Design elements in the Pickmere to Agden and Hulseheath (MA03) community area

2.1.3 Design elements in the Pickmere to Agden and Hulseheath (MA03) community area between the Heyrose embankment to Hoo Green North embankment retaining wall No.2 include:

- Hoo Green South embankment retaining wall No.2, 177m in length and up to 5m in height (see main ES Volume 2: MA03 Map Book, map CT-06-319, I6 to J6);
- Hoo Green North embankment retaining wall No.2, 172m in length and up to 3m in height (see main ES Volume 2: MA03 Map Book, map CT-06-320, B6 to C6); and
- Hoo Green North cutting, 2.7km in length, up to 13m in depth and 92m in width (see main ES Volume 2: MA03 Map Book, map CT-06-320, C6 to J5 and map CT-06-321, A4 to H5).

2.1.4 Design elements associated with the HS2 Manchester Spur and Northern Powerhouse Rail (NPR) London to Liverpool junction include:

- Hoo Green South cutting retaining wall, 359m in length, all of which will be below existing ground level, located to the west and east of the HS2 Manchester spur (northbound), 120m east of Winterbottom Lane (see main ES Volume 2: MA03 Map Book, map CT-06-319, I5 to J6 to map CT-06-320, A6 to B6);
- Hoo Green box structure, 232m in length and up to 5m in height, to carry the HS2 Manchester spur (southbound) around Hoo Green tunnel (see main ES Volume 2: MA03 Map Book, map CT-06-319, J6 and map CT-06-320, A6 to B6);
- Hoo Green tunnel, 297m in length and up to 6m in depth, to carry the HS2 Manchester spur (northbound) under the route of the AP1 revised scheme and NPR London to Liverpool junction (southbound) (see main ES Volume 2: MA03 Map Book, map CT-06-320, B6 to C6);

- Hoo Green North embankment No.2, 205m in length and up to 3m in height (see main ES Volume 2: MA03 Map Book, map CT-06-320, B6 to C6);
- Hoo Green North cutting retaining wall, 501m in length in this section, all of which will be below existing ground level, located to the west and east of the HS2 Manchester spur (northbound) (see main ES Volume 2: MA03 Map Book, map CT-06-320, C6 to F6); and
- Hoo Green North cutting, 905m in length, up to 13m in depth and 92m in width (see main ES Volume 2: MA03 Map Book, map CT-06-320, F6 to J7).

Design elements in the Hulseheath to Manchester Airport (MA06) community area

2.1.5 Design elements in the Hulseheath to Manchester Airport (MA06) community area include:

- Rostherne cutting, 1.2km in length, up to 6m in depth and 83m in width, (see main ES Volume 2: MA06 Map Book, map CT-06-352, H5 to J7 and 353, A5 to E5) with retaining walls to the west and east as follows:
  - Rostherne Cutting retaining wall west, 110m in length, all of which will be below ground level (see main ES Volume 2; MA06 Map book, map CT-06-352, H5 to I5);
  - Rostherne Cutting retaining wall east, 323m in length, all of which will be below ground level (see main ES Volume 2: MA06 Map Book, CT-06-353, D5 to E5); and
  - Millington cutting (containing the Millington North cutting), 1.5km in length, up to 13m in depth and 94m in width (see main ES Volume 2: MA06 Map Book, map CT-06-351, F6 to J4, and map CT-06-352, A7 to H6).

Construction traffic routes

2.1.6 Discrete sections of the construction traffic routes lie in proximity to Rostherne Mere or The Mere, Mere. In the case of Rostherne Mere, the construction traffic route along Cherry Tree Lane lies immediately adjacent to the Ramsar site. The Mere, Mere lies 193m north of a construction traffic route along the A50. All roads within 200m of both Ramsar sites have been subjected to air quality analysis to determine the scale of potential impacts from air pollution.

2.2 Previous assessment

Rostherne Mere Ramsar site

2.2.1 In November 2012, the original HRA screening exercise assessed the impacts of ten potential route options on Rostherne Mere. Whilst this identified potential effects from pollution incidents (or similar) associated with construction activities, and the intrusion of (some) potential routes into the groundwater catchment of this Ramsar site, it subsequently concluded that the adoption of best-practice working methods and suitable engineering techniques to address possible changes in sub-surface flows would rule out the possibility of likely significant effects alone or in-combination.

The Midland Meres and Mosses Phase 1 Ramsar site

2.2.2 In 2012, an HRA screening report was prepared for two of the constituent SSSI of the Midland Meres and Mosses Phase 1 Ramsar site in closest proximity to the AP1 revised scheme; Betley Mere SSSI and The Mere, Mere SSSI which, at the time, were 400m and 1.2km distant respectively from the closest potential HS2 route. Whilst distances to the land required for construction of the AP1 revised scheme remain unchanged, design changes now mean The Mere, Mere lies 193m from a construction traffic route.

2.2.3 All of the other constituent SSSI were screened out of the HRA process in 2012 on the basis of distance (all were found to be more than 2km distant) supported by a hydrological assessment based on evidence available at the time.

2.2.4 The 2012 HRA identified that risks from construction related activities such as waterborne pollution were low, given the distances between the Ramsar sites and the land required for the construction of the original scheme. However, it also identified possible permanent hydrological impacts where potential route options would intrude on areas considered to be within the groundwater catchment of The Mere, Mere SSSI, even though significant effects on water levels were thought unlikely. However, to avoid the possibility of any effect, it was proposed that groundwater underpass structures would be incorporated into the Hoo Green North and Hoo Green South cuttings (or the 'Hoo Green Cuttings', to reflect current design and nomenclature).

2.2.5 As part of HS2 Phase 2a, an addendum to the HRA screening report was prepared in 2017 to assess the potential impact of gravel extraction from a borrow pit approximately 280m from Betley Mere. It concluded that, as a result of the measures that would be put in place, likely significant effects on the Betley Mere SSSI component of the Midland Meres and Mosses Phase 1 Ramsar site could be ruled out, either alone or in-combination with other plans or projects.

2.3 Site description and conservation objectives

Rostherne Mere Ramsar site

2.3.1 Rostherne Mere Ramsar site extends over 79.76ha comprising, amongst other features, 45.8ha of open water and 3.3ha of fringing reed swamp. It is wholly contained within the larger Rostherne Mere SSSI (152.9ha), which is also designated as a National Nature Reserve (NNR).

2.3.2 It is listed under Ramsar Criterion 1[11] because it is one of the deepest and largest of the meres (lakes) of the Shropshire-Cheshire Plain. The Ramsar description adds that Rostherne Mere supports little submerged vegetation, but its shoreline is fringed with common reed swamp for over half its circumference. As in the case here, Ramsar qualifying features are often broadly described in the formal 'Information Sheet' and to provide clarity, Natural England has relied on the descriptions and objectives provided by the Favourable Condition Tables (FCT)[12] for the underpinning SSSI (Annex A). This confirms the qualifying features are:

- standing open water habitat: natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation; and
- fen, marsh and swamp habitat (edge component of the above standing open water): water-fringe vegetation.

2.3.3 Unlike SPA and SAC, Ramsar sites do not benefit from the production of formal conservation objectives, Site Improvement Plans (SIP) or Supplementary Advice. Consequently, Natural England also draws on the objectives from the FCT, relevant extracts of which are provided below.

Habitat extent

2.3.4 To maintain the designated features in favourable condition, which is defined in part in relation to a balance of habitat extents (extent attribute). Favourable condition is defined at this site in terms of the following site-specific standards:

- no permanent change in lake area (48.7ha); and
- no significant loss (>5%) in fringing reed swamp (3.3ha).

Site specific habitat condition objectives for open water

2.3.5 To maintain the standing open water and canals at Rostherne Mere in favourable condition, with particular reference to relevant specific designated interest features. Favourable condition is defined at this site in terms of the following site-specific standards:

- presence of at least six characteristic species;
- presence of characteristic zones of vegetation. No deterioration in extent from baseline situation;

[11] Joint Nature Conservation Committee (1981), *Ramsar Information Sheet (RIS). Rostherne Mere*. Available online at: https://jncc.gov.uk/jncc-assets/RIS/UK11060.pdf.

[12] Natural England (2016), *Definitions of Favourable Condition for designated features of interest. Rostherne Mere*.

- the maximum depth of plant colonisation should be at least 3.5m;
- total nitrogen TN annual mean 0.6mg L^{-1}. This is a site-specific target;
- no deterioration in hydrological regime compared with baseline; and
- no loss of [hydrological] connectivity (between lake and surrounding areas).

2.3.6 It should be noted that FCT were designed to facilitate monitoring activities and so where quantitative parameters are described (e.g. no loss in habitat extent above 5%) this should be viewed in the context of natural change; it does not mean that losses below 5% as a consequence of development would be acceptable. This also applies to the FCT of The Mere, Mere below.

Condition assessment

2.3.7 Natural England's condition monitoring programme evaluates the status of SSSI against these objectives. The last assessment for Rostherne Mere was carried out in 2009[13] and found that 48.2% was in 'favourable' condition, 15.1% 'unfavourable recovering and 36.7% 'unfavourable no change'. Whilst this encompassed a wider area than the Ramsar site, the division by habitat clearly shows that the entire unfavourable component comprised the open water within the Ramsar boundary. In contrast, all terrestrial habitats were favourable or unfavourable recovering.

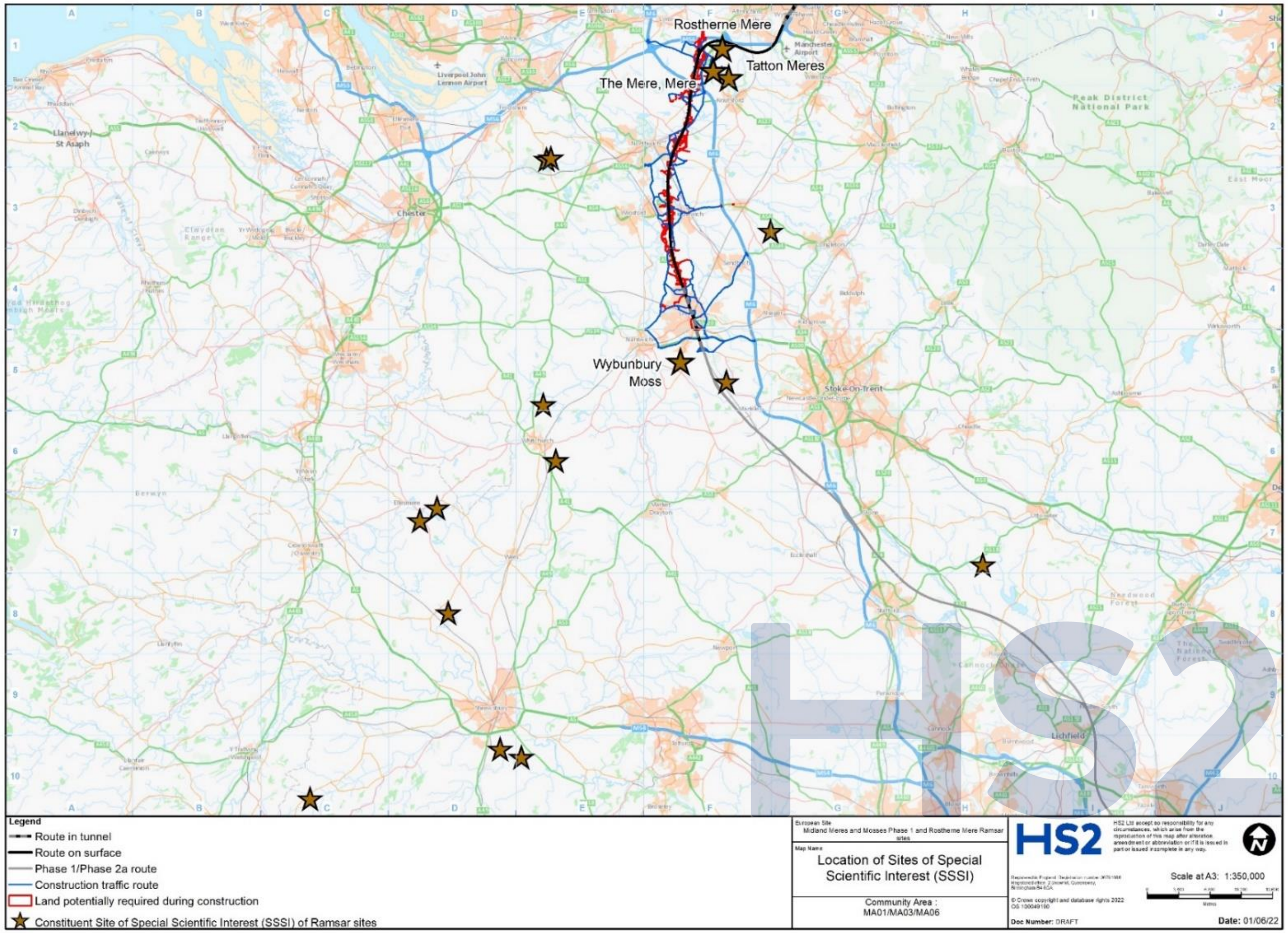
The Midland Meres and Mosses Phase 1 Ramsar site

2.3.8 The Midland Meres and Mosses Phase 1 Ramsar site (total area 510.88 ha) is composed of a series of 16 discrete sites across the north-west Midlands[14]. These sites, which include open water (meres) and their associated fringing habitats (for example, reed swamps, fen, carr and damp pasture) and a smaller number of nutrient poor peat bogs (mosses), are individually designated as SSSI for their characteristic habitats, flora and fauna. The location of the constituent SSSI of Midland Meres and Mosses Phase 1 Ramsar, which highlights those relevant to the AP1 revised scheme is provided in Figure 1 below.

[13] Natural England (2009), SSSI Condition Summary: Rostherne Mere SSSI. Available online at: https://designatedsites.naturalengland.org.uk/ReportConditionSummary.aspx?SiteCode=S1003353&ReportTitle=Rostherne%20Mere%20SSSI.

[14] Joint Nature Conservation Committee (1994), *Ramsar Information Sheet (RIS): Midland Meres and Mosses Phase 1*. Available online at: https://jncc.gov.uk/jncc-assets/RIS/UK11043.pdf.

Figure 1: Location of the constituent SSSI forming the Midland Meres and Mosses Phase 1 and Rostherne Mere Ramsar sites



2.3.9 The main interest of the Ramsar site is the wide range of lowland wetland types and successional stages present within a distinct biogeographical area. The FCT[15] for the nearest component of the Ramsar site to the AP1 revised scheme, 'The Mere, Mere SSSI' identifies that the qualifying features of this component are:

- fen, marsh and swamp: S4 *Phragmites australis* reedbed and S6 *Carex riparia* swamp; and
- standing open water: Standing water on sedimentary rock, eutrophic pH >7: A8 *Nuphar lutea* community.

2.3.10 The Mere, Mere SSSI comprises two discrete water bodies, The Mere and Little Mere, separated by a narrow spillway. These once comprised a single water body with a fluctuating water level that left large expanses of bare mud exposed in late summer/autumn. This supported the rarest plant communities and so represented the most important feature of the site. Exposure of the lake sediments now occurs less frequently since the removal of a sluice around 30 years ago. In its absence, the primary interest comprises the beds of water lilies, marginal sedge and reed swamp and the populations of red-eyed damselfly.

2.3.11 Conservation Objectives are taken from the FCT for The Mere, Mere SSSI; relevant extracts are provided below.

Habitat extent

2.3.12 To maintain the designated features in favourable condition, which is defined in part in relation to a balance of habitat extents (extent attribute). Favourable condition is defined at this site in terms of the following site-specific standards:

- the lake needs to fluctuate on an annual basis in order to maintain the habitat and vegetation; and
- there should be no reduction in the combined area of open water and drawdown zone habitat that is exposed to full sunlight.

Site-specific definitions of favourable condition for fen, marsh and swamp

2.3.13 'To maintain the fen, marsh and swamp at The Mere, Mere in favourable condition, with particular reference to relevant specific designated interest features:

- no reduction in the total combined extent of swamp in relation to the established baseline;

[15] Natural England (2008), *Conservation Objectives and Definitions of Favourable Condition for Designated Features of Interest. Rostherne Mere.*

- the total extent of emergent swamp should not exceed 50% of the shoreline and should not be less than 10%;
- no loss of the following components of the wetland/swamp: *Typha latifolia* swamp; *Phragmites australis* swamp; *Carex riparia* swamp. Presence of some *Typha angustifolia* swamp desirable;
- the Mere should significantly dry up at least one summer each decade and have less than 50% shading around the margin;
- for the S4 *Phragmites australis* reedbed:
  - *Phragmites australis* to form a closed or open stand of >90% cover; and
- for the S6 *Carex riparia* swamp:
  - *Carex riparia* cover >70%; and
  - at least two of the following associated species to be present with a combined cover less than 30% (*Phragmites australis*, *Equisetum fluviatile, E. palustre, Phalaris arundinacea, Epilobium hirsutum, Filipendula ulmaria*).'

Site-specific definitions of favourable condition for open water

2.3.14 'To maintain the open water at The Mere, Mere in favourable condition, with particular reference to relevant specific designated interest features:

- no loss of extent of standing water;
- no loss of characteristic species recorded from the site;
- characteristic zones of vegetation should be present;
- there should be a natural hydrological regime; and
- red-eyed damselfly should be present.'

Condition assessment

2.3.15 Natural England's condition monitoring programme evaluates the status of SSSI against these objectives. The last assessment at The Mere, Mere was carried out in 2008[16] and evaluated the SSSI against the 2008 conservation objectives. This found that the condition of the entire site was considered 'unfavourable no change'. There has been no condition assessment against the more recent objectives described in the FCT.

[16] Natural England (2009), *SSSI Condition Summary: The Mere, Mere SSSI*. Available online at: https://designatedsites.naturalengland.org.uk/ReportConditionSummary.aspx?SiteCode=S1001818&ReportTitle=The Mere.

2.4 Case law

2.4.1 In recent years there have been a number of important rulings made by both domestic and European courts which could influence this HRA. The most relevant are described below.

People Over Wind judgement

2.4.2 The People Over Wind judgement drew a distinction between incorporated mitigation measures which are represented by the essential characteristics of a scheme and those added specifically to avoid or reduce an impact on qualifying features. The former, such as the general alignment of HS2, can be considered at screening whereas the latter are reserved for consideration in an appropriate assessment.

Wealden judgement

2.4.3 The Wealden judgement clarifies a limitation on the use of thresholds when used to rule out the likelihood of significant effects alone or in-combination with other plans or projects, specifically the use of Annual Average Daily Traffic (AADT) figures. The Court concluded that where the likely effect of an individual plan or project does not itself exceed the threshold of 1,000 AADT, its impact must still be considered alongside the similar effects of other plans and projects to assess whether the combined effect could be significant. Where the in-combination effect is greater than this threshold, an appropriate assessment is typically required. In line with Regulation 63(1), the need to consider in-combination assessment, is also carried through into the appropriate assessment if one is necessary.

Dutch Nitrogen case

2.4.4 Here, the Court of Justice of the European Union (CJEU)[17] confirmed that an appropriate assessment is not to take into account the future benefits of mitigation measures if those benefits are uncertain, including where the procedures needed to accomplish them have not yet been carried out or because the level of scientific knowledge does not allow them to be identified or quantified with certainty.

[17] Coöperatie Mobilisation for the Environment UA, Vereniging Leefmilieu v College van gedeputeerde staten van Limburg, College van gedeputeerde staten van Gelderland, European Court of Justice, (C 293/17, C 294/17) [2019] Env. L.R. 27 at paragraph 30.

Compton case

2.4.5 This case[18] explored how exceedances of the critical loads should be assessed. The Court ruled that when considering what approach is required in order to conclude no adverse effect on the integrity of a site:

2.4.6 'That could not be answered, one way or the other, by simply considering whether there were exceedances of critical loads or levels, albeit rather lower than currently. What was required was an assessment of the significance of the exceedances for the SPA birds and their habitats …'.

2.5 Changes in evidence since 2012 HRA

Reliance on previous HRA

2.5.1 The original 2012 'HRA Screening Reports' concluded that likely significant effects on both Rostherne Mere and The Mere, Mere could be ruled out, subject to the implementation of mitigation; an outcome that was subsequently endorsed by Natural England.

2.5.2 Government guidance[8] allows competent authorities to rely on previous HRA if they remain both *robust and up to date*, or, in other words, that there has been no material change in evidence in the intervening period. In terms of broad design parameters, the identification of potential impacts and vulnerable sites, for example, much within the original HRA remains valid and where possible, these elements are relied upon in this report.

2.5.3 However, new assessment will be needed where new issues (such as air pollution) have arisen which have not been evaluated before. Similarly, the HRA will have to take account of new case law, such as the Wealden decision[10] and People Over Wind. Furthermore, new plans and projects nearby such as the A556 could either affect the environmental baseline or influence any in-combination assessment, if required. In addition, the ecological and hydrological characteristics of Rostherne Mere in particular are now better understood and all will require consideration. These are discussed below.

Ecological characteristics of Rostherne Mere and the Midland Meres and Mosses

2.5.4 The 2009 draft conservation objectives for Rostherne Mere have been replaced, and its features and characteristics have been more clearly defined, by the 2016 FCT, the

[18] Compton Parish Council, Julian Cranwell and Ockham Parish Council v Guildford Borough Council, SoS for Housing, Communities and Local Government (2019), High Court of Justice, EWHC 3242 (Admin) CO/2173,2174,2175/2019.

understanding of which has been further refined in 2019 (Annex A). However, the condition of the SSSI has not been assessed against these new criteria. In contrast, the 2005 FCT for The Mere, Mere remain valid.

2.5.5 In addition, botanical surveys of accessible wetland habitats at Rostherne Mere and The Mere, Mere were carried out in July 2019 and 2020, respectively. In the case of the former, this provides the means to compare change over time with similar surveys carried out over the past decade. Both surveys identify the presence, extent and composition of the qualifying features although in the case of The Mere, Mere, the survey was restricted to terrestrial habitats only.

Implications of the People Over Wind decision

2.5.6 The People Over Wind decision effectively restricts the evaluation of mitigation to the appropriate assessment and, consequently the outcomes of the 2012 HRA which employed bespoke engineering solutions and the use of the Code of Construction Practice (CoCP) to mitigate potentially harmful, localised effects such as dust pollution at the screening stage, cannot now be relied upon. Further consideration will therefore be required.

Design changes

2.5.7 Whilst the broad parameters of the AP1 revised scheme remain largely unchanged from the original scheme, recent design changes will require the re-evaluation of previous outcomes. Refinement of the intensity of use and location of construction traffic routes south of The Mere, Mere and around Rostherne Mere, now mean these lie within 200m of the former and 50m of (and at one point directly adjacent to) the latter. All could increase air pollution (largely in the form of nitrogen deposition) within the Ramsar sites and so will also merit new assessment.

2.6 Basis for preparing a joint assessment

2.6.1 The rationale for pursuing a joint HRA primarily reflects the hydrological linkages between Rostherne Mere and The Mere, Mere. The Mere, Mere (itself comprising two water bodies, The Mere and Little Mere), lies within the same catchment as Rostherne Mere. This connection has led to the production of a hydrological assessment and mitigation proposals that address the potential for hydrological change for both sites: Rostherne Mere and The Mere, Mere-Impact of cuttings on the water environment and ecology (hereafter referred to as 'the Technical note' and appended in Annex B).

2.6.2 Similarly, for both sites, the proximity of nearby roads requires consideration of the impact of air pollution and has prompted production of an air quality assessment (Annex C).

2.6.3 In addition, Rostherne Mere and all 16 components of the Midland Meres and Mosses display similar characteristics: highly characteristic water bodies with distinctive hydrological regimes, water chemistry and vegetation communities. Although Ramsar site selection criteria are quite broadly described, this HRA assumes that both Rostherne Mere and all components of the Midland Meres and Mosses Phase 1 Ramsar sites share similar features. Confidence in this approach can be drawn from the relatively standardised wording of the relevant FCT.

2.6.4 The Ramsar description for the entire Midland Meres and Mosses includes 'an assemblage of rare wetland invertebrates'. This does not mean that all components of the assemblage are present at each of the 16 component sites but rather that together, they support the overall assemblage. Although not listed as a feature within the FCT for the Mere, Mere, the red-eyed damselfly is present and comprises part of the assemblage and is described as 'should be present' as a component of the standing open water community. Given the limited knowledge surrounding the abundance and distribution of this species, it is not assessed specifically in this HRA, but its requirements are considered to be addressed satisfactorily in the assessment of its supporting habitat.

3 Likely significant effects

3.1 The likely significant effects test

3.1.1 Regulation 63(1) identifies whether a proposed development will result in a 'likely significant effect … (either alone or in-combination …)' on a European site. An 'in-combination' assessment is only required where an impact is identified which would not result in a significant effect on its own but where significant effects may arise when combined with other plans or projects. The screening test is seen only as a 'trigger'[19] and identifies whether the greater scrutiny of an 'appropriate assessment' is necessary. Case law interprets how Regulation 63(1) should be interpreted as follows:

- 'significant' means 'any effect that would undermine the conservation objectives of a European site'[20];
- 'Likely' is a low threshold and simply means that there is a 'risk' or 'doubt' regarding such an effect[21]; and
- [it] '… is not that significant effects are probable, a risk is sufficient'… and there must be 'credible evidence that there was a real, rather than a hypothetical, risk'[22].

3.2 Potential impacts

3.2.1 Drawing on the outcomes of the original 2012 HRA and more recent information summarised in Sections 2.3 and 2.4 above, the following impacts on Rostherne Mere and The Mere, Mere have been identified as requiring further consideration in this joint HRA:

- construction related impacts typically comprising inter alia, localised contamination of air, water and land as a consequence of dust, siltation and erosion (though excluding emissions from construction vehicles);
- changes to the local hydrological regime from construction of the Rostherne, Millington, Hoo Green cuttings; and
- increased air pollution caused by:
  - construction traffic within the alignment near Rostherne Mere;

[19] Bagmoor Wind Limited v The Scottish Ministers (2012), Court of Session, CSIH 93.

[20] Landelijke Vereniging tot Behoud van de Waddenzee and Nederlandse Vereniging tot Bescherming van Vogels v Staatssecretaris van Landbouw, Natuurbeheer en Visserij (2004), European Court of Justice, C-127/02 (referred to as the Waddenzee judgement) at paragraphs 44, 47 and 48.

[21] Waddenzee at paragraph 44.

[22] Peter Charles Boggis and Easton Bavants Conservation v Natural England and Waveney District Council (2009), High Court of Justice Court of Appeal case. C1/2009/0041/QBACF.

- construction and operational traffic using Cherry Tree Lane, Marsh Lane, Rostherne Lane, New Road, Chester Road and the A556 near Rostherne Mere; and
- construction and operational traffic using the A5034 Mereside Road and the A50 Warrington Road both near The Mere, Mere.

3.2.2 The potential for likely significant effects as a result of these impacts is discussed below.

3.3 Construction related activities

3.3.1 The Cherry Tree Lane construction traffic route runs within 50m of Rostherne Mere along much of the northern boundary, and lies directly adjacent, at one point. The land required for construction of the original scheme extends southwards to Cherry Tree Lane at several points. The Ramsar site will therefore be at risk from a range of possible effects including pollution of surface and sub-surface flows from spillages, siltation and airborne dust from vehicles amongst others. All provide mechanisms by which harm could arise, for instance via eutrophication of wetland features and the subsequent encouragement of more ruderal communities at the expense of the typically more sensitive qualifying features. It should be noted that air pollution (in terms of NOx, and both nitrogen and acid deposition) from construction vehicle exhausts are assessed under in Section 3.5.

3.3.2 In 2012, the potential for harm arising from these activities was considered remote, given implementation of the CoCP and the distances involved. However, the People Over Wind decision now prevents consideration of the CoCP at the screening stage, and, therefore, harm cannot be screened out.

3.3.3 Therefore, there is a credible risk that the AP1 revised scheme could undermine the conservation objectives of Rostherne Mere and The Mere, Mere. Likely significant effects cannot be ruled out (alone); an appropriate assessment is therefore required.

3.4 Construction/excavation of cuttings

3.4.1 This potential effect is concerned with the long-term impact on surface and sub-surface flows resulting from drainage to cuttings excavated along the route of the AP1 revised scheme. A preliminary review shows that the wetland features of Rostherne Mere and The Mere, Mere could be affected. The potential hydrological impacts were considered in the separate Technical note (Annex B).

3.4.2 Aquatic and fringing macrophyte communities are all dependent to a greater or lesser degree on the maintenance of a favourable hydrological regime that incorporates both water quality and water resource elements. The Hoo Green cuttings along the proposed alignment are located, in part, up-gradient of Rostherne Mere and may, therefore, affect groundwater flows in the catchment. In addition, it is possible, although unlikely, that the cuttings could affect groundwater flows to The Mere, Mere. The Millington and Rostherne cuttings could have an additional effect in the catchment of Rostherne Mere. Consequently, both Rostherne Mere and The Mere, Mere could be vulnerable. Drainage of groundwater in the cuttings might possibly affect surface or sub-surface flows to both Ramsar sites, potentially prompting changes to the extent, species composition, abundance and/or distribution of wetland communities.

3.4.3 Therefore, there is a credible risk that the AP1 revised scheme could undermine the conservation objectives of Rostherne Mere and The Mere, Mere. Likely significant effects cannot be ruled out (alone); an appropriate assessment is therefore required.

3.5 Air pollution

Methodology

3.5.1 For Rostherne Mere, as reported in the main ES, the need to assess air pollution has been brought about by the presence of a construction traffic route along Chester Road and Cherry Tree Lane for part of the construction phase, though the primary impact is the result of the redistribution of other traffic along the A556 during the construction phase. At The Mere, Mere, as updated for the AP1 revised scheme, traffic impacts are primarily the result of the use of the A50 Warrington Road and the A5034 Mereside Road by construction traffic and, during the operational phase, redistributed traffic along the A50 Warrington Road.

3.5.2 The assessment of air pollution comprises the analysis of changes brought about by increases in NOx, and both acid and nitrogen deposition.

3.5.3 Natural or semi-natural habitats can be harmed by airborne pollution from cars and heavy vehicles through two intimately linked pathways: via the concentration of NOx in gaseous form, and the subsequent deposition of nitrogen and acid.

3.5.4 Harm can arise in two ways. Firstly, in sufficient concentrations, airborne NOx can result in direct toxic effects on vegetation and secondly, the deposition of nitrogen compounds can lead to the acidification and nutrient enrichment of land and water. Over time, this may not only hinder the growth, abundance and distribution of plants, and especially, bryophytes and lichens, but can also prompt the growth of ruderal species and algal blooms which can cause changes in the structure and function of qualifying or supporting habitats. Whilst certain species and communities are less susceptible to harm than others, increases in the airborne concentration of pollutants or the rate of their deposition can also exacerbate the effects of other factors such as climate change or pathogens leading to negative, synergistic effects.

3.5.5 The assessment of air pollution is influenced by established best practice guidance provided by National Highways (the Design Manual for Roads and Bridges (DMRB))[23], Natural England[24] and the Institute for Air Quality Management (IAQM)[25].

3.5.6 Importantly, all affirm that impacts are only possible where a European site lies within 200m of a road. This is because the rate of deposition of airborne pollution falls quickly in the first few metres from the roadside before gradually levelling out; beyond 200m, and frequently across shorter distances, the rate of deposition becomes difficult to distinguish from background levels. A similar pattern can be found with the concentration of airborne NOx though the decline can be less pronounced. Therefore, it is clear that impacts at 10m, 50m or more can be very different from those at the roadside. Beyond 200m, significant effects can be ruled out.

3.5.7 Where a European site lies within 200m of a road, established guidance recommends that detailed assessment should take place where one or more of the following criteria are met:

- change in road alignment by 5m or more;
- change in daily traffic flows of all vehicles by 1,000 (average annual daily traffic or AADT) or more;
- change in daily flows of Heavy Duty Vehicles (HDV)[26] by 200 AADT or more;
- change in daily average speed by 10kph or more; or
- change in peak hour speed by 20kph or more.

3.5.8 As no changes in road alignments or speed is proposed, the only criterion that could possibly apply would be the change in daily traffic flows brought about by the construction or operation of the AP1 revised scheme.

3.5.9 It can be seen, therefore, that an increase in the airborne concentration of NOx and/or nitrogen and acid deposition is only likely to be significant where marked increases in traffic flows are expected on a road within 200m of a European site. Should these circumstances be met, best practice guidance recommends that the ecological characteristics of the European site should be explored and, if necessary, traffic and/or air quality assessments carried out to evaluate any impacts during construction or operation as necessary.

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[23] Highways Agency (2019), *Design Manual for Roads and Bridges (DMRB), Sustainability and Environmental Appraisal, LA 105 Air Quality*, Highways Agency, London. Available online at: https://www.standardsforhighways.co.uk/dmrb/search/10191621-07df-44a3-892e-c1d5c7a28d90.

[24] Natural England (2018), *Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations*. Available online at: http://publications.naturalengland.org.uk/publication/4720542048845824.

[25] Institute of Air Quality Management (2020), *A guide to the assessment of air quality impacts on designated nature conservation sites*, v1.1. Available online at: https://iaqm.co.uk/guidance/.

[26] HDV are defined as those with an unladen weight of greater than 3.5 tonnes, including large vans; medium goods vehicles (rigid and artic); heavy goods vehicles (rigid and artic) and buses/coaches.

3.5.10 The ecological characteristics of the European sites are derived from the formal citations, condition assessments, conservation objectives, FCT, SIP, supplementary advice and any other surveys and management plans where available.

3.5.11 Traffic flows are assessed by calculating AADT figures using established models. Should increases in traffic (alone and in-combination) be less than 1,000 AADT[27] or 200 HDV, the risk of a significant effect can be ruled out and no further assessment is required. Should flows exceed these values, air quality analysis is required. Here, impacts are assessed by calculating the relative contribution of the plan or project in relation to the critical level for NOx and the relevant critical loads for the deposition of nitrogen and acid. The air quality analysis typically models any changes at fixed points on a 200m transect extending from the roadside.

3.5.12 The critical level for NOx is fixed and is expressed as a concentration: 30µg/m^3. It is a precautionary threshold below which there is confidence that harmful effects on vegetation communities will not arise, and further assessment may not be necessary. If exceeded, the assessment of nitrogen and acid deposition is required. The critical loads for nitrogen deposition vary and are specific to each qualifying feature. These are presented as a range of values (expressed as a rate, e.g. 10kg N/ha/yr – 20kg N/ha/yr) and typically, as a precautionary approach, only the lowest value is used (unless there are compelling reasons to do otherwise) as this will emphasise any negative outcomes.

3.5.13 Acid deposition is also assessed via critical loads though measured in keq/ha/yr. As it shares a direct, linear relationship with nitrogen deposition, acidity is not always assessed as its impact can be assumed. However, following feedback by Natural England, this was also evaluated.

3.5.14 For NOx and nitrogen deposition, where background values prior to development lie below the critical levels or loads, significant effects can be ruled out for any increases in pollution brought about by a new plan or project provided they do not lead to an exceedance of the critical level (NOx) or the lower critical load (nitrogen deposition).

3.5.15 However, it is important to recognise that these thresholds do not represent the points where harm will arise. Consequently, exceedance of these thresholds does not necessarily mean that harm will occur. Indeed, in circumstances where background values already exceed the critical values or loads, which is typically the case across much of lowland England, an increase of less than 1% of the critical level or the lower critical load also allows significant effects to be ruled out though each case should be assessed on the particular circumstances. This is because the 1% threshold, at two orders of magnitude below the

[27] These values are utilised as there is evidence to show that these equate approximately to a 1% change in critical loads (see paragraph 2.4.3).

critical level or load, is set at a level where measurable impacts would be difficult to detect. It is, therefore, considered to be highly precautionary.

3.5.16 In contrast, should increases in pollution from a new plan or project be greater than 1% of the critical level or lower critical load, the risk of a significant effect cannot be ruled out and an appropriate assessment will be required. Again, however, an exceedance of the 1% threshold does not necessarily mean that an adverse effect on the integrity of a European site will automatically occur. Indeed, this emphasises that assessment is not about establishing a simple mathematical relationship. Account must be taken of the type of qualifying feature (some are more resilient than others), their location (as not all will be distributed evenly across sites), and other factors that may be at play.

3.5.17 The assessment of acid deposition differs because if the total concentration is predicted to be less than the lower critical load, then the effect is considered to be not significant. If the change in concentration is more than the 1% of the maximum critical load and the total for acid deposition is greater than the maximum critical load, then an appropriate assessment will be required.

3.5.18 Natural England adds that where the existing background levels of NOx or rates of deposition already exceed these values prior to implementation of a plan or project, the conservation objectives shift from seeking to maintain the qualifying features to securing their restoration to a favourable conservation status. This reflects the greater challenge of restoring a site that could already be suffering harm from air pollution. It also makes clear that the impact assessment should focus on those objectives related to the structure and function of a site; those objectives most relevant to the impacts that could arise from air pollution are provided in Section 2.3 above.

3.5.19 Whilst assessment should, in the first instance, evaluate the plan or project in isolation, the Wealden decision makes clear that should insignificant outcomes arise alone, the outcomes should also be assessed in-combination with other plans or projects. This test is also carried through to the appropriate assessment (if one is required). To determine whether a formal screening exercise is required, this document to inform the HRA firstly assesses the preliminary criteria: proximity of the European site to a road and the volume of anticipated traffic. If necessary, it then screens the construction and/or operational phase either alone or in-combination. An appropriate assessment follows subsequently, should one be considered necessary. An assessment of any impacts on the entire Midland Meres and Mosses Phase 1 Ramsar site concludes the assessment.

Initial assessment – Rostherne Mere

Background

3.5.20 Key information is presented in the air quality assessment (Annex C) which summarises the associated air quality analysis. The following assessment draws on best practice guidance from Natural England, DMRB and IAQM and utilises selected information from Annex C though reference to the latter is encouraged. Whilst not explicitly following the five tests laid out in the Natural England Guidance, all the information required is provided so that the steps are followed sequentially, and the conclusions drawn are consistent with that advice.

Proximity

3.5.21 Rostherne Mere is bordered by both the old and the new A556 to the west, Cherry Tree Lane to the north, Marsh Lane in the east and Rostherne Lane to the south. All lie well within the 200m threshold. Consequently, a traffic assessment is required.

Traffic assessment

3.5.22 At Rostherne Mere, a planned construction traffic route runs along Chester Road and Cherry Tree Lane for part of the construction period, with approximately 200 HDV movements per day predicted. In addition, an internal haul road runs parallel to Cherry Tree Lane. Other roads will be subjected to increased traffic flows from journeys domestic traffic unrelated to HS2 displaced from other routes by delays and diversions during the construction and operation periods. Construction is anticipated to commence in 2025 and cease in 2038 when the operational phase begins.

Rostherne Mere (construction phase)

Air quality assessment of traffic flows (construction phase) alone

3.5.23 The air quality assessment of traffic flows at Rostherne Mere has been undertaken in accordance with the main ES Volume 5, Appendix: CT-001-00001, Environmental Impact Assessment Scope and Methodology Report (SMR)[28]. The assessment is summarised in Annex C. Despite the presence of the construction traffic route, impacts are primarily the result of increased flows of traffic along the A556 re-distributed from other routes during construction of the original scheme.

3.5.24 Annex C identifies four roads that were found to exceed the screening thresholds:

- A556;
- Chester Road (between Millington Lane and Cherry Tree Lane);
- Cherry Tree Lane (between Chester Road and Birkinheath Lane); and
- an on-site haul route, north of Cherry Tree Lane.

[28] High Speed Two Ltd (2022), High Speed Rail (Crewe – Manchester), *Environmental Statement, Environmental Impact Assessment Scope and Methodology Report,* Volume 5, Appendix CT-001-00001. Available online at: https://www.gov.uk/government/collections/hs2-phase2b-crewe-manchester-environmental-statement.

3.5.25 Six transects (T3, T4, T5, T6, T7 and T9), each 200m long, were established around the circumference of Rostherne Mere: T3 and T4 in the west near the A556; T5 in the north-west near Cherry Tree Lane; and, T6, T7 and T9 to the north and north-east, again near Cherry Tree Lane. Each transect started from the kerbside and intercepted the boundary of the European site at 194m, 184m, 53m, 86m, 72m and 0m, respectively. All subsequent points fell within the Ramsar site. The location and distribution of transects is shown in Figure 2.

3.5.26 The air pollution assessment has used traffic data based on an estimate of the average daily flows in the peak year during the construction period and adopts vehicle emission rates and background pollutant concentrations from the first year of construction. It should be noted that the air quality model takes a conservative approach and assumes that the highest flows in any one year are applied to the entire construction period. In reality, there will be considerable periods, perhaps years, where traffic flows and hence nitrogen deposition are less than this. However, the approach adopted meets the precautionary principle embedded in the Habitats Regulations.

3.5.27 Background NOx and nitrogen deposition rates were obtained from the Air Pollution Information System (APIS)[29]. Several habitat types were identified within the European site and are listed below with the appropriate critical loads:

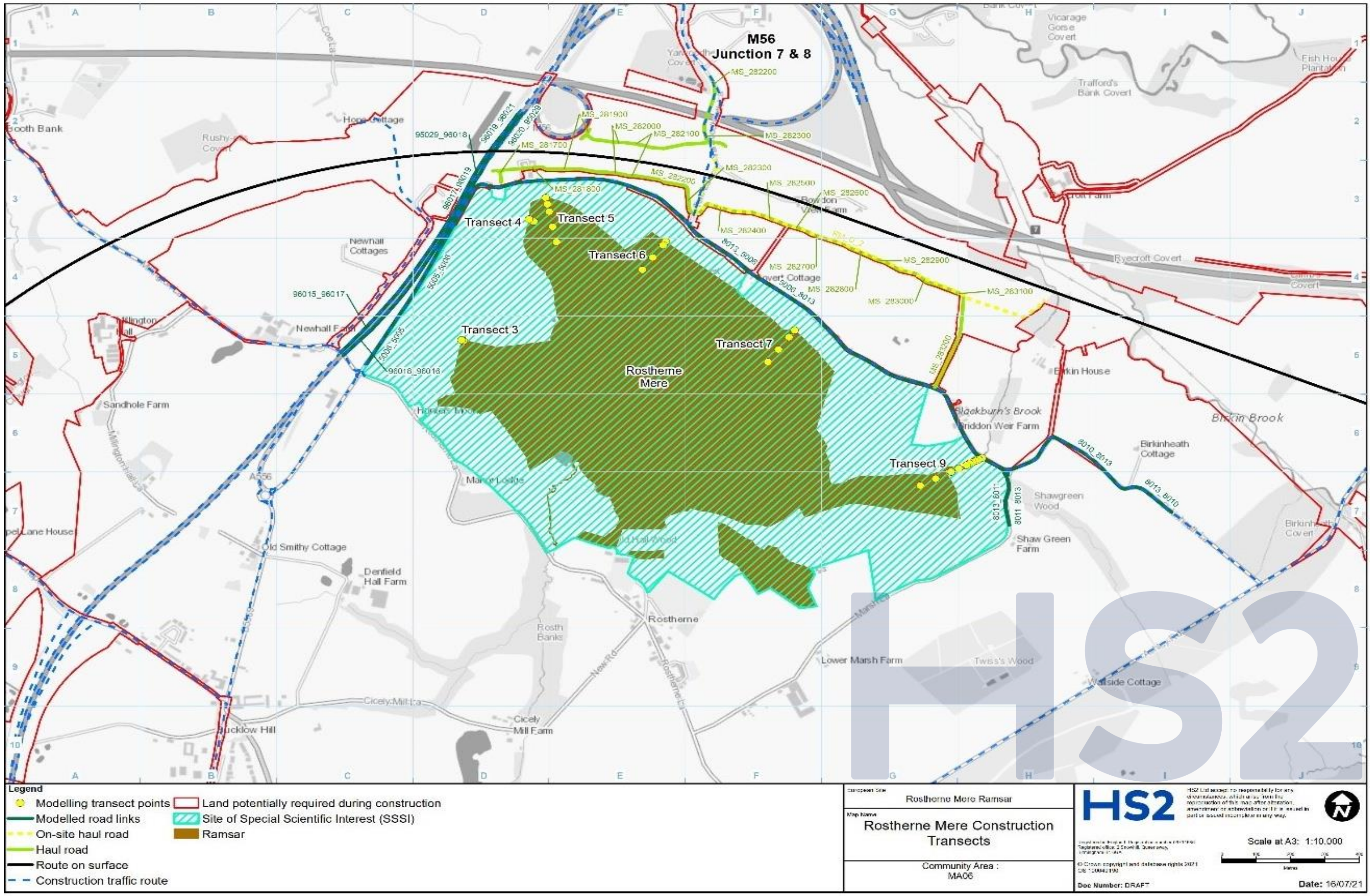
- neutral grassland (20kg N/ha/yr – 30kg N/ha/yr);
- broadleaved woodland (10kg N/ha/yr – 20kg N/ha/yr); and
- poor fen (10kg N/ha/yr – 15kg N/ha/yr).

3.5.28 The allocation of critical loads merits clarification. Best practice guidance encourages the use of the lowest value in the critical load range as a precautionary measure, as it will emphasise any negative outcomes. However, in addition to the semi-natural habitats, Rostherne Mere also includes substantial areas of woodland including Harpers Bank Wood to the west, Mere Covert (excluding Gale Bog) to the north and Wood Bongs to the south-east. These do not represent qualifying features and it is understood these were included within the Ramsar site and SSSI boundary to provide influence over surrounding land management with the FCT describing their role 'as a buffer to the mere'. Consequently, each is regarded as 'site fabric'[30] but in reflection of its semi-natural character and as a precautionary measure, it has been classified as broadleaved woodland with a critical load of 10kg N/ha/yr – 20kg N/ha/yr though, reflecting its status as site fabric, the highest value in the range has been used.

[29] UK Centre for Ecology and Hydrology (2021), *Air Pollution Information System*. Available online at: http://www.apis.ac.uk.

[30] Site fabric is defined in Natural England (2018) as '… land and or permanent structures present within a designated site boundary which are not and never have been, part of the special interest of the site, nor do they contribute towards supporting a special interest feature in any way, but which have been unavoidably included within a boundary for convenience or practical reasons. Areas of site fabric … will not be expected to make a contribution to the achievement of conservation objectives.'

Figure 2: Distribution of transects, Rostherne Mere



3.5.29 The correct identification of the qualifying feature at Rostherne Mere that best represents the Ramsar criteria is of fundamental importance as the differing critical loads will directly influence the overall outcome of this assessment. Table 2 of the FCT identifies that the National Vegetation Classification (NVC) communities that comprise the fen, marsh and swamp community at Rostherne Mere comprise the following:

- S4 – *Phragmites australis* swamp and reed-beds;
- S13 – *Typha angustifolia* swamp; and
- S26 – *Phragmites australis-Urtica dioica* tall-herb fen.

3.5.30 This has been confirmed by site survey in July 2019. Based on Natural England's advice (Annex A), these three communities, despite occupying neutral, eutrophic locations and dominated by tall emergent vegetation and more akin to the late successional stages of swamp vegetation, are considered to represent 'poor fen' communities. The prevalence of these floristic characteristics can also be found in previous surveys referred to by the FCT, suggesting little change over the last decade or so.

3.5.31 Importantly, although undeniably wet woodland today, management objectives for Gale Bog seek to restore this to fen, marsh and swamp or similar vegetation and so, again on the advice on Natural England, this too is evaluated as a component of this poor fen community. Similarly, and importantly, the standing open water is also evaluated under the critical loads used for poor fen.

3.5.32 In order to satisfy the precautionary nature of HRA, best practice guidance recommends that unless there are compelling reasons to do otherwise, only the lowest figure in the range should be used. Consequently, the value of 10kg N/ha/yr for poor fen was used to assess the wetland qualifying features.

3.5.33 Table C4 describes the change in NOx concentrations brought about by the AP1 revised scheme alone during construction and is described in Annex C as follows:

'NOx concentrations are predicted to be within the air quality standard in 2025 at all locations with or without the original scheme. No potentially significant effects are therefore predicted'.

3.5.34 This evidence shows that not only are background values already below the critical level but remain so even when the impact of the AP1 revised scheme alone is added. Best practice guidance is clear that likely significant effects can be ruled out. However, mindful of the requirements of the Wealden decision, an in-combination assessment is also required. Despite this positive outcome, an assessment of nitrogen deposition was also made across all transects during the construction period (alone) (see Table C5 and repeated below in Table 1[31].

Table 1: Assessment of nitrogen deposition at Rostherne Mere (construction, original scheme alone)

Transect (T)	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	% Change in relation to lower critical load
		2018 baseline	2025 without the original scheme	2025 with the original scheme			
T3	194	39.91	39.64	39.66	0.02	20	0.1%
	200	39.89	39.63	39.65	0.02	20	0.1%
T4	184	24.23	24.03	24.05	0.02	10	0.2%
	200	24.19	24.01	24.03	0.02	10	0.2%
T5	53	24.20	24.01	24.03	0.02	10	0.2%
	75	24.17	24.00	24.02	0.02	10	0.2%
	100	24.15	23.99	24.00	0.01	10	0.2%
	150	24.10	23.96	23.98	0.02	10	0.2%
	200	24.07	23.94	23.96	0.02	10	0.1%
T6	86	39.58	39.47	39.50	0.03	20	0.1%
	100	39.58	39.47	39.49	0.02	20	0.1%
	150	39.58	39.47	39.49	0.02	20	0.1%
	200	39.59	39.47	39.49	0.02	20	0.1%
T7	72	39.44	39.39	39.41	0.02	20	<0.1%
	75	39.44	39.39	39.41	0.02	20	<0.1%
	100	39.44	39.39	39.41	0.02	20	<0.1%
	150	39.44	39.39	39.41	0.02	20	<0.1%
	200	39.44	39.39	39.41	0.02	20	<0.1%
T9	0	39.41	39.38	39.45	0.07	20	0.3%
	10	39.39	39.37	39.40	0.03	20	0.1%
	20	39.39	39.37	39.39	0.02	20	0.1%
	30	39.39	39.37	39.39	0.02	20	<0.1%
	40	39.39	39.37	39.38	0.01	20	<0.1%
	50	39.39	39.37	39.38	0.01	20	<0.1%
	75	39.39	39.37	39.38	0.01	20	<0.1%
	100	39.39	39.37	39.38	<0.01	20	<0.1%
	150	39.39	39.37	39.38	<0.01	20	<0.1%
	200	39.39	39.37	39.37	<0.01	20	<0.1%

[31] Note that all tables in this HRA are drawn from Annex C. Whilst minor changes have been made to the layout, the data remains unchanged.

3.5.35 With reference to this data, Annex C states:

'Nitrogen deposition is predicted to be above the lower critical load in all scenarios. However, the changes in nitrogen deposition due to the AP1 revised scheme are lower than 1% of the lower critical load at all modelled receptors. No potentially significant effects are therefore predicted.'

3.5.36 This evidence shows that predicted increases in deposition brought about by the AP1 revised scheme alone are modest, and no higher than 0.07kg N/ha/yr at any point on any transect. Indeed, the 1% threshold is not exceeded anywhere and only a handful of points on Transects T4 and T5 actually fall within the poor fen/open water qualifying feature, the rest falling on land regarded as site fabric. Best practice guidance is clear that with such modest increases, likely significant effects can be ruled out. However, mindful of the requirements of the Wealden decision, an in-combination assessment is also required.

Screening opinion for Rostherne Mere (construction) alone

3.5.37 The original scheme has been screened for the purposes of Regulation 63 of the Habitats Regulations 2017 as amended. It is considered that there is no credible risk that nitrogen deposition during the construction phase could undermine the conservation objectives of Rostherne Mere and likely significant effects (alone) can be ruled out. An in-combination assessment is required.

Air quality assessment of traffic flows (construction phase) in-combination

Rationale

3.5.38 Although likely significant effects during construction alone were ruled out in paragraph 3.5.33, an assessment of the original scheme during construction in-combination with other plans or projects is also required. As the Directive[32] makes clear, the in-combination test seeks to identify cumulative effects, and consequently they are limited to those that can affect the same feature. Therefore, the in-combination assessment was limited to those plans or projects that had the potential to increase nitrogen deposition on the qualifying features of Rostherne Mere; all other potential impacts were ruled out. The range and scope

[32] *Directive 92/43/EEC of the European Parliament and of the Council of 21st May 1992 on the conservation of natural habitats and of wild fauna and flora aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements*. Strasbourg, European Parliament and European Council.

of in-combination assessments has been addressed in various settings; relevant examples include:

- Regulation 63(2) states:

[the developer] 'must provide such information as the competent authority may reasonably require for the purposes of such an assessment.'

- Furthermore, on 22 April 2005, the European Commission stated, in response to a parliamentary question (P-0917/05):

'The [in-] combination provision must be applied in a manner that is proportionate …'

- In Foster and Langton[33], the Court stated:

'There is no basis to carry out an assessment of the in-combination effects when there are no effects to take into account.' (paragraph 36).

3.5.39 This evidence has determined the need for and scope of any in-combination assessment required for this European site as explained in Section 5.2.

Methodology

3.5.40 In-combination effects are largely taken into account in the traffic data used for the assessment which incorporates likely changes brought about by other proposed and committed developments. The approach to this assessment, which has been agreed with Natural England, is provided in Section 2 of Annex C. A separate review identified other non-traffic related sources of air pollution, which are accounted for in the modelling where relevant.

3.5.41 In order to comply with the Wealden decision, the scope of the in-combination assessment has been limited to those plans or projects that could contribute to a cumulative increase in air pollution at Rostherne Mere. Annex C details how development that could cause traffic emission related in-combination effects have been accounted for within the traffic data used in the air quality assessment of traffic flows. Searches were also carried out for the following non-traffic related emission sources (which are also included in the air quality model) within a 5km radius:

- combustion and energy > 1MW;
- farming, livestock and poultry (any);
- waste, e.g. landfill gas (any); and
- minerals activities.

[33] R (Foster and Langton) v Forest of Dean DC and Homes and Communities Agency (2015), High Court of Justice, EWHC 2684.

3.5.42 This is considered to be reasonable and proportionate and meets the expectations laid down in Section 4.48 of Natural England's guidance[24].

Air quality assessment of traffic flows in-combination

3.5.43 Annex C identifies four roads that were found to exceed the screening thresholds:

- A556;
- Chester Road (between Millington Lane and Cherry Tree Lane);
- Cherry Tree Lane (between Chester Road and Birkinheath Lane); and
- on-site haul route, north of Cherry Tree Lane.

3.5.44 Despite the presence of the construction traffic route, impacts are primarily the result of increased flows of traffic growth along the A556 from the 2018 Base Year.

3.5.45 As with the assessment of the original scheme alone, changes in NOx are summarised first and reference to Annex C states:

'NOx concentrations are predicted to be within the air quality standard in 2025 at all locations with or without the original scheme. No potentially significant effects are therefore predicted.'

3.5.46 This evidence shows that not only are background values already below the critical level but remain so even when the impact of the original scheme alone is added. Best practice guidance is clear that likely significant effects can be ruled out. However, mindful of the requirements of the Wealden decision, an in-combination assessment is also required. Despite the same positive outcome as achieved in the assessment alone, an assessment of nitrogen deposition was also made across all transects during the construction period (in-combination) (see Table C8) and is repeated below in Table 2.

Table 2: Assessment of nitrogen deposition at Rostherne Mere (construction, original scheme in-combination)

Transect (T)	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	% Change in relation to lower critical load
		Baseline 2018	2025 do nothing	2025 with the original scheme			
T3	194	39.91	39.60	39.66	0.06	20	0.3%
	200	39.89	39.59	39.65	0.06	20	0.3%
T4	184	24.23	24.00	24.05	0.05	10	0.5%
	200	24.19	23.98	24.03	0.05	10	0.5%
T5	53	24.20	23.99	24.03	0.04	10	0.5%
	75	24.17	23.97	24.02	0.05	10	0.4%

Transect (T)	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	% Change in relation to lower critical load
		Baseline 2018	2025 do nothing	2025 with the original scheme			
	100	24.15	23.96	24.00	0.04	10	0.4%
	150	24.10	23.94	23.98	0.04	10	0.4%
	200	24.07	23.93	23.96	0.03	10	0.3%
T6	86	39.58	39.45	39.50	0.05	20	0.2%
	100	39.58	39.45	39.49	0.04	20	0.2%
	150	39.58	39.46	39.49	0.03	20	0.2%
	200	39.59	39.46	39.49	0.03	20	0.2%
T7	72	39.44	39.39	39.41	0.02	20	0.1%
	75	39.44	39.39	39.41	0.02	20	0.1%
	100	39.44	39.39	39.41	0.02	20	0.1%
	150	39.44	39.39	39.41	0.02	20	<0.1%
	200	39.44	39.39	39.41	0.02	20	<0.1%
T9	0	39.41	39.38	39.45	0.07	20	0.3%
	10	39.39	39.37	39.40	0.03	20	0.2%
	20	39.39	39.37	39.39	0.02	20	0.1%
	30	39.39	39.37	39.39	0.02	20	0.1%
	40	39.39	39.36	39.38	0.02	20	0.1%
	50	39.39	39.36	39.38	0.02	20	<0.1%
	75	39.39	39.36	39.38	0.02	20	<0.1%
	100	39.39	39.36	39.38	0.02	20	<0.1%
	150	39.39	39.36	39.38	0.02	20	<0.1%
	200	39.39	39.36	39.37	0.01	20	<0.1%

3.5.47 With reference to this data, Annex C states:

'Nitrogen deposition is predicted to be above the lower critical load in all scenarios. However, the changes in nitrogen deposition due to the original scheme in-combination are lower than 1% of the lower critical load at all modelled receptors. No potentially significant effects are therefore predicted.'

3.5.48 This evidence shows that predicted increases in deposition brought about by the original scheme in-combination with other plans or projects are modest, and no higher than 0.07kg N/ha/yr at any point on any transect. Indeed, the 1% threshold is not exceeded anywhere and only a handful of points on Transects T4 and T5 fall within the poor fen/open water qualifying feature, the rest falling on land regarded as site fabric. Best practice guidance is clear that with such modest increases, likely significant effects can be ruled out. As this assessment has been carried on in-combination with other plans or projects, there is no need for any further assessment.

Screening opinion for Rostherne Mere (construction) in-combination

3.5.49 The original scheme has been screened for the purposes of Regulation 63 of the Habitats Regulations 2017 as amended. It is considered that there is no credible risk that nitrogen deposition during the construction phase could undermine the conservation objectives of Rostherne Mere and likely significant effects (in-combination) can be ruled out. No further assessment is required.

Rostherne Mere (operational phase)

Air quality assessment of traffic flows (operation phase) alone

3.5.50 The same tasks, according to the same criteria as for the screening assessment for construction alone (see paragraphs 3.5.15 to 3.5.19), were carried out for the operational phase and so they are not repeated here.

3.5.51 Annex C identifies that the only road meeting the screening thresholds under this scenario was the A556. Traffic impacts are primarily the result of increased traffic along the A556.

3.5.52 Consequently, only Transects 3 and 4 were triggered. As with the assessment of the original scheme alone, changes in NOx are summarised first and reference to Table D16 is encouraged for the detail. Annex C states:

'NOx concentrations are predicted to be within the air quality standard in 2038 at all locations with or without the AP1 revised scheme. No potentially significant effects are therefore predicted.'

3.5.53 This is the same positive outcome as achieved for the assessments for the construction phase both alone and in-combination, albeit from 2038 onwards. As with those exercises, an assessment of nitrogen deposition was also made across all transects during the construction period (in-combination) (see Table C5) and is repeated below in Table 3.

Table 3: Assessment of nitrogen deposition at Rostherne Mere (operation, original scheme alone)

Transect (T)	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	% Change in relation to lower critical load
		2018 baseline	2038 without the original scheme	2038 with the original scheme			
T3	194	39.91	39.46	39.46	<0.01	20	<0.1%
	200	39.89	39.45	39.46	<0.01	20	<0.1%
T4	184	24.23	23.89	23.89	<0.01	10	<0.1%
	200	24.19	23.88	23.89	<0.01	10	<0.1%

3.5.54 Annex C states:

'Nitrogen deposition is predicted to be above the lower critical load in all scenarios. However, the changes in nitrogen deposition due to the original scheme are lower than 1% of the lower critical load at all modelled receptors. No potentially significant effects are therefore predicted.'

3.5.55 Again, the evidence shows that predicted increases in deposition brought about by the original scheme alone are modest, and no higher than 0.01kg N/ha/yr at any point on either of the two transect. The 1% threshold is not exceeded anywhere and only two points on Transect T4 fall within the poor fen/open water qualifying feature, the rest falling on land regarded as site fabric. Best practice guidance is clear that with such modest increases, likely significant effects alone can be ruled out. However, mindful of the requirements of the Wealden decision, an in-combination assessment is also required.

Screening opinion for Rostherne Mere (operation) alone

3.5.56 The original scheme has been screened for the purposes of Regulations 63 of the Habitats Regulations 2017 as amended. It is considered that there is no credible risk that nitrogen deposition during the construction phase could undermine the conservation objectives of Rostherne Mere and likely significant effects (alone) can be ruled out. An in-combination assessment is required.

Air quality assessment of traffic flows (operation phase) in-combination

3.5.57 The same tasks, according to the same criteria as for the screening assessment for construction in-combination (see paragraphs 3.5.31 to 3.5.35), were carried out for the operational phase and so are not repeated here.

3.5.58 Reflecting the outcome for the operational phase alone, the only road meeting the screening thresholds under this scenario was the A556. Traffic impacts are primarily the result of increased traffic growth along the A556 from the 2018 Base Year Consequently, only Transects 3 and 4 were triggered. As with the assessment of the original scheme alone, changes in NOx are summarised first and reference to Table C14 is encouraged for the detail. The Annex C states:

'NOx concentrations are predicted to be within the air quality standard in 2038 at all locations with or without the AP1 revised scheme. No potentially significant effects are therefore predicted.'

3.5.59 This is the same positive outcome, albeit from 2038 onwards, as achieved under other scenarios. As with those exercises, an assessment of nitrogen deposition was also made across all transects during the construction period (in-combination) (see Table C15) and is repeated below in Table 4.

Table 4: Assessment of nitrogen deposition at Rostherne Mere (operation, original scheme in-combination)

Transect (T)	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	% Change in relation to lower critical load
		Baseline 2018	2038 do nothing	2038 with the original scheme			
T3	194	39.91	39.44	39.46	0.02	20	0.1%
	200	39.89	39.43	39.46	0.03	20	0.1%
T4	184	24.23	23.87	23.89	0.02	10	0.2%
	200	24.19	23.87	23.89	0.02	10	0.2%

3.5.60 Annex C states:

'Nitrogen deposition is predicted to be above the lower critical load in all scenarios. However, the changes in nitrogen deposition due to the original scheme in- combination are lower than 1% of the lower critical load at all modelled receptors. No potentially significant effects are therefore predicted.'

3.5.61 Again, the evidence shows that predicted increases in deposition brought about by the AP1 revised scheme in-combination are modest, and less than 0.1kg N/ha/yr at any point on either of the two transect. The 1% threshold is not exceeded anywhere and only two points on Transect T4 fall within the poor fen/open water qualifying feature, the rest falling on land regarded as site fabric. Best practice guidance is clear that with such modest increases, likely significant effects can be ruled out. As this assessment has been carried out in-combination with other plans or projects, there is no need for any further assessment.

Screening opinion for Rostherne Mere (operation) in-combination

3.5.62 The original scheme has been screened for the purposes of Regulations 63 of the Habitats Regulations 2017 as amended. It is considered that there is no credible risk that nitrogen deposition during the operation phase could undermine the conservation objectives of Rostherne Mere and likely significant effects (in-combination) can be ruled out. No further assessment is required.

Initial assessment – The Mere, Mere

Background

3.5.63 Key information is presented in the air quality assessment (Annex D) which summarises the associated air quality analysis.

Proximity

3.5.64 The Mere, Mere is bordered by A5034 Mereside Road to the east, and north, A50 Warrington Road to the south and Chester Road to the west. The latter lies over 200m from the Ramsar site boundary and so is dismissed from any further scrutiny. In contrast, the A5034 Mereside Road and A50 Warrington Road lie within the 200m threshold and, consequently, a traffic assessment is required.

Traffic assessment

3.5.65 The assessment of traffic flows identified that the screening thresholds were triggered by both the A5034 and the A50 across a range of different scenarios including both construction and operational phases, alone or in-combination. Consequently, likely significant effects cannot be ruled out alone or in-combination. Accordingly, the evidence to inform the air quality assessment of traffic flows and the subsequent screening assessment for each scenario is provided below. Each scenario is taken in turn.

The Mere, Mere (construction phase)

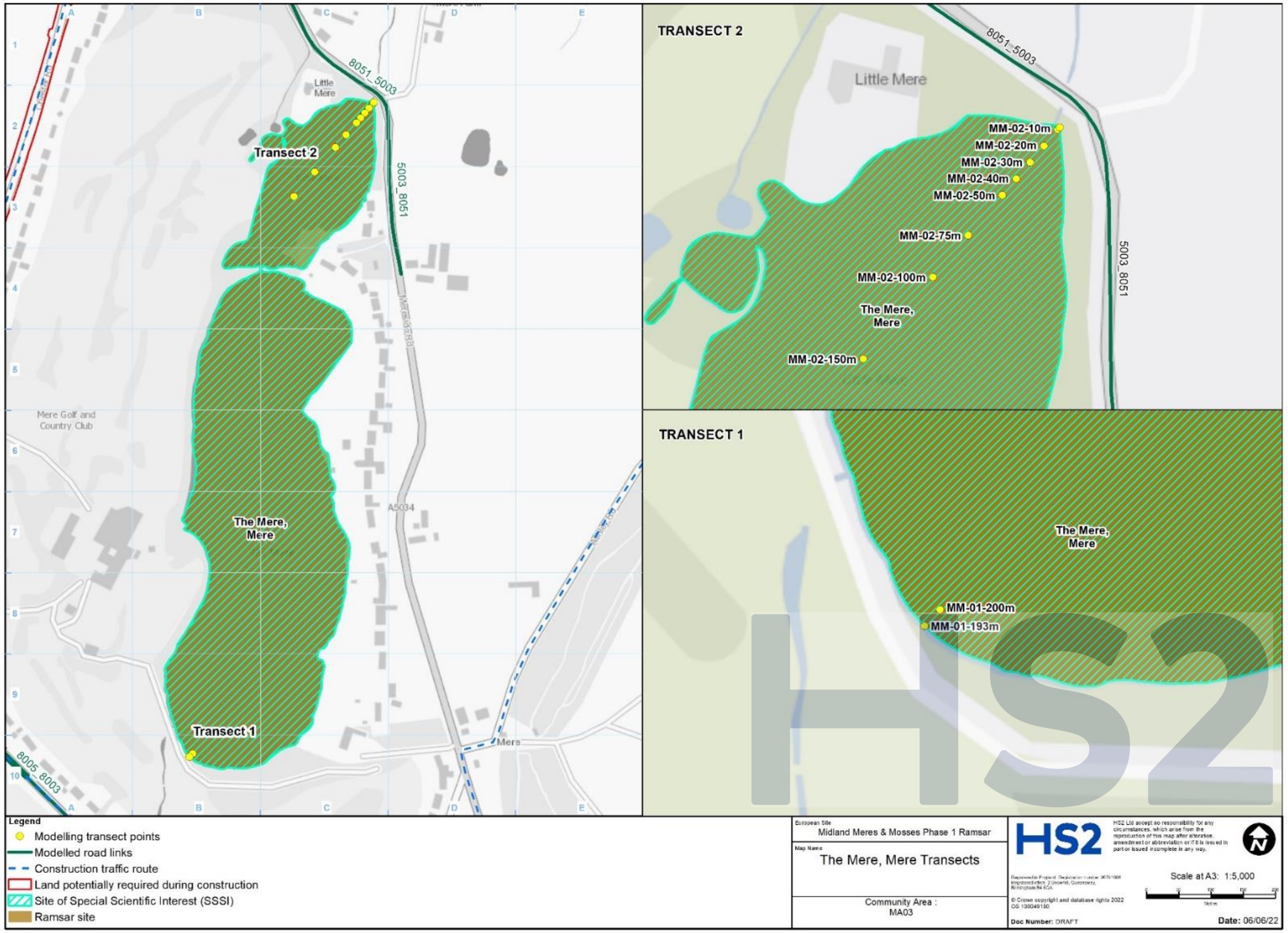
3.5.66 The air quality assessment of traffic flows at the Mere, Mere has been undertaken in accordance with the Volume 5, Appendix: CT-001-00001, Environmental Impact Assessment SMR. The assessment is summarised in Annex D. The methodology, guidance and legislation described for the assessment of Rostherne Mere above all applies to the various exercises carried out below and is not repeated here.

Air quality assessment of traffic flows (construction phase) alone

3.5.67 Annex D shows that only one road, the A50 (Warrington Road) which lies to the south of The Mere, Mere, was found to exceed the screening thresholds under this scenario. Traffic impacts are primarily the result of increased traffic from diversionary effects during the construction phase. Consequently, a single 200m transect (T1) was established and its location is shown on Figure 3. This transect started at the kerbside and intercepted the SSSI/Ramsar site boundary at a distance of 193m.

3.5.68 The methodologies described above for Rostherne Mere were also applied to The Mere, Mere and are not repeated here. In contrast, given its different characteristics, only one habitat type, 'poor fen' with a critical load of 10kg N/ha/yr – 15kg N/ha/yr was of relevance here. Drawing on the findings of the Rostherne Mere assessment, critical loads of 10kg N/ha/yr – 15kg N/ha/yr were applied for nitrogen deposition. Unusually, APIS does not provide a critical load for acid deposition. Consequently, and as agreed with Natural England, the critical loads from the transition mire/quaking bog community at Oak Mere SAC/Midlands Meres and Mosses Phase 2 Ramsar site, were applied as a reasonable surrogate. Whilst occupying a not dissimilar position on the interface between terrestrial and aquatic habitats (so sharing some characteristics of the important shoreline community at The Mere, Mere, it is markedly different in others) it is considered to be more sensitive to acidification and represents a precautionary approach. The critical level for NOx is a constant (30µg/m^3) and remains unaltered.

Figure 3: Location of transects, The Mere, Mere



3.5.69 Table D5 describes the change in NOx concentrations brought about by construction of the AP1 revised scheme alone. It shows that the background concentrations of NOx prior to construction were considerably below the 30µg/m^3 critical level and remained so throughout the construction period. It is described in Annex D as follows:

'NOx concentrations at the site are predicted to be within the air quality standard at all receptors. Changes in NOx concentrations are less than 1% of the air quality standard at all receptors. No potentially significant effects are therefore predicted'.

3.5.70 This evidence shows that the predicted change in NOx brought about by the AP1 revised scheme is modest and fails to exceed the critical level at any point in time. This means that likely significant effects can be ruled out for NOx for construction impacts alone though mindful of the requirements of the Wealden decision, an in-combination assessment is also required.

3.5.71 Despite the possibility that this positive outcome could be taken to preclude the need for further analysis, an assessment of nitrogen deposition was also made across T1 during the construction period (alone) (see Table D17) and repeated below in Table 5.

Table 5: Assessment of nitrogen deposition at The Mere, Mere (construction, AP1 revised scheme alone)

Transect (T)	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	Percent change in relation to lower critical load
		2018 baseline	2025 without the AP1 revised scheme	2025 with the AP1 revised scheme			
T1	193	24.14	23.99	24.00	0.01	10	0.2%
	200	24.14	23.98	24.00	0.02	10	0.2%

3.5.72 Table 5 and Table D6 describe the change in nitrogen deposition brought about by construction of the AP1 revised scheme alone. They show that background rates of nitrogen deposition exceeded the lower critical load for poor fen prior to and throughout the construction phase although, reflecting anticipated improvements in air quality, the exceedance was slightly less at the end of the construction period than at the beginning. With reference to this data, Annex D states:

'Nitrogen deposition rates are predicted to be above the lower critical load at all modelled receptors in the baseline and future scenarios with or without the AP1 revised scheme. Predicted nitrogen deposition rates in 2025, with the AP1 revised scheme, are lower than the 2018 baseline rates at all modelled locations. The changes in nitrogen deposition between the 2025 do minimum scenario and with the AP1 revised scheme scenario (are) less than 1% of the lower critical load. No potentially significant effects are therefore predicted.'

3.5.73 This evidence shows that predicted increases in the rate of nitrogen deposition brought about by construction of the AP1 revised scheme alone are modest, and less than 0.02kg

N/ha/yr or 0.2% of the lower critical load for poor fen at any point on T1. Best practice guidance is clear that with such modest increases, likely significant effects can be ruled out alone because even though background rates of nitrogen deposition exceed the lower critical load, the predicted increase falls below the 1% threshold. However, mindful of the requirements of the Wealden decision, an in-combination assessment is also required.

Table 6: Assessment of acid deposition at The Mere, Mere (construction, AP1 revised scheme alone)

Transect (T)	Distance to road (m)	Acid deposition (k eq/ha/yr)			Change in acid deposition as percent of CLmax	Total With AP1 revised scheme acid deposition as percent of CLmax
		2018 baseline	2025 without the AP1 revised scheme	2025 with the AP1 revised scheme		
T1	193	1.81	1.81	1.81	0.20%	314.4%
	200	1.81	1.81	1.81	0.20%	314.4%

3.5.74 Table 6 and Table D7 describe the change in acid deposition brought about by construction of the AP1 revised scheme alone. They show that background levels of acid deposition exceeded the critical load prior to and throughout the construction period. No improvement in background values was apparent during this period. With reference to this data, Annex D states:

'Acid deposition rates are predicted to be above the lower critical load, at all modelled receptors in all scenarios with or without the AP1 revised scheme. The changes in acid deposition between the 2025 do minimum scenario and with the AP1 revised scheme scenario are less than 1% of the maximum critical load. No potentially significant effects are therefore predicted.'

3.5.75 This evidence shows that predicted increases in acid deposition brought about by construction of the AP1 revised scheme alone are modest, and only 0.2% of the critical load at any point on T1. Best practice guidance is clear that with such modest increases, likely significant effects can be ruled out alone even though the critical load is exceeded. However, mindful of the Wealden decision, an in-combination assessment is also required.

Screening opinion for The Mere, Mere (construction) alone

3.5.76 The AP1 revised scheme has been screened for the purposes of Regulations 63 of the Habitats Regulations 2017 as amended. It is considered that there is no credible risk that changes in NOx, nitrogen deposition or acid deposition during the construction phase could undermine the conservation objectives of The Mere, Mere and likely significant effects (alone) can be ruled out. However, an in-combination assessment is required.

Air quality assessment of traffic flows (construction phase) in-combination

3.5.77 Annex D identifies one road found to exceed the screening thresholds:

- the A50 Warrington Road, Mere.

3.5.78 Traffic impacts are primarily the result of increased traffic from diversionary effects during the construction phase.

3.5.79 Table D10 describes the change in NOx concentrations brought about by construction of the AP1 revised scheme in-combination. It shows that the background levels of NOx prior to construction were considerably below the 30μg/m^3 critical level and remained so throughout the construction period. It is described in Annex D as follows:

'NOx concentrations at the site are predicted to be within the air quality standard at all receptors. However, changes in NOx concentrations due to the AP1 revised scheme in-combination are greater than 1% of the air quality standard. Potentially significant effects are therefore predicted.'

3.5.80 Even though increases in the concentration of NOx were shown to exceed the 1% threshold, this evidence shows that the predicted change brought about by the AP1 revised scheme is modest and fails to exceed the critical level at any point in time. This means that likely significant effects can be ruled out for NOx for construction impacts in-combination.

3.5.81 Despite the possibility that this positive outcome can be taken to preclude the need for further analysis, an assessment of nitrogen deposition was also made across T1 during the construction period (in-combination) (see Table D11) and repeated below in Table 7.

Table 7: Assessment of nitrogen deposition at The Mere, Mere (construction, AP1 revised scheme in-combination)

Transect (T)	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	Percent change in relation to lower critical load
		Baseline 2018	2025 do nothing	2025 with the AP1 revised scheme In-combination			
T1	193	24.14	23.96	24.00	0.04	10	0.4%
	200	24.14	23.96	24.00	0.04	10	0.4%

3.5.82 Table 7 and Table D11 describe the change in nitrogen deposition brought about by construction of the AP1 revised scheme in-combination. They show that background levels of nitrogen deposition exceeded the lower critical load for poor fen prior to and throughout the construction phase although, reflecting anticipated improvements in air quality, the exceedance was slightly less at the end of the construction period than at the beginning. With reference to this data, Annex D states:

'Nitrogen deposition rates are predicted to be above the lower critical load in all scenarios. Predicted nitrogen deposition rates in 2025, with the AP1 revised scheme in-combination, are lower than the 2018 baseline rates at all modelled locations. The changes in nitrogen deposition between the 2025 do nothing scenario and with the AP1 revised scheme in-combination scenario (are) less than 1% of the lower critical load. No potentially significant effects are therefore predicted.'

3.5.83 This evidence shows that predicted increases in deposition brought about by construction of the AP1 revised scheme alone are modest, and less than 0.04kg N/ha/yr or 0.4% of the critical load for poor fen at any point on T1. Best practice guidance is clear that with such modest increases, likely significant effects can be ruled out in-combination with other plans or projects even though the critical load is exceeded.

Table 8: Assessment of acid deposition at The Mere, Mere (construction, AP1 revised scheme in-combination)

Transect (T)	Distance to road (m)	Acid deposition (k eq/ha/yr)			Change in acid deposition as percent of CLmax	Total with AP1 revised scheme acid deposition as percent of CLmax
		2018 baseline	2025 do nothing	2025 with the AP1 revised scheme		
T1	193	1.81	1.81	1.81	0.52%	314.8%
	200	1.81	1.81	1.81	0.52%	314.8%

3.5.84 Table 8 and Table D12 describe the change in acid deposition brought about by construction of the AP1 revised scheme in-combination. They show that background levels of acid deposition exceeded the lower critical load prior to and throughout the construction period. No improvement in background values was apparent during this period. With reference to this data, Annex D states:

'Acid deposition rates are predicted to be above the lower critical load at all modelled receptors in all scenarios. The changes in acid deposition between the 2025 do nothing scenario and with the AP1 revised scheme in-combination scenario are less 1% of the maximum critical load. No potentially significant effects are therefore predicted.'

3.5.85 This evidence shows that predicted increases in acid deposition brought about by construction of the AP1 revised scheme alone are modest, and less than 0.6% of the higher critical load at any point on T1. Best practice guidance is clear that with such modest increases, likely significant effects can be ruled out alone even though the critical load is exceeded. However, mindful of the Wealden decision, an in-combination assessment is also required.

Screening opinion for The Mere, Mere (construction) in-combination

3.5.86 It is considered that there is no credible risk that changes in NOx, nitrogen deposition or acid deposition during the construction phase could undermine the conservation objectives of The Mere, Mere and likely significant effects (in-combination with other plans or projects) can be ruled out. No further assessment is required.

The Mere, Mere (operational phase)

3.5.87 The air quality assessment of traffic flows at the Mere, Mere has been undertaken in accordance with the Volume 5, Appendix: CT-001-00001, Environmental Impact Assessment SMR. The assessment is summarised in Annex D. The methodology, guidance and legislation described for the assessment of Rostherne Mere above all applies to the various exercises carried out below and is not repeated here.

Air quality assessment of traffic flows (operational phase) alone

3.5.88 Annex D shows that only one road, the A5034 (Mereside Road) which lies to the north of The Mere, Mere, was found to exceed the screening thresholds during the operational phase alone. Traffic impacts as a result of the AP1 revised scheme are primarily the result of the re-distribution of traffic during the operational phase. Consequently, a single 200m transect (T2) was established; its location is shown on Figure 3. This transect started at the kerbside and intercepted the Ramsar site boundary at a distance of 9m; all subsequent points of the transect fell within The Mere, Mere. Despite the shift in location to the north, the same, single qualifying feature is potentially at risk and, consequently, the same critical level for NOx and critical loads for nitrogen and acid deposition continue to apply.

3.5.89 Table D16 describes the change in NOx concentrations during the operational phase of the AP1 revised scheme alone. It shows that the background levels of NOx prior to and at the end of the construction period and at the beginning of the operational phase were considerably below the 30µg/m^3 critical level and followed a downward trend over this period. Reference to Table D16 is encouraged for the detail. It is described in Annex D as follows:

'NOx concentrations at the site are predicted to be within the air quality standard at all receptors. Changes in NOx concentrations due to the AP1 revised scheme are equal to or less than 1% of the air quality standard'.

3.5.90 This evidence shows that the predicted change in NOx brought about by the AP1 revised scheme is modest and fails to exceed the critical level at any point in time. This means that likely significant effects can be ruled out for NOx during the operational phase alone.

Despite the possibility that this positive outcome could be taken to preclude the need for further analysis, an assessment of nitrogen deposition was also made across T2 for the operational period (see Table D17 and repeated below in Table 9). Reflecting anticipated improvements in air quality over time, both tables show a reduction in nitrogen deposition as a result of the scheme-alone. However, mindful of the requirements of the Wealden decision an in-combination assessment is also required.

Table 9: Assessment of nitrogen deposition at The Mere, Mere (operation, AP1 revised scheme alone)

Transect (T)	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	Percent change in relation to lower critical load
		2018 baseline	2038 without the AP1 revised scheme	2038 with the AP1 revised scheme			
T2	9	24.56	23.94	23.96	0.02	10	0.2%
	10	24.52	23.94	23.96	0.02	10	0.2%
	20	24.34	23.90	23.92	0.02	10	0.2%
	30	24.24	23.88	23.89	0.01	10	0.1%
	40	24.18	23.87	23.88	0.01	10	0.1%
	50	24.13	23.86	23.87	<0.01	10	<0.1%
	75	24.06	23.85	23.86	<0.01	10	<0.1%
	100	24.02	23.84	23.85	<0.01	10	<0.1%
	150	23.97	23.83	23.84	<0.01	10	<0.1%
	200	23.94	23.83	23.83	<0.01	10	<0.1%

3.5.91 Table 9 and Table D17 describe the change in nitrogen deposition brought about during the operational phase of the AP1 revised scheme alone. They show that background levels of nitrogen deposition exceeded the lower critical load for poor fen prior to and throughout the operational phase although, reflecting anticipated improvements in air quality, the exceedance was less at the start of the operational phased than prior to construction. With reference to this data, Annex D states:

'Nitrogen deposition rates are predicted to be above the lower critical load in all scenarios. Predicted nitrogen deposition rates in 2038, with the AP1 revised scheme are lower than the 2018 baseline rates at all modelled locations. The changes in nitrogen deposition between the 2038 do nothing scenario and with the AP1 revised scheme scenario (are) less than 1% of the lower critical load. No potentially significant effects are therefore predicted.'

3.5.92 This evidence shows that predicted increases in deposition brought about during the operational phase of the AP1 revised scheme alone are modest, and less than 0.02kg N/ha/yr or 0.2% at any point on T2. Best practice guidance is clear that with such modest increases, likely significant effects can be ruled out alone because even though background levels exceed the critical load the predicted increase falls below the 1% threshold. However, mindful of the requirements of the Wealden decision, an in-combination assessment is also required.

3.5.93 Table 10 and Table D18 describe the change in acid deposition brought about during the operational phase of the AP1 revised scheme alone. They show that background levels of acid deposition exceeded the critical load prior to and throughout the operational phase. No improvement in background values was apparent during this period. With reference to this data, Annex D states:

'Acid deposition rates are predicted to be above the lower critical load at all modelled receptors in all scenarios. The changes in acid deposition between the 2038 do nothing scenario and with the AP1 revised scheme scenario are less than 1% of the maximum critical load. No potentially significant effects are therefore predicted.'

Table 10: Assessment of acid deposition at The Mere, Mere (operation, AP1 revised scheme alone)

Transect (T)	Distance to road (m)	Acid deposition (k eq/ha/yr)			Change in acid deposition as percent of CLmax	Total with AP1 revised scheme acid deposition as percent of CLmax
		2018 baseline	2038 without the AP1 revised scheme	2038 with the AP1 revised scheme		
T2	9	1.81	1.81	1.81	0.27%	314.5%
	10	1.81	1.81	1.81	0.25%	314.5%
	20	1.81	1.81	1.81	0.20%	314.4%
	30	1.81	1.81	1.81	0.14%	314.4%
	40	1.81	1.81	1.81	0.12%	314.4%
	50	1.81	1.81	1.81	0.11%	314.3%
	75	1.81	1.81	1.81	0.09%	314.3%
	100	1.81	1.81	1.81	0.05%	314.3%
	150	1.81	1.81	1.81	0.05%	314.3%
	200	1.81	1.81	1.81	0.04%	314.3%

3.5.94 This evidence shows that predicted increases in acid deposition brought about by operation of the AP1 revised scheme alone are modest, and less than 0.3% of the critical load at any point on T2. Best practice guidance is clear that with such modest increases, likely significant effects can be ruled out alone even though the critical load is exceeded. However, mindful of the Wealden decision, an in-combination assessment is also required.

Screening opinion for The Mere, Mere (operation) alone

3.5.95 It is considered that there is no credible risk that changes in NOx, nitrogen deposition or acid deposition during the operational phase could undermine the conservation objectives of The Mere, Mere and likely significant effects (alone) can be ruled out.

3.5.96 Whilst an in-combination assessment is required to satisfy the requirements of the Wealden decision, the traffic data (see Table D13) shows that operational traffic flows on the A5034, in-combination with other plans or projects, failed to trigger the need for this assessment. This is because it was found that greater use was being made of the A556. In contrast, however, these thresholds were triggered for the A50 (though they were not triggered alone for this road). Consequently, it is this road which is assessed in-combination.

Air quality assessment of traffic flows (operational phase) in-combination

3.5.97 Annex D indicated that one road was to exceed the screening thresholds:

- the A50 Warrington Road, Mere.

3.5.98 Traffic impacts of the AP1 revised scheme are primarily the result of the redistribution of traffic during the operational phase.

3.5.99 Table D21 described the change in NOx concentrations during the operational phase of the AP1 revised scheme in-combination. It shows that the background levels of NOx prior to construction were considerably below the 30μg/m^3 critical level and remained so throughout the construction period. It is described in Annex D as follows:

'NOx concentrations at the site are predicted to be within the air quality standard at all receptors. Changes in NOx concentrations due to the AP1 revised scheme in-combination are less than 1% of the air quality standard. No potentially significant effects are therefore predicted'.

3.5.100 This evidence shows that the predicted change in NOx brought about by the AP1 revised scheme is modest and fails to exceed the critical level at any point in time. This means that likely significant effects can be ruled out for NOx during the operational phase in-combination. Despite the possibility that this positive outcome can be taken to preclude the need for further analysis, an assessment of nitrogen deposition was also made across T1 for the operational period (in-combination) (see Table D22) and is repeated below in Table 11.

Table 11: Assessment of nitrogen deposition at The Mere, Mere (operation, AP1 revised scheme in-combination)

Transect (T)	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in Nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	Percent Change in relation to lower critical load
		Baseline 2018	2038 do nothing	2038 with the AP1 revised scheme			
T1	193	24.00	23.84	23.84	<0.01	10	<0.1%
	200	23.99	23.84	23.84	<0.01	10	<0.1%

3.5.101 With reference to this data, Annex D states:

'Nitrogen deposition is predicted to be above the lower critical load in all scenarios. Predicted nitrogen deposition rates in 2038, with the AP1 revised scheme in-combination, are lower than the 2018 baseline rates at all modelled locations However, the changes in nitrogen deposition as a result of the AP1 revised scheme in-combination are lower than 1% of the lower critical load at all modelled receptors. No potentially significant effects are therefore predicted.'

3.5.102 This evidence shows that predicted increases in deposition brought about by the AP1 revised scheme are modest, less than 0.01kg N/ha/yr. Indeed, the 1% threshold is not exceeded anywhere along T1. Best practice guidance is clear that with such modest changes, likely significant effects can be ruled out.

3.5.103 Tables 12 and D23 describe the change in acid deposition brought about during the operational phase of the AP1 revised scheme in-combination. Traffic thresholds were only triggered on Transect 1.

Table 12: Assessment of acid deposition at The Mere, Mere (operation, AP1 revised scheme in-combination)

Transect (T)	Distance to road (m)	Acid deposition (k eq/ha/yr)			Change in acid deposition as percent of CLmax	Total With AP1 revised scheme acid deposition as percent of CLmax
		2018 baseline	2038 do nothing	2038 with the AP1 revised scheme		
T1	193	1.81	1.81	1.81	0.05%	314.3%
	200	1.81	1.81	1.81	0.05%	314.3%

3.5.104 These tables show that background levels of acid deposition exceeded the critical load prior to and throughout the operational phase. No improvement in background values was apparent during this period. With reference to this data, Annex D states:

'Acid deposition rates are predicted to be above the lower critical load at all modelled receptors in all scenarios. The changes in acid deposition between the 2038 do nothing scenario and with the AP1 revised scheme in-combination scenario are less than 1% of the maximum critical load. No potentially significant effects are therefore predicted.'

3.5.105 This evidence shows that predicted increases in acid deposition brought about by operation of the AP1 revised scheme alone are modest, and less than 0.1% of the critical load at any point on T1. Best practice guidance is clear that with such modest increases, likely significant effects can be ruled out alone even though the critical load is exceeded.

Screening opinion for The Mere, Mere (operation) in-combination)

3.5.106 The AP1 revised scheme has been screened for the purposes of Regulations 63 of the Habitats Regulations 2017 as amended. It is considered that there is no credible risk that NOx, nitrogen deposition or acid deposition during the operational phase could undermine the conservation objectives of The Mere, Mere and likely significant effects (in-combination) can be ruled out. No further assessment is required.

3.6 Screening assessment

3.6.1 Having applied the screening test in Regulation 63, HS2 Ltd considered that likely significant effects and the need for further assessment could not be ruled out in terms of:

- construction-related impacts on the Rostherne Mere and The Mere, Mere (alone); and
- changes to the hydrological regime from construction of the Rostherne, Millington and Hoo Green cuttings (alone).

3.6.2 In contrast, there is no credible risk that NOx, nitrogen deposition or acid deposition during either the construction or operation phases could undermine the conservation objectives of either Rostherne Mere or The Mere, Mere (alone or in-combination) and likely significant effects can be ruled out.

3.6.3 Because likely significant effects related to construction related impacts and from changes to the hydrological regime have been identified alone, an appropriate assessment of each is required alone; there is no need for the in-combination assessment of either at this stage.

3.6.4 With the exception of air pollution, which was not considered originally, these outcomes correspond closely with the findings of the 2012 HRA although, as the latter pre-dated the People Over Wind decision, these relied upon mitigation at the screening stage.

4 Appropriate assessment

4.1 The appropriate assessment test

4.1.1 The screening assessment has identified that likely significant effects could not be ruled out in terms of impacts arising from construction related activities and the construction/excavation of the Rostherne, Millington and Hoo Green cuttings. Both potential impacts require appropriate assessment. All other potential impacts, including nitrogen deposition have been screened out of the need for further assessment.

4.1.2 The appropriate assessment is defined in Regulation 63(5). The following definitions are applied as necessary to the subsequent assessment of likely significant effects.

4.1.3 Regulation 63(5) states where a project is 'likely to have a significant effect alone or in-combination', it can only be consented if the competent authority can ascertain (following an appropriate assessment) that it 'will not adversely affect the integrity of the European site'. Drawing on Waddenzee, the 'in-combination test' is also carried forward into the appropriate assessment.

4.1.4 In Sweetman[34], 'integrity' is defined as:

'...the lasting preservation of the constitutive characteristics of the site … whose preservation was the objective justifying the designation of the site'.

4.1.5 In the Advocate General's opinion on the above case (Sweetman)[35], she stated that a plan or project involving '… some strictly temporary loss of amenity which is capable of being fully undone …' would avoid an adverse effect on the integrity of a site. This was supported by the Court which ruled that '… the lasting and irreparable loss…' of part of a European site would represent an adverse effect on its integrity.

4.1.6 In Planning Practice Guidance[9] above', integrity' is described as:

'...the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was designated.'

4.1.7 In Grace & Sweetman[36] the CJEU held that it is only when it is sufficiently certain that a measure will make an effective contribution to avoiding harm, guaranteeing beyond all

[34] Sweetman v An Bord Pleanála (C 258-11) [2014] PTSR 1092 at paragraph 39.

[35] Minister for the Environment, Heritage and Local Government v An Bord Pleanála (2013), Sweetman reference for a preliminary ruling from the Supreme Court of Ireland, Peter Sweetman Ireland Attorney General (together with the opinion of the Advocate General delivered on 22 November 2012). C-258/11.

[36] Grace & Sweetman v An Bord Pleanála (C-164/17) (2019) PTSR 266 at paragraphs 51-53 and 57.

reasonable doubt that the project will not adversely affect the integrity of the area, that such a measure may be taken into consideration.

4.1.8 Mindful of this, it is clear that for mitigation to be considered to remove adverse effects, it should be effective, reliable, timely and guaranteed to be delivered for as long as necessary to achieve its objectives'[37].

4.1.9 The burden of proof is made clear in Waddenzee and where 'doubt remains as to the absence of adverse effects … the competent authority will have to refuse authorisation'[38] and 'that is the case where no reasonable scientific doubt remains as to the absence of such effects'[39]. However, absolute certainty is not required. In Champion, whilst referring to Advocate General Kokott in Waddenzee at paragraph 107, the Supreme Court found that 'absolute certainty' is not required as: '… the necessary certainty cannot be construed as meaning absolute certainty since that is almost impossible to attain …'.

4.2 Construction related activities

Assessment of effects

4.2.1 The screening exercise identified that likely significant effects from pollution and other impacts associated with construction activities cannot be ruled out alone (though this excludes the impact of vehicle emissions which are assessed elsewhere). Construction is anticipated to extend over a period of around four or five years and comprise intense activity, including but not limited to the use of potentially harmful materials and the movement of large number of vehicles, the movement and stockpiling of soils, excavations, and the storage of materials all represent potential risks to the Ramsar sites which could result in contamination of surface and sub-surface flows, or the generation of dust from vehicles on construction traffic routes.

4.2.2 Therefore, in the absence of mitigation, it is uncertain if these potential changes would conflict with the conservation objectives for Rostherne Mere and the Mere, Mere and threaten the integrity of both sites by compromising the ability 'To maintain the designated features in favourable condition …'.

4.2.3 Therefore, in terms of construction related activities, it is concluded that adverse effects on the integrity of the Rostherne Mere and The Mere, Mere cannot be ruled out. Mitigation is required.

[37] From Tyldesley, D., and Chapman, C. (2013), *The Habitats Regulations Handbook,* April 2021 edition UK: DTA Publications Limited.

[38] Waddenzee at paragraph 57.

[39] Waddenzee at paragraph 59.

Mitigation of construction related impacts

4.2.4 Mitigation is required because adverse effects on the integrity of Rostherne Mere and The Mere, Mere cannot be ruled out in terms of possible effects caused by construction related activities.

4.2.5 The type of effects identified above are common to most major construction projects. Consequently, a range of relatively straightforward, robust and reliable techniques have been developed by the industry over decades to avoid, cancel or reduce the scale of effects to acceptable levels, even in proximity to fragile sites. Most, if not all, are required as a matter of best practice guidance and law, providing confidence that they will be effective, reliable, deliverable and will be implemented for as long as is necessary.

4.2.6 These are typically supported by sophisticated management and monitoring programmes to ensure correct implementation and enable prompt remedial action should any fail.

4.2.7 These measures are proposed via an Environmental Memorandum forming part of the Environmental Minimum Requirements for HS2. This includes implementation of a (draft) CoCP which contains control measures and the standards to be implemented throughout the AP1 revised scheme. For Phase One and Phase 2a of HS2, the CoCP is implemented thought site-specific control measures identified in Local Environmental Management Plans (LEMP) to be developed following consultation with the relevant stakeholders. Additionally, Key Environmentally Sensitive Works Sites are identified for areas with complex and in-combination sensitivities and complex consenting procedures that must be addressed during construction. The nominated undertaker and its contractors will be required to work in accordance with the CoCP and LEMP and prepare and monitor implementation site-specific management plans for environmentally sensitive worksites.

4.2.8 HS2 Ltd will work with Natural England to develop robust and effective local measures for the implementation of the CoCP to avoid adverse effects from the construction of HS2 on Rostherne Mere Ramsar site and the Midland Meres and Mosses Phase 1 Ramsar site. Consequently, there is no reasonable doubt as to why measures to control the effects of construction activities will not be effective at removing the threat throughout the construction process.

4.2.9 Therefore, in terms of construction related activities, it is considered, beyond reasonable scientific doubt, that implementation of the CoCP allows adverse effects on the integrity of Rostherne Mere and The Mere, Mere to be ruled out alone.

4.3 Construction/excavation of cuttings

Assessment of effects

4.3.1 The screening assessment has concluded that a likely significant effect cannot be ruled out alone in terms of the potential impact of changes to the hydrological regime on the wetland features of both Rostherne Mere and The Mere, Mere brought about by construction of the AP1 revised scheme.

4.3.2 Locally, the AP1 revised scheme comprises a range of features including bridges and cuttings but in terms of the impacts on groundwater, it is the latter which are of most significance. If the depth to the water table is above the base of cutting drainage, the discharge of groundwater to the cutting would give rise to a reduction in groundwater levels over the area surrounding the cutting and affect groundwater flows. Construction of retaining walls in cuttings can prevent, or significantly reduce, the drainage of groundwater to the cuttings although the retaining walls may also interrupt groundwater flow. In addition, if a retaining wall is constructed on only one side of a cutting, drainage of groundwater to the cutting may still occur on the open side of the cutting.

4.3.3 It is uncertain if the potential changes in groundwater flows resulting from the construction of cuttings would conflict with the conservation objectives for both Ramsar sites and threaten their integrity by compromising the ability 'To maintain the designated features in favourable condition …'. Consequently, further scrutiny of the Ramsar site characteristics is required to thoroughly evaluate this issue.

4.3.4 Both Rostherne Mere and The Mere, Mere support a broadly similar aquatic and fringing macrophyte flora; both also support a characteristic assemblage of macroinvertebrates. All components of these communities are dependent to a greater or lesser extent on the maintenance of a favourable hydrological regime. Reductions in groundwater flow could affect surface and sub-surface flows to both Ramsar sites prompting damaging changes to the extent, species composition, abundance and/or distribution of wetland communities and threaten achievement of the conservation objectives.

4.3.5 Hydrological assessment in the form of the Technical note (see Annex B) has been undertaken to address this issue; extracts and summaries of the details provided in the Technical note are included in the following text. The Technical note takes account of the hybrid Bill design and includes an assessment of the potential impacts of changes in groundwater flows, due to the cuttings, on water levels in Rostherne Mere, based on a water balance model. The effects of these changes in water level on the ecology of Rostherne Mere are also considered.

4.3.6 The water balance model is used to assess the potential impacts for conditions in 2018, a reasonably dry year, and also in very dry or drought conditions as occurred in 1976 and 1996.

4.3.7 Similar levels of data and assessment are not available for The Mere, Mere. For the hydrological assessment, reliance has therefore been placed on publicly available information, a small number of observations in the area in 2018, and information provided by local parish councillors at a meeting in August 2019. Using this information, the Technical note therefore presents a very approximate assessment of a theoretical maximum limit for the impact of the AP1 revised scheme cuttings on the water level in Little Mere. This theoretical value would, however, be substantially greater than any impact which may actually occur as explained below (see paragraphs 4.3.49 to 4.3.58). Furthermore, there may be no actual impact at all. Given the distance of The Mere, Mere from land required for the construction of the AP1 revised scheme and that the likely maximum zones of influence on groundwater from dewatering/drainage in the cuttings (see below) are likely to be overestimated, the risk of adverse effects arising is considered to be low. Therefore, this approach is considered appropriate in the circumstances but has prompted a highly precautionary approach in terms of the hydrological assessment below.

Hydrological assessment – Rostherne Mere and The Mere, Mere

4.3.8 Rostherne Mere lies in the catchment of the River Bollin just to the south of the M56. The AP1 revised scheme lies in part in substantial cuttings in the area between Rostherne Mere and the motorway (MA06), and in the Rostherne Mere catchment area to the west of The Mere, Mere (MA03). The outflow from Rostherne Mere discharges to Blackburn's Brook which then flows into Birkin Brook near the M56. The latter subsequently joins the River Bollin to the north of the motorway.

4.3.9 The Mere, Mere comprises two water bodies, The Mere and Little Mere. Both are located approximately 1.5km upstream of Rostherne Mere and both lie within its surface water catchment. Little Mere lies downstream and to the north of The Mere, and slightly closer to the AP1 revised scheme. It is uncertain, however, whether impacts due to the cuttings could occur in either water body.

4.3.10 Springs are located within superficial glaciofluvial deposits, comprising predominantly sands and gravels, or close to the contact between the glaciofluvial deposits and glacial till in the Rostherne Mere catchment. Hence, much of the groundwater in the catchment may emanate from sand and gravel deposits.

4.3.11 The AP1 revised scheme intercepts the surface water catchment of Rostherne Mere and The Mere, Mere at the following locations:

- just to the north of Rostherne Mere, in the Rostherne Cutting and Millington Cutting, affecting Rostherne Mere only; and

- to the west of The Mere, Mere and Little Mere, where the Hoo Green cuttings intercept a western extension of the surface water catchment associated with Rostherne Mere, The Mere, Mere and Little Mere.

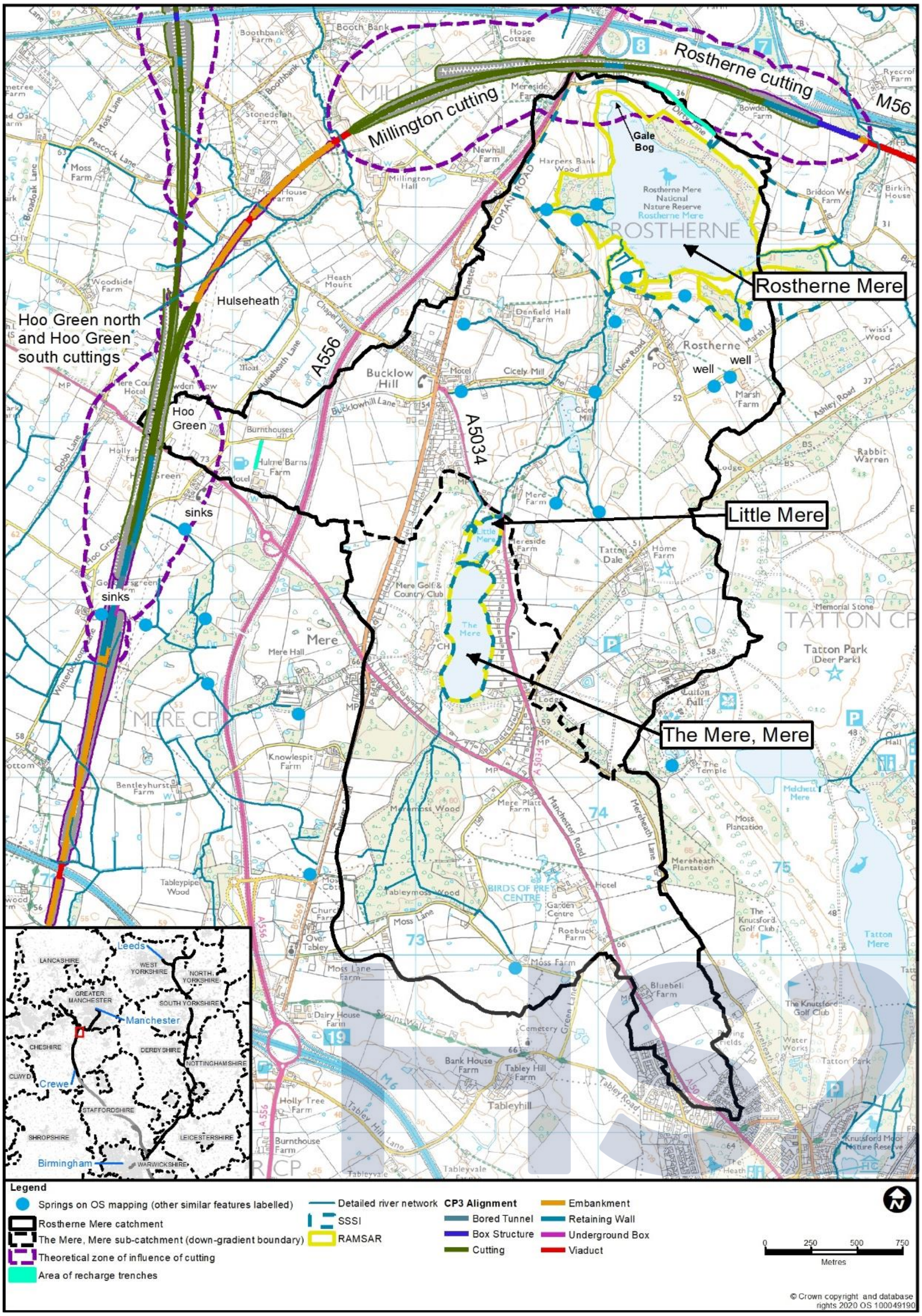
4.3.12 Figure 4 illustrates the location of Rostherne Mere and The Mere, Mere, along with the extent of relevant catchments and sub-catchments, the location of springs and the extent of the proposed cuttings.

4.3.13 The substantial number of springs in the Rostherne Mere catchment indicates that groundwater is likely to play a major role in supporting base flows in streams particularly in dry periods and, therefore, in maintaining water levels in the meres. In turn, they could also influence the type, distribution and species composition of the wetland features of the Ramsar sites. It is, therefore, important to understand the relative contributions to the meres of springs and watercourses, particularly during the drier summer months.

4.3.14 The Millington and Rostherne cuttings are located east and west of the A556 and to the south of an existing slip road between the M56 and A556 close to the northern end of Rostherne Mere. The cuttings would be excavated in glacial till close to the northern boundary of the Rostherne Mere catchment. The likely maximum zone of influence on groundwater from dewatering/drainage from the cuttings includes an area of the Rostherne Mere catchment between the cuttings and Rostherne Mere.

4.3.15 The Hoo Green cuttings to the west of The Mere, Mere and the zone of influence of the cuttings, are located in areas underlain by both glacial till and glaciofluvial deposits within the Rostherne Mere surface water catchment. This area of the Rostherne Mere catchment is not located in the surface water sub-catchment area for The Mere, Mere. However, due to the configuration of the superficial deposits, it is possible that some groundwater from the area might flow to The Mere, Mere sub-catchment.

Figure 4: Location of Ramsar sites, catchments and extent of earthworks



Impact of cuttings on water levels at Rostherne Mere

Impact of Millington and Rostherne cuttings on water levels at Rostherne Mere

4.3.16 At its closest location, the Rostherne and Millington cuttings lie approximately 170m to the north of the Rostherne Mere Ramsar site boundary with a maximum depth of 13.2m.

4.3.17 The theoretical zone of influence of the Millington and Rostherne cuttings includes parts of Gale Bog, the fields behind Gale Bog, the northernmost part of the open water of Rostherne Mere and the northern corner of Mere Covert, all found in or slightly beyond the north-western corner of the Ramsar site. Gale Bog is of particular interest as it once supported a small area of raised bog and is described as such in various formal site descriptions. Whilst this interest has been submerged by rising water levels and affected by vegetation succession, site management objectives seek its restoration to poor fen, or similar, reflecting the marginal vegetation frequently found around the perimeter of the mere.

4.3.18 However, the lowest point in the drainage in the Millington and Rostherne cuttings is approximately 24.8mAOD, with Gale Bog at an elevation of about 21mAOD. As Gale Bog is below the lowest possible level of dewatering in the cutting, in practice, the zone of influence of the cuttings could not extend as far as Gale Bog or the open water of Rostherne Mere.

4.3.19 It is possible that groundwater supplying any seepages within or close to the area of the cuttings could be intercepted within the zone of influence and would discharge to the drainage in the cuttings. However, the drainage in the cuttings could not create a reversal in groundwater flow at or below the level of Rostherne Mere. In addition, seepages in the area of fields located between Gale Bog and Harpers Bank Wood on the western side of Rostherne Mere, and those springs feeding watercourses in Harper Bank Wood are unlikely to be affected. These springs are located well outside the zone of influence of the cuttings.

4.3.20 The Technical note in Annex B observes that in theory, the zone of influence of the Rostherne and Millington cuttings could intercept discharges in a small area of Mere Covert.

4.3.21 Hydrological surveys in late spring and summer 2018 indicated that the groundwater inflow to Rostherne Mere from seepages located within or close to the zone of influence for the Millington and Rostherne cuttings amounted to only 0.1 to 0.3% of the total inflow to Rostherne Mere. In addition, there was no discharge evident from seepages above Gale Bog during surveys in the summer in 2018. However, in the water balance modelling it was assumed that, if the discharge in the area between the cuttings and Rostherne Mere was lost as a result of construction of the cutting, it is assumed (as a worst-case scenario), that total inflows to Rostherne Mere would also be reduced by up to 0.3% in all conditions.

4.3.22 However, in order to assess the impact on the integrity and conservation objectives of the Ramsar site, notably to ensure there is no permanent change in lake area, and no significant loss in the extent of the fringing reed swamp, and to maintain the characteristic zones of vegetation, it is necessary to assess what impact this change in inflow would have on the water level of the mere.

4.3.23 The water balance model used to assess the potential impacts of cuttings on water levels in Rostherne Mere was set up and calibrated using mere water levels and flow data obtained from the field surveys for a period of generally dry, hot weather from late May to September 2018, together with hydrological and meteorological data available from public sources. Model results were also checked against occasional outflow data for the Blackburn's Brook for several years including 1996, a drought year, provided by the Environment Agency. In addition, the model output was checked using mere water level data collected in 2019. This included continuous water level logger data for October and November 2019.

4.3.24 The potential impacts of the cuttings on water levels were then assessed for the conditions in 2018, and also for the very dry or drought conditions which prevailed in 1976 and 1996. In these latter years, flows in the catchment and mere water levels would have been particularly low.

4.3.25 Calibration of the model is explained in the Technical note in Annex B and is not repeated here other than to acknowledge that it has followed best practice guidance and the assumptions made were conservative. Whilst mindful of inevitable limitations, the model results can be considered to provide a reasonable assessment. Overall, there is confidence in using the model to assess the impacts of small changes in inflow to Rostherne Mere, particularly in periods of dry weather as in 2018, when mere water levels are low. This confidence in use of the model was increased by a reasonably close simulation of the outflow data for 1996, provided by the Environment Agency, and also the water level data for 2019.

4.3.26 The model suggested that water levels would decline by a maximum of about 0.6mm from April onwards through the late spring and summer months, as a result of the presence of the Rostherne and Millington cuttings, increasing slightly in the winter period when inflows and water levels are higher.

4.3.27 For comparison, combining the observed low levels in summer 2018 with data from further surveys in 2019, including levels derived from a data logger, suggested that Rostherne Mere experienced a range of water levels of about 0.96m (960mm) in the period July 2018 to October 2019.

Impact of Hoo Green cuttings on water levels at Rostherne Mere

4.3.28 Within the catchment, the maximum depth of the Hoo Green North cutting is approximately 13.7m. Whilst the cutting deepens elsewhere to the north to approximately 23.8m, this point lies around 2km outside the catchment.

4.3.29 The potential zone of influence of the cuttings to the west of The Mere, Mere intersects approximately 2% of the area of the Rostherne Mere surface water catchment downgradient of The Mere, Mere sub-catchment. However, the area of the catchment to the west of The Mere, Mere extends out between the catchments to the south of Hoo Green (Tabley Brook) and to the north towards Hulseheath (Millington Clough). Some groundwater in this area may therefore contribute to the adjacent catchments rather than following a more extended groundwater flow path and direction within the Rostherne catchment.

4.3.30 The model indicates that water levels in Rostherne Mere decline by about 3.5 and 4.0mm from April onwards through the late spring and summer months as a result of the presence of the Hoo Green cuttings. This simulated decline in water level is greater in the winter months or following major rainfall/runoff events. The impact increases to more than 5mm when inflows and water levels are higher. However, if some, or all, of the recharge in the potential zone of influence of the cuttings contributes to the adjacent Tabley Brook and Millington Clough catchments, then the impacts on Rostherne Mere water levels would be reduced in all conditions.

Combined impacts of both sets of cuttings

4.3.31 Taking into account an overall 2.3% reduction in baseflows (i.e. 0.3% + 2.0%) and model results for extremely dry years in 1976 and 1996, as well as for slightly drier than average conditions in 2018, the water balance assessment suggested that the combined effect of the two sets of cuttings could be to produce a decline in water levels in Rostherne Mere of 4 – 5mm from April onwards through the late spring and summer months. The decline in water level would, again, generally be greater in the winter months, increasing up to 6mm when inflows and water levels are higher.

4.3.32 The modelled hydrographs in Figure 23 of the Technical note (Annex B), with and without the cuttings in place, demonstrate the marginal impact of changes in water level due to the cuttings when compared with the total variation of about 440mm in water levels for the period of modelling from February to September 2018. Importantly, there is only a total of five days (in July/August 2018) when the modelled mere water level with the cuttings in place falls below the minimum modelled water level in 2018 without the cuttings.

4.3.33 In particularly dry conditions such as in 1996, the combined effect was to produce a decline in water levels of 3.5mm to 5mm throughout the period from February to September. Again, this is considered to be marginal when compared with the total modelled variation of about

270mm in 1996. This led to a period of only six days (in August 1996) when the modelled mere water level with the cuttings in place falls below the minimum modelled water level for 1996 without the cuttings.

4.3.34 The same pattern emerged for 1976 when simulated outflow from Rostherne Mere was less than in 1996. Again, water levels were predicted to decline by about 3.5 – 4.5mm. The range in decline in water level was again considered marginal in the context of overall variation (about 310mm), with 10 days in August/September 1976 when modelled mere water levels fell below the minimum levels without the cuttings in place.

4.3.35 In both 1976 and 1996, the impact of the Millington and Rostherne cuttings was to produce a decline of up to 0.6mm, similar to the late spring and summer of 2018.

4.3.36 In summary, therefore, although the results from the water balance model may not be precise, they do indicate that:

- the Millington and Rostherne cuttings are likely to have an impact of less than one millimetre on water levels in Rostherne Mere, and potentially no impact in particularly dry conditions as seepages in the fields above Gale Bog and the near surface discharges in Mere Covert dry up;
- water levels in Rostherne Mere could decline by up to 3 – 4mm from April onwards through the late spring and summer months in dry or very dry conditions as a result of the presence of the Hoo Green cuttings, increasing slightly in the winter period when inflows and water levels are higher. However, these impacts could be reduced depending on the actual directions of drainage and groundwater flow in the surface water catchment to the west of The Mere, Mere. In addition, a cutting along the new A556 in the Rostherne Mere surface water catchment may have an impact in draining groundwater flow in this area;
- the combined effects of the two cuttings could be to produce a decline in water levels in Rostherne Mere of a few millimetres (modelled as about 4 – 5mm) in dry or very dry conditions. The decline in water level would be slightly greater generally in the late autumn, winter and early spring, or following major rainfall/runoff events, when inflows and water levels are higher; and
- overall, the impact of the cuttings on mere water levels is considered marginal when compared with the total variations in water level which have been modelled. It is reasonable to expect that there would only be short periods (between five and ten days) in low water level conditions in which the mere water level would fall below the minimum water level for that year without the cuttings. These impacts would almost certainly be undetectable and might, potentially, be less than the temporary impact of cutting of reed in Blackburn Brook; without this management, the reedbed could impede outflows and maintain a slightly higher water level in the mere.

4.3.37 Evidence from field visits and local landowners indicates that groundwater seepages and flows in Mere Covert (on the north bank of Rostherne Mere) should not be affected by the

AP1 revised scheme. Two seepages, identified in Mere Covert during a site reconnaissance visit with Natural England in May 2018, are likely to be too small to be affected by the zone of influence of the Rostherne cutting. The seepages were dry during the site visits between July and September 2018, suggesting they are ephemeral in nature and only active when groundwater levels are high, or after significant rainfall events.

4.3.38 Minor flows seen in a channel through the centre of Mere Covert during the site visits in 2018 are understood to originate as near-surface drainage which responds rapidly to rainfall. Based on topography, surface water resulting from rainfall in the area of the cutting closest to Mere Covert would be expected to drain to the north rather than through Mere Covert to Rostherne Mere. Therefore, the cutting would not be expected to affect the surface flows in Mere Covert, although the current directions of drainage between the cutting and Mere Covert may also be controlled by the depth of any field drains and drainage connections in the area.

4.3.39 Drawing on existing bathymetry survey data, this indicates that for a reduction of 5mm, the loss of lake area would be approximately 0.05ha or 0.1%, and about 2.6% of the shelf area above the 1m depth of water. It is considered this evidence suggests that although the anticipated fall in water levels of up to 5mm from both sets of cuttings is considered marginal in a hydrological context, a decline of this magnitude could conflict with the conservation objective to ensure no permanent change in lake area (amongst others). Therefore, further assessment of the impact on the ecology of Rostherne Mere is required.

Groundwater and seepages north of Rostherne Mere

4.3.40 It is acknowledged that although the contribution is small, the seepages to the north do form part of the wider hydrological system that influences, directly, the water balance regime of Rostherne Mere, and, therefore, that the hydrological conservation objectives apply.

4.3.41 The Technical note in Annex B has drawn on an investigation carried out in 1991 for the A556 (M56-M6) to the north and west of Rostherne Mere, to inform a more detailed assessment of the impact of the cuttings on groundwater flows and seepages. The assessment indicated that, over much of the period of monitoring in July to November 1991:

- groundwater levels are likely to have been at about (or possibly just below) average levels for a summer/autumn period; and
- levels were probably close to and slightly above the base of proposed track filter drainage in the cuttings at the closest point to Rostherne Mere, indicating that some groundwater may be intercepted in the drainage in these conditions. This might then give rise to an impact in reducing groundwater seepages in the slopes above Gale Bog. However, whilst the presence of the cuttings might have an effect on seepages, this

depends on the directions of groundwater flow between the cuttings and the slopes above Gale Bog.

4.3.42 The evidence from site visits is that groundwater seepages in the slopes above Gale Bog dried up completely in the summer in 2018. In addition, in these drier conditions, it seems very likely that the groundwater level would also fall below the level of the base of the drainage in the cuttings. In drier conditions, therefore, the drainage should not affect any minor groundwater discharges in the area.

4.3.43 The variability of the glacial till underlying the area to the north of Rostherne Mere indicates that sandy deposits in the lower part of the glacial till are unlikely to be a particularly significant aquifer. In addition, these deposits could be poorly connected hydraulically with the mere or Gale Bog through the alluvium, mire and lake bed sediments. Therefore, in average conditions, or in wetter periods, drainage in the cuttings is unlikely to have a discernible impact on any minor groundwater discharge into Gale Bog or Rostherne Mere, if any such discharge does actually occur.

4.3.44 Furthermore, water levels in the soil underlying Gale Bog are likely to be linked closely to water levels in Rostherne Mere when the mere water level is at or below the ground level in the bog. When Gale Bog is inundated/flooded, the surface water level would be the same as for Rostherne Mere.

4.3.45 The zone of influence of the Rostherne cuttings was based on the assumption that groundwater levels are at ground level. However, data from 1991 indicates this is not the case in the area of the cuttings with groundwater levels in some boreholes about 10m or more below ground level. Using data from 1991indicated that the zone of influence is likely to be substantially reduced as indicated in Figure B31 (Depth to groundwater below surface (July to November 1991)) in the Technical note (Annex B). As a result, fewer seepages should be affected by the cuttings, with a reduction to discharges only from seepages in the slopes around the northern part of Gale Bog. A similar approach was taken in terms of the Millington cutting further to the west. A substantial reduction in the extent of the zone of influence is also indicated for this area.

4.3.46 The data for 1991 only allows an approximate re-assessment of the extent of the zone of influence of some parts of the cuttings based on actual groundwater levels. Furthermore, the extent would increase in higher groundwater level conditions. However, it does indicate that the actual zone of influence of the cuttings is likely to be substantially smaller than produced assuming the groundwater level is at ground level.

4.3.47 Elsewhere, the Technical note in Annex B assesses the design of proposed carrier drains in trenches beneath the Rostherne cutting. It is concluded that the drains should only have a marginal impact at most on groundwater flow, particularly close to the northern end of the Ramsar site where the drains are at their shallowest.

4.3.48 The Technical note also addressed the impact of a proposed overbridge for the A556 close to the eastern end of the Millington cutting. Taking into account the limited extent of the overbridge, it was considered that the impact of the associated piling on groundwater flows should be negligible.

Impact of cuttings on water levels at The Mere, Mere

4.3.49 Figure 4 (this report) shows the location and zone of influence of the Hoo Green cuttings to the west of The Mere, Mere. The AP1 revised scheme intercepts only the extreme western extent of the Rostherne Mere surface water catchment. In addition, Figure 4 shows that the cuttings are not located within the sub-catchment for The Mere, Mere.

4.3.50 The Technical note makes it clear that any groundwater in the Rostherne Mere catchment which would be intercepted by the Hoo Green cuttings is assumed to contribute to the Rostherne Mere catchment. However, as already indicated, some groundwater in this area may contribute to the adjacent catchments rather than following a more extended groundwater flow path and direction within the Rostherne catchment. In addition, the A556 drainage may also be intercepting some groundwater moving from this area of the catchment towards Rostherne Mere.

4.3.51 In the current conditions, at least some of the groundwater within the zone of influence for the cuttings in the west of the Rostherne Mere catchment may, however, drain down the topographical gradient to the north-east. Groundwater discharge from the zone of influence could occur naturally at a spring in Bucklow Hill, although the flow might also be affected by the A556 drainage. However, groundwater flow to the spring may be restricted by lower permeability horizons in glacial till deposits. As a result, some groundwater in the Rostherne Mere catchment might, in theory, move towards Little Mere, the closest potential discharge location in The Mere, Mere sub-catchment.

4.3.52 The Technical note indicates that there is no evidence of discharges in the vicinity of Little Mere which could be a result of groundwater flow from the area of the Hoo Green cuttings. It seems unlikely therefore, that any groundwater from the zone of influence contributes to Little Mere although it is not possible to confirm this at present. In wetter conditions, groundwater may, perhaps, emerge in springs or might discharge through the base of Little Mere.

4.3.53 An assessment was, therefore, carried out to determine a theoretical maximum limit of impact of the Hoo Green cuttings on the water level of Little Mere. It was assumed in the assessment that all the potential recharge to the superficial deposits in the zone of influence within the Rostherne Mere catchment discharges in Little Mere. As a result, the theoretical limit would be substantially higher than any possible impact on the water level that might realistically arise from the presence of the Hoo Green cuttings. Furthermore, taking into account current evidence, the actual impact is more likely to be zero. Allowing, however, for the possibility of some recharge discharging in Little Mere, the impact might, at worst, be one or two orders of magnitude lower than the calculated theoretical limit.

4.3.54 No surface water outflow was occurring from Little Mere when visited at the end of July 2018. The assessment of impact indicated that, in periods in which there is no outflow from Little Mere, a maximum total, cumulative reduction in water level of approximately 270mm (0.27m) could theoretically occur. In contrast, the maximum theoretical impact on the water level when there is outflow from Little Mere would be minor, probably a few millimetres or less, similar to the impact calculated for Rostherne Mere. Details of the assessment calculations are provided in the Technical note.

4.3.55 The Technical note makes clear there are several reasons why this impact would not actually be expected to occur. Firstly, as the zone of influence of the Hoo Green cuttings is not in the surface water catchment for Little Mere, groundwater from the zone of influence may not contribute to Little Mere. If groundwater flow in the area follows the topographic gradient, it would discharge in the Rostherne Mere catchment downgradient of Little Mere. Alternatively, as discussed in the Technical note, it is possible the groundwater could discharge to surface water catchments to the north and south of the zone of influence, or via land drainage to Bucklow Hill. Secondly, in the event that some groundwater does discharge in Little Mere, the removal of this groundwater flow component would lead to some compensation by groundwater inflow from adjacent groundwater catchments, which would then discharge to Little Mere. Finally, if water levels in Little Mere were reduced, it is very likely that additional water would be drawn into Little Mere from the main body of The Mere by leakage through the ground. Hence, any change in water level would be distributed to some extent across the whole of The Mere, Mere water body.

4.3.56 Information from local sources, provided in August 2019, indicated that Little Mere had been dredged 'in recent years'. If so, this could have removed substantial amounts of fine sediment which may previously have restricted the leakage of surface water through the mere bed in dry years. This could explain why there was no discharge over a few months in 2018, contrasting with the additional anecdotal evidence that, in previous extremely dry years such as 1976, discharge continued throughout the summer.

4.3.57 Assuming the dredging did give rise to significant leakage losses from Little Mere, the bed of the mere may be located above the water table in underlying superficial deposits in dry periods. The leakage from Little Mere would pass through an unsaturated zone in the top of the superficial deposits before reaching the water table. If this is the case, it is unlikely there could be any groundwater inflow to Little Mere in these periods. Hence, any change in groundwater flow in the catchment, following construction of the AP1 revised scheme, could have no direct impact on water levels in dry conditions.

4.3.58 Overall, it is considered this evidence suggests that although an impact on water levels is unlikely, some uncertainty and the potential for a reduction in water levels remains. This cannot be dismissed and could conflict with the conservation objective to ensure no loss of [hydrological] connectivity (between lake and surrounding areas) (amongst others). Further assessment of the impact on the ecology of The Mere, Mere is required.

Ecological impacts of water level changes at Rostherne Mere and The Mere, Mere

4.3.59 The assessment of purely hydrological impacts above has confirmed that changes in water levels at Rostherne Mere are likely to be a few millimetres (5mm at most in dry or very dry conditions). In terms of The Mere, Mere, calculations suggested that a maximum theoretical reduction in groundwater inflow could give rise to a total, maximum reduction in water level of approximately 270mm in Little Mere. This theoretical maximum reduction in water level was calculated during dry periods in which there is no outflow from Little Mere. However, several reasons were provided to explain why this impact would not occur. As already indicated (see paragraph 4.3.55), the actual impact is more likely to be zero, taking into account current evidence, or, at worst, one or two orders of magnitude lower than the calculated theoretical limit. Ecological impacts of water level changes at Rostherne Mere and The Mere, Mere are discussed in turn below.

4.3.60 Given that the qualifying feature for Rostherne Mere includes the fringing swamp/marsh/fen community, the ecological impact of a change in water levels would be greatest in the margins where either:

- the distribution of submerged and exposed areas could change; and/or
- the proportionate change in depth would be greatest.

4.3.61 The lateral changes in shoreline were calculated for a combined, maximum reduction in water level of 5mm resulting from the cuttings to the north of Rostherne Mere and the set of cuttings to the west of The Mere, Mere. Using Environment Agency data, the approximate lateral movement of the water line of Rostherne Mere, in response to a maximum water level change of 5mm resulting from all cuttings, was calculated to be between 80mm and 267mm.

4.3.62 Drawing on existing bathymetry survey data, this indicates that for a reduction of 5mm, the loss of lake area would be approximately 0.05ha or 0.1%, and about 2.6% of the shelf area above the 1m depth of water. The existing habitat type lost would represent about 1.5% of the 3.3ha of the current extent of the swamp/marsh/fen currently present. The calculations do not, however, allow for any new areas of the habitat which might establish in the resulting marginally shallower water at the edge of the shelf, although this is very unlikely to compensate entirely for the loss of habitat.

4.3.63 The NVC report (2010)[40] describes the main body of water at Rostherne Mere as 'extremely species-poor'. The lack of macrophyte species is attributed to a combination of lake depth, poor water quality and turbidity (the latter a consequence of increased pelagic algal growth due to phosphate loading for which the presence of blue-green algal blooms provided additional evidence). Survey data shows a consistently species-poor aquatic macrophyte flora. This suggests that 'Favourable Condition' requirements are not met at Rostherne Mere.

4.3.64 In contrast, the same report describes the margins of Rostherne Mere as supporting a 'good range of swamp, mire, and wet woodland communities' supporting S4 *Phragmites australis* swamp, S7 *Carex acutiformis* swamp, S13 *Typha angustifolia* swamp, S15 *Acorus calamus* swamp, S24 *Phragmites australis–Peucedanum palustris* tall-herb fen, S25 *Phragmites australis-Eupatorium cannabinum* tall-herb fen and S26 *Phragmites australis-Urtica dioica* tall-herb fen NVC communities, amongst others. The characteristic species are found growing in shallow water or above the water line on the damp margins of the mere although in places extended tens of metres into the open water. The current overall Water Framework Directive (WFD) river basin management plan cycle 2 status is 'Bad' reflecting the failure to meet both biological and physio-chemical parameters. As with the NVC survey above, this was considered to be caused by excessive phosphate loading within the mere.

4.3.65 However, it should be noted that measures to improve water quality within the catchment and the water bodies is underway which in time can be expected to reduce the overall nutrient status of both meres.

4.3.66 Similar outcomes were reported in macrophyte surveys carried out by the Environment Agency in 2007, 2012, 2015 and 2018 with only between four and six species recorded in in each, although these were found to colonise water down to 3.5m depth (reflecting 'moderate' turbidity).

4.3.67 The subsequent 2019 NVC survey[41] essentially endorsed these findings, identifying that the fringing swamp vegetation comprised NVC communities S4a S4 *Phragmites australis* sub-community, S6 *Carex riparia* swamp and S13, suggesting only modest change in species composition, abundance and distribution. *Phragmites* and *Typha* spp. continued to form the dominant species.

4.3.68 The same survey was able to confirm that the raised bog community of Gale Bog has been lost and replaced with fen, marsh and swamp, and wet woodland. However, unlike the woodland of Harpers Bank Wood and Mere Covert, its position within the vegetation

[40] JBA Consulting (2010), Rostherne Mere NNR – National Vegetation Classification - Final Report.

[41] High Speed Two Ltd (2022), High Speed Rail (Crewe - Manchester), Background Information and Data, *Ecological baseline data - National Vegetation Classification and ancient woodland, BID EC-004-00001. Available online at*: https://www.gov.uk/government/collections/hs2-phase2b-crewe-manchester-environmental-statement.

zonation, provides grounds for it to be considered as a component of the swamp/marsh/fen feature and it is included in that assessment accordingly.

4.3.69 Gale Bog provides important diversity amongst the fringing vegetation of Rostherne Mere. Once representing an area of raised bog (and described in the citation), it appears to have been swamped by the rising (eutrophic) water level in the mere prompting the establishment of mature wet woodland. The 2010 NVC noted the presence of a mosaic of W1-W2-W2a-W6b (*Salix cinerea-Galium palustre*, *Salix cinerea-Betula pubescens-Phragmites, Alnus glutinosa-Urtica dioica)* wet woodlands. An area of swamp vegetation remains with S7, S7-14 *Sparganium erectum* swamp, and S25-26-S28 *Phalaris arundinacea* tall-herb fen communities. Though dominated by purple loosestrife and meadowsweet, also supports a population of purple small-reed (also noted in the SSSI citation) as a regionally uncommon species and a key component of the marginal habitat. However, small changes in water levels are unlikely to have an adverse effect on the status of this species as it is a robust rhizomatous perennial with an affinity with habitats subject to winter flooding.

4.3.70 Similar characteristics are displayed by other components of the marginal communities along the perimeter of the lake reflecting the zonation and the ability to adapt to modestly changing water levels in natural circumstances. However, the potential loss of 2.6% of the shelf area represents a considerable decline in the amount of substrate available for colonisation and this would represent a direct challenge to the achievement of the conservation objectives.

4.3.71 Even when set in the context of an annual variation in water levels of about 600mm (suggested by Natural England with evidence to support this found by HS2 Ltd.) and a range of 960mm recorded by HS2 Ltd (between an extended hot, dry spell in July 2018 and very wet conditions in October 2019 when surface water would have extended across Gale Bog), a reduction in water level of a few millimetres will result in a loss of this qualifying feature.

4.3.72 A bathymetric survey in 2004 identified three zones: less than 1m depth able to support fringing emergent vegetation such as common reed, 1m–3.5m potentially suitable for colonisation by submerged macrophytes, and greater than 3.5 deep with macrophytes generally absent with production dominated by pelagic algae. These extended across approximately 5%, 10% and 85% of the mere respectively.

4.3.73 However, despite the evidence gained from recent surveys, the distribution, abundance, species composition and the status of the marginal vegetation remains only partly understood, especially in relation to the extent and profile of the surrounding shelf as the 2004 study only extrapolated data across the shelf; depending on the time of year, even very small changes in water level could have some effect on the amount of habitat available for colonisation and growth. Consequently, the effect on species composition, abundance and distribution and the structure and function of the overall marginal macrophyte communities cannot be predicted with certainty.

4.3.74 In terms of The Mere, Mere, these issues are less well defined though in 2020, an NVC survey recorded the following. Surrounding vegetation comprises W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland and W6d *Alnus glutinosa-Urtica dioica Sambucus nigra* sub-community. Several small areas of swamp were identified comprising vegetation typical of S23 'other water-margin vegetation' or S28 *Iris pseudacorus-Filipendula ulmaria* mire. Elsewhere, fringing swamp resembled both *Phragmites australis* swamp and reedbed or a transition community between S4 and S7 *Carex acutiformis* swamp (or a similar mire community) or S12 *Typha latifolia* swamp. In addition, small, fragmentary stands of S19 *Eleocharis palustris* swamp and OV26b *Epilobium hirsutum-Phragmites australis-Iris pseudacorus* sub-community were recorded. Another small stand of dense, tall-herb wetland vegetation was observed (S23), distinctive because of the abundance of yellow loosestrife and was considered to be more widespread but restrictions on access prevented closer inspection of this and other fringing and aquatic communities, although floating mats of white water-lily resembling A7 *Nymphaea alba* community were observed. Separately, an area of short, tussocky grassland with attributes of the MG6 *Lolium perenne-Cynosurus cristatus* community was present along with a sward dominated by *Holcus lanatus*, *Festuca rubra* and *Anthoxanthum odoratum*. Although the hydrological Technical note provides reasons why impacts on water levels are unlikely, harmful effects on the marginal and aquatic vegetation and macroinvertebrate communities, and, in particular, the red-eyed damselfly population cannot be ruled out with any certainty.

4.3.75 Therefore, it is considered adverse effects from cuttings on the integrity of Rostherne Mere and The Mere, Mere cannot be ruled out beyond reasonable scientific doubt. Mitigation is therefore required.

4.4 Mitigation for the impact of cuttings

4.4.1 Mitigation is required because there is a risk that the Millington, Rostherne and Hoo Green cuttings could lead to a reduction in water levels which could conflict with the conservation objectives of Rostherne Mere. In addition, there is a risk that the Hoo Green cuttings could lead to a reduction in water levels which could conflict with the conservation objectives of The Mere, Mere. Because it has not yet been possible to explore this further by detailed ground investigations, the precautionary principle demanded that adverse effects on the integrity of both Rostherne Mere and The Mere, Mere could not be ruled out.

4.4.2 The management of groundwater flows may form a component of large-scale infrastructure developments and engineering solutions can be employed to maintain groundwater flows in catchment areas. In addition, there needs to be a reasonable degree of confidence that mitigation will be effective, timely, resilient, and deliverable in the long-term. The mitigation schemes proposed in relation to Rostherne Mere and The Mere, Mere are summarised below, and are explained more fully in the Technical note.

4.4.3 In terms of the Millington and Rostherne cuttings, filtered drainage water from an area of the cuttings extending a considerable distance outside the Rostherne Mere catchment could be discharged to Rostherne Mere via a recharge trench. The approximate section of the cuttings contributing to the mitigation drainage scheme and the location of the recharge trench north-east of Rostherne Mere are shown in Figure 5. The timing of the discharge from the cuttings to the recharge trenches may be different to the timing of any natural groundwater discharge in the area above Gale Bog. However, the additional discharge from the extended area of the cuttings would mean that the total discharge is likely to exceed the natural groundwater discharge in the area.

4.4.4 Because the proposed location of the recharge trench lies on glacial till which is likely to be of low permeability, recharge wells may be constructed in the base of the trench, through the upper clay layer and into the lower sandy deposits underlying the area. Infiltration could then take place to the lower sandy deposits through these wells. A recharge scheme might also restore or increase discharges from some seepages in the slopes north-east of Gale Bog which could otherwise be affected by the AP1 revised scheme although there could be no guarantee that the current seepage conditions would be replicated closely across any of the slopes.

4.4.5 If there is a risk that any groundwater in the vicinity of Rostherne Mere could drain away through the bedding material for the carrier drains, concrete dams or geomembrane could be installed across the lower section of the trench just downgradient of points of significant groundwater inflow. In addition, the backfill material above the drains could be varied to prevent groundwater draining away along the trench. Any groundwater would then be expected to re-establish a flow path through the trench backfill or bedding material.

4.4.6 For the area to the north-west of The Mere, Mere, drainage from sections of the cuttings extending across and outside the Rostherne Mere catchment could be pumped to recharge trenches in the superficial deposits to the east of the zone of influence of the Hoo Green cuttings. The approximate sections of the cuttings contributing to the mitigation drainage scheme, and also the provisional location of the recharge trenches to which the drainage water will be discharged, are shown on Figure 6. The geological mapping indicates that glaciofluvial deposits comprising permeable sands and gravels are likely to be present at the location of the recharge trenches.

4.4.7 As with the Millington and Rostherne cuttings, the recharge trenches provided to address the impact of the Hoo Green cuttings should produce a contribution which exceeds the natural recharge in the area of the zone of influence. Again, there may be differences in precise timing between recharge through the trenches and the natural groundwater throughflow. However, taking into account the distance of the recharge scheme from Rostherne Mere or The Mere, Mere, (if some groundwater does flow towards the latter) a slight variation in the timing of recharge should make no significant difference to the timing of groundwater discharge in the catchment.

4.4.8 The proposed recharge scheme does not take into account any impact caused by the A556 or drainage patterns in the area. The A556 scheme is likely to have cut through much of the sands in the southern half of the outcrop of glaciofluvial deposits. Potentially, therefore, the A556 drainage might be intercepting some groundwater moving from this area of the catchment towards Rostherne Mere. However, the mitigation included in the design will provide mitigation for the potential additional impact on groundwater flow from the AP1 revised scheme.

Figure 5: Recharge trenches north of Rostherne Mere

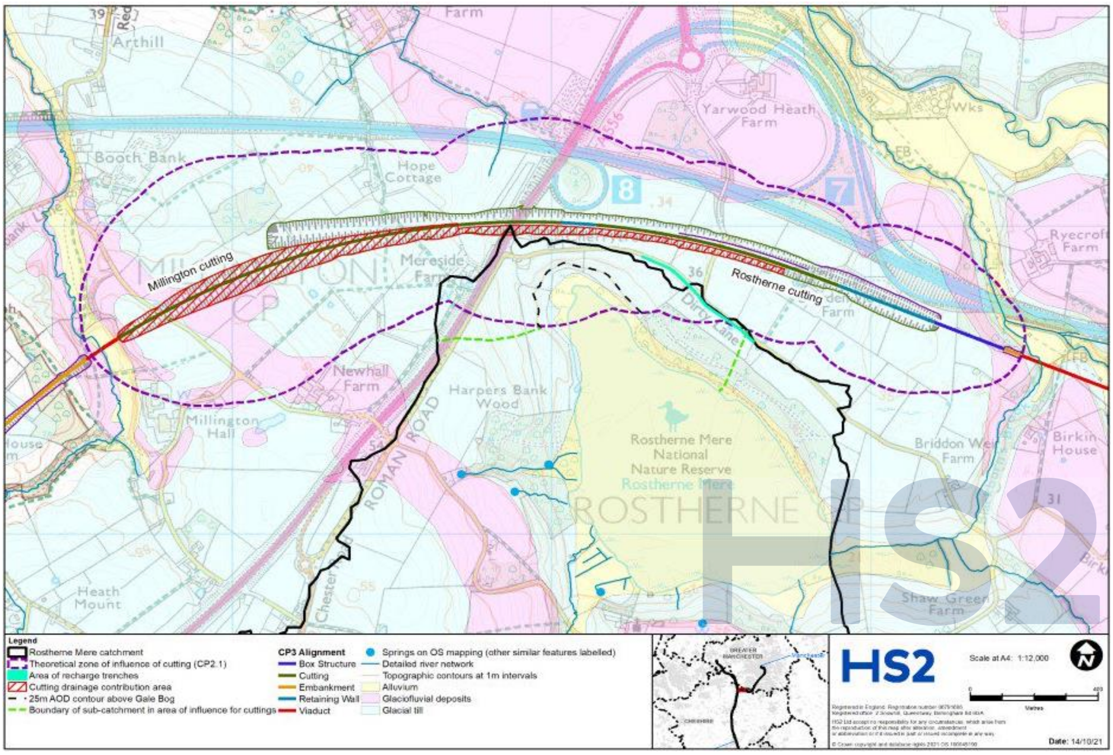
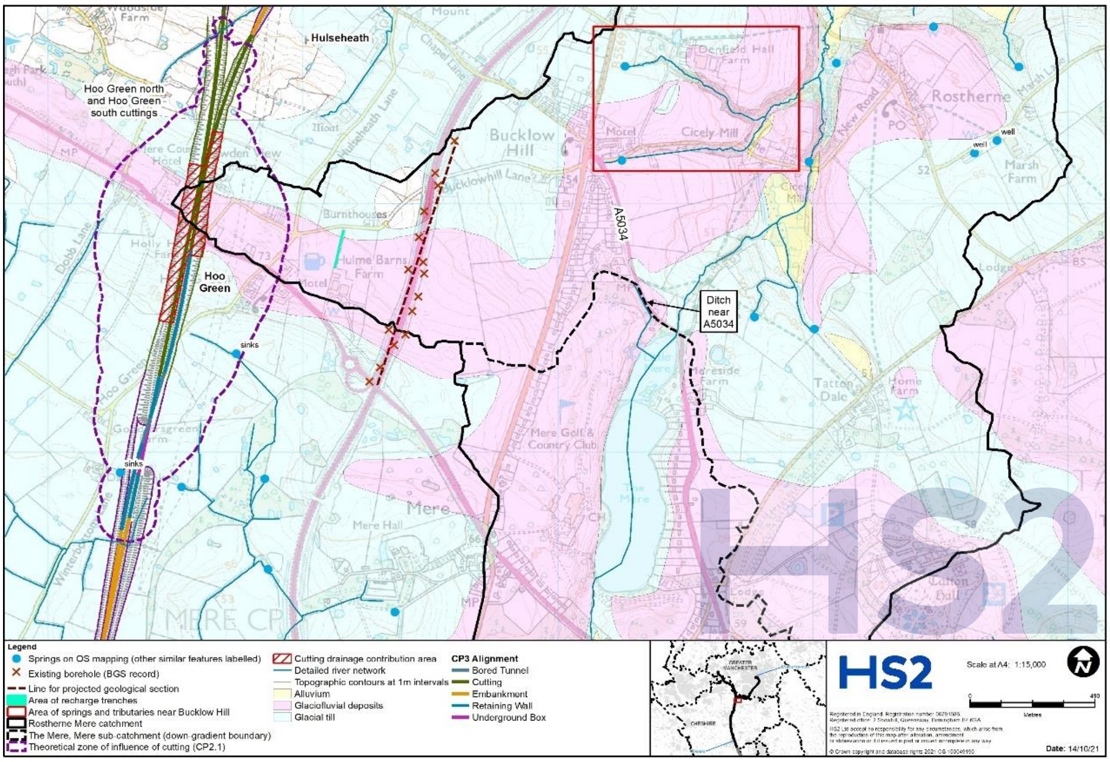


Figure 6: Recharge trenches west of Rostherne Mere



4.4.9 On the basis of the considerations set out above, the mitigation proposed is considered to provide reassurance beyond reasonable scientific doubt that there would be no reductions in water levels in Rostherne Mere. With this mitigation it is expected that Gale Bog, and both the marginal and aquatic vegetation would remain unaffected by the AP1 revised scheme.

4.4.10 The springs and seepages above Gale Bog lie outside, and do not represent qualifying features of the Ramsar site. This means that even though the vegetation communities of the springs and seepages comprise some elements of the fringing swamp communities, their future species composition, abundance and distribution cannot be considered a factor when assessing impacts on the floristic conservation objectives of Rostherne Mere and any impacts do not require mitigation.

4.4.11 This forms the basis of the approach to mitigation of the Millington and Rostherne cuttings. This seeks to maintain the overall water balance but does not aim, and is unable to guarantee, that either the timing of discharges from the springs and seepages or their location and vegetation composition will remain unchanged. Overall, this is not considered to conflict with the conservation objectives allowing adverse effects to be avoided.

4.4.12 A similar rationale underpins the approach to mitigation in relation to The Mere, Mere. Uncertainty remains about the scale of a fall in water levels, to the extent that it is considered unlikely there would be any fall in levels at all. However, regardless of any actual impact, the adoption of mitigation measures is considered to provide, beyond reasonable scientific doubt, the necessary confidence that there would be no resulting reductions in water levels in The Mere, Mere. It is expected that there will be no measurable effect on the extent, distribution and composition of the qualifying features and, consequently, there would be no conflict with the conservation objectives for Rostherne Mere Therefore, it is considered that an adverse effect on the integrity of Rostherne Mere can be ruled out.

4.4.13 The implementation of the recharge schemes would be preceded by detailed site and ground investigations to refine the design or, indeed, to establish whether the schemes are actually required or not. If necessary, the recharge schemes would be subject to careful management, operation and maintenance to ensure they remain functional throughout the lifetime of the AP1 revised scheme. This would be supported by a suitable groundwater level monitoring programme to confirm that the recharge schemes are operating as planned; if required this would also allow remedial action to be taken. Both the monitoring programme and recharge scheme would, if necessary, be developed in consultation with Natural England.

4.4.14 Therefore, in terms of hydrological impacts, it is considered, beyond reasonable scientific doubt, that with allowance for implementation of the proposed mitigation measures, adverse effects on the integrity of Rostherne Mere and The Mere, Mere can be ruled out alone. Consequently, there is no need for an in-combination assessment.

5 In-combination assessment

5.1 Need for assessment

5.1.1 The possible need for an in-combination assessment is addressed by Regulation 63. If required, this would evaluate the cumulative effect of those impacts which are not significant or adverse alone but when combined with the impacts of the AP1 revised scheme could make those effects more likely, more significant or more adverse.

5.1.2 Because this HRA has shown that adverse effects have been avoided alone in terms of impacts from construction activities, and hydrological change on both Rostherne Mere and The Mere, Mere, the potential for adverse effects to arise in-combination can also be ruled out. Therefore, it is considered there is no need for an in-combination assessment.

5.1.3 The evaluation of air pollution represents the single exception to this. To be consistent with the Wealden decision the in-combination effects of air pollution have already been considered in the screening assessment. Therefore, no further assessment of air pollution is required.

5.1.4 Therefore, and mindful of case law (Foster and Langton), with the exception of air pollution where this additional consideration is built into the assessment process, it is considered there is no need for any further in-combination assessment.

5.2 Impacts on other components of the Midland Meres and Mosses Phase 1 Ramsar site

5.2.1 It is recognised that as the Phase 1 Ramsar site comprises multiple components, should the AP1 revised scheme, following an appropriate assessment, be found to be likely to cause adverse effects to arise on one, this could require the consideration of whether the AP1 revised scheme or other plans or projects had caused adverse effects to arise on other components. The cumulative impact of these could result in a greater adverse effect.

5.2.2 However, as it is considered that adverse effects have been ruled out at The Mere, Mere and, in separate HRA for two other components of the Ramsar site, Tatton Meres and Wybunbury Moss, (as part of the original scheme and the AP1 revised scheme respectively) which were also considered to be potentially at risk from air pollution, there is no potential for any cumulative impact with any other plans or projects. No other components of the Phase 1 Ramsar site were considered to be at risk from hydrological impacts or construction related activities and so the potential for cumulative impacts arising from these factors can also be ruled out. Therefore, it is considered there is no need for any further assessment.

6 Integrity test

6.1.1 On the basis of the assessment above, it is considered that the competent authority is able to ascertain that an adverse effect on the integrity of both European sites can be ruled out alone or in-combination.

7 Conclusions

7.1.1 This document provides all relevant information to enable a HRA to be carried out for the purposes of Regulation 63 of the Habitats Regulations 2017, as amended, should one be required. The outcomes allow the following conclusions to be drawn for the Rostherne Mere and The Mere, Mere component of the Midland Meres and Mosses Phase 1 Ramsar site:

- air pollution: it is considered there is no credible risk that changes in NOx, nitrogen deposition or acid deposition, during either construction or operation of the AP1 revised scheme, alone or in-combination with other plans or projects, could undermine the conservation objectives of Rostherne Mere or The Mere, Mere. Therefore, it is considered that likely significant effects alone or in-combination can be ruled out and there is no need for an appropriate assessment (alone or in-combination);
- construction related activities: it is considered that the mitigation proposed is effective, reliable and deliverable, and allows the appropriate assessment to ascertain, beyond reasonable scientific doubt, that adverse effects on the integrity of Rostherne Mere and The Mere, Mere will be avoided alone. It is considered there is no need for an in-combination assessment; and
- changes to the hydrological regime: it is considered that the mitigation proposed is effective, reliable and deliverable, and allows the appropriate assessment to ascertain, beyond reasonable scientific doubt, that adverse effects on the integrity of Rostherne Mere and The Mere, Mere will be avoided alone. It is considered there is no need for an in-combination assessment.

Annex A: Natural England advice 2019

HS2/NE Work Request Response	
Title	Formal Advice on qualifying Ramsar features and grassland management at Rostherne Mere Ramsar site
NE Reference	HS200058
Date of Advice	18 February 2019.
Request Originator	Jon Riley, MWJV (Mott MacDonald WSP Joint Venture)
Date of Request	5 February 2019
Phase	☐ Phase 1 ☐ Phase 2a ☒ Phase 2b ☐ OIMD
Request	Information required to prepare an Appropriate Assessment of potential hydrological and air quality impacts arising from the construction of HS2 Phase 2b on Rostherne Mere Ramsar site, a follows: • Confirmation of the features that form the basis for designation of the Ramsar site. The 2012 screening report for the HS2 Phase 2 states that the key qualify features are – standing open water habitat: natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation; and – fen, marsh and swamp habitat (edge component of the above standing open water): water-fringe vegetation. However, the 2016 SSSI Favourable Condition Table (which also identifies the Ramsar features) lists only the following: – naturally eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation In contrast, the Ramsar Information Sheet identifies the feature as: – Rostherne Mere is one of the deepest and largest of the meres of the Shropshire-Cheshire Plain. Its shoreline is fringed with common reed Phragmites australis. Consultation with NE for the 2012 screening report established that birds listed as noteworthy fauna and those listed under the SSSI designation do not form part of the qualifying interest of the Ramsar. However, subsequently NE has referred to additional features; geology and remnant raised bog that may also contribute to reasons for designation of the Ramsar site. HS2 therefore requests Natural England's formal advice on the qualifying features of the Ramsar site to enable a robust and comprehensive HRA to be carried out. In addition, we seek NE's opinion on the sensitivity (including critical loads if possible and failing that informed opinion) of the final list of features to nitrogen deposition and increased acidity – the sensitivity of Ramsar features is typically poorly described on APIS and can hinder assessment by struggling to provide the objective information required. • Information on the management of grassland in Rostherne Mere NNR that surrounds the Ramsar site, particularly in terms of inputs of fertilizer, slurry and any other nutrients that require consideration in assessing the impacts of nitrogen deposition from HS2 construction activities on the integrity of the SSSI/Ramsar.

HS2/NE Work Request Response	
Response	Ramsar qualifying features The correct interpretation of the Ramsar qualification features at Rostherne Mere is that Rostherne Mere is designated under criterion 1 where, 'A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.' At Rostherne this includes both the standing open water element but also the fringing fen, marsh and swamp habitat. Whilst the Favourable Condition Table (FCT) appears to concentrate on the standing open water element of the Ramsar feature it goes on, in the extent attribute, to say that this feature includes the fringing fen, marsh and swamp habitat. A loss in extent of the fringing habitats could affect site condition. Shoveler and Pochard are mentioned in the February 1999 version of the Ramsar Information sheet but were removed from the June 2008 version as the population numbers were below the Ramsar selection threshold. Peat bog (Gale Bog) was also referred to in the February 1999 information sheet and contributed to the habitat designated under criterion 1. However, the bog element of the fringing habitat has reduced in extent due, we think, to subsidence and changes in water level. The remnants of Gale Bog should be treated as part of the fringing habitat mosaic extent. In the HRA for the A556 construction no special consideration was required for bog habitat and this approach should also be taken for the HS2 HRA/AA. The salt karst is a SSSI feature does not require consideration under the HRA/AA process but would need to be considered when impacts on the SSSI are being looked at. **Sensitivities to air pollution** The Air Pollution Information System (APIS) does not include site specific information for Ramsar sites. Searching for Rostherne Mere SSSI only returns information for duck species feature. In the absence of specific site information for the habitat features at Rostherne we recommend the use of data within the APIS Habitat/Pollutant impact Database. Information on Sensitivities and critical loads (where available) should be used for the following habitat types; • Fen, marsh and swamp • Standing Open water and Canals It is difficult to specify appropriate critical load/levels for standing open waters and the approach generally taken is to apply the relevant loads/levels from associated terrestrial habitat so in the case of Rostherne Mere those relevant to Fen, marsh and swamp should be used when assessing impact. **Grassland Management at Rostherne Mere NNR** In summary, NE has permitted low levels of grazing between approx. 7 April and 31 October on the fields surrounding Rostherne Mere SSSI, with no fertiliser inputs. This management is delivered through a supplementary Nature Reserve Agreement, agri-environment scheme prescription or consent. Further detail is provided below. **Supplementary Nature Reserve Agreement areas – compartments 24, 4, 3 and part of 2**

HS2/NE Work Request Response	
	Grazing between 1 May to end September only. Low stocking May to June. Low stocking is generally considered to be 0.6 Lu/ha. Increased in grazing levels July until September – higher stocking rate of 2 Lu/ha. If heifers are grazed (heifers up to 2 years of age) these are considered to be 0.6 Lu/ha. **Compartments 2, 1, 25, 22 and 21** – these compartments have the same landowner as above, but are not in the supplementary NRA. Grazing may be at higher levels and for a longer period than specified. Grazing management is being discussed with this owner. We would only consent grazing at the levels and timings above, with no fertiliser inputs. **HLS Agreement AG00458797 - Compartments 5, 6, 7, 11, 12, 13, 14, 15 and 16** Option HK15 Maintenance of grassland for target features: From year 1 onwards, manage the sward by grazing between 7 April and 31 October or cutting to achieve a sward height of between 5cm and 15cm during April and May (unless the land has been shut for hay) and between 5cm and 15cm in November. Remove livestock between 1 November and 6 April. Do not cut hay or silage before 15 July, always leaving at least 10% uncut in any one year (which need not be the same 10% each year). All cuttings that could damage the sward must be removed. Do not apply fertilisers, organic manures or waste materials (including sewage sludge) **Consent 240216 - Compartments 17, 18, 19, 20** Low intensity grazing with cattle or sheep from 7 April to 31 October, to achieve sward height of 5cm – 15cm throughout the growing season. No application of fertilisers, organic manures or waste materials.
Deadline of response	Tuesday 12 February 2019 for clarification of Ramsar qualifying features and NNR land management agreements. Tuesday 19 February for information on sensitivity of the final list of qualifying features to nitrogen deposition and increased acidity.
Nature of response: e.g. Meeting (telephone/face to face), formal/informal advice, site visit	Formal advice (follow up meeting may be necessary).
NE contact (if known)	Chris Hogarth

Annex B: Technical note on the water environment and ecology of Rostherne Mere and The Mere, Mere

See Annex B of the Document to inform a Habitats Regulations Assessment for Rostherne Mere Ramsar site and Midland Meres and Mosses Phase 1 Ramsar site, that accompanied the High Speed Rail (Crewe –Manchester) Environmental Statement published in 2022[5] (the main ES).

Annex C: Additional air quality information to inform a Habitats Regulations Assessment

1 Purpose

This Annex provides additional air quality information in relation to impacts from vehicle emissions to support the document to inform a HRA for the Rostherne Mere Ramsar site.

2 Scope, assumptions and limitations

The scope, assumptions and limitations for the air quality assessment are set out in full in Volume 1 (Section 8), in the Environmental Impact Assessment Scope and Methodology Report (SMR) (see Volume 5, Appendix: CT-001-00001) and accompanying SMR Technical note – Air quality: Guidance on the assessment methodology in the main ES.

Key elements in relation to the assessment of vehicle emissions on ecologically sensitive sites are:

- screening of traffic data using the criteria set out in the SMR, which is based on the DMRB criteria[23], to identify where assessment is required;
- these criteria are the following for assessing the impacts of the scheme alone:
  - change in road alignment by 5m or more;
  - change in daily traffic flows by 1,000 vehicles or more as AADT;
  - change in daily flows of HDV by 200 AADT or more;
  - change in daily average speed by 10kph or more; or
  - change in peak hour speed by 20kph or more.
- these criteria are the following for assessing the impacts of the scheme in-combination with other plans and projects:
  - change in daily traffic flows by 1,000 vehicles or more as AADT; or
  - change in daily flows of HDV by 200 AADT or more.
- ecological receptors included in the air quality assessment are designated sites with habitats sensitive to NOx deposition. These could include SAC, SPA and Ramsar sites;
- transects have been used within a designated site with modelled points at 0m, 10m, 20m, 30m, 40m, 50m, 75m, 100m, 150m and 200m from the edge of the road unless the shape of the site and potential impacts necessitates different distances to characterise the impacts;
- a deposition velocity relevant to the habitat of each site has been used, as detailed in the IAQM ecological guidance[25]. Data on nitrogen and acid deposition has been taken from the most recent information available on the APIS[29] website. No reduction in future background deposition rates has been applied;
- the following scenarios are assessed:
  - baseline;
  - selected year(s) within the construction period for the assessment of the effects of construction. The year(s) of assessment are selected based on the worse case peak period during the construction programme and on when significant effects might be expected; and

  - an operational scenario will be assessed for the first full operational year after construction is completed.
- for each assessment year, both the scenario without the AP1 revised scheme in place and the scenario with the AP1 revised scheme in place has been modelled. This comparison is used to assess the impacts of the AP1 revised scheme alone;
- for the assessment of the AP1 revised scheme in-combination with other plans and projects, a different without scheme scenario is used and described as the 'do nothing' scenario. This uses traffic data from the 2018 baseline, but background pollutant concentrations/ deposition rates and emission factors representing the future year being assessed;
- the assessment incorporates HS2 Ltd's Policy on construction vehicle emissions standards. These standards are published in Information Paper E31[42]; Air Quality and include Euro VI for Heavy Good Vehicles (HGV), and Euro 6 and Euro 4 for diesel and petrol Light-Duty Vehicles (LDV) respectively;
- in-combination effects are largely taken into account in the traffic data used for the assessment which incorporates likely changes brought about by other proposed and committed developments[43]; and
- consideration is also given to relevant non-road plans and projects.

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[42] High Speed Two (2017), *High Speed Two Phase One Information Paper E31: Air Quality. Version 1.5*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/672406/E31_-_Air_Quality_v1.5.pdf.

[43] A number of strategic traffic models have been sourced from key stakeholders, including Local Highway Authorities and National Highways. In combination, these models cover the areas that are expected to be affected by the AP1 revised scheme and have been used as the basis of assessment for traffic flow analysis. The models have been developed by the relevant stakeholders in accordance with Transport Analysis Guidance (TAG) provided by the Department for Transport, with each model representing a Base Year position between 2016 and 2018.

Forecast year models have also been supplied by the above stakeholders which reflect committed and planned changes to the transport network and growth associated with committed and planned developments that are sufficiently certain to be introduced after the Base Year of the strategic model. Reviews of committed developments will have been undertaken by the relevant stakeholders at the same time as preparing and validating the Base Year model and developing future year models. Given that the models represent a Base Year position between 2016 and 2018, it is likely that the reviews of forecast committed developments will have been undertaken between 2016 and 2018 depending on when each model was last updated.

In order to account for traffic growth from 2018 to future years, growth factors were directly obtained from TEMPro version 7.2 which uses the National Trip End Model (NTEM 7.2 ((2017)) dataset and the National Transport Model (NTM) 2015. TEMPro inherently incorporates future planned development, being based on approved plans, irrespective of whether it is approved, committed, or simply included in approved plans. It includes all economic and population growth forecasts, and assumes growth in housing and commercial development, therefore providing a prediction of traffic growth by area.

3 Air quality standards

Air quality limit values and objectives are quality standards for clean air and to protect human health or harm to vegetation. The term 'air quality standards' will be used to refer to both the English air quality objectives and the air quality limit values and critical levels introduced in the UK based on EU Directives. Table C1 sets out the air quality standard for NOx.

Table C1: Air quality standards

Pollutant	Averaging period	Standard
NOx (for protection of vegetation)	Annual mean	$30\mu g/m^3$

For the assessment of changes in nitrogen, comparison has been made against the applicable lower critical load[44] for the site, as provided by APIS.

[44] The critical loads for nitrogen deposition vary and are specific to each qualifying feature. These are presented as a range of values (expressed as a rate, e.g. 10kg N/ha/yr – 20 kg N/ha/yr) and typically, as a precautionary approach, only the lowest value is used (unless there are compelling reasons to do otherwise) as this will emphasise any negative outcomes.

4 How significance is assessed

For the assessment of NOx concentrations, the effect is considered to be not significant if the total predicted NOx concentrations are below the air quality standard of 30μg/m^3.

For the assessment of nitrogen deposition, if the change in nitrogen deposition is predicted to be less than 1% of the lower critical load, then the effect is considered to be not significant. However, should the nitrogen deposition change by more than 1%, then the assessment of significance will be undertaken by an ecologist and reported within Section 3 of the main ES HRA report[5].

5 Assessment of construction traffic effects – the original scheme alone

5.1 Screening of traffic data

The assessment of construction traffic impacts has used traffic data based on an estimate of the average daily flows in the peak year during the construction period (2025 – 2037). Traffic data are presented in Table C2.

The screening process identified a total of four roads in the area exceeding the screening thresholds:

- A556;
- Chester Road (between Millington Lane and Cherry Tree Lane);
- Cherry Tree Lane (between Chester Road and Birkinheath Lane); and
- on-site haul route, north of Cherry Tree Lane.

Further roads have been included in the assessment to account for their emissions at nearby receptors.

Rostherne Mere is located east of the A556, just south of M56 Junction 7 and 8. A planned HS2 construction traffic route runs adjacent to Rostherne Mere, along Chester Road and Cherry Tree Lane for part of the construction period, with approximately 200 HDV movements per day predicted. Traffic impacts, however, are primarily the result of increased traffic along the A556 from diversionary effects during the construction phase. Traffic data for construction vehicles using the site haul routes and moving between compounds has also been included in the assessment.

Table C2: Traffic data summary (construction phase)

Road ID	Road name	Annual Average Daily Traffic (AADT)					Heavy Duty Vehicles (HDV)				
		2018 baseline	2025 without the original scheme	2025 with the original scheme	AP1 revised scheme alone change (2025 with the original scheme – 2025 without the original scheme)	In-combination change (2025 with the original scheme – 2018 baseline)	2018 baseline	2025 without the original scheme	2025 with the original scheme	AP1 revised scheme alone change (2025 with the original scheme – 2025 without the original scheme)	In-combination change (2025 with the original scheme – 2018 baseline)
8013_5006, 5006_8013	Cherry Tree Lane, Rostherne Mere	60	73	286	213	226	-	-	205	205	205
5006_5005, 5005_5006	Chester Road, Rostherne Mere	60	73	1,377	1,305	1,317	-	-	205	205	205
96017_96019	A556	28,029	35,316	36,678	1,362	8,649	2,081	2,555	3,264	710	1,183
96015_96017	A556	28,029	35,316	36,678	1,362	8,649	2,081	2,555	3,264	710	1,183
95029_96018	A556	31,147	32,931	36,163	3,232	5,016	2,061	2,334	2,957	624	896
96018_96016	A556	31,147	32,931	36,163	3,232	5,016	2,061	2,334	2,957	624	896
96020_95029	A556	31,147	32,931	36,163	3,232	5,016	2,061	2,334	2,957	624	896
8013_8010, 8010_8013	A556	60	73	286	213	226	-	-	205	205	205

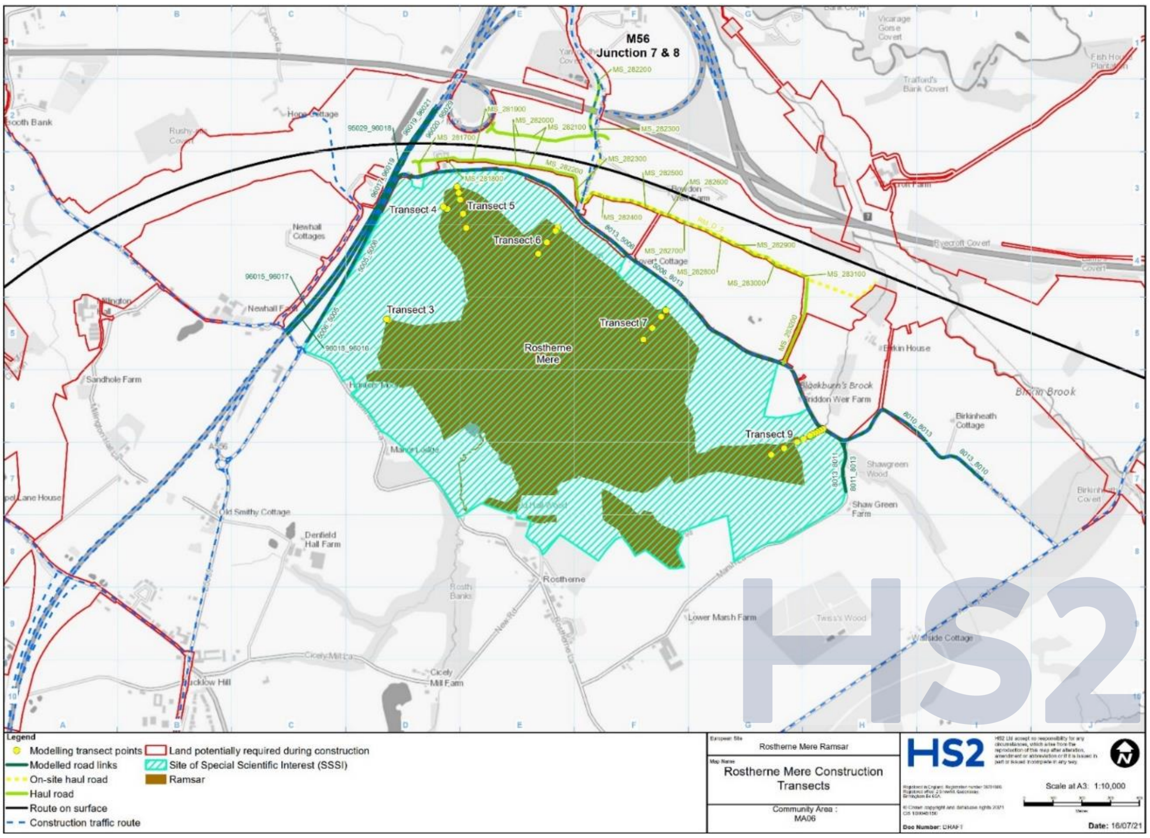
Road ID	Road name	Annual Average Daily Traffic (AADT)					Heavy Duty Vehicles (HDV)				
		2018 baseline	2025 without the original scheme	2025 with the original scheme	AP1 revised scheme alone change (2025 with the original scheme – 2025 without the original scheme)	In-combination change (2025 with the original scheme – 2018 baseline)	2018 baseline	2025 without the original scheme	2025 with the original scheme	AP1 revised scheme alone change (2025 with the original scheme – 2025 without the original scheme)	In-combination change (2025 with the original scheme – 2018 baseline)
8011_8013, 8013_8011	Marsh Lane, Rostherne Mere	-	-	-	-	-	-	-	-	-	-
96019_96021	Birkinheath Lane, Rostherne Mere	28,029	35,316	36,731	1,415	8,702	2,081	2,555	3,269	715	1,188
RM_D_2	On-site Haul Route	-	-	418	418	418	-	-	418	418	418

5.2 Receptors assessed and background concentrations

Figure C1 presents a detailed map of the modelled area including assessed roads (road network in blue, haul roads in green) and modelled receptors (yellow dots).

Table C3 presents the details of the receptor assessed, background concentrations, background deposition and relevant critical loads.

Figure C1: Map of Rostherne Mere construction transects, including modelled links and modelled ecological receptor points



Note: Transects 1, 2 and 8 reported in main ES Volume 5, Appendix: AQ-002-0MA06, and not deemed relevant to this assessment.

Table C3: Modelled ecological receptor backgrounds, APIS data and critical loads (construction phase, original scheme alone)

Receptor	Sensitive habitat	2018 NOx background concentration (µg/m^3)	2025 NOx background concentration (µg/m^3)	APIS data[29] of average total nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)
Rostherne Mere Transect 3	Broadleaved deciduous woodland	16.7	11.7	39.3	20
Rostherne Mere Transect 4	Poor Fen	16.7 – 19.1	11.7 – 13.3	23.8	10
Rostherne Mere Transect 5	Poor fen	19.1	13.3	23.8	10
Rostherne Mere Transect 6	Broadleaved deciduous woodland	19.1	13.3	39.3	20
Rostherne Mere Transect 7	Broadleaved deciduous woodland	19.1	13.3	39.3	20
Rostherne Mere Transect 9	Broadleaved deciduous woodland	16.0 – 30.8	11.6 – 20.1	39.3	20

5.3 Assessment results

Table C4 presents a summary of the modelled NOx concentrations for the ecological site, the change in concentration and a comparison against the air quality standard (30µg/m^3).

Table C5 presents a summary of the modelled nitrogen deposition, change in deposition and percentage change in relation to the lower critical load.

Table C4: Predicted annual mean of NOx concentrations at ecological sites (construction phase, original alone)

Ecological site	Distance to road (m)	NOx concentrations (μg/m³)			Change in NOx concentrations (μg/m³)	Comparison against air quality standard (30μg/m³)
		2018 baseline	2025 without the original scheme	2025 with the original scheme		
Rostherne Mere Transect 3	194	20.29	13.62	13.77	0.15	Within standard
	200	20.17	13.56	13.70	0.14	Within standard
Rostherne Mere Transect 4	184	22.15	14.63	14.89	0.26	Within standard
	200	24.08	15.97	16.21	0.24	Within standard
Rostherne Mere Transect 5	53	24.11	15.99	16.26	0.27	Within standard
	75	23.8	15.82	16.07	0.25	Within standard
	100	23.47	15.65	15.88	0.23	Within standard
	150	22.93	15.36	15.56	0.20	Within standard
	200	22.47	15.12	15.30	0.18	Within standard
Rostherne Mere Transect 6	86	20.55	14.10	14.27	0.17	Within standard
	100	20.56	14.11	14.27	0.16	Within standard
	150	20.6	14.13	14.27	0.14	Within standard
	200	20.63	14.14	14.27	0.13	Within standard
Rostherne Mere Transect 7	72	19.71	13.65	13.74	0.09	Within standard
	75	19.71	13.65	13.74	0.09	Within standard
	100	19.71	13.65	13.73	0.08	Within standard
	150	19.71	13.65	13.72	0.07	Within standard
	200	19.71	13.65	13.72	0.07	Within standard
Rostherne Mere Transect 9	0	31.29	20.39	20.81	0.42	Within standard
	10	31.18	20.32	20.50	0.18	Within standard
	20	31.16	20.31	20.44	0.13	Within standard

Ecological site	Distance to road (m)	NOx concentrations (µg/m³)			Change in NOx concentrations (µg/m³)	Comparison against air quality standard (30µg/m³)
		2018 baseline	2025 without the original scheme	2025 with the original scheme		
	30	31.15	20.30	20.41	0.11	Within standard
	40	31.15	20.30	20.40	0.10	Within standard
	50	31.15	20.30	20.39	0.09	Within standard
	75	16.36	11.77	11.85	0.08	Within standard
	100	16.36	11.77	11.84	0.07	Within standard
	150	16.36	11.77	11.83	0.06	Within standard
	200	16.37	11.77	11.82	0.05	Within standard

Table C5: Assessment of nitrogen deposition at ecological sites (construction phase, original scheme alone)

Ecological site	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	% Change in relation to lower critical load
		2018 baseline	2025 without the original scheme	2025 with the original scheme			
Rostherne Mere Transect 3	194	39.91	39.64	39.66	0.02	20	0.1%
	200	39.89	39.63	39.65	0.02	20	0.1%
Rostherne Mere Transect 4	184	24.23	24.03	24.05	0.02	10	0.2%
	200	24.19	24.01	24.03	0.02	10	0.2%
Rostherne Mere Transect 5	53	24.20	24.01	24.03	0.02	10	0.2%
	75	24.17	24.00	24.02	0.02	10	0.2%
	100	24.15	23.99	24.00	0.01	10	0.2%
	150	24.10	23.96	23.98	0.02	10	0.2%
	200	24.07	23.94	23.96	0.02	10	0.1%
Rostherne Mere Transect 6	86	39.58	39.47	39.50	0.03	20	0.1%

Ecological site	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	% Change in relation to lower critical load
		2018 baseline	2025 without the original scheme	2025 with the original scheme			
	100	39.58	39.47	39.49	0.02	20	0.1%
	150	39.58	39.47	39.49	0.02	20	0.1%
	200	39.59	39.47	39.49	0.02	20	0.1%
Rostherne Mere Transect 7	72	39.44	39.39	39.41	0.02	20	<0.1%
	75	39.44	39.39	39.41	0.02	20	<0.1%
	100	39.44	39.39	39.41	0.02	20	<0.1%
	150	39.44	39.39	39.41	0.02	20	<0.1%
	200	39.44	39.39	39.41	0.02	20	<0.1%
Rostherne Mere Transect 9	0	39.41	39.38	39.45	0.07	20	0.3%
	10	39.39	39.37	39.40	0.03	20	0.1%
	20	39.39	39.37	39.39	0.02	20	0.1%
	30	39.39	39.37	39.39	0.02	20	<0.1%
	40	39.39	39.37	39.38	0.01	20	<0.1%
	50	39.39	39.37	39.38	0.01	20	<0.1%
	75	39.39	39.37	39.38	0.01	20	<0.1%
	100	39.39	39.37	39.38	<0.01	20	<0.1%
	150	39.39	39.37	39.38	<0.01	20	<0.1%
	200	39.39	39.37	39.37	<0.01	20	<0.1%

5.4 Assessment of significance (construction phase, original scheme alone)

NOx concentrations are predicted to be within the air quality standard in 2025 at all locations with or without the original scheme.

Nitrogen deposition is predicted to be above the lower critical load in all scenarios. However, the changes in nitrogen deposition due to the original scheme are lower than 1% of the lower critical load at all modelled receptors. No potentially significant effects are therefore predicted.

6 Assessment of construction traffic effects – original scheme in-combination with other plans and projects

6.1 Screening of traffic data

The assessment of construction traffic impacts has used traffic data based on an estimate of the average daily flows in the peak year during the construction period (2025 – 2037). Traffic data is presented in Table C2.

The screening process identified a total of four roads in the area exceeding the screening thresholds:

- A556;
- Chester Road (between Millington Land and Cherry Tree Lane);
- Cherry Tree Lane (between Chester Road and Birkinheath Lane); and
- on-site haul route, north of Cherry Tree Lane.

Further roads have been included in the assessment to account for their emissions at nearby receptors. Rostherne Mere is located east of the A556, just south of M56 Junction 7/8. A planned HS2 construction traffic route runs adjacent to Rostherne Mere, along Chester Road and Cherry Tree Lane for part of the construction period, with approximately 200 HDV movements per day predicted. Traffic impacts, however, are primarily the result of traffic growth along the A556 from the 2018 Base Year.

6.2 Non-road plans and projects

No non-road plans or projects have been identified that require further consideration within the in-combination assessment.

6.3 Receptors assessed and background concentrations

Figure C2 presents a detailed map of the modelled area including assessed roads (road network in blue, haul roads in green) and modelled receptors (yellow dots).

Table C6 presents the details of the receptor assessed, background concentrations, background deposition and relevant critical loads.

Table C6: Modelled ecological receptor backgrounds, APIS data and critical loads

Receptor	Sensitive habitat	2018 NOx background concentration (µg/m³)	2025 NOx background concentration (µg/m³)	APIS data[29] of average total nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)
Rostherne Mere Transect 3	Broadleaved deciduous woodland	16.7	11.7	39.3	20
Rostherne Mere Transect 4	Poor fen	16.7 - 19.1	11.7 - 13.3	23.8	10
Rostherne Mere Transect 5	Poor fen	19.1	13.3	23.8	10
Rostherne Mere Transect 6	Broadleaved deciduous woodland	19.1	13.3	39.3	20
Rostherne Mere Transect 7	Broadleaved deciduous woodland	19.1	13.3	39.3	20
Rostherne Mere Transect 9	Broadleaved deciduous woodland	16.0 - 30.8	11.6 - 20.1	39.3	20

6.4 Assessment results

Table C7 presents a summary of the modelled NOx concentrations for the ecological site, the change in concentration and a comparison against the air quality standard (30µg/m³).

Table C8 presents a summary of the modelled nitrogen deposition, change in deposition and percentage change in relation to the lower critical load.

Table C7: Predicted annual mean of NOx concentrations at ecological sites (construction phase, original scheme in-combination)

Ecological site	Distance to road (m)	NOx concentrations (μg/m³)			Change in NOx concentrations (μg/m³)	Comparison against air quality standard (30μg/m³)
		Baseline 2018	2025 do nothing	2025 with the original scheme		
Rostherne Mere Transect 3	194	20.29	13.39	13.77	0.38	Within standard
	200	20.17	13.34	13.70	0.36	Within standard
Rostherne Mere Transect 4	184	22.15	14.26	14.89	0.63	Within standard
	200	24.08	15.62	16.21	0.59	Within standard
Rostherne Mere Transect 5	53	24.11	15.64	16.26	0.62	Within standard
	75	23.80	15.50	16.07	0.57	Within standard
	100	23.47	15.35	15.88	0.53	Within standard
	150	22.93	15.10	15.56	0.46	Within standard
	200	22.47	14.89	15.30	0.41	Within standard
Rostherne Mere Transect 6	86	20.55	14.00	14.27	0.27	Within standard
	100	20.56	14.00	14.27	0.27	Within standard
	150	20.60	14.02	14.27	0.25	Within standard
	200	20.63	14.03	14.27	0.24	Within standard
Rostherne Mere Transect 7	72	19.71	13.61	13.74	0.13	Within standard
	75	19.71	13.61	13.74	0.13	Within standard
	100	19.71	13.61	13.73	0.12	Within standard
	150	19.71	13.61	13.72	0.11	Within standard
	200	19.71	13.61	13.72	0.11	Within standard
Rostherne Mere Transect 9	0	31.29	20.35	20.81	0.46	Within standard
	10	31.18	20.29	20.50	0.21	Within standard
	20	31.16	20.28	20.44	0.16	Within standard

Ecological site	Distance to road (m)	NOx concentrations (µg/m³)			Change in NOx concentrations (µg/m³)	Comparison against air quality standard (30µg/m³)
		Baseline 2018	2025 do nothing	2025 with the original scheme		
	30	31.15	20.28	20.41	0.13	Within standard
	40	31.15	20.28	20.40	0.12	Within standard
	50	31.15	20.27	20.39	0.12	Within standard
	75	16.36	11.75	11.85	0.10	Within standard
	100	16.36	11.75	11.84	0.09	Within standard
	150	16.36	11.75	11.83	0.08	Within standard
	200	16.37	11.75	11.82	0.07	Within standard

Table C8: Assessment of Nitrogen deposition at ecological sites (construction phase, AP1 revised scheme in-combination)

Ecological site	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	% Change in relation to lower critical load
		Baseline 2018	2025 do nothing	2025 with the AP1 revised scheme			
Rostherne Mere Transect 3	194	39.91	39.60	39.66	0.06	20	0.3%
	200	39.89	39.59	39.65	0.06	20	0.3%
Rostherne Mere Transect 4	184	24.23	24.00	24.05	0.05	10	0.5%
	200	24.19	23.98	24.03	0.05	10	0.5%
Rostherne Mere Transect 5	53	24.20	23.99	24.03	0.04	10	0.5%
	75	24.17	23.97	24.02	0.05	10	0.4%
	100	24.15	23.96	24.00	0.04	10	0.4%
	150	24.10	23.94	23.98	0.04	10	0.4%
	200	24.07	23.93	23.96	0.03	10	0.3%
Rostherne Mere Transect 6	86	39.58	39.45	39.50	0.05	20	0.2%
	100	39.58	39.45	39.49	0.04	20	0.2%

Ecological site	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	% Change in relation to lower critical load
		Baseline 2018	2025 do nothing	2025 with the AP1 revised scheme			
	150	39.58	39.46	39.49	0.03	20	0.2%
	200	39.59	39.46	39.49	0.03	20	0.2%
Rostherne Mere Transect 7	72	39.44	39.39	39.41	0.02	20	0.1%
	75	39.44	39.39	39.41	0.02	20	0.1%
	100	39.44	39.39	39.41	0.02	20	0.1%
	150	39.44	39.39	39.41	0.02	20	<0.1%
	200	39.44	39.39	39.41	0.02	20	<0.1%
Rostherne Mere Transect 9	0	39.41	39.38	39.45	0.07	20	0.3%
	10	39.39	39.37	39.40	0.03	20	0.2%
	20	39.39	39.37	39.39	0.02	20	0.1%
	30	39.39	39.37	39.39	0.02	20	0.1%
	40	39.39	39.36	39.38	0.02	20	0.1%
	50	39.39	39.36	39.38	0.02	20	<0.1%
	75	39.39	39.36	39.38	0.02	20	<0.1%
	100	39.39	39.36	39.38	0.02	20	<0.1%
	150	39.39	39.36	39.38	0.02	20	<0.1%
	200	39.39	39.36	39.37	0.01	20	<0.1%

6.5 Assessment of significance (construction phase, AP1 revised scheme in-combination)

NOx concentrations are predicted to be within the air quality standard in 2025 at all locations with or without the AP1 revised scheme.

Nitrogen deposition is predicted to be above the lower critical load in all scenarios. However, the changes in nitrogen deposition due to the AP1 revised scheme in-combination are lower than 1% of the lower critical load at all modelled receptors. No potentially significant effects are therefore predicted.

7 Assessment of operational traffic effects – AP1 revised scheme alone

7.1 Screening of traffic data

The assessment of operational traffic impacts has used traffic data based on an estimate of the average daily flows in the opening year of operation (2038). Traffic data are presented in Table C9.

The screening process identified one road in the area exceeding the screening thresholds: the A556.

Further roads have been included in the assessment to account for their emissions at nearby receptors.

Rostherne Mere is located east of the A556, just south of M56 Junction 7/8. Traffic impacts are primarily the result of increased traffic along the A556.

Table C9: Traffic data summary (operational phase)

Road ID	Road name	Annual Average Daily Traffic (AADT)			AP1 revised scheme alone change (2038 with AP1 revised scheme – 2038 without AP1 revised scheme)	In-combination change (2038 with Scheme – 2018 baseline)	Heavy Duty Vehicles (HDV)			AP1 revised scheme alone change (2038 with AP1 revised scheme – 2038 without AP1 revised scheme)	In-combination change (2038 with Scheme – 2018 baseline)
		2018 baseline	2038 without the AP1 revised scheme	2038 with the AP1 revised scheme			2018 baseline	2038 without the hAP1 revised scheme	2038 with the AP1 revised scheme		
8003_8005, 8005_8003	A50 Warrington Road	12,860	14,459	14,550	91	**1,690**	312	268	308	40	-4
8051_5003, 5003_8051	A50 Warrington Road	6,924	6,490	7,604	**1,114**	680	185	53	53	0	-132

Note: Values in bold indicate change in traffic flow triggering for assessment

7.2 Receptors assessed and background concentrations

Figure C2: Map of the site, assessed roads and modelled receptors

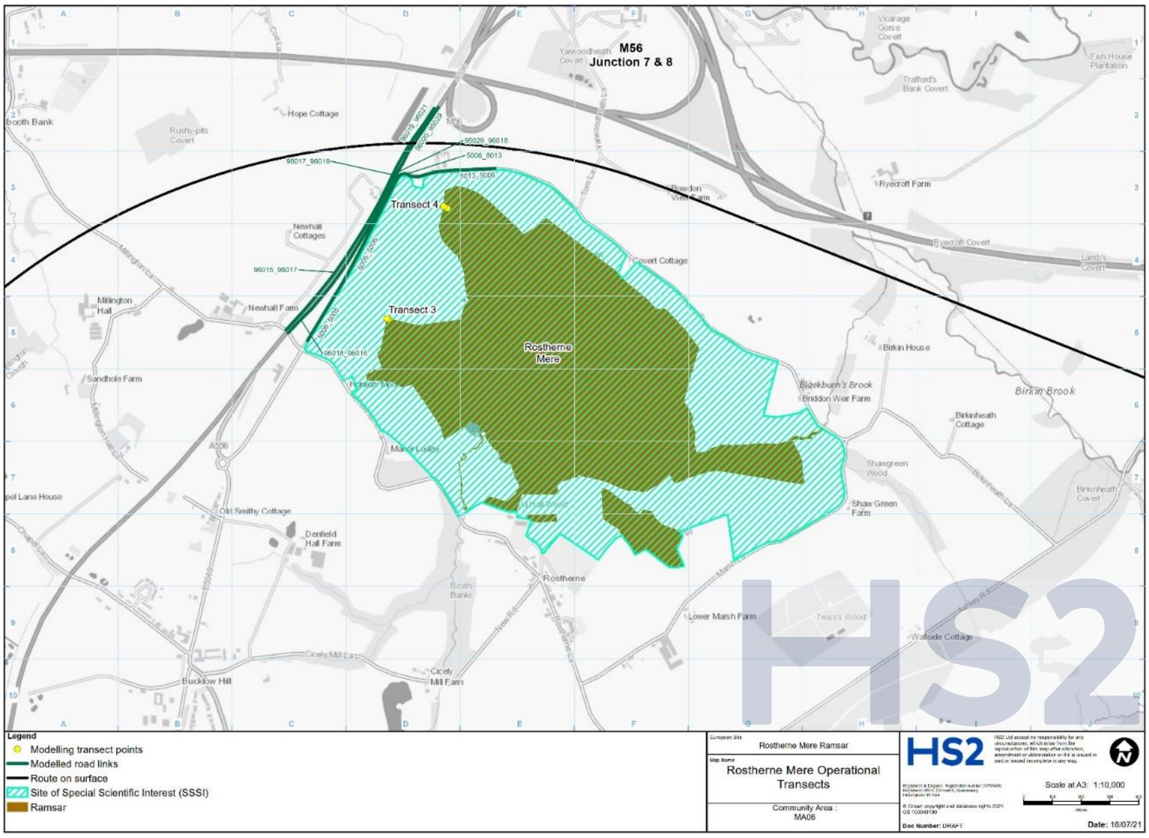


Table C10: Modelled ecological receptor backgrounds, APIS data and critical loads

Receptor	Sensitive habitat	2018 NOx background concentration (µg/m³)	2038 NOx background concentration (µg/m³)	APIS data[29] of average total nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)
Rostherne Mere Transect 3	Broadleaved deciduous woodland	16.7	10.1	39.3	20
Rostherne Mere Transect 4	Poor Fen	16.7 – 19.1	10.1 – 11.2	23.8	10

7.3 Assessment results

Table C11 presents a summary of the modelled NOx concentrations for the ecological site, the change in concentration and a comparison against the air quality standard (30µg/m³).

Table C12 presents a summary of the modelled nitrogen deposition, change in deposition and percentage change in relation to the lower critical load.

Table C11: Predicted annual mean of NOx concentrations at ecological sites (operational phase, AP1 revised scheme alone)

Ecological site	Distance to road (m)	NOx concentrations (μg/m³)			Change in NOx concentrations (μg/m³)	Comparison against air quality standard (30μg/m³)
		2018 Baseline	2038 without the AP1 revised scheme	2038 with the AP1 revised scheme		
Rostherne Mere Transect 3	194	20.29	10.86	10.88	0.02	Within standard
	200	20.17	10.84	10.86	0.02	Within standard
Rostherne Mere Transect 4	184	22.15	11.28	11.31	0.03	Within standard
	200	24.08	12.25	12.28	0.03	Within standard

Table C12: Assessment of nitrogen deposition at ecological sites (operational phase, AP1 revised scheme alone)

Ecological site	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	% Change in relation to lower critical load
		2018 baseline	2038 without the AP1 revised scheme	2038 with the AP1 revised scheme			
Rostherne Mere Transect 3	194	39.91	39.46	39.46	<0.01	20	<0.1%
	200	39.89	39.45	39.46	<0.01	20	<0.1%
Rostherne Mere Transect 4	184	24.23	23.89	23.89	<0.01	10	<0.1%
	200	24.19	23.88	23.89	<0.01	10	<0.1%

7.4 Assessment of significance (operational phase, AP1 revised scheme alone)

NOx concentrations are predicted to be within the air quality standard in 2038 at all locations with or without the AP1 revised scheme.

Nitrogen deposition is predicted to be above the lower critical load in all scenarios. However, the changes in nitrogen deposition due to the AP1 revised scheme are lower than 1% of the lower critical load at all modelled receptors. No potentially significant effects are therefore predicted.

8 Assessment of operational traffic effects – AP1 revised scheme in-combination with other plans and projects

8.1 Screening of traffic data

The assessment of operational traffic impacts has used traffic data based on an estimate of the average daily flows in the opening year of operation (2038). Traffic data are presented in Table C9.

The screening process identified one road in the area exceeding the screening thresholds: the A556.

Further roads have been included in the assessment to account for their emissions at nearby receptors.

Rostherne Mere is located east of the A556, just south of M56 Junction 7/8. Traffic impacts are primarily the result of increased traffic growth along the A556 from the 2018 Base Year.

8.2 Non-road plans and projects

No non-road plans or projects have been identified that require further consideration within the in-combination assessment.

8.3 Receptors assessed and background concentrations

Figure C2 presents a map of the sites, assessed roads and modelled receptors.

Table C13 presents the details of the receptor assessed, background concentrations, background deposition and relevant critical loads.

Table C13: Modelled ecological receptor backgrounds, APIS data and critical loads

Receptor	Sensitive habitat	2018 NOx background concentration (µg/m³)	2038 NOx background concentration (µg/m³)	APIS data[29] of average total nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)
Rostherne Mere Transect 3	Broadleaved deciduous woodland	16.7	10.1	39.3	20
Rostherne Mere Transect 4	Poor Fen	16.7 – 19.1	10.1 – 11.2	23.8	10

8.4 Assessment results

Table C14 presents a summary of the modelled NOx concentrations for the ecological site, the change in concentration and a comparison against the air quality standard (30μg/m^3).

Table C15 presents a summary of the modelled nitrogen deposition, change in deposition and percentage change in relation to the lower critical load.

Table C14: Predicted annual mean of NOx concentrations at ecological sites (operational phase, AP1 revised scheme in-combination)

Ecological site	Distance to road (m)	NOx concentrations (μg/m³)			Change in NOx concentrations (μg/m³)	Comparison against air quality standard (30μg/m³)
		Baseline 2018	2038 do nothing	2038 with the AP1 revised scheme		
Rostherne Mere Transect 3	194	20.29	10.74	10.88	0.14	Within standard
	200	20.17	10.72	10.86	0.14	Within standard
Rostherne Mere Transect 4	184	22.15	11.08	11.31	0.23	Within standard
	200	24.08	12.07	12.28	0.22	Within standard

Table C15: Assessment of nitrogen deposition at ecological sites (operational phase, AP1 revised scheme in-combination)

Ecological site	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	% Change in relation to lower critical load
		Baseline 2018	2038 do nothing	2038 with the AP1 revised scheme			
Rostherne Mere Transect 3	194	39.91	39.44	39.46	0.02	20	0.1%
	200	39.89	39.43	39.46	0.03	20	0.1%
Rostherne Mere Transect 4	184	24.23	23.87	23.89	0.02	10	0.2%
	200	24.19	23.87	23.89	0.02	10	0.2%

8.5 Assessment of significance (operational phase, AP1 revised scheme in-combination)

NOx concentrations are predicted to be within the air quality standard in 2038 at all locations with or without the AP1 revised scheme.

Nitrogen deposition is predicted to be above the lower critical load in all scenarios. However, the changes in nitrogen deposition due to the AP1 revised scheme in-combination are lower than 1% of the lower critical load at all modelled receptors. No potentially significant effects are therefore predicted.

Annex D: Additional air quality information to inform a Habitats Regulation Assessment

1 Purpose

This Annex provides additional air quality information in relation to impacts from vehicle emissions to support the document to inform a HRA for the Midland Meres and Mosses Phase 1 Ramsar site (The Mere, Mere).

2 Scope, assumptions and limitations

The scope, assumptions and limitations for the air quality assessment are set out in full in Volume 1 (Section 8) of the SMR and accompanying Technical note – Air quality: Guidance on the assessment methodology.

Key elements in relation to the assessment of vehicle emissions on ecologically sensitive sites are:

- screening of traffic data using the criteria set out in the SMR which is based on the DMRB criteria[23], to identify where assessment is required;
- these criteria are the following for assessing the impacts of the scheme alone:
  - change in road alignment by 5m or more;
  - change in daily traffic flows by 1,000 vehicles or more as AADT;
  - change in daily flows of HDV by 200 AADT or more;
  - change in daily average speed by 10kph or more; or
  - change in peak hour speed by 20kph or more.
- these criteria are the following for assessing the impacts of the scheme in-combination with other plans and projects:
  - change in daily traffic flows by 1,000 vehicles or more as AADT; or
  - change in daily flows of HDV by 200 AADT or more.
- ecological receptors included in the air quality assessment are designated sites with habitats sensitive to nitrogen. These could include SAC, SPA and Ramsar sites;
- transects have been used within a designated site with modelled points at 0m, 10m, 20m, 30m, 40m, 50m, 75m, 100m, 150m and 200m from the edge of the road unless the shape of the site and potential impacts necessitates different distances to characterise the impacts;
- a deposition velocity relevant to the habitat of each site has been used, as detailed in the IAQM ecological guidance[25]. Data on nitrogen and acid deposition has been taken from the most recent information available on the APIS[29] website. No reduction in future background deposition rates has been applied;
- the following scenarios were assessed:
  - baseline;
  - selected year(s) within the construction period for the assessment of the effects of construction. The year(s) of assessment were selected based on the worse case peak period during the construction programme and on when significant effects might be expected; and
  - an operational scenario was assessed for the first full operational year after construction is completed.

- for each assessment year, both the scenario without the AP1 revised scheme in place and the scenario with the AP1 revised scheme in place have been modelled. This comparison was used to assess the impacts of the AP1 revised scheme alone;
- for the assessment of the AP1 revised scheme in-combination with other plans and projects, a different without scheme scenario was used and described as the 'do nothing' scenario. This uses traffic data from the 2018 baseline, but background pollutant concentrations/ deposition rates and emission factors representing the future year being assessed;
- the assessment incorporated HS2 Ltd's Policy on construction vehicle emissions standards. These standards are published in Information Paper E31[42]; Air Quality and include Euro VI for HGVs, and Euro 6 and Euro 4 for diesel and petrol Light-Duty Vehicles (LDV) respectively;
- in-combination effects were largely into account in the traffic data used for the assessment which incorporates likely changes brought about by other proposed and committed developments[45]; and
- consideration was also given to relevant non-road plans and projects.

[45] A number of strategic traffic models have been sourced from key stakeholders, including Local Highway Authorities and National Highways. In combination, these models cover the areas that are expected to be affected by the AP1 Revised Scheme and have been used as the basis of assessment for traffic flow analysis. The models have been developed by the relevant stakeholders in accordance with Transport Analysis Guidance (TAG) provided by the Department for Transport, with each model representing a Base Year position between 2016 and 2018.

Forecast year models have also been supplied by the above stakeholders which reflect committed and planned changes to the transport network and growth associated with committed and planned developments that are sufficiently certain to be introduced after the Base Year of the strategic model. Reviews of committed developments will have been undertaken by the relevant stakeholders at the same time as preparing and validating the Base Year model and developing future year models. Given that the models represent a Base Year position between 2016 and 2018, it is likely that the reviews of forecast committed developments will have been undertaken between 2016 and 2018 depending on when each model was last updated.

In order to account for traffic growth from 2018 to future years, growth factors were directly obtained from TEMPro version 7.2 which uses the National Trip End Model (NTEM 7.2 (2017)) dataset and the National Transport Model (NTM) 2015. TEMPro inherently incorporates future planned development, being based on approved plans, irrespective of whether it is approved, committed, or simply included in approved plans. It includes all economic and population growth forecasts, and assumes growth in housing and commercial development, therefore providing a prediction of traffic growth by area.

3 Air quality standards

Air quality limit values and objectives are quality standards for clean air and to protect human health or harm to vegetation. The term 'air quality standards' has been used to refer to both the English air quality objectives and the air quality limit values and critical levels introduced in the UK based on EU Directives. Table D1 sets out the air quality standard for NOx.

Table D1: Air quality standards

Pollutant	Averaging period	Standard
NOx (for protection of vegetation)	Annual mean	30µg/m^3

For the assessment of changes in nitrogen and acid deposition, comparison has been made against the applicable critical loads[46] for the site, as provided by APIS.

[46] The critical loads for nitrogen and acid deposition vary and are specific to each qualifying feature. These are presented as a range of values (expressed as a rate, e.g. 10kg N/ha/yr – 20 kg N/ha/yr) and typically, as a precautionary approach, only the lowest value is used (unless there are compelling reasons to do otherwise) as this will emphasise any negative outcomes.

4 How significance is assessed

For the assessment of NOx concentrations, if the change is predicted to be less than 1% of the air quality standard then the effect is considered to be not significant. However, should the NOx concentration change by more than 1% then the assessment of significance will be undertaken by an ecologist and reported within Section 3 of the main ES HRA report.

For the assessment of nitrogen deposition, if the change is predicted to be less than 1% of the lower critical load[46], then the effect is considered to be not significant. However, should the deposition change by more than 1% of the minimum critical load for nitrogen deposition, then the assessment of significance will be undertaken by an ecologist and reported within Section 3 of the main ES HRA report.

For the assessment of acid deposition, if the total concentration is predicted to be less than the lower critical load, then the effect is considered to be not significant. If the total deposition concentration be greater than the minimum critical load, and the if the change in concentration is more than 1% of the maximum critical load and the total for acid deposition is greater than the maximum critical load, then the assessment of significance will be undertaken by an ecologist and reported within Section 3 of the main ES HRA report.

5 Assessment of construction traffic effects – AP1 revised scheme alone

5.1 Screening of traffic data

The assessment of construction traffic impacts has used traffic data based on an estimate of the average daily flows in the peak year during the construction period (2025 – 2037). Traffic data are presented in Table D2.

The screening process identified one road in the area exceeding the screening thresholds:

- the A50 Warrington Road, Mere.

Therefore, in this scenario, only impacts in Transect 1 are considered.

Further roads have been included in the assessment to account for their emissions at nearby receptors.

Traffic impacts are primarily the result of increased traffic along the A50 Warrington Road from diversionary effects during the construction phase.

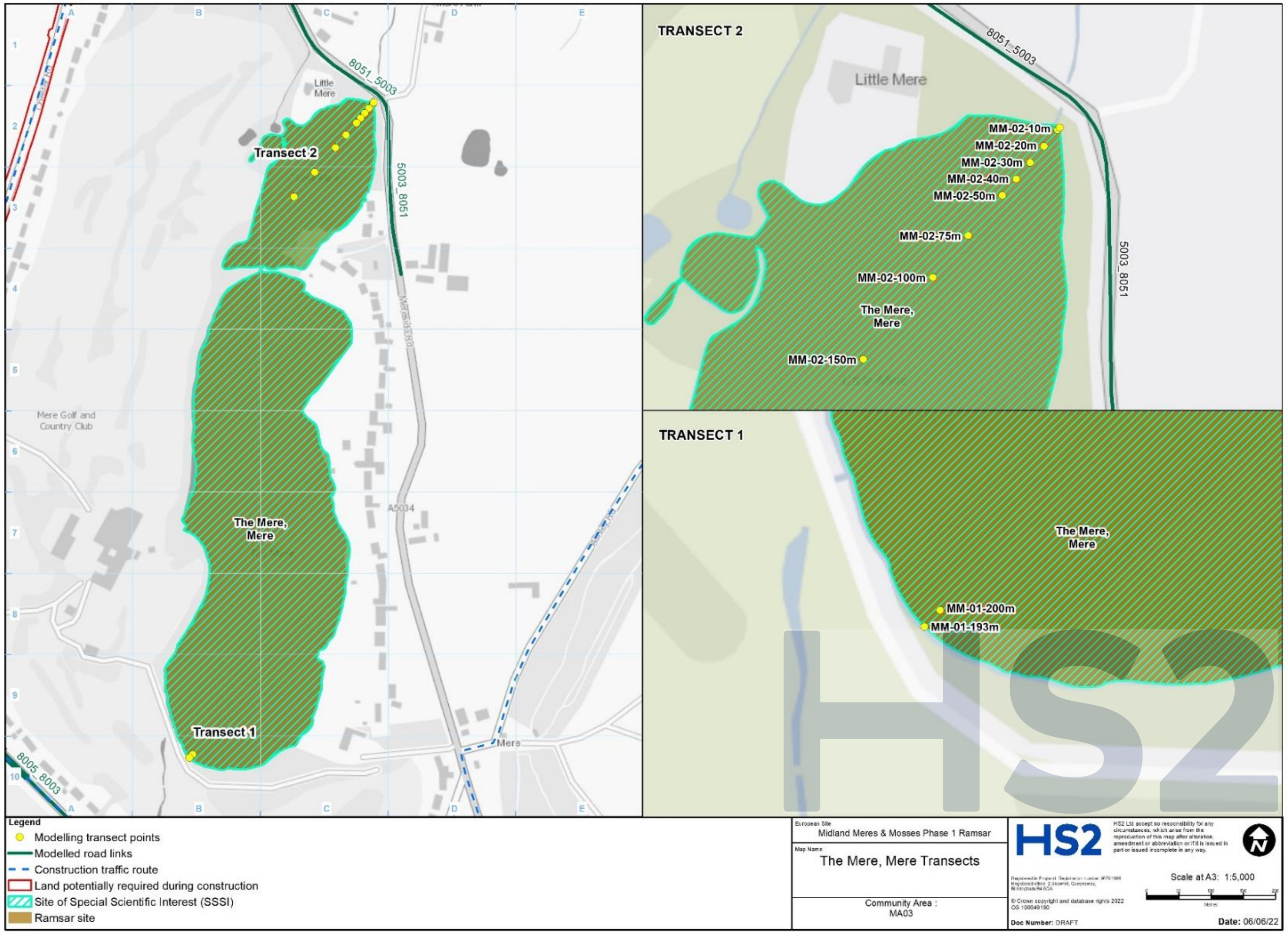
Figure D1 present maps of the site, assessed roads and modelled receptors.

Table D2: Traffic data summary (construction phase)

Road ID	Road name	Annual Average Daily Traffic (AADT)					Heavy Duty Vehicles (HDV)				
		2018 baseline	2025 without the AP1 revised scheme	2025 with the AP1 revised scheme	AP1 revised scheme alone change (2025 with AP1 revised scheme – 2025 without AP1 revised scheme)	In-combination change (2025 with the AP1 revised scheme – 2018 baseline)	2018 baseline	2025 without the AP1 revised scheme	2025 with the AP1 revised scheme	AP1 revised scheme alone change (2025 with AP1 revised scheme – 2025 without AP1 revised scheme)	In-combination change (2025 with the AP1 revised scheme – 2018 baseline)
8003_8005, 8005_8003	A50 Warrington Road	12,860	14,070	15,658	1,588	2,798	312	305	750	445	438

Note: Values in bold indicate change in traffic flow triggering for assessment

Figure D1: Map of The Mere, Mere Transect 1 and 2, including modelled links and modelled ecological receptor points



5.2 Receptors assessed and background concentrations

Table D3 and Table D4 present the details of the receptor assessed, background concentrations, background deposition and relevant critical loads. Acid deposition critical loads for Oak Mere were used as a proxy for The Mere, Mere.

Table D3: Modelled ecological receptor NOx and nitrogen deposition backgrounds, APIS data and critical loads (construction phase – AP1 revised scheme alone)

Receptor	Sensitive habitat	2018 NOx background concentration (μg/m^3)	2025 NOx background concentration (μg/m^3)	APIS data of average total nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)
The Mere, Mere Transect 1	Poor fen	14.8	10.7	23.8	10

Table D4: Modelled ecological receptor acid deposition backgrounds, APIS data and critical loads (construction phase – AP1 revised scheme alone)

Receptor	Sensitive habitat	APIS data[29] of average total acid deposition (k eq/ha/yr)	Critical load (k eq/ha/yr) (min)	Critical load (k eq/ha/yr) (max)
The Mere, Mere Transect 1	Poor fen	1.8	0.2	0.6

5.3 Assessment results

Table D5 presents a summary of the modelled NOx concentrations for the ecological site, the change in concentration and a comparison against the air quality standard (30μg/m^3).

Table D6 presents a summary of the modelled nitrogen deposition, change in deposition and percentage change in relation to the lower critical load.

Table D7 presents a summary of the modelled acid deposition, percentage change in deposition and percentage change in relation to the critical load.

Table D5: Predicted annual mean of NOx concentrations at ecological sites (construction phase – AP1 revised scheme alone)

Ecological site	Distance to road (m)	NOx concentrations (μg/m³)			Change in NOx concentrations (μg/m³)	Comparison against air quality standard (30μg/m³)	Percent change in relation to air quality standard
		2018 baseline	2025 without the AP1 revised scheme	2025 with the AP1 revised scheme			
The Mere, Mere Transect 1	193	19.14	13.05	13.26	0.21	Within standard	0.7%
	200	19.07	13.01	13.21	0.20	Within standard	0.7%

Table D6: Assessment of nitrogen deposition at ecological sites (construction phase – AP1 revised scheme alone)

Ecological site	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	Percent change in relation to lower critical load
		2018 baseline	2025 without the AP1 revised scheme	2025 with the AP1 revised scheme			
The Mere, Mere Transect 1	193	24.14	23.99	24.00	0.01	10	0.2%
	200	24.14	23.98	24.00	0.02	10	0.2%

Table D7: Assessment of acid deposition at ecological sites (construction phase – AP1 revised scheme alone)

Ecological site	Distance to road (m)	Acid deposition (k eq/ha/yr)			Change in acid deposition as percent of CLmax	Total With AP1 revised scheme acid deposition as percent of CLmax
		2018 baseline	2025 without the AP1 revised scheme	2025 with the AP1 revised scheme		
The Mere, Mere Transect 1	193	1.81	1.81	1.81	0.20%	314.4%
	200	1.81	1.81	1.81	0.20%	314.4%

5.4 Assessment of significance (construction phase, AP1 revised scheme alone)

NOx concentrations at the site are predicted to be within the standard at all receptors. Changes in NOx concentrations are less than 1% of the air quality standard at all receptors.

Nitrogen deposition rates are predicted to be above the lower critical load at all modelled receptors in the baseline and future scenarios with or without the AP1 revised scheme. Predicted nitrogen deposition rates in 2025, with the AP1 revised scheme, are lower than the 2018 baseline rates at all modelled locations. The changes in nitrogen deposition between the 2025 do minimum scenario and with the AP1 revised scheme scenario are less than 1% of the lower critical load.

Acid deposition rates are predicted to be above the lower critical load at all modelled receptors in all scenarios with or without the AP1 revised scheme. The changes in acid deposition between the 2025 do minimum scenario and with the AP1 revised scheme scenario are less than 1% of the maximum critical load.

No potentially significant effects are therefore predicted.

6 Assessment of construction traffic effects – AP1 revised scheme in-combination with other plans and projects

6.1 Screening of traffic data

The screening process identified one road in the area exceeding the screening thresholds:

- the A50 Warrington Road, Mere.
- Therefore, in this scenario, only impacts in Transect 1 are considered. As noted above, traffic impacts from the AP1 revised scheme are primarily the result of increased traffic along the A50 Warrington Road from diversionary effects during the construction phase.

Table D2 presents the traffic data used in the assessment.

Figure D1 presents a map of the site, assessed roads and modelled receptors.

6.2 Non-road plans and projects

No non-road plans or projects have been identified that require further consideration within the in-combination assessment.

6.3 Receptors assessed and background concentrations

Table D8 and Table D9 present the details of the receptor assessed, background concentrations, background deposition and relevant critical loads. Acid deposition critical loads for Oak Mere used as a proxy for The Mere, Mere.

Table D8: Modelled ecological receptor NOx and nitrogen deposition backgrounds, APIS data and critical loads (construction phase – AP1 revised scheme in-combination)

Receptor	Sensitive habitat	2018 NOx background concentration (μg/m³)	2025 NOx background concentration (μg/m³)	APIS data[29] of average total nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)
The Mere, Mere Transect 1	Poor fen	14.8	10.7	23.8	10

Table D9: Modelled ecological receptor acid deposition backgrounds, APIS data and critical loads (construction phase – AP1 revised scheme in-combination)

Receptor	Sensitive habitat	APIS data[29] of average total acid deposition (k eq/ha/yr)	Critical load (k eq/ha/yr) (min)	Critical load (k eq/ha/yr) (max)
The Mere, Mere Transect 1	Poor fen	1.8	0.2	0.6

6.4 Assessment results

Table D10 presents a summary of the modelled NOx concentrations for the ecological site, the change in concentration and a comparison against the air quality standard (30μg/m^3).

Table D11 presents a summary of the modelled nitrogen deposition, change in deposition and percentage change in relation to the lower critical load.

Table D12 presents a summary of the modelled acid deposition, percentage change in deposition and percentage change in relation to the critical load.

Table D10: Predicted annual mean of NOx concentrations at ecological sites (construction phase – AP1 revised scheme in-combination)

Ecological site	Distance to road (m)	NOx concentrations (µg/m³)			Change in NOx concentrations (µg/m³)	Comparison against air quality standard (30µg/m³)	Percent change in relation to air quality standard
		Baseline 2018	2025 do nothing	2025 with the AP1 revised scheme in-combination			
The Mere, Mere Transect 1	193	19.14	12.73	13.26	0.53	Within standard	1.8%
	200	19.07	12.70	13.21	0.51	Within standard	1.7%

Table D11: Assessment of nitrogen deposition at ecological sites (construction phase – AP1 revised scheme in-combination)

Ecological site	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	Percent change in relation to lower critical load
		Baseline 2018	2025 do nothing	2025 with the AP1 revised scheme In-combination			
The Mere, Mere Transect 1	193	24.14	23.96	24.00	0.04	10	0.4%
	200	24.14	23.96	24.00	0.04	10	0.4%

Table D12: Assessment of acid deposition at ecological sites (construction phase – AP1 revised scheme in-combination)

Ecological site	Distance to road	Acid deposition (k eq/ha/yr)			Change in acid deposition as percent of CLmax	Total with AP1 revised scheme acid deposition as percent of CLmax
		2018 baseline	2025 do nothing	2025 with the AP1 revised scheme In-combination		
The Mere, Mere Transect 1	193	1.81	1.81	1.81	0.52%	314.8%
	200	1.81	1.81	1.81	0.52%	314.8%

6.5 Assessment of significance (construction phase, AP1 revised scheme in-combination)

NOx concentrations at the site are predicted to be within the air quality standard at all receptors. However, changes in NOx concentrations due to the AP1 revised scheme in-combination are greater than 1% of the air quality standard. Potentially significant effects are therefore predicted, and this is addressed further in paragraphs 3.5.79 to 3.5.80 of the main ES HRA report.

Nitrogen deposition rates are predicted to be above the lower critical load in all scenarios. Predicted nitrogen deposition rates in 2025, with the AP1 revised scheme in-combination, are lower than the 2018 baseline rates at all modelled locations. The changes in nitrogen deposition between the 2025 do nothing scenario and with the AP1 revised scheme in-combination scenario are less than 1% of the lower critical load. No potentially significant effects are therefore predicted.

Acid deposition rates are predicted to be above the lower critical load at all modelled receptors in all scenarios. The changes in acid deposition between the 2025 do nothing scenario and with the AP1 revised scheme in-combination scenario are less than 1% of the maximum critical load. No potentially significant effects are therefore predicted.

7 Assessment of operational traffic effects – AP1 revised scheme alone

7.1 Screening of traffic data

The assessment of operational traffic impacts has used traffic data based on an estimate of the average daily flows in 2038. Traffic data are presented in Table D13.

- The screening process identified one road in the area exceeding the screening thresholds: the A5034 Mereside Road, Mere.
- Therefore, in this scenario, only impacts in Transect 2 are considered. Traffic impacts are primarily the result of rerouting of traffic along the A5034 Mereside Road as a result of the AP1 revised scheme.
- Further roads have been included in the assessment to account for their emissions at nearby receptors.

Figure D1 presents a map of the site, assessed roads and modelled receptors.

Table D13: Traffic data summary (operational phase)

Road ID	Road name	Annual Average Daily Traffic (AADT)					Heavy Duty Vehicles (HDV)				
		2018 baseline	2038 without the AP1 revised scheme	2038 with the AP1 revised scheme	AP1 revised scheme alone change (2038 with AP1 revised scheme – 2038 without AP1 revised scheme)	In-combination change (2038 with the AP1 revised scheme – 2018 baseline)	2018 baseline	2038 without the AP1 revised scheme	2038 with the AP1 revised scheme	AP1 revised scheme alone change (2038 with AP1 revised scheme – 2038 without AP1 revised scheme)	In-combination change (2038 with the AP1 revised scheme – 2018 baseline)
8003_8005, 8005_8003	A50 Warrington Road	12,860	14,459	14,550	91	1,690	312	268	308	40	-4
8051_5003, 5003_8051	A5034 Mereside Road	6,924	6,490	7,604	1,114	680	185	53	53	0	-132

7.2 Receptors assessed and background concentrations

Table D14 and Table D15 present the details of the receptor assessed, background concentrations, background deposition and relevant critical loads.

Table D14: Modelled ecological receptor NOx and nitrogen deposition, backgrounds, APIS data and critical loads (operation phase – AP1 revised scheme alone)

Receptor	Sensitive habitat	2018 NOx background concentration (µg/m³)	2038 NOx background concentration (µg/m³)	APIS data[29] of average total nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)
The Mere, Mere Transect 2	Poor fen	15.1	9.5	23.8	10

Table D15: Modelled ecological receptor acid deposition backgrounds, APIS data and critical loads (operational phase – AP1 revised scheme alone)

Receptor	Sensitive habitat	APIS data[29] of average total acid deposition (k eq/ha/yr)	Critical load (k eq/ha/yr) (min)	Critical load (k eq/ha/yr) (max)
The Mere, Mere Transect 2	Poor fen	1.8	0.2	0.6

7.3 Assessment results

Table D16 presents a summary of the modelled NOx concentrations for the ecological site, the change in concentration and a comparison against the air quality standard (30µg/m³).

Table D17 presents a summary of the modelled nitrogen deposition, change in deposition and percentage change in relation to the lower critical load.

Table D18 presents a summary of the modelled acid deposition, percentage change in deposition and percentage change in relation to the critical load.

Table D16: Predicted annual mean of NOx concentrations at ecological sites (operation phase – AP1 revised scheme alone)

Ecological site	Distance to road (m)	NOx concentrations (µg/m³)			Change in NOx concentrations (µg/m³)	Comparison against air quality standard (30µg/m³)	Percent change in relation to air quality standard
		2018 baseline	2038 without the AP1 revised scheme	2038 with the AP1 revised scheme			
The Mere, Mere Transect 2	9	24.77	11.27	11.56	0.29	Within standard	1.0%
	10	24.28	11.18	11.45	0.27	Within standard	0.9%
	20	21.88	10.74	10.93	0.19	Within standard	0.6%
	30	20.62	10.51	10.66	0.15	Within standard	0.5%
	40	19.82	10.36	10.49	0.13	Within standard	0.4%
	50	19.26	10.26	10.36	0.10	Within standard	0.3%
	75	18.37	10.09	10.17	0.08	Within standard	0.3%
	100	17.82	9.99	10.05	0.06	Within standard	0.2%
	150	17.20	9.88	9.92	0.04	Within standard	0.1%
	200	16.86	9.82	9.85	0.03	Within standard	0.1%

Table D17: Assessment of nitrogen deposition at ecological sites (operation phase – AP1 revised scheme alone)

Ecological site	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	Percent change in relation to lower critical load
		2018 baseline	2038 without the AP1 revised scheme	2038 with the AP1 revised scheme			
The Mere, Mere Transect 2	9	24.56	23.94	23.96	0.02	10	0.2%
	10	24.52	23.94	23.96	0.02	10	0.2%
	20	24.34	23.90	23.92	0.02	10	0.2%
	30	24.24	23.88	23.89	0.01	10	0.1%
	40	24.18	23.87	23.88	0.01	10	0.1%

Ecological site	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	Percent change in relation to lower critical load
		2018 baseline	2038 without the AP1 revised scheme	2038 with the AP1 revised scheme			
	50	24.13	23.86	23.87	<0.01	10	<0.1%
	75	24.06	23.85	23.86	<0.01	10	<0.1%
	100	24.02	23.84	23.85	<0.01	10	<0.1%
	150	23.97	23.83	23.84	<0.01	10	<0.1%
	200	23.94	23.83	23.83	<0.01	10	<0.1%

Table D18: Assessment of acid deposition at ecological sites (operational phase – AP1 revised scheme alone)

Ecological site	Distance to road	Acid deposition (k eq/ha/yr)			Change in acid deposition as percent of CLmax	Total with AP1 revised scheme acid deposition as percent of CLmax
		2018 baseline	2038 without the AP1 revised scheme	2038 with the AP1 revised scheme		
The Mere, Mere Transect 2	9	1.81	1.81	1.81	0.27%	314.5%
	10	1.81	1.81	1.81	0.25%	314.5%
	20	1.81	1.81	1.81	0.20%	314.4%
	30	1.81	1.81	1.81	0.14%	314.4%
	40	1.81	1.81	1.81	0.12%	314.4%
	50	1.81	1.81	1.81	0.11%	314.3%
	75	1.81	1.81	1.81	0.09%	314.3%
	100	1.81	1.81	1.81	0.05%	314.3%
	150	1.81	1.81	1.81	0.05%	314.3%
	200	1.81	1.81	1.81	0.04%	314.3%

7.4 Assessment of significance (operational phase, AP1 revised scheme alone)

NOx concentrations at the site are predicted to be within the air quality standard at all receptors. Changes in NOx concentrations due to the AP1 revised scheme are equal to or less than 1% of the air quality standard.

Nitrogen deposition rates are predicted to be above the lower critical load in all scenarios. Predicted nitrogen deposition rates in 2038, with the AP1 revised scheme are lower than the 2018 baseline rates at all modelled locations. The changes in nitrogen deposition between the 2038 do nothing scenario and with the AP1 revised scheme scenario are less than 1% of the lower critical load.

Acid deposition rates are predicted to be above the lower critical load at all modelled receptors in all scenarios. The changes in acid deposition between the 2038 do nothing scenario and with the AP1 revised scheme scenario are less than 1% of the maximum critical load.

No potentially significant effects are therefore predicted.

8 Assessment of operational traffic effects – AP1 revised scheme in-combination with other plans and projects

8.1 Screening of traffic data

The screening process identified one road in the area exceeding the screening thresholds:

- A50 Warrington Road, Mere

Therefore, in this scenario, only impacts in Transect 1 are considered.

Table D2 presents the traffic data used in the assessment.

Figure D1 presents a map of the site, assessed roads and modelled receptors.

Non-road plans and projects

No non-road plans or projects have been identified that require further consideration within the in-combination assessment.

Receptors assessed and background concentrations

Table D19 and Table D20 present the details of the receptor assessed, background concentrations, background deposition and relevant critical loads.

Table D19: Modelled ecological receptor NOx and nitrogen deposition backgrounds, APIS data and critical loads (operational phase – AP1 revised scheme in-combination)

Receptor	Sensitive habitat	2018 NOx background concentration (μg/m³)	2038 NOx background concentration (μg/m³)	APIS data[29] of average total nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)
The Mere, Mere Transect 1	Poor fen	14.8	9.4	23.8	10

Table D20: Modelled ecological receptor acid deposition backgrounds, APIS data and critical loads (operational phase – AP1 revised scheme in-combination)

Receptor	Sensitive habitat	APIS data[29] of average total acid deposition (k eq/ha/yr)	Critical load (k eq/ha/yr) (min)	Critical load (k eq/ha/yr) (max)
The Mere, Mere Transect 1	Poor fen	1.8	0.2	0.6

8.2 Assessment results

Table D21 presents a summary of the modelled NOx concentrations for the ecological site, the change in concentration and a comparison against the air quality standard (30μg/m^3).

Table D22 presents a summary of the modelled nitrogen deposition, change in deposition and percentage change in relation to the lower critical load.

Table D23 presents a summary of the modelled acid deposition, percentage change in deposition and percentage change in relation to the critical load.

Table D21: Predicted annual mean of NOx concentrations at ecological sites (operational phase – AP1 revised scheme in-combination)

Ecological site	Distance to road (m)	NOx concentrations (µg/m³)			Change in NOx concentrations (µg/m³)	Comparison against air quality standard (30µg/m³)	Percent change in relation to air quality standard
		Baseline 2018	2038 do nothing	2038 with the AP1 revised scheme			
The Mere, Mere Transect 1	193	17.31	9.89	9.95	0.06	Within standard	0.2%
	200	17.24	9.87	9.93	0.06	Within standard	0.2%

Table D22: Assessment of nitrogen deposition at ecological sites (operation phase – AP1 revised scheme in-combination)

Ecological site	Distance to road (m)	Dry deposition (kg N/ha/yr)			Change in nitrogen deposition (kg N/ha/yr)	Lower critical load (kg N/ha/yr)	% Change in relation to lower critical load
		Baseline 2018	2038 do nothing	2038 with the AP1 revised scheme			
The Mere, Mere Transect 1	193	24.00	23.84	23.84	<0.01	10	< 0.1%
	200	23.99	23.84	23.84	<0.01	10	< 0.1%

Table D23: Assessment of acid deposition at ecological sites (operation phase – AP1 revised scheme in-combination)

Ecological site	Distance to road	Acid position (k eq/ha/yr)			Change in acid deposition as percent of CLmax	Total with AP1 revised scheme acid deposition as percent of CLmax
		2018 baseline	2038 do nothing	2038 with the AP1 revised scheme In-combination		
The Mere, Mere Transect 1	193	1.81	1.81	1.81	0.05%	314.3%
	200	1.81	1.81	1.81	0.07%	314.3%

8.3 Assessment of significance (operational phase, AP1 revised scheme in-combination)

NOx concentrations at the site are predicted to be within the air quality standard at all receptors. Changes in NOx concentrations due to the AP1 revised scheme in-combination are less than 1% of the air quality standard.

Nitrogen deposition rates are predicted to be above the lower critical load in all scenarios. Predicted nitrogen deposition rates in 2038, with the AP1 revised scheme in-combination, are lower than the 2018 baseline rates at all modelled locations. However, the changes in nitrogen deposition as a result of the AP1 revised scheme in-combination are lower than 1% of the lower critical load at all modelled receptors.

Acid deposition rates are predicted to be above the lower critical load at all modelled receptors in all scenarios. The changes in acid deposition between the 2038 do nothing scenario and with the AP1 revised scheme in-combination scenario are less than 1% of the maximum critical load.

No potentially significant effects are therefore predicted.

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