



# High Speed Rail (West Midlands - Crewe)

## Environmental Statement

### Volume 5: Technical appendices

Ecology and biodiversity

Habitats Regulations Assessment screening report for Midland Meres  
and Mosses Phase 1 Ramsar site (EC-017-001)



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# Department for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

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## **HS2 Phase 2**

### **HRA Screening Report for Midland Meres and Mosses Phase 1 Ramsar Site**

**November 2012**

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## 1. Introduction

- 1.1.1. A number of proposed route options for the High Speed 2 rail link pass close to The Mere and Little Mere, which are collectively designated as The Mere, Mere SSSI. The SSSI is part of the Midland Meres and Mosses Phase 1 Ramsar site. Midland Meres and Mosses Phase 1 is listed under Ramsar Criteria 1 and 2 which identifies it as a wetland of international importance under the *Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971* (the Ramsar Convention).
- 1.1.2. The Ramsar Convention was ratified by the UK in 1976 and seeks to promote the conservation and wise use of wetlands, particularly those which support internationally significant numbers of water birds. In order to ensure compliance with the requirements of the Convention, it is government policy<sup>1</sup> that Ramsar sites are treated as 'European Sites' and afforded the same level of protection as Natura 2000 sites<sup>2</sup> are under the *Conservation of Habitats and Species Regulations 2010 (as amended)*. Consequently the 'competent authority' must assess the effects of development on Ramsar sites and determine if the development will result in a likely significant effect on the site, either alone or in combination with other projects and plans. Where a likely significant effect is concluded, the competent authority must then undertake an Appropriate Assessment (AA) to determine whether the effects will result in an adverse effect on the integrity of any Ramsar site. If the assessment concludes that adverse effects may occur, further factors may need to be considered before any approval of a development can be given. It is UK policy that the project must demonstrate that there are no other feasible alternatives, that there are Imperative Reasons of Overriding Public Interest (IROPI), and that appropriate compensation measures will be put in place to maintain the integrity of the site. It should be noted, however, that unlike SPAs and SACs this policy is not underpinned by EU Directives.
- 1.1.3. The assessment is termed a Habitats Regulations Assessment (HRA) and there is a well-established process for undertaking the assessment (see Chapter 2). Although it is the responsibility of the competent authority to undertake the HRA, it is expected that the proponent of any development will provide sufficient information to enable such an assessment to be undertaken. It is a very stringent process; often with demanding requirements (focusing on the conservation objectives for each European site) if it is to be demonstrated that a project can avoid adverse effects on the integrity of a European site.
- 1.1.4. HS2 Ltd in consultation with Natural England (NE) and the Environment Agency (EA) has recognised the need to consider the likely significant effects of the Birmingham to Manchester route options on the Midland Meres and Mosses Phase 1 Ramsar site at an early stage in the development of the scheme design.
- 1.1.5. This report summarises the findings of HRA screening. It has sought to identify issues relating to the route options close to The Mere, Mere SSSI which have been considered thus far, and the likely potential impacts to Midland Meres and Mosses Phase 1 Ramsar site from each. It identifies avoidance measures for generic impacts at each stage of a typical large scale infrastructure development. Where applicable, a typical worst case scenario approach for the consideration of impacts has been adopted as appropriate to allow for uncertainty over development impact parameters.

<sup>1</sup>Office of the Deputy Prime Minister (2005) *Planning Policy Statement 9: Biodiversity and Geological Conservation*. August 2005.

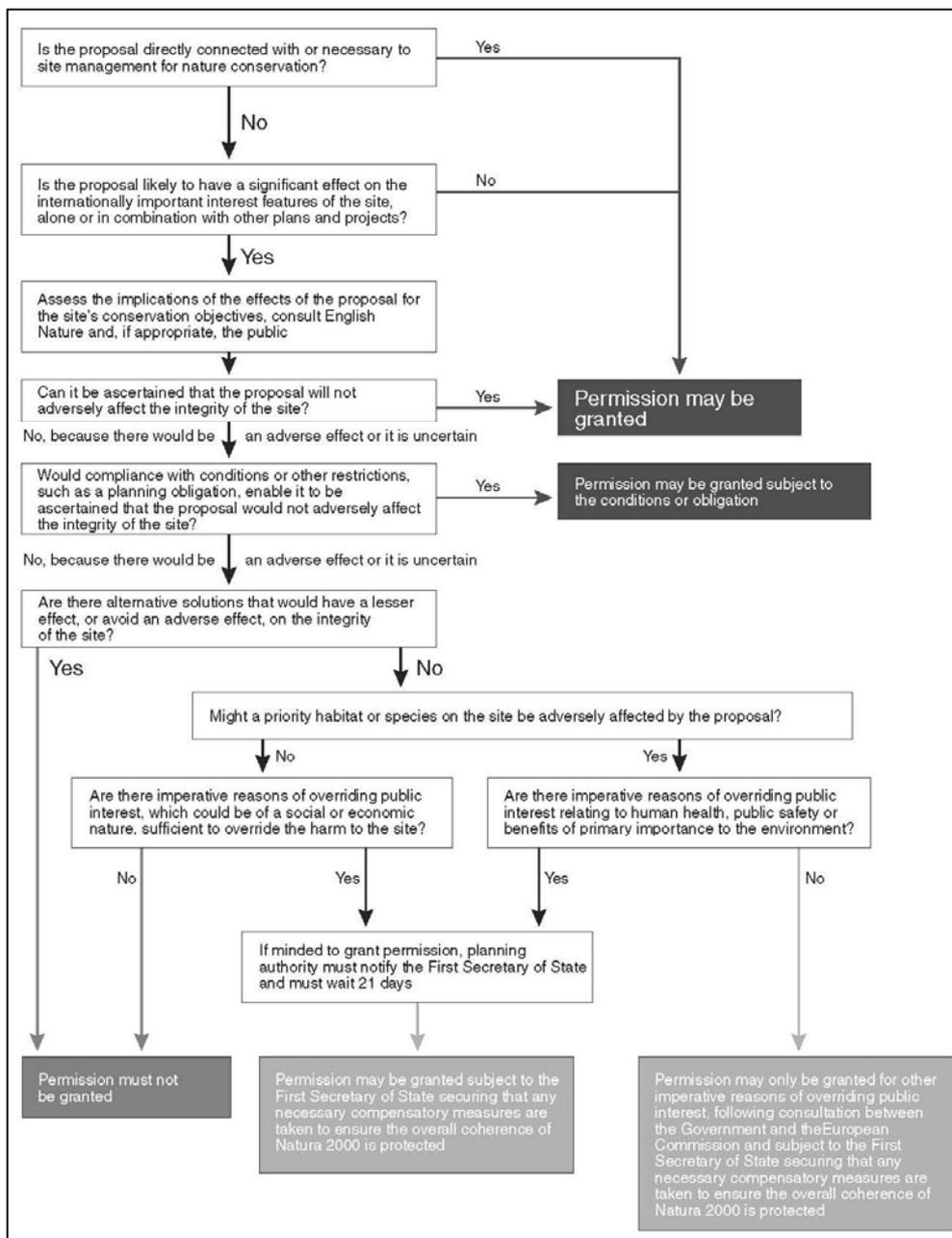
<sup>2</sup>Special Areas of Conservation (SACs) and Special Protection Areas (SPAs)

## 2. Appraisal method

### 2.1. Summary of HRA process

2.1.1. Although Ramsar sites are not legally protected in the same way that Natura 2000 sites are, it is Government policy to follow the same appraisal process for plans and projects that may affect them (i.e. the process set out in the Habitats Regulations). The HRA process comprises a number of stages as shown in Figure 2-1 which is taken from Circular 06/2005 produced by the Office of the Deputy Prime Minister (ODPM).

**Figure 2-1 – Consideration of development proposals affecting internationally designated nature conservation sites**



- 2.1.2. The HRA screening stage examines the likely effects of a project either alone, or in combination with other projects and plans on a protected site, and seeks to answer the question “can it be concluded that no likely significant effect will occur?” To determine if the proposals are likely to have any significant effects on the designated sites the following issues are considered:
- could the proposals affect the qualifying interest and are they sensitive / vulnerable to the effect;
  - the probability of the effect happening;
  - the likely consequences for the site’s Conservation Objectives if the effect occurred; and
  - the magnitude, duration and reversibility of the effect.
- 2.1.3. The screening stage has therefore sought to conclude one of the following three outcomes:
1. no likely significant effect;
  2. a likely significant effect; or
  3. it cannot be concluded that there will be no likely significant effect.
- 2.1.4. If the assessment concludes outcomes two or three, then the need for an Appropriate Assessment will be triggered.
- ‘Likely significant effect’ in this context is any effect that may reasonably be predicted as a consequence of the project that may significantly affect the conservation or management objectives of the features for which a site was designated<sup>1</sup>.*
- 2.1.5. A judgement as to the significance of an effect must take into account factors such as temporal considerations (e.g. length of time of effect) and physical considerations (e.g. extent of effect on the European site and the elements of the site including its conservation objectives). It is possible, therefore, for an effect to damage something on the European site, but because such damage is fleeting, limited in extent or damaging to something out with any conservation objectives the effect is insignificant on the European site. The judgement should also take into account the likely effects once avoidance measures have been applied.

## 2.2. Consultations

- 2.2.1. Consultations with NE, the government’s statutory advisors on nature conservation including HRA, are an important part of the process. HS2 Ltd has undertaken consultations with NE, as well as the EA, and continues to do so. Consultation has also been undertaken with the EA in relation to hydrological matters.

<sup>1</sup>Habitats Regulations Guidance Note 3. *The Determination of Likely Significant Effect under the Conservation (Natural Habitats &c) Regulations 1994*. English Nature. 1999.

### 3. Midland Meres and Mosses Phase 1 Ramsar Site

#### 3.1. Location and general description

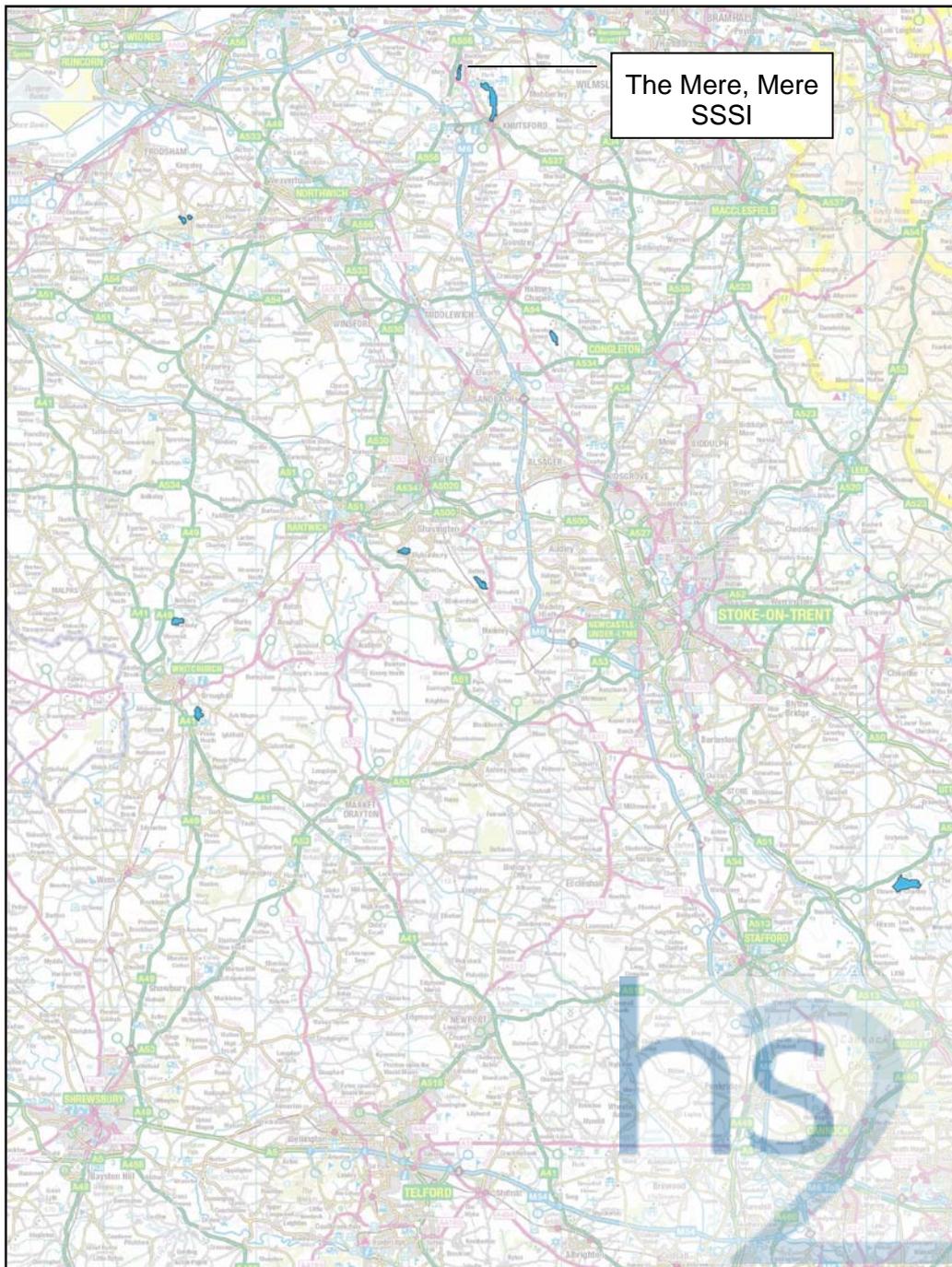
- 3.1.1. The Midland Meres and Mosses Phase 1 Ramsar site<sup>1</sup> (total area 510.88 ha) is composed of a series of 16 discrete lowland open water (mere) and peatland (mosses) sites across the north-west Midlands. These sites, which include meres and their associated fringing habitats (e.g. reed swamps, fen, carr and damp pasture) and a smaller number of nutrient poor peat bogs, are individually designated as Sites of Special Scientific Interest (SSSIs) for their flora and fauna. Together they form the overarching Ramsar designation (see Figure 3-1). The main interest of the Ramsar site is the wide range of lowland wetland types and successional stages present within a distinct biogeographical area.

#### 3.2. Qualifying interest features

- 3.2.1. The Midland Meres and Mosses Phase 1 site is listed as a Ramsar site because it fulfils two criteria that identify it as a wetland of international importance, namely:
- Ramsar Criterion 1 – the site comprises a diverse range of habitats from open water to raised bog; and
  - Ramsar Criterion 2 – the site supports a number of rare species of plants associated with wetlands (including five nationally rare species) and an assemblage of rare wetland invertebrates (three endangered insects and five other British Red Data Book species of invertebrates).
- 3.2.2. Nationally important plant species that occur on the site include *Elatine hexandra* (six-stamened waterwort), *Eleocharis acicularis* (needle spike-rush), *Cicuta virosa* (cowbane), *Thelypteris palustris* (marsh fen) and *Carex elongata* (elongated sedge).
- 3.2.3. Nationally important invertebrate species that occur on the site include *Hagenella clathrata* (window winged sedge – a type of caddis fly), *Limnophila fasciata* (a crane fly), *Cararita limnaea* (a spider), *Lathrobium rufipenne* (a rove beetle), *Donacia aquatica* (Zircon reed beetle), *Prionocera pubescens* (a crane fly), *Gonomyia abbreviata* (a crane fly) and *Sitticus floricola* (a spider).

<sup>1</sup>Site ref: UK11043

Figure 3-1 – Extent and location of Midland Meres and Mosses Phase 1 Ramsar Site



### 3.3. Conservation objectives

- 3.3.1. Conservation objectives define the desired ecological state of a site in term of the features (e.g. habitats and species) for which it has been designated. Where these objectives are met, the site is deemed to be in favourable condition. Ramsar sites themselves do not have conservation objectives set for them by NE. Conservation objectives for The Mere, Mere<sup>1</sup> SSSI, which are also applicable to the Ramsar criteria, are summarised in Table 3-1

<sup>1</sup>Lockton, A., Walsh, K. & Slater, K. (2008) Conservation Objectives and Definitions of Favourable Condition for Designated Features of Interest: The Mere, Mere SSSI. Draft March 2008. Natural England.

below. The conservation objectives are set by NE for each SSSI site, and can be used as a guide to maintain the favourable conservation status of the site, and to inform the appraisal process of determining whether the effects of a plan or project are likely to have a significant effect<sup>1</sup> on the qualifying interests of the site.

- 3.3.2. Midland Meres and Mosses Phase 1 Ramsar site is made up of 16 constituent SSSIs, each with its own specific Conservation Objectives. The nearest of these to the proposed route options are Betley Mere SSSI (0.4km) and The Mere, Mere SSSI (1.2km). All of the other SSSIs are over 2km from the nearest route option. Impacts to the Betley Mere SSSI were screened out at the end of the initial screening process in January 2012 as no hydrological impacts to the site were predicted (see Appendix 1).
- 3.3.3. The HRA Screening Sheet produced for Midland Meres and Mosses Phase 1 Ramsar site (provided in Appendix 1) established that only one of the component sites – The Mere, Mere SSSI (labelled in Figure 3-1) – required further investigation in terms of potential impacts arising from the scheme. The other 15 SSSIs were scoped out of the assessment as no potential impacts are predicted. Therefore this screening report focuses on The Mere, Mere SSSI only from this point onward.

**Table 3-1 – The Mere, Mere SSSI Conservation Objectives**

Qualifying Features(habitats and species)	Conservation Objectives
Fen, Marsh and Swamp Habitat: <ul style="list-style-type: none"> <li>• S4 <i>Phragmites australis</i> reed bed; and</li> <li>• S6 <i>Carex riparia</i> swamp.</li> </ul>	To maintain, in favourable condition <sup>2</sup> , the fen, marsh and swamp habitats listed (feature includes small stands of marginal sedge and reed swamp). Favourable condition requires the maintenance of the extent of the habitat. No reduction in the total combined extent of swamp in relation to the established baseline should occur. Site-specific standards defining favourable condition include maintaining: <ul style="list-style-type: none"> <li>• habitat composition and structure; and</li> <li>• vegetation composition.</li> </ul>
Standing Open Water Habitat: Standing water on sedimentary rock, eutrophic pH >7: A8 <i>Nuphar lutea</i> community	To maintain, in favourable condition <sup>1</sup> , the A8 <i>Nuphar lutea</i> community (feature includes shallow lake with fluctuating water levels). Favourable condition requires the maintenance of the extent of the habitat. While the lake needs to fluctuate on an annual basis in order to maintain the habitat and vegetation, there should be no reduction in the combined area of open water and drawdown zone habitat that is exposed to full sunlight. Site-specific standards defining favourable condition include maintaining: <ul style="list-style-type: none"> <li>• habitat extent;</li> <li>• vegetation composition;</li> <li>• water quality;</li> <li>• hydrological regime;</li> <li>• lake substrate; and</li> <li>• indicators of local distinctiveness (maintaining local populations of notable species).</li> </ul>

<sup>1</sup> Article 6.2 of the Habitats Directive

<sup>2</sup> or restore to favourable condition if features are judged to be unfavourable

### 3.4. Key site vulnerabilities and sensitivities

- 3.4.1. The key site vulnerabilities and sensitivities for each habitat type identified as a qualifying interest feature were established by reviewing information provided within the JNCC *Conservation Status Assessment Article 17 reports (2007)*<sup>1</sup> and the conservation objectives of the underlying The Mere, Mere SSSI site, and are detailed in Table 3-2.

**Table 3-2 – Midland Meres and Mosses Phase 1 Ramsar site vulnerabilities and sensitivities**

Interest Feature	Key Sensitivities and Vulnerabilities
Standing Open Water Habitat (which broadly corresponds with the Annex I Habitat: Natural eutrophic lakes with <i>Magnopotamion</i> or <i>Hydrocharition</i> -type vegetation)	<p><b>Pollution – Eutrophication:</b></p> <p>Eutrophication is a known issue at The Mere, Mere SSSI. Water pollution from direct discharges and diffuse sources (such as agricultural run-off in the wider catchment) has led to nutrient enrichment which has adversely affected the condition of the site. Eutrophication can lead to a loss of aquatic plants and reduce diversity in favour of algae and also impact on associated invertebrate species.</p>
Fen, Marsh and Swamp Habitat forms an edge feature of the above and therefore the same key sensitivities and vulnerabilities apply.	<p><b>Invasive and Non-native Species:</b></p> <p>Lakes are susceptible to the introduction of invasive species (such as non-native crayfish, <i>Crassula helmsii</i> (Australian swamp stonecrop) and <i>Fallopia japonica</i> (Japanese knotweed)), which can spread rapidly once established and adversely affect the ecology of small, standing water habitats. Woodland encroachment is a key issue at The Mere, Mere SSSI. Additionally, the presence of invasive freshwater species is listed as a reason for the current adverse condition of the site.</p> <p><b>Hydrological Pressures:</b></p> <p>Abstractions from ground and surface water or changes to drainage can lead to reduced flushing rates and changes in water level fluctuations. Changing water levels can also alter nutrient regimes and change the available area of some habitats. Water level fluctuations are a key feature of the Mere, Mere SSSI. Previously, these fluctuations led to a drawdown zone (a large expanse of bare mud exposed during later summer/early autumn in dry years) which was the most important feature of the site. Water level management (including the removal of a sluice) has reduced this feature so that drawdown does not occur much anymore. The remaining fluctuations in water level need to be maintained as much as possible.</p> <p><b>Recreation Pressures:</b></p> <p>Angling, and the associated stocking with benthic feeding fish (particularly carp, is the main recreational pressure that affects lakes in the UK. Recreational water sports or other activities can also conflict with conservation interests and cause damage or disturbance to the habitat.</p> <p><b>Sedimentation:</b></p> <p>Increases in the amount of sediment entering a lake may smother stony beds, reduce water depth in shallow lakes and increase the amount of nutrients present.</p>

<sup>1</sup>Joint Nature Conservation Committee. 2007. *Second Report by the UK under Article 17 on the implementation of the Habitats Directive from January 2001 to December 2006*. Peterborough: JNCC. Available from: [www.jncc.gov.uk/article17](http://www.jncc.gov.uk/article17)

Interest Feature	Key Sensitivities and Vulnerabilities
	<p><b>Inappropriate Management:</b> Inappropriate management such as the control or removal of the natural aquatic vegetation or lack of management of encroaching vegetation can lead to a decrease in aquatic plant diversity, scrub encroachment and the development of successional woodland. Fen habitats usually require some management, such as rotational cutting or grazing, to maintain species diversity and prevent the encroachment of scrub.</p> <p><b>Air Pollution:</b> Standing open water is potentially sensitive to air pollution, though acidification arising from atmospheric deposition is unlikely to be a major issue as there is generally good buffering capacity within catchment soils.</p>

(Lockton, A., Walsh, K. & Slater, K. (2008) Conservation Objectives and Definitions of Favourable Condition for Designated Features of Interest: The Mere, Mere SSSI. Draft March 2008. Natural England, and

Joint Nature Conservation Committee. 2007. *Second Report by the UK under Article 17 on the implementation of the Habitats Directive from January 2001 to December 2006*. Peterborough: JNCC. Available from: [www.jncc.gov.uk/article17](http://www.jncc.gov.uk/article17))

### 3.5. Current site condition

- 3.5.1. Information regarding the conservation status of the Ramsar site is informed by the condition monitoring of each SSSI underpinning the Ramsar designation. Site condition is monitored by NE through condition assessments that are undertaken regularly on each SSSI. To ensure appropriate management and monitoring of each SSSI, the sites are often divided into units and are assessed individually during the condition assessments so that appropriate management practices can be prescribed for the site. During condition assessments the site is assessed against the criteria set out in the Common Standards Monitoring Guidance<sup>1</sup>, which includes criteria such as the extent of each habitat present. The site only has to fail one of these criteria to be considered unfavourable.
- 3.5.2. The latest Condition Assessment for The Mere, Mere SSSI was carried out in February 2008. The whole site (consisting of two management units) was classed as being in 'Unfavourable No Change' condition (i.e. unfavourable and no change in the status of the mere is predicted at this time). Reasons for the adverse condition of the site included the presence of invasive freshwater species and water pollution from agricultural/run-off and discharges. As the SSSI underlies the Ramsar designation, the interest features of the Midland Meres and Mosses Phase 1 Ramsar site at this SSSI are therefore also classed as being in unfavourable condition.
- 3.5.3. The Ramsar interest features are vulnerable to a number of threats in relation to the site specific targets set for the favourable conservation status for each feature (as listed within the conservation objectives for the site). The targets along with the specific threats to the Favourable Conservation Status (FCS) of the SSSI are detailed in Table 3-3.

<sup>1</sup>JNCC (2004) Common Standards Monitoring Guidance for Lowland Wetland Habitats.



**Table 3-3 – Condition assessment attributes, site-specific targets and key threats or comments for the Mere, Mere SSSI**

Interest Features	Attribute	Site-specific target (for favorable condition status)	Key Threats / Comments
<p><b>Fen, marsh and swamp habitat:</b></p> <ul style="list-style-type: none"> <li>S4 <i>Phragmites australis</i> reedbed; and</li> <li>S6 <i>Carex riparia</i> swamp.</li> </ul>	<p><b>Habitat Composition</b></p>	<p>No reduction in the total combined extent of swamp in relation to the established baseline.</p> <p>The total extent of emergent swamp should not exceed 50% of the shoreline and should not be less than 10%.</p> <p>No loss of the following components of the wetlands/swamp: <i>Typha latifolia</i> swamp, <i>P. australis</i> swamp or <i>Carex riparia</i> swamp.</p> <p>Presence of some <i>Typha angustifolia</i> swamp desirable.</p>	<p>Changes to water levels that affect habitat extent.</p>
	<p><b>Habitat Structure</b></p>	<p>The Mere should significantly dry up at least one summer every decade and have less than 50% shading around the margin.</p>	<p>Changes to hydrological regime and water levels – a key feature of the Mere, Mere SSSI is a fluctuating water level and the resultant vegetation communities.</p>
	<p><b>Vegetation Composition:</b> Positive indicators</p>	<p>For the S4 <i>Phragmites australis</i> reedbed:</p> <ul style="list-style-type: none"> <li><i>P.australis</i> to form a closed or open stand of &gt;90% cover.</li> <li>Associated species <i>T.latifolia</i>, <i>T. angustifolia</i>, <i>Carex roparia</i>, <i>Cladium mariscus</i> and <i>Breula erecta</i> can be locally prominent, but should be about 5% cover overall.</li> </ul> <p>For the S6 <i>Carex riparia</i> swamp:</p> <ul style="list-style-type: none"> <li><i>C. riparia</i> cover &gt;70%.</li> <li>At least two of the following associated species to be present with a combined cover &lt;30% (<i>P. australis</i>, <i>Equisetum fluviatile</i>, <i>Equisetum palustre</i>, <i>Phalaris arundinacea</i>, <i>Epilobium hirsutum</i> and <i>Filipendula ulmaria</i>).</li> </ul>	
	<p><b>Vegetation Composition:</b> Indicators of negative change – undesirable non-woody species</p>	<p>Invasive non-native species should be absent, or no more than rare if present.</p> <p>High or increasing frequency/cover of other undesirable sp is unfavourable (eg <i>Urtica dioica</i>, <i>Galium aparine</i> or <i>Impatiens glandulifera</i>).</p> <p>Woody species (including <i>Betula</i>, <i>Salix</i>, <i>Rhododendron</i>, <i>Pinus</i> and other gymnosperms) should be no more than scattered, predominantly &lt;1.5m high. Cover should be &lt;10% on open fen. Saplings/seedlings should be no more than rare.</p> <p>Less than 50% of the swamp should be shaded.</p>	<p>Spread of invasive alien species or other negative indicator species eg as a result of dereliction, drainage, eutrophication or disturbance.</p> <p>Invasion by woody species which may indicate drying out, dereliction, disturbance and/or enrichment. The establishment of trees and shrubs may exacerbate drying out. Woodland encroachment is the main threat to this site.</p>



Interest Features	Attribute	Site-specific target (for favorable condition status)	Key Threats / Comments
<p><b>Standing open water habitat:</b> Standing water on sedimentary rock, eutrophic pH &gt;7: A8 <i>Nuphar lutea</i> community</p>	<p><b>Habitat Extent</b></p>	<p>No loss of extent of standing water.</p>	<p>Changes in water level should remain under review. Some loss of standing open water may be acceptable to allow for a small gain in emergent swamp vegetation.</p>
	<p><b>Vegetation Composition:</b> Macrophyte community composition</p>	<p>At least one characteristic species should be present (see Conservation Objectives for species list). 6 out of 10 sample spots (boat or wader survey) should include at least one characteristic species. There should be no loss of characteristic species recorded from the site.</p>	
	<p><b>Vegetation Composition:</b> Negative indicator species</p>	<p>Non-native species should be absent or present at low frequency. Cover of benthic and epiphytic filamentous algae should be less than 10%.</p>	<p>Introduction of non-native species. Nutrient enrichment – can lead to excessive growths of filamentous algae on lake substrate or macrophytes</p>
	<p><b>Vegetation Composition:</b> Macrophyte community structure</p>	<p>Characteristic zones of vegetation should be present. Maximum depth distribution should be maintained. At least the present structure should be maintained.</p>	<p>Changes to water clarity –the maximum depth at which submerged vegetation grows is a direct indicator of water clarity.</p>
	<p><b>Water Quality</b></p>	<p>Stable nutrient levels appropriate to lake type. Stable pH &gt;7 and &lt;9. Adequate dissolved oxygen levels for health of characteristic fauna. No excessive growth of cyanobacterial or green algae.</p>	<p>Eutrophication</p>
	<p><b>Hydrology</b></p>	<p>There should be a natural hydrological regime. No loss of marginal vegetation.</p>	<p>The natural flushing rate and seasonal water level fluctuations of the lake should not be affected by abstractions from inflow streams, groundwater or the lake, or by changes to outflows.</p>
	<p><b>Lake Substrate</b></p>	<p>Maintain natural shoreline. Maintain natural and characteristic substrate (no more than 5% of lakeshore should be heavily modified).</p>	<p>Increased sediment loads may result in smothering of coarse substrates with fine sediments. Fine sediments may be disturbed by movements in the overlying water column or passage of a plant sampling grapnel. Enriched sediments without an accompanying change in water chemistry may lead to a change in plant community.</p>



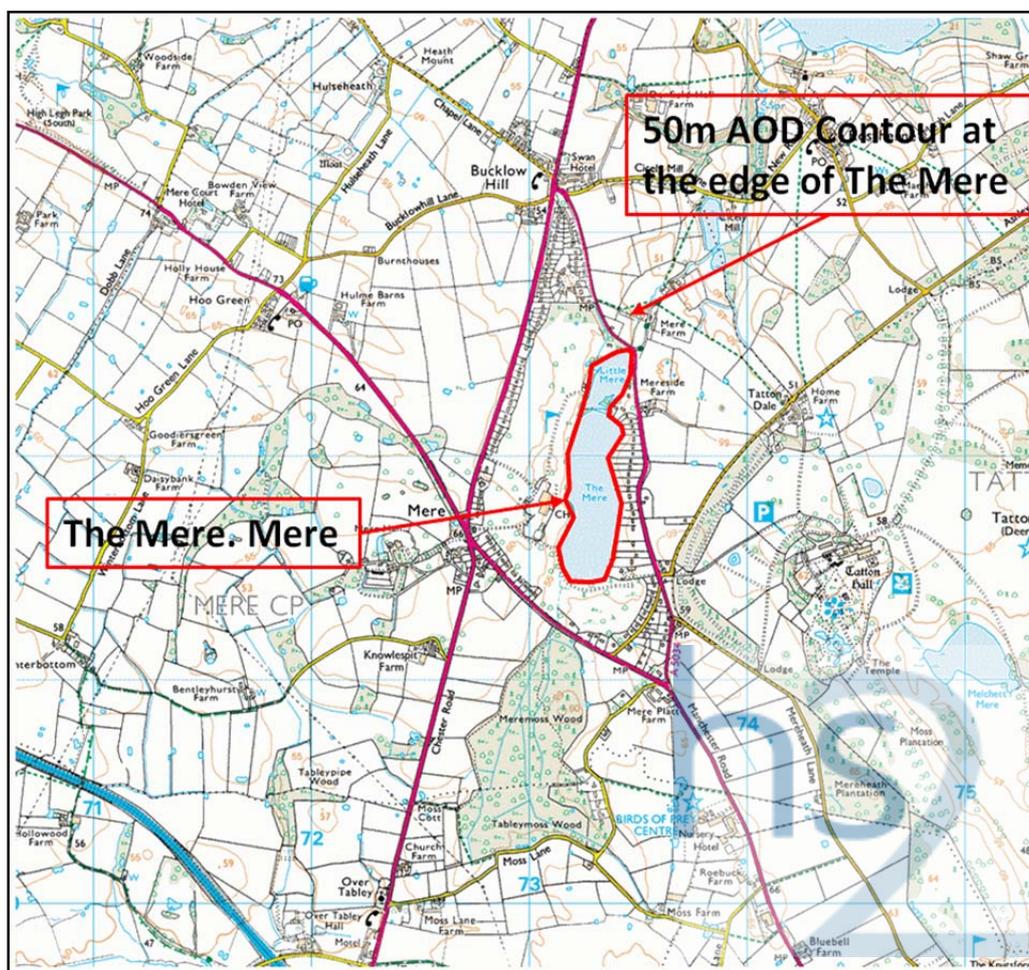
Interest Features	Attribute	Site-specific target (for favorable condition status)	Key Threats / Comments
	<b>Indicators of Local Distinctiveness</b>	<p>The presence of the following species would be desirable (these species have been recorded previously on this site): the nationally scarce <i>Elatine hexandra</i> and, scarce in Cheshire, <i>Callitriche hermaphroditica</i>, <i>Littorella uniflora</i> and <i>Eleocharis acicularis</i>.</p> <p>Red-eyed damselfly should be present.</p>	<p>The Mere and Little Mere (the two component waterbodies of the SSSI) were once essentially a single waterbody with a fluctuating water level that left large expanses of bare mud exposed during the later summer and early autumn, in dry years. This drawdown zone was the most important feature of the site, and was where the rare and interesting species occurred. However, due to water level management, there has not been much drawdown since the sluice was removed for repairs in ca. 1990.</p> <p>In the absence of drawdown, the main features of interest are beds of water lilies (<i>Nuphar lutea</i> and <i>Nymphaea alba</i>). No reduction in the extent of water lily beds should occur.</p>

(Source: NE, 2008. The Mere, Mere SSSI Condition Assessment, available at: [http://www.sssi.naturalengland.org.uk/special/sssi/sssi\\_details.cfm?sssi\\_id=1001818](http://www.sssi.naturalengland.org.uk/special/sssi/sssi_details.cfm?sssi_id=1001818))

### 3.6. Hydrological characteristics

- 3.6.1. Only one of the 16 SSSIs which make up the Midland Meres and Mosses Ramsar Site has the potential for its hydrological regime to be affected by the HS2 proposals, namely The Mere, Mere SSSI. It has two connected water bodies known as The Mere and Little Mere. None of the other sites are affected by HS2 proposals because all proposed route options are outside of their surface water and groundwater catchments. For this reason only the hydrological regime which supports The Mere, Mere SSSI will be discussed in the sections which follow.
- 3.6.2. The Mere and Little Mere are upstream of Rostherne Mere (see Figure 3-2). They have a normal water level of approximately 49.5m AOD<sup>1</sup> as inferred from Ordnance Survey mapping of the area shown in Figure 3-2. It was formed either as a result of surface subsidence following the dissolution of halite (rock salt) structures beneath, or by a process of gouging out soft glacial deposits as the ice retreated at the end of the last ice age.

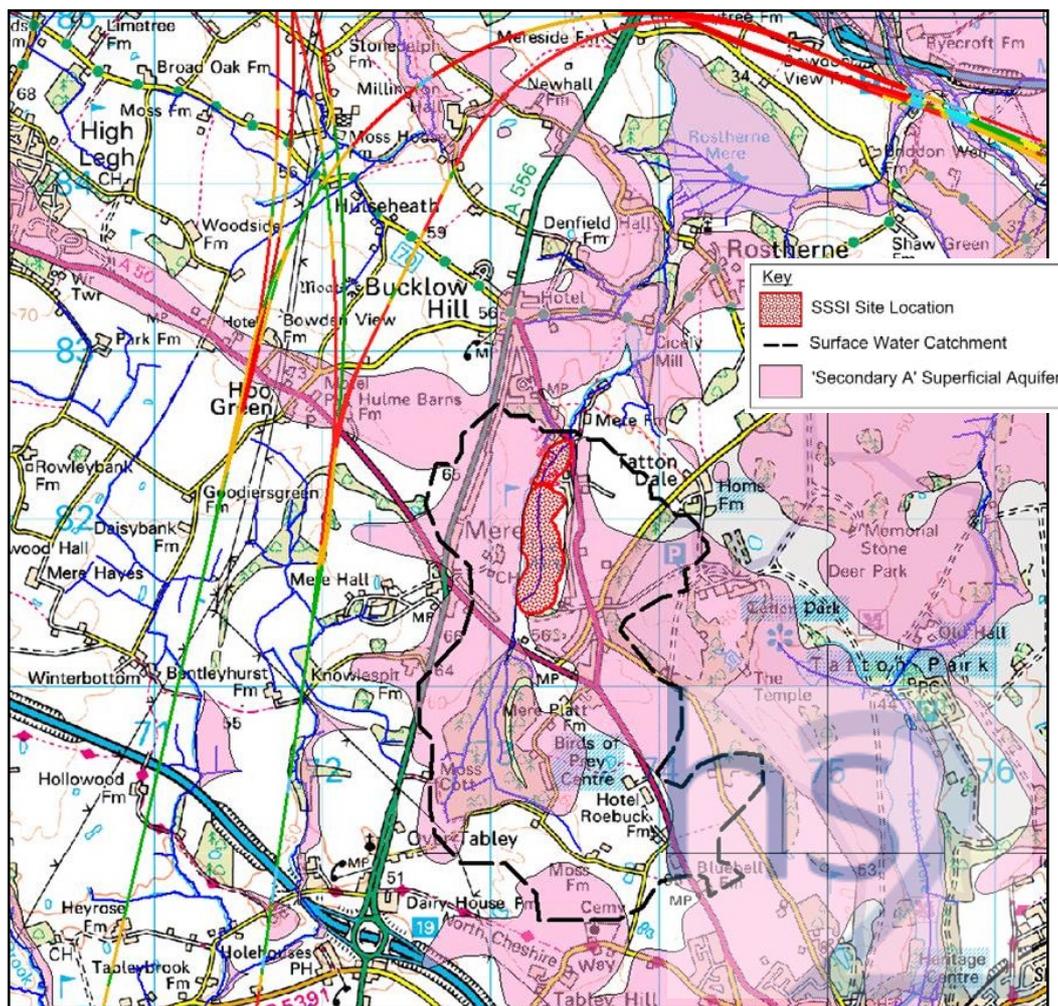
Figure 3-2 – Ordnance Survey mapping to illustrate the surrounding topography



<sup>1</sup>Water levels indicated by contours on the 1:25,000 OS map

- 3.6.3. Sources of water which feed The Mere, Mere SSSI include some flow from the stream through Mere Moss Wood from the south and some runoff flow from the adjacent hillsides, but most of the flow comes from groundwater in the underlying superficial and bedrock aquifers.
- 3.6.4. The extent of superficial aquifers and route options around the site are illustrated in Figure 3-3. Indicative route options are illustrated relative to the aquifer and surface water catchment. The thin red line shows the extent of The Mere, Mere SSSI and the shaded pink areas represent the extent of the superficial aquifer according to the British Geological Survey. The dotted black line represents the total surface water catchment of The Mere, Mere SSSI. Figure 4-1 in Section 4 sets out more clearly the section of route options at grade, in cutting, on embankment, in tunnel and on viaduct.

**Figure 3-3 – Superficial aquifer and surface water catchment of The Mere, Mere SSSI**



- 3.6.5. The British Geological Survey (BGS) map in Figure 3-4 shows that the geology to the south-west of the site is defined by outcrops of Glaciofluvial sand and gravel deposits and till over Boulder Clay; bedrock geology for the surrounding area is entirely Bollin Mudstone. Borehole logs for locations along the proposed routes, including two key locations illustrated on the map within the designated area of the BGS superficial aquifer, are included in Appendix 2. It is not surprising that the extent of the superficial aquifer



## 4. Route Options

- 4.1.1. At the end of February 2012, there remained five principal route options that are in the vicinity of The Mere, Mere SSSI. These are listed below in Table 4-1 (distances given are the shortest approximate distance between each route option and The Mere, Mere SSSI). These route options are illustrated fully in Figure 4-1.

**Table 4-1– Relevant route options**

Route Option	Closest distance to the Mere, Mere SSSI component of the Midland Meres and Mosses Ramsar Site
These routes all run approximately 1.2km at their nearest point to the west of the Ramsar site through a predominantly arable landscape.	1.2km
HSM12	1.2km
HSM13	1.2km
HSM16	1.2km
HSM28A	1.2km
HSM29	1.2km

- 4.1.2. The potential effects of the route options during construction and operation are discussed in more detail in the following sections in the context of each of the qualifying interest features of Midland Meres and Mosses Phase 1 Ramsar site.

Figure 4-1 – Overview of Sift 3 Route Options around The Mere, Mere SSSI



## 5. Potential impacts

### 5.1. Introduction

- 5.1.1. The impact identification process has considered the principal risks from the construction and operation of the various route options in relation to the key sensitivities and vulnerabilities of the Ramsar qualifying interest features.
- 5.1.2. The impacts described below follow on from the initial Midland Meres and Mosses Phase 1 HRA Screening Sheet (provided in Appendix 1) which provided an early overview of the potential impacts at an earlier stage in option development. These potential impacts have been described in more detail as further information has become available.

### 5.2. Temporary construction impacts

#### Direct habitat loss

- 5.2.1. There would be no direct loss of habitats or qualifying interest features from the Ramsar site, and construction works would be kept away from the site boundary.

#### Changes in groundwater quality

- 5.2.2. Pollution could include dust (cement powder) and hydrocarbons (fuels/oils) being released during movement across the construction site or from general construction activities such as any spillages, the release of metal fines and construction material pollutants (welding and wet concrete). Construction works that cut into the aquifer could pollute The Mere, Mere via the groundwater and affect the qualifying interest features of the site.

#### Changes in surface water quality

- 5.2.3. With reference to the surface water catchment of The Mere, Mere SSSI shown in Figure 3-4, none of the proposed routes extend into the surface water catchment of the two constituent water bodies. Consequently there is no risk of affecting the quality of the surface water entering The Mere, Mere SSSI.

#### Direct air pollution

- 5.2.4. At distances of approximately 1.2km between The Mere, Mere SSSI and nearest route option, impacts from dust generation due to construction activities are unlikely.

### 5.3. Permanent and operational impacts

#### Direct habitat loss

- 5.3.1. There would be no direct loss of habitats or qualifying interest features from The Mere, Mere SSSI (the nearest route option passes approximately 1.2km west of the site).

#### Changes in groundwater flow

- 5.3.2. As shown in Figure 3-3 there is a superficial aquifer<sup>1</sup> extending to the west of the SSSI through Hoo Green and High Legh (illustrated by shaded pink areas) which might

<sup>1</sup>An underground layer of water-bearing permeable unconsolidated (loose) deposits, such as sands and gravels, from which groundwater can be extracted.

contribute to flows into The Mere, Mere SSSI. As such, if any route were to cut through this aquifer there is potential to impede or alter groundwater flow towards the Mere, Mere SSSI. The contribution of flow into The Mere from this source is unlikely to be significant, but in the absence of detailed groundwater flow information, it cannot be discounted. Any change in the water levels of the mere could affect features that are identified in the qualifying criteria of the Ramsar site, namely the mere habitats and associated plant and invertebrate species.

#### **Changes in surface water flow**

- 5.3.3. The surface water catchment of The Mere, Mere SSSI and associated waterbodies extends southwards from the Mere itself (illustrated by the black dashed line in Figure 3-3). Route options as presented in Figure 3-3 and Figure 4-1 do not intersect the surface water catchment of The Mere, Mere SSSI and consequently the routes would have no impact on the contributing surface water flow.

#### **Changes in surface water and groundwater quality**

- 5.3.4. Since none of the routes intersect the surface water catchment of The Mere the surface water quality would not be affected by the proposed routes.
- 5.3.5. Where routes intersect the contributing groundwater catchment of the Ramsar site (at Hulme Barns Farm over 1km to the north-west), operation of the railway has the potential to pollute the groundwater. Pollution could arise from spills, leaks, sediments and discharges from the operational railway. However the likelihood of these impacts is predicted to be low as the passenger trains would be electrically powered and any discharges are likely to be limited to lubricants required by such trains. Diesel powered maintenance vehicle use would be very infrequent. Therefore the risk of hydrocarbon contamination would be mainly associated with mechanical failure, or an accident of the passenger trains.

## 6. Potential effect of route options on qualifying features

### 6.1. Standing open water habitat

- 6.1.1. There would be no direct impacts such as habitat loss from the route options which all lie approximately 1.2km or more to the west of The Mere, Mere SSSI.
- 6.1.2. With reference to the relevant plan and profile drawings in Appendix 3 for each of the proposed route sections, all route options to the west of The Mere, Mere would require cuts through the BGS-defined superficial aquifer beneath Hoo Green and High Legh, and these have the potential to interfere with any water from the superficial aquifer which might augment flows in the The Mere, Mere.
- 6.1.3. Drawing SKG05\_1 in Appendix 2 shows the vertical profile of HSM28A superimposed on the nearest available BGS borehole data logs along the route.
- 6.1.4. From examination of the borehole logs in this area, near-surface strata which might support the superficial aquifer comprise sand and fractured marl deposits which only exist to a depth of approximately 3.5m below the surface, resting on an impermeable clay base. Consequently even a shallow cut through this feature could isolate the strip of superficial aquifer which extends to the west through Hoo Green and High Legh (see Figure 3-3), and therefore reduce groundwater flow into The Mere, Mere.
- 6.1.5. None of the borehole logs examined (many of which extended for depths of up to 20m below the surface) within the delimited BGS aquifer have recorded groundwater levels. Considering the narrow shape of the BGS superficial aquifer, in combination with the BGS borehole records in the area, and the fact that the superficial aquifer extends through the top of Bucklow Hill which is the watershed between Rostherne Mere and the Agden Brook, it is unlikely that the superficial aquifer is a major source of water for The Mere, Mere, at least not in the upper few meters through which the proposed routes may cut.
- 6.1.6. Changes to the groundwater catchment as a result of the proposed works are therefore not predicted to be significant, with any potential impacts avoidable through measures outlined in Section 8.
- 6.1.7. Intersection of the groundwater catchment could also provide a route for pollution to enter the Ramsar site during construction and operation and could result in a negative impact on qualifying interest vegetation. Potential pollutants such as fuels, oils or other materials could feed into The Mere, Mere SSSI potentially causing pollution of the mere. However given the distance of the proposed route options from The Mere, Mere SSSI and the lack of evidence that groundwater flows from the superficial aquifer are a significant source of water to The Mere, Mere SSSI it is concluded that there would be no likely significant effect on natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation from pollution.
- 6.1.8. Indirect impacts from dust pollution during construction are not predicted due to the distance of the route options from The Mere, Mere SSSI.

### 6.2. Fen, marsh and swamp habitat (water-fringe vegetation of the above areas of standing water)

- 6.2.1. There would be no direct impacts such as habitat loss as a result of the western route options which lie approximately 1.2km from The Mere, Mere SSSI.
- 6.2.2. As stated above in Section 6.1, some of the routes cut through a superficial aquifer which might contribute to groundwater flows into The Mere. This is not expected to have a

significant impact on water levels in the mere as the superficial aquifer is not considered likely to be a significant source of water for The Mere (as detailed in Section 6.1). Changes to the groundwater catchment as a result of the proposed works are therefore not predicted to be significant with any potential impacts avoidable through measures outlined in Section 8.

- 6.2.3. Indirect impacts from dust pollution during construction are not predicted due to the distance of the route options from the Ramsar site.
- 6.2.4. Intersection of the groundwater catchment could also provide a route for pollution to enter the Ramsar site during construction and operation and could result in a negative impact on the reedbed habitat. Pollution could include fuels, oils or other materials and feed into The Mere and lead to an increase in dominance of undesirable non-woody species, through competition from more tolerant species. However given the distance of the proposed route options from the Mere and the lack of evidence that groundwater flows from the superficial aquifer are a significant source of water to the Mere, there is no likely pathway for pollution and therefore no impacts are likely.

### 6.3. Options summary

- 6.3.1. There would be no direct habitat loss at The Mere, Mere SSSI as a result of any of the route options due to their distances from the site. All of the route options (situated approximately 1.2km from the site) have a low potential of impacting the flow and quality of groundwater into The Mere, Mere SSSI and consequent indirect effects on the qualifying interest features.
- 6.3.2. The potential for hydrological impacts is low, but additional avoidance measures are required to ensure no likely significant effect. These measures are described in Section 8.

## 7. Potential in-combination effects

- 7.1.1. Other plans and projects within the local area may have a significant in-combination effect when considered together with the identified impacts of the HS2 route options. A summary of the main plans and projects which need to be considered as they have been identified within the Local Development Framework are set out in Table 7-1.
- 7.1.2. The Mere, Mere SSSI is located in a primarily rural area which is designated under local policy as an Area of Special County Value (ASCV), which protects the area from development which may have an adverse impact on its character and appearance. Current policy documents recognise the protected status of the Ramsar site and the rigorous assessment which will be required for any potential developments on or near the site. There are no significant proposed or permitted housing or employment allocations in within 1km of the site. The local planning officer for Cheshire East confirmed that the council is likely to focus on directing development to the larger towns and cities within its jurisdiction and that the local authority has no plans to direct any major development to the area around The Mere, Mere SSSI.

**Table 7-1 – Potential in-combination effects**

Plan/ Project	Proposal	Source of possible likely significant effect
Cheshire 2016 Structure Plan Alteration (Saved Policies)	There are no significant proposed or permitted housing or employment allocations in close vicinity of The Mere, Mere SSSI. Policy R2 designates the site and area around it to be an Area of Special County Value (ASCV) because of its landscape, archaeological, historic and nature conservation importance. Development will only be permitted if it does not have an adverse effect on the characters and features for which the ASCV has been designated.	No Presumption against development in the ASCV area and the need for appropriate mitigation to protect sites of nature conservation importance.
Macclesfield Borough Plan Saved Policies 2004	There are no significant proposed or permitted housing or employment allocations in close vicinity of The Mere, Mere SSSI. Nature conservation interests will be conserved and enhanced. The site is located within an ASCV and green belt, both of which discourage development. Development will only be permitted where it can be demonstrated that there will be no likely adverse effects.	No Presumption against development and the need for appropriate mitigation to avoid adverse effects if development does go ahead.
Cheshire East Local Development Framework Core Strategy, Issues and Options Paper, Nov 2010	The Core Strategy strives to conserve, enhance and manage natural resources. The site lies within a Green Belt which is intended to protect the countryside and avoid urban sprawl.	No Presumption against development without sufficient mitigation.
Cheshire Replacement Waste Local Plan 2007	The Waste Local Plan allocates an industrial area – Parkgate Industrial Estate, Knutsford for a Materials Recycling/Bulking Facility. This lies approx. 2.5-3km from The Mere, Mere SSSI and no more local developments	No No Sufficiently distant

Plan/ Project	Proposal	Source of possible likely significant effect
	are proposed.	from site.
Macclesfield Borough Council Nature Conservation Strategy. October 2006. Supplementary Planning Guidance Document (SPG)	Recognises that The Mere, Mere SSSI is a designated Ramsar and SSSI. Seeks to protect and conserve the quality of such areas and restrict adverse effects from development. Policy NE12 states that development which adversely affects any sites of nature conservation importance would not be permitted and neither would be unsympathetic development on adjacent sites.	No Presumption against development and the need for appropriate mitigation to avoid adverse effects if development does go ahead.
Highways Agency 2012. Public Consultation on improvements to the A556	Proposed upgrade to the A556 between Junction 19 of the M6 and Junction 7 of the M56. Proposed route passes The Mere, Mere SSSI at a distance of approximately 800m to the west.	Cannot be assessed as this stage because insufficient information is available.  However any such development will require IPC approval and associated mitigation to minimise any impacts on protected sites.

- 7.1.3. The Highways Agency is planning improvements to the A556 between Junction 19 of the M6 and Junction 7 of the M56. Part of these proposed improvement works include a new section of the A556 being built to the west of the existing carriageway. The plans are still being consulted upon and an application will be made for authorisation of the scheme. Works are scheduled to commence in 2015 and take two years to complete.
- 7.1.4. Little information on the details of the scheme is available at present. However, if undertaken the project would be subject to consideration against the requirements of the Habitats Regulations, and any likely significant effects would need to be avoided in consultation with NE and the EA.
- 7.1.5. A preliminary environmental information report for the scheme<sup>1</sup> includes a separate screening assessment to determine whether the scheme would have significant effects on The Mere, Mere SSSI and hence the Midland Meres and Mosses Ramsar Site. The provisional conclusion is that there would be no significant adverse effects; furthermore:
- “Neither the internationally-important Ramsar sites nor the nationally-important SSSI and NNR sites at... The Mere/Little Mere would be subject to significant negative impacts as a result of the scheme. There would be no direct impacts such as habitat loss from these sites. A separate draft report presents the assessment of whether significant effects on the integrity or favourable status of*

<sup>1</sup>Preliminary Environmental Information: A556 Knutsford to Bowdon Environmental Improvement. (2012). Highways Agency, Department for Transport.

*the European designated sites are likely to occur, and the conclusions of this report are to be confirmed through consultation with Natural England.” (DfT, 2012)*

- 7.1.6. From the information that currently exists, the closest component of the new scheme to The Mere, Mere SSSI would run to the west of the A556, approximately 830 m to the west of The Mere, Mere SSSI, outside of the surface water catchment of The Mere, Mere SSSI.
- 7.1.7. The vertical alignment of the road is not known, specifically whether there is cut through the superficial aquifer, however the road rises steeply from the M56 up Bucklow Hill and as a wide and impermeable carriageway it would have the potential to form a barrier to surface and groundwater flows. Since it would be located between the proposed HS2 routes and The Mere, Mere SSSI unless specifically designed to avoid these effects, it may form an effective barrier between HS2 and The Mere, Mere SSSI, thereby nullifying any impacts of HS2. Alternatively, if the road has been designed to allow the natural surface and groundwater flows to continue unimpeded, then the proposed track can be designed to work with any impact avoidance measures within the design of the road so that there are no net in-combination effects.

## 8. Impact Avoidance Measures

### 8.1. Introduction

- 8.1.1. The early incorporation of control and avoidance measures (through an iterative design process) has been a priority for those parts of the route options potentially affecting Natura 2000 and Ramsar sites. Effectively at this early stage of assessment and route refinement, this has included changes to the vertical and horizontal alignment, and the incorporation of specific control and design measures, as outlined in Sections 8.2 and 8.3 below. The following sections summarise the potential impact avoidance measures which could be implemented by HS2 Ltd.
- 8.1.2. HS2 Ltd will dictate strict environmental performance standards and specific control measures that contractors will be required to adhere to as a condition of appointment. The use of a *Code of Construction Practice* or similar will be the principal tool through which standards are defined and implemented and this will be developed in close consultation with relevant agencies, including the EA and NE. The preliminary construction control measures to be implemented are set out below.

### 8.2. Avoidance of temporary construction impacts

- 8.2.1. Impacts arising from the construction stage would be most likely to occur due to changes to pollution. Potential impacts include dust pollution and other sources of pollution such as spillages during construction.
- 8.2.2. To avoid the risk of pollution (eg spills, leakages etc) entering the water catchment of The Mere, Mere SSSI, the following industry best practice guidelines would be followed (where applicable) by incorporation within a *Code of Construction Practice* or similar:
- PPG1 – General Guide to Prevention of Pollution;
  - PPG3 – Use and Design of Oil Separators in Surface Water Drainage Systems;
  - PPG5 – Works In, Near or Liable to Affect Watercourses;
  - PPG6 – Working at Construction and Demolition Sites; and
  - CIRIA C648 – Control of Water Pollution from Linear Construction Projects.

### 8.3. Avoidance of permanent impacts

- 8.3.1. The potential permanent impacts associated with the HS2 routes are centred on hydrological impacts on The Mere, Mere SSSI. Risks of pollution would be very low.
- 8.3.2. The proposed routes would intrude on the potential groundwater catchment that supports the Mere, Mere SSSI although it is not expected that the area of the catchment affected would have a significant contribution to the water levels in The Mere, Mere SSSI.
- 8.3.3. In order to avoid any potential affect, groundwater underpass structures will be incorporated into the cutting. This can be achieved by design as illustrated in Mott Macdonald Scott Wilson Grimshaw (MSG) schematic sketch in Appendix 3, which depicts the cross-section of a groundwater underpass.
- 8.3.4. The sketch shows the proposed HS2 cutting in an impermeable box structure, in order to prevent the natural groundwater flow from the Mere towards the railway alignment draining into the HS2 cutting, while allowing the groundwater to flow beneath the cutting via a granular surround.

- 8.3.5. Typically these groundwater underpass structures would be in the order of 20m wide and several of these would be installed along the length of the cutting through the superficial aquifer. The width of the structures would be narrow enough to avoid any significant longitudinal flow along the length of the track and wide enough for practical construction. The spacing between these groundwater underpass structures and their exact geometry will be designed in order to match the existing flow when detailed site investigation is available. The schematic serves to illustrate a practical means by which it is possible to maintain groundwater flow beneath the proposed track, and thereby maintain existing groundwater levels either side of the proposed track, in order to avoid any impact which could manifest as a change in the water level in The Mere, Mere.
- 8.3.6. By virtue of the fact that these structures will convey only groundwater within the existing sand and gravel aquifer, they are unlikely to require significant maintenance over the lifetime of the proposed route. Groundwater flows are not expected to carry large amounts of silt. Nevertheless, inspection chambers outside of the box on both sides of the track, extending into the selected permeable granular fill, could be used to monitor the performance of the groundwater underpass. Any difference in water levels recorded simultaneously on either side of the sealed cutting would indicate an increase in impedance and therefore a failure in the groundwater underpass and a requirement for repair.
- 8.3.7. Surface water drainage from the sealed cut will be collected within a separate track drainage and attenuated to equivalent Greenfield runoff rates before being discharged into the Rostherne Brook.
- 8.3.8. It is therefore concluded that, with this avoidance measure in place, there would be no likely significant effect to the Ramsar Site.

## 9. Conclusions and recommendations

### 9.1. Conclusions

- 9.1.1. The findings of the assessment show that some of the proposed routes might intrude on the groundwater catchment that support the mere, although it is not expected that this would have a significant contribution to the water levels in The Mere, Mere SSSI.
- 9.1.2. However, based on the available information, and incorporating avoidance measures such as a groundwater underpass as shown in Appendix 3, it has been demonstrated that any impacts on the groundwater regime would be avoided. After these avoidance measures have been implemented by design, it is considered that the impacts on the groundwater regime (and therefore the water levels and water quality in The Mere, Mere SSSI) would be insignificant and that there would be no likely significant effect to the Midland Meres and Mosses Ramsar site.
- 9.1.3. Standard good practice would ensure that risks from pollution are minimised. This is principally a construction issue, as the operational railway would have very little requirement for use of potentially polluting materials. As a result there are not expected to be any likely significant effects on the Ramsar site.
- 9.1.4. The only development which was identified that could result in any in-combination impacts on The Mere is the construction of the A556. Design details of the A556 are not known. However, assuming that it has been designed to convey ground and surface water flows beneath the road in much the same way as discussed in the preceding chapters, these measures could be adopted to convey the same flows beneath any HS2 proposals.
- 9.1.5. The overall conclusion of this screening report is that with the appropriate avoidance measures in place and agreed with NE and the EA, there would be no likely significant effect to the Ramsar site and Appropriate Assessment is not required.

### 9.2. Ongoing appraisal and consultations

- 9.2.1. HS2 Ltd will continue to consult NE and the EA in relation to the Midland Meres and Mosses Phase 1 Ramsar site and the scheme options that could potentially affect it.

# **APPENDIX 1**

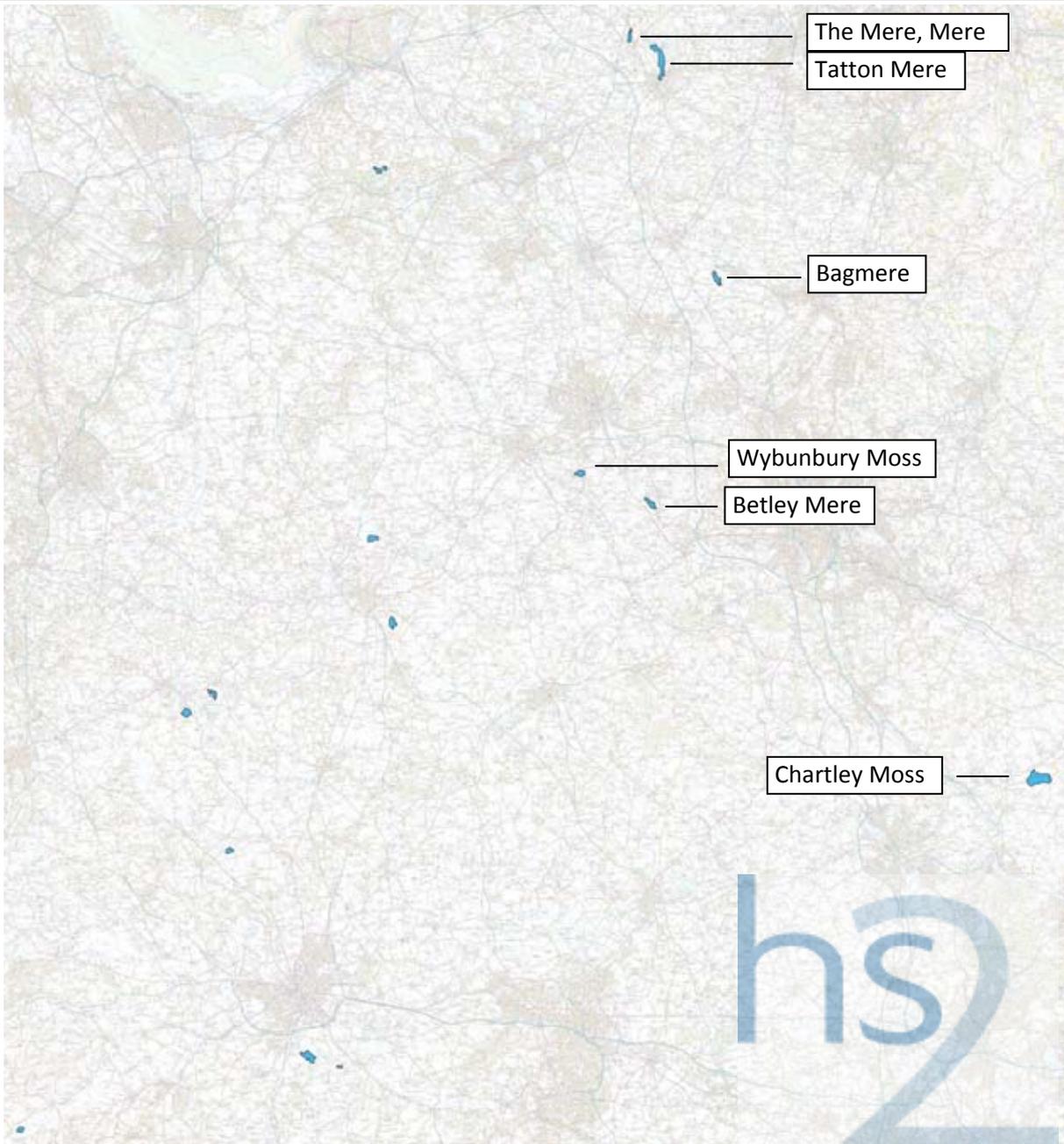
## **Midland Meres and Mosses Phase 1 Ramsar HRA Screening Sheet**

**Site name:** MIDLAND MERES AND MOSSSES - PHASE 1

SAC

SPA

Ramsar ✓



**Location and general description**

The Midland Meres & Mosses – Phase 1 Ramsar site (510.88 ha) is a series of 16 discrete lowland open water (mere) and peatland sites across the north-west Midlands.

**Qualifying Interest**

The Midland Meres & Mosses – Phase 1 site is designated as a Ramsar site because it fulfils a number of criteria that identify it as a wetland of international importance under the *Convention on Wetlands of International Importance* (Ramsar, 1971). These include:

- **Ramsar Criterion 1** – the site comprises a diverse range of habitats from open water to raised bog.
- **Ramsar Criterion 2** – the site supports a number of rare species of plants associated with wetlands including five nationally rare species together with an assemblage of rare wetland invertebrates (three endangered insects and five other British Red Data Book species of invertebrates).

Nationally important plant species that occur on the site include *Elatine hexandra* (six-stamened waterwort), *Eleocharis acicularis* (needle spike-rush), *Cicuta virosa* (cowbane), *Thelypteris palustris* (marsh fen) and *Carex elongata* (elongated sedge).

Nationally important invertebrate species that occur on the site include *Hagenella clathrata* (caddis fly), *Limnophila fasciata* (a crane fly), *Cararita limnaea* (a spider), *Lathrobium rufipenne* (rove beetle), *Donacia aquatica* (reed beetle), *Prionocera pubescens* (a crane fly), *Gonomyia abbreviata* (a crane fly) and *Sitticus floricola* (a spider).

#### **Other noteworthy flora and fauna :**

##### **Higher Plants:**

*Elatine hexandra*, *Eleocharis acicularis*, *Cicuta virosa*, *Thelypteris palustris* and *Carex elongata*.

#### **Conservation objectives**

Conservation Objectives are written at the underlying Site of Special Scientific Interest (SSSI) level. The Midland Meres & Mosses – Phase 1 Ramsar site is made up of 16 constituent SSSIs. The nearest of these to the proposed route options are Betley Mere SSSI (0.4 km) and The Mere, Mere SSSI (1.2 km).

The Conservation Objectives for Betley Mere SSSI are, subject to natural change, to maintain the following habitats in favourable condition (or restore to favourable if features are assessed as unfavourable):

- broadleaved, mixed & yew woodland;
- fen, marsh & swamp; and
- standing open water.

Habitat extent objectives aim to maintain the extent of the above habitats.

Site-specific standards defining favourable condition in the **broadleaved, mixed & yew woodland** habitat include maintaining:

- woodland structure and composition;
- indicators of local distinctiveness (to maintain locally important habitat types); and
- the regeneration potential of the trees.

Site-specific standards defining favourable condition in the **fen, marsh & swamp** habitat include maintaining:

- habitat structure (% cover litter and exposed substrates);
- habitat composition;
- vegetation composition (positive and negative indicator species); and
- indicators of local distinctiveness (maintaining local populations of rare/scarce plant species).

Site-specific standards defining favourable condition in the **standing open water** habitat include maintaining:

- vegetation composition (macrophyte community composition & structure, low numbers of non-native species);
- water quality;
- hydrology;
- lake substrate; and
- indicators of local distinctiveness (maintaining local populations of rare/scarce plant species).

The Conservation Objectives for the Mere, Mere SSSI are, subject to natural change, to maintain the following habitats in favourable condition (or restore to favourable if features are assessed as unfavourable):

- fen, marsh & swamp; and
- standing open water.

Site-specific standards defining favourable condition for these features are the same as those listed for Betley Mere SSSI.

#### **Current site condition and site vulnerabilities and sensitivities**

The condition status of the Ramsar site is determined through monitoring of the SSSIs by Natural England. The condition assessments <sup>(1)</sup> for the various SSSIs that underlie the Midland Meres & Mosses – Phase 1 Ramsar site vary by site, but in general the majority of the site is assessed as being in an unfavourable condition but is predicted to recover to a favourable condition over time.

#### **Vulnerabilities and sensitivities**

Adverse factors that may have a major impact on this Ramsar site (as detailed on the Ramsar Site Information Sheet) include:

- **Eutrophication** (an on and off-site problem which is thought to have a major impact on the site).
- **Introduction / invasion** of non-native plant species (a problem on site which is thought to have a major impact).

Reasons for the unfavourable condition of the SSSIs vary by site, but main issues include:

- **Inappropriate scrub control.**
- **Over/under grazing.**
- **Water pollution through agricultural run off.**

(1) Accessed from the SSSI section of the Natural England website on 25.05.11 - <http://www.sssi.naturalengland.org.uk/Special/sssi/search.cfm>

<b>GENERIC POTENTIAL IMPACTS</b>		
<b>Potential impact</b>	<b>Source of impact</b>	<b>Potential extent</b>
1. Direct habitat loss	<ul style="list-style-type: none"> <li>• New railway corridor.</li> <li>• Associated infrastructure including new bridges, depots, culverts, and access.</li> <li>• Temporary construction areas and haul roads.</li> </ul>	Localised within site boundary
2. Direct/indirect impact on species	<ul style="list-style-type: none"> <li>• Loss of habitat for species.</li> <li>• Risk of killing and injury (e.g. from movement of vehicles during construction and operation, construction).</li> </ul>	Localised within site boundary
3. Fragmentation or severance of habitat and/or animal species	<ul style="list-style-type: none"> <li>• New rail corridor and associated access routes.</li> <li>• Temporary construction work areas preventing movement of species.</li> </ul>	Extent depends on habitat type and typical ranges of fauna species affected.
4. Permanent or temporary effects on habitats and species through:		
<ul style="list-style-type: none"> <li>• 4a: changes in surface water</li> </ul>	<ul style="list-style-type: none"> <li>• Surface run-off during construction and operation.</li> <li>• Pollution during construction and operation (e.g. from spills / leaks, sediments).</li> <li>• Discharges from excavated voids.</li> </ul>	Localised effects likely but could extend large distances downstream if pollution / inappropriate discharge is released into a watercourse.
<ul style="list-style-type: none"> <li>• 4b: changes in ground water</li> </ul>	<ul style="list-style-type: none"> <li>• Changes due to flows and profiles from excavations including tunnelling.</li> <li>• Pollution during construction and operation (e.g. from spills / leaks).</li> </ul>	Localised effects likely but could affect a much wider area if pollution connects with groundwater.
<ul style="list-style-type: none"> <li>• 4c: air pollution</li> </ul>	<ul style="list-style-type: none"> <li>• Dust from construction activities especially in dry weather and involving soil stripping, excavations, blasting or piling.</li> </ul>	Localised effects (often ≤ 200 m subject to controls). Concerns more likely if sensitive habitats in surrounds.
<ul style="list-style-type: none"> <li>• 4d: shading</li> </ul>	<ul style="list-style-type: none"> <li>• Bridges, culverts, embankments, buildings.</li> </ul>	Localised on site and immediate surrounds. Extent will depend on size and location of structures.
5. Disturbance to fauna	<ul style="list-style-type: none"> <li>• Construction activities generating noise, human presence and lighting especially at night, or where blasting or piling.</li> <li>• Operating trains and depots.</li> <li>• Maintenance activities.</li> </ul>	Largely localised to in and around site with effects possible up to 100m if blasting / piling. Wider effects possible if certain bird species present.

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	Betley Mere SSSI	The Mere, Mere SSSI							
Potential impact	MR28D02A 1	MA90D02A 2	MR94D03 A 1	MR94D04 A 1	MR94D06 1	MR94D07 A 1	MA90D02 A 1	MR94D08 A 1	(Closest route options)
Approximate distance to Ramsar (at nearest point)	0.4 km	1.2 km	1.2 km	1.2 km	1.2 km	1.2 km	1.2 km	1.2 km	
Direct habitat loss									
Direct/indirect effects on species*		✓	✓	✓	✓	✓	✓	✓	
Fragmentation or severance of habitat and/or animal species									
Changes in surface water		✓	✓	✓	✓	✓	✓	✓	
Changes in ground water		✓	✓	✓	✓	✓	✓	✓	
Air pollution									
Shading									
Disturbance to fauna									

\*No direct effects predicted but indirect effects on the wetland species and associated habitats are possible if changes in surface or ground water impact on the qualifying interests of the site.

✓✓ denotes a likely significant effect

✓ denotes that it cannot be concluded that there will be no likely significant effect

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Note 1

Out of the 16 component SSSIs, only The Mere, Mere cannot be ruled out in terms of potential hydrological impacts to the Ramsar site (see Conclusions section).

The reasoning for scoping out all of the other SSSIs in proximity to the scheme is outlined below.

With the exceptions of Bagmere, Betley Mere, Chartley Moss, Tatton Meres, The Mere and Wybunbury Moss, the proposed routes do not intersect the contributing surface-water catchments of the remaining component sites and there are no sections of route in cut through any aquifer which could affect flows into them. There will be no impact on the hydrology of these sites. The remaining sites are discussed below.

Figure 1 – Hydrological Assessment for Bagmere SSSI

Contributing surface-water catchment is to the east of the site while routes are to the west, so there is no interference with the surface-water contributions. The site is not within a superficial aquifer, although it is surrounded by superficial aquifer; however there are no sections of route in cut through any aquifer which could affect flows into Bagmere. There will be no impact on the hydrology of this site.



Key: Red line = Site Boundary, Black dotted line = FEH Surface Water Catchment, Pink shading = BGS Superficial Aquifer

Figure 2 – Hydrological Assessment for Betley Mere SSSI

The nearest route passes in cut through the aquifer immediately to the west of the mere and appears to isolate surface-water flows from the western 10% of the contributing surface-water catchment. However on closer inspection, the contributing catchment to the west of the existing railway line is collected within a reservoir which discharges beneath the existing railway line and then flows into Betley Mere. Since the proposed route is at a similar level to the existing line and assuming best-practice construction techniques are employed to ensure that there is no risk of pollution to the aquifer or the watercourse, there should be no impact on the hydrology of Betley Mere.

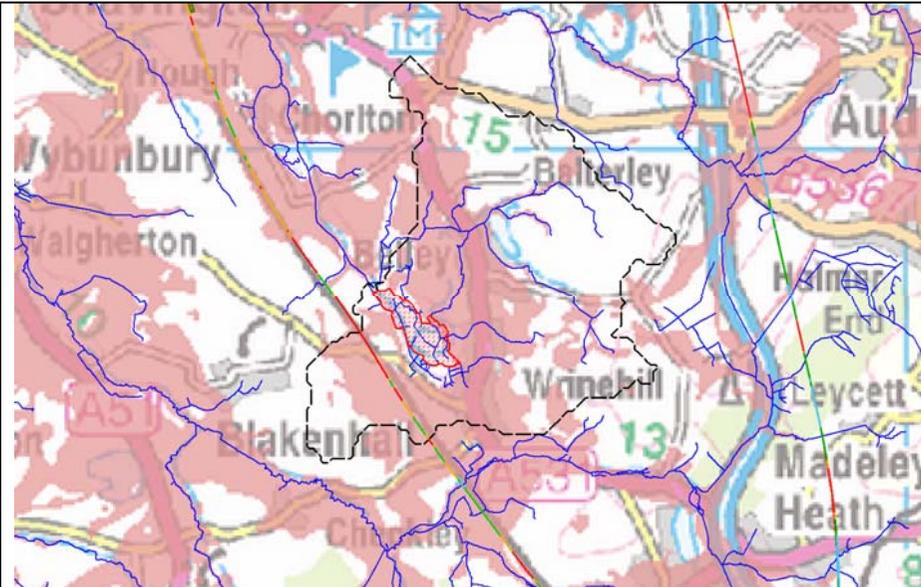
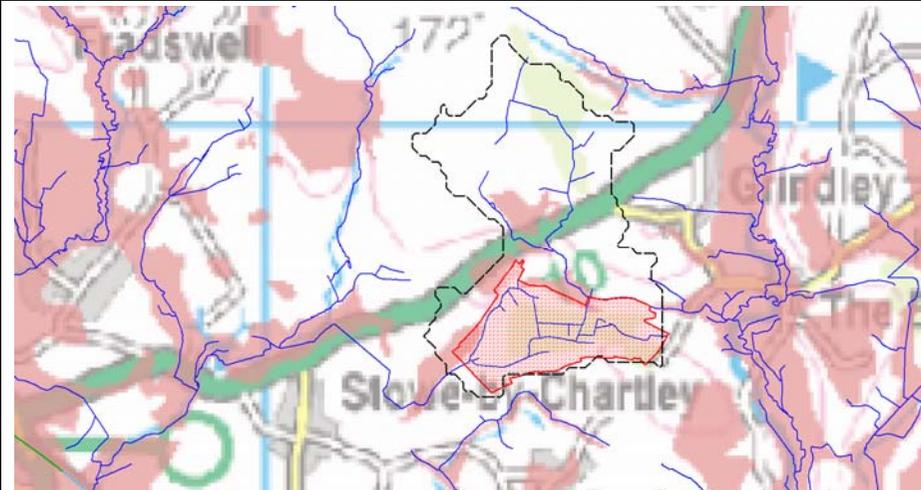


Figure 3 – Hydrological Assessment for Chartley Moss SSSI

The site is located on the brow of a small hill. Local watercourses drain away from the site. Provided that crossings of nearby watercourses do not impede flows, the surface-water hydrology will not be impacted by any of the proposed routes and since it is not within a superficial aquifer, there would be no impact on the hydrology of this site.



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Figure 4 – Hydrological Assessment for Tatton Mere SSSI

The proposed routes do not intersect the contributing surface-water catchment and there are no sections of route in cut through any aquifer which could affect flows into Tatton Mere. There will be no impact on the hydrology of this site.

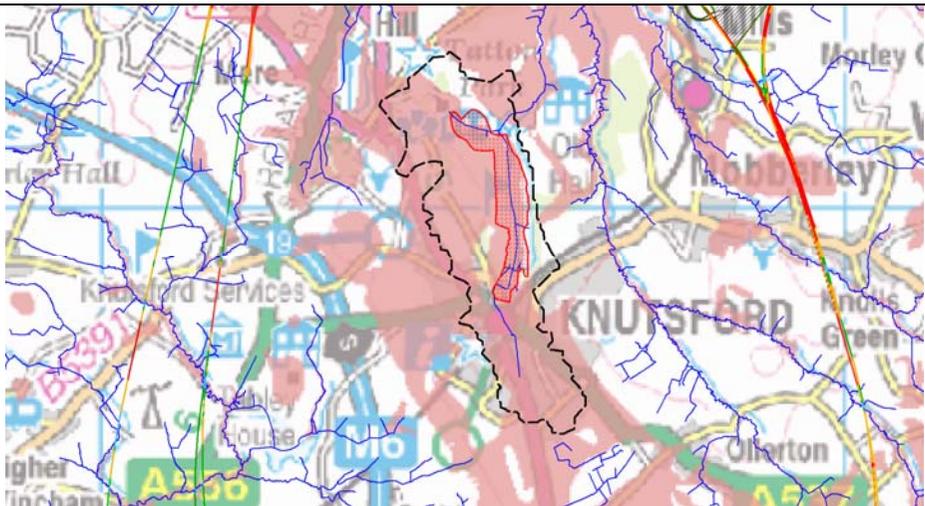
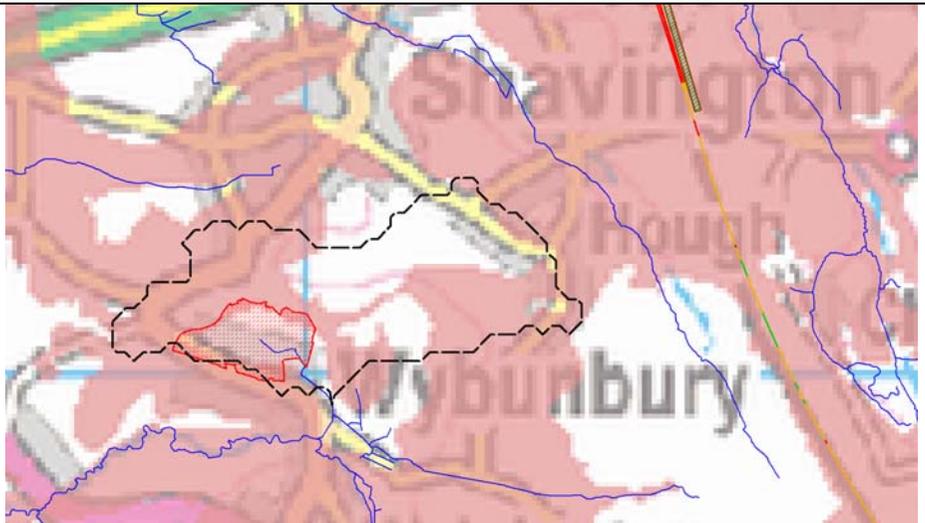


Figure 5 – Hydrological Assessment for Wybunbury Moss SSSI

The proposed routes do not intersect the contributing surface-water catchment. Local watercourses drain away from the site and consequently there will be no impact on the surface-water hydrology of the Moss. There are sections of route in cut through an aquifer approximately 3km to the north-east of the Moss, however this is on the opposite bank of the Swill Brook and consequently it is very unlikely that the proposed route would have any impact on the groundwater at the Moss.



## Conclusions

To determine if the proposals are likely to have any significant effects on the designated sites the following issues are considered:

- could the proposals affect the qualifying interest and are they sensitive / vulnerable to the effect;
- the probability of the effect happening;
- the likely consequences for the site's Conservation Objectives if the effect occurred; and
- the magnitude, duration and reversibility of the effect.

'Likely significant effect' in this context is any effect that may reasonably be predicted as a consequence of the project that may significantly affect the conservation or management objectives of the features for which a site was designated. A judgement as to significance must take into account factors relevant to the question of significance as described above. These will include temporal considerations (i.e. length of time of effect) and physical considerations (i.e. extent of effect on the European site and the elements of the site including its conservation objectives). It is possible, therefore, for an effect to damage something on the European site, but because such damage is fleeting, limited in extent or damaging to something outwith any conservation objectives the effect is insignificant on the European site.

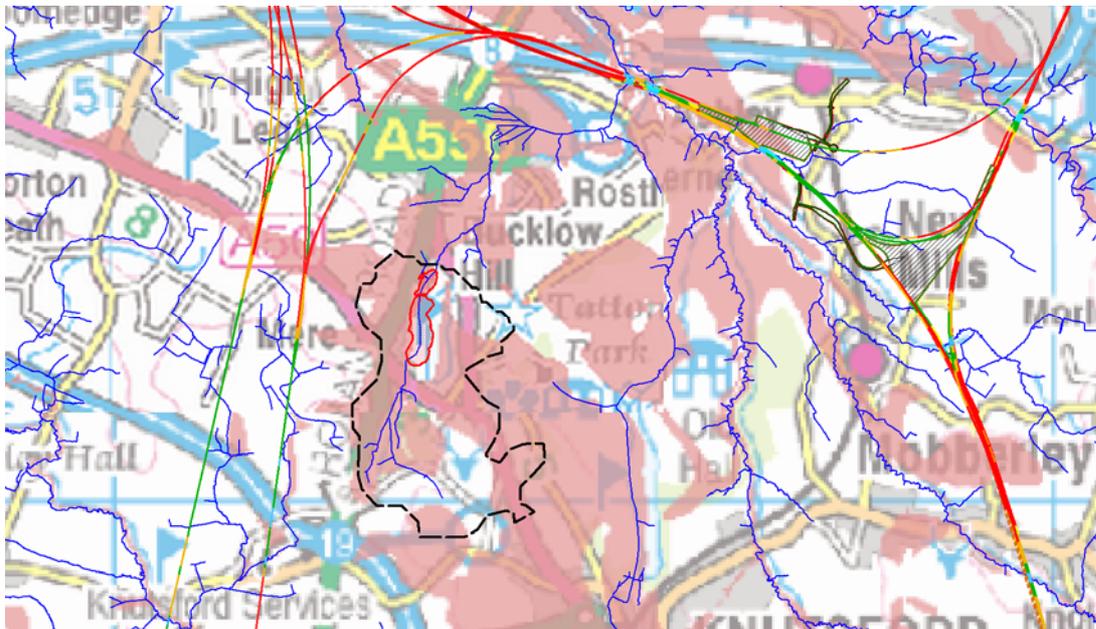
The screening stage should conclude one of the following three outcomes:

1. no likely significant effect;
2. a likely significant effect; or
3. it cannot be concluded that there will be no likely significant effect.

The following route options either would or may result in a significant effect to the Midland Meres & Mosses – Phase 1 Ramsar site as a result of Manchester Sift 3, since a significant effect is either considered likely or cannot be ruled out on the basis of information currently available. Were any of these options to be progressed, an appropriate assessment of the site would be required under Regulation 21 of the *Conservation of Habitats and Species Regulations 2010*.

Route option ref	A significant effect is considered likely because:	It cannot be concluded that no significant effects will occur because:
Route options  MA90D02A 2 MR94D03A 1 MR94D04A 1 MR94D06 1 MR94D07A 1 MA90D02A 1 MR94D08A 1		<p>The Mere Mere SSSI - potential impacts to surface/ground water and associated potential indirect effects on species and habitats of the Ramsar site cannot be ruled out at this stage.</p> <p>The proposed routes intersect the contributing surface-water catchment, and there is a section of cut through superficial aquifer to the west of the Mere which may contribute to flows into The Mere (see Figure 5). More detailed investigation will be required in order to determine the depth of the aquifer and the direction of groundwater flow, although the impacts are unlikely to be significant. Nevertheless, mitigation would require an engineered solution which allows groundwater and surface water to pass under the proposed line. Construction will need careful control in order to ensure that the aquifer does not become polluted during the construction process.</p>

Figure 5 – Hydrological Catchment – The Mere, Mere SSSI

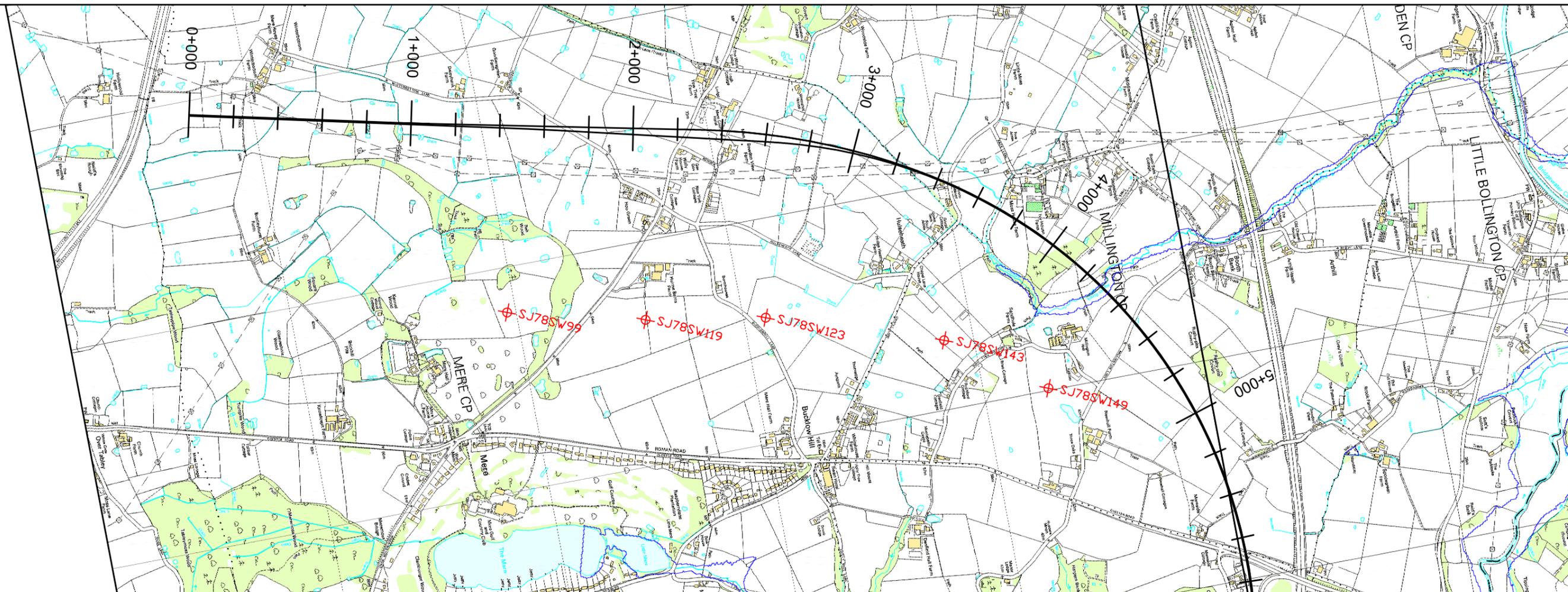


Key: Red line = Site Boundary, Black dotted line = FEH Surface Water Catchment, Pink shading= BGS Superficial Aquifer

## **APPENDIX 2**

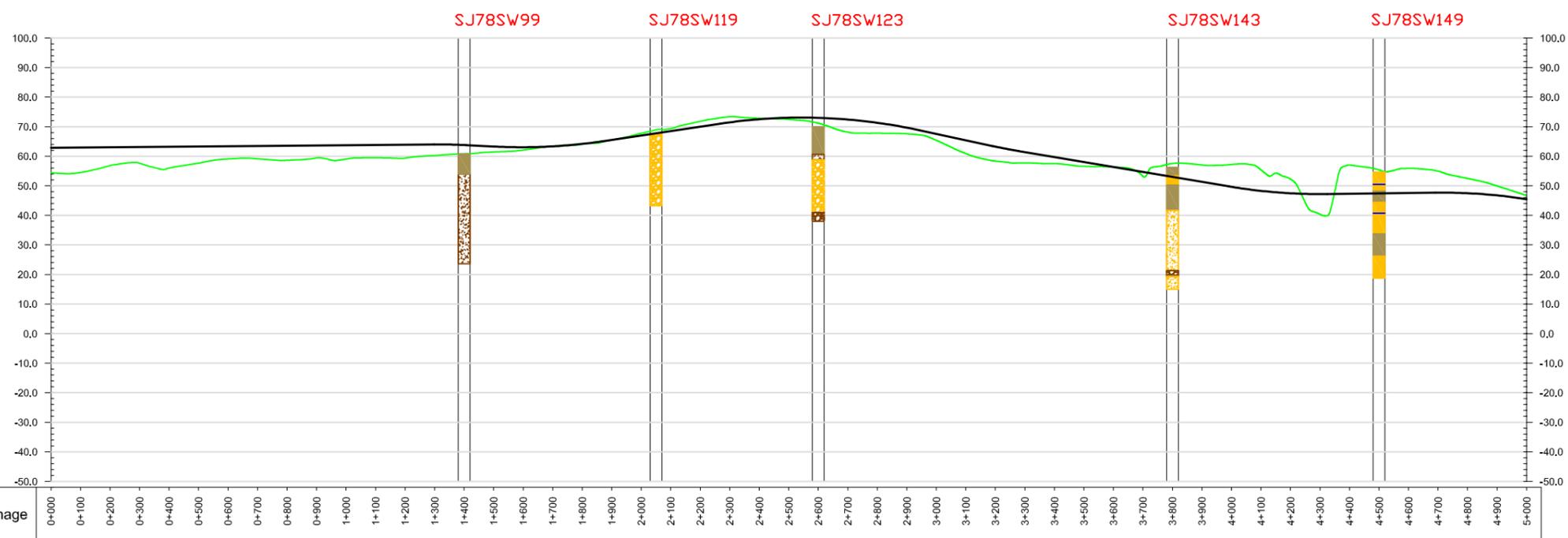
### **Relevant borehole data along the proposed route**

- a. Index number 7 - SJ78SW7 (west of The Mere) carried out water well exploration down to a depth of 24m. Done in 2 phases, the first in 1910 down to a depth of 30' (10m) which had a water level of 10' below the surface. The borehole was later extended to a depth of 81' (24.7m) below the surface.
- b. Index number 35 – SJ78SW122 (west of The Mere at location of proposed cut through superficial aquifer). Showing sand and fractured marl to a depth of 3.5m below the surface. No groundwater encountered for this borehole or any of the others in this local area where cut is proposed.

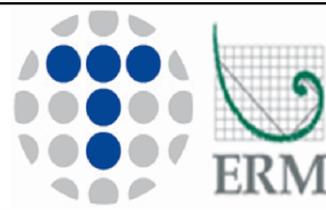


**KEY**

- Clay
- Sand
- Sands and Clays
- Mudstone
- Sandstone
- Siltstone
- Mudstone and Siltstone
- Sandstone and Siltstone
- Ground Level
- Track Elevation
- Groundwater Level



# HSM28



Notes

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Rev	Date	Amendments	Drawn	Approved

Client	HS2	Drawing No	SKG05_1
Job Title	High Speed 2 Manchester Leeds Appraisal of Sustainability	Rev	Draft
Drawing Title	Rostherne Mere Preferred route impact (Part 1)	Scale	NTS
		Date	2/11/12
		Drawn by	NM
		Checked by	TC
		Approved by	TC





SJ78SW 99

Sampling				Strata					
Drill Run	TCR (SCR)	Casing (ROD)	Date/Water	FI	Description	Depth (Thickness)	Level	Legend	
			23/10	NR	(See previous sheet - MUDSTONE)				
21.30	91% (61%)	(31%)		NI	Green-grey thinly to thickly laminated SILTSTONE, very weak to weak. Apparent bedding sub-horizontal. (Mercia Mudstone WG I1) (f22)	20.60	46.60	XXXXXX	
				NR		20.69m to 20.82m: non-intact, many angular lithorelicts in a clayey matrix.	(0.80)	45.80	XXXXXX
				NI	Red-brown silty MUDSTONE, very weak to moderately weak (Mercia Mudstone WGII). Occasional grey-green reduction spots. Discontinuities generally sub-horizontal, open to tight.	21.40		XXXXXX	
				NI					XXXXXX
	72% (32%)	(20%)		NR	22.80m to 22.88m: thin bed of green-grey thinly to thickly laminated siltstone.			XXXXXX	
				NI					XXXXXX
24.00				NR	25.29m to 25.83m: mudstone thinly laminated. 25.49m to 25.83m: predominantly green-grey siltstone.			XXXXXX	
				NI					XXXXXX
				3-4	26.32m to 26.36m: very thin bed of green-grey siltstone.			XXXXXX	
				NI					XXXXXX
	96% (83%)	(58%)		NI	28.51m to 28.60m: two inclined (45°), open discontinuities.			XXXXXX	
				3-4					XXXXXX
27.00			18.00 24/10 14.00	NI				XXXXXX	
				3-4					XXXXXX
				NI				XXXXXX	
				6					XXXXXX
	64% (32%)	(11%)		NI				XXXXXX	
30.00				NI				XXXXXX	
<b>Equipment:</b> Top Drive Rotary Rig Borehole Dia (mm) 150 to 13.00m P to 13.60m P to 43.60m Casing Dia (mm) 150 to 13.00m 125 to 13.00m 125 to 13.10m				<b>Groundwater</b> No. Struck Behaviour Sealed		Ground Level 67.2m OD Coordinates 372200 mE 381960 mN Drilled by BH Logged by JSK Checked by			
<b>Remarks</b> See key sheet and appendices for explanations.									
<b>Borehole Record</b> Exploration Associates				<b>Project</b> A556 (M56 - M6) Improvement Department of Transport			<b>Contract</b> 01133		<b>Borehole</b> 103R (3 of 5)

SJ78SW 99

Sampling					Strata			
Drill Run	TCR (SCR)	Casing (RQD)	Date/Water	FI	Description	Depth (Thickness)	Level	Legend
			24/10		(See previous sheet - MUDSTONE)			
	94% (69%)	(38%)		8	30.05m to 30.10m: very thin bed of green-grey siltstone.			
					31.12m to 32.00m: thinly laminated mudstone occasional interlamination of green-grey siltstone, dip of apparent bedding 5°.			
					31.80m to 32.30m: sub-vertical, open to tight discontinuity.			
32.40				NI	Below 33.20m: mudstone thinly laminated.			
	78% (42%)	(27%)		6	34.10m to 34.30m: thin bed of green-grey thinly to thickly laminated siltstone.			
					34.20m to 36.50m: dip off apparent bedding 5°.			
35.40				NI				
				6				
				NI				
				6				
				NI				
38.20				12				
	87% (33%)	(17%)		NI	39.40m to 40.50m: thinly to thickly laminated and interlaminated red-brown siltstone and mudstone.			
<b>Equipment:</b> Top Drive Rotary Rig Borehole Dia (mm) 150 to 13.00m P to 13.60m P to 43.60m Casing Dia (mm) 150 to 13.00m 125 to 13.00m 125 to 13.10m					<b>Groundwater</b> No. Struck Behaviour Sealed		Ground Level 67.2m OD Coordinates 372200 mE 381960 mN Drilled by BH Logged by JSK Checked by	
<b>Remarks</b> See key sheet and appendices for explanations.								
<b>Borehole Record</b>					<b>Project</b> A556 (M56 - M6) Improvement Department of Transport		<b>Contract</b> D1133	
Exploration Associates					<b>Borehole</b> 103R (4 of 5)			

SJ78SW 99

Sampling					Strata			
Drill Run	TCR (SCR)	Casing (RQD)	Date/Water	FI	Description	Depth (Thickness)	Level	Legend
41.20	98% (69%)	(24%)	24/10	12	(See previous sheet - MUDSTONE) 40.16m to 40.24m: many thin interlaminations of green-grey siltstone.	43.60	23.60	
				NI				
				12				
				NI				
				12	41.50m to 41.62m: inclined (70°) open discontinuity.			
43.60	98% (78%)	(28%)	24.00	NI	42.05m to 42.70m: generally non-intact, sub-vertical/ inclined (70°), open discontinuity.	43.60	23.60	
				6	42.60m to 42.70m: predominantly siltstone. At 42.70m: red-brown silty mudstone occasional halite pseudomorphs and occasional grey-green thin siltstone laminations. Below 43.15m: some to many thin interlaminations of green-grey siltstone.			
					End of Borehole.			
<b>Equipment:</b> Top Drive Rotary Rig Borehole Dia (mm) 150 to 13.00m P to 13.60m P to 43.60m Casing Dia (mm) 150 to 13.00m 125 to 13.00m 125 to 13.10m					<b>Groundwater</b> No. Struck Behaviour Sealed		<b>Ground Level 67.2m OD</b> Coordinates 372200 mE 381960 mN Drilled by BH Logged by JSK Checked by	
<b>Remarks</b> See key sheet and appendices for explanations.								
<b>Borehole Record</b>					<b>Project</b> A556 (M56 - M6) Improvement Department of Transport		<b>Contract</b> D1133	
Exploration Associates					<b>Borehole</b> 103R (5 of 5)			

SJ78SW 119

Sampling				Strata				
Drill Run	TCR (SCR)	Casing (RQD)	Date/Water	FI	Description	Depth (Thickness)	Level	Legend
			01/08 1991 DRY		TOPSOIL**[a].	G.L.	69.10	
					Red-brown silty CLAY**[e61].	0.30 (0.70)	68.80	
					Red-brown moderately strong slightly fractured sandy marl with occasional very weak SANDSTONE**[h4].	1.00 (0.60)	68.10	
				NI	Red-brown, locally grey-brown, thinly locally thickly laminated interlaminated fine and medium grained SANDSTONE and SILTSTONE, weak to moderately strong. Apparent bedding sub-horizontal. Very closely to closely spaced open sub-horizontal discontinuities. (Mercia Mudstone WG I-II; III at top of strata). Micaceous in part.[h41].	1.60	67.50	
	100% (33%)	(13%)		10	British Geological Survey			
				NI				
				25	British Geological Survey			
				NI				
	93% (70%)	(35%)					(9.00)	
					British Geological Survey			
				10	British Geological Survey			
	97% (90%)	(52%)						
					British Geological Survey			
Equipment: Top Drive Rotary Rig				Groundwater		Sealed		Ground Level 69.1 m 00
Borehole Dia (mm) PWF to 25.80m				Casing Dia (mm) 150 to 1.60m		Coordinates S 372349		382566 mE mN
Drilled by PH				Logged by DJS		Checked by SCL		
Remarks Piezometer installed; tip at 5.00m, sand response zone from 4.50m to 5.50m.								
See key sheet and appendices for explanations.								
Borehole Record				Project				Contract
				A556 (M56 - M6) Improvements Department of Transport				D1133
				Exploration Associates				Borehole
								117R (1 of 3)

SJ78SW 119

Sampling				Strata				
Drill Run	TCR (SCR)	Casing (RQD)	Date/Water	FI	Description	Depth (Thickness)	Level	Legend
10.60			01/08	NI	(See previous sheet - SANDSTONE and SILTSTONE).	10.60	58.50	
	93% (22%)	(10%)		12	Red-brown thinly to thickly laminated fine and medium, locally coarse SANDSTONE, very weak to weak. Apparent bedding sub-horizontal. Very closely to closely spaced open sub-horizontal discontinuities. (Mercia Mudstone WG 11-II1), (h42).	(2.50)		
				NI				
				12	12.70m to 13.10m: sub-vertical open discontinuity.			
				5	Red-brown, locally grey thinly to thickly laminated SILTSTONE and SANDSTONE, weak to moderately strong. Apparent bedding sub-horizontal. Closely spaced open sub-horizontal discontinuities. (Mercia Mudstone WG 1-11), (h42).	13.10	56.00	
13.60				NI				
	100% (23%)	(0%)		12	13.70m to 13.85m: sub-vertical open arcuate discontinuities with sandstone infill.			
				20	14.70m to 15.10m: sub-vertical open arcuate discontinuity. Below 14.90m: red-brown, with rare grey mottling.			
15.60								
	97% (56%)	(47%)			16.00m to 16.20m: sub-vertical open smooth discontinuity.			
17.40					17.60m to 18.20m: sub-vertical open discontinuities.	(9.70)		
	88% (84%)	(58%)		5				
					19.10m: pale green crystal filled void.			
19.90								
Equipment: Top Drive Rotary Rig				Groundwater No. Struck Behaviour		Sealed	Ground Level 69.1 m OD Coordinates 372349 382566 mE mN	
Borehole Dia (mm) PWF to 25.80m		Casing Dia (mm) 150 to 1.60m				Drilled by PH Logged by DJS Checked by SCL		
Remarks								
See key sheet and appendices for explanations.								
Borehole Record				Project A556 (M56 - M6) Improvements Department of Transport			Contract D1133	
Exploration Associates							Borehole 117R (2 of 3)	



SJ78SW 123

Sampling					Strata				
Depth / Drill Run	Type / TCR/SCR	Casing (RQD)	Date/ Water	SPT N (Cu)/FI	Description	Depth (Thickness)	Level	Legend	
0.50-0.95	U	NIL	31/07 1991 DRY		TOPSOIL**[a].	G.L. (0.40)	65.00		
1.00	D				Light brown sandy CLAY.[Glacial Soil e61].	0.40 (0.60)	64.60		
1.50-1.95	SD	1.50		12	Soft to firm red-brown occasionally mottled blue-grey sandy CLAY with a little fine and medium gravel including coal.[e61].	1.00 (1.50)	64.00		
2.50-2.95 2.50-3.00	SD B	2.50		6	Loose red-brown silty, very clayey fine and medium SAND.[e2].	2.50 (1.00)	62.50		
3.50-3.95	U	3.50		(74)	Firm red-brown sandy CLAY, very silty in places, with a little fine, medium and coarse gravel.[e61].	3.50 (0.60)	61.50		
4.00	D				Weathered light blue-grey SILTSTONE in a very silty clay matrix.[h2].	4.10	60.90		
4.50-4.95	SD	4.50		71	Weathered red-brown micaceous silty MUDSTONE.[h1].	4.40 (1.75)	60.60		
5.50	D								
6.00-6.15 6.15	CD	6.00		79*/150	Red-brown, grey thinly laminated interlaminated fine locally medium and coarse grained SANDSTONE and SILTSTONE, occasional red-brown mudstone laminae/lenses. Moderate weak, locally weak. Apparent bedding sub-horizontal, locally inclined (60°). Closely spaced discontinuities sub-parallel to bedding. Rare grey-green reduction spots (2-5mm). (Mercia Mudstone 1). Occasional voids in sandstone (1mm), increasing with depth.[h41].	6.15	58.85		
				NI					
				8	7.70m to 7.80m: sub-vertical closed discontinuity.				
				NI					
				10	8.60m to 8.80m, 8.90m to 9.45m: sub-vertical open discontinuity.				
				NI					
	97% (63%)	(25%)							
Equipment: Light Cable Percussive Rig Top Drive Rotary Rig					Groundwater No. Struck Behaviour		Sealed		Ground Level 65.0 m OD Coordinates 372440 383099
Borehole Dia (mm) 150 to 6.15m P to 27.00m		Casing Dia (mm) 150 to 6.00m 125 to 7.50m				Drilled by BH Logged by DJS Checked by SCL		ME MN	
Remarks Chiselling from 5.50m to 6.00m for 1 hour. Piezometer installed; tip at 5.75m, sand response zone from 5.00m to 7.00m.									
See key sheet and appendices for explanations.									
Borehole Record				Project A556 (M56 - M6) Improvements Department of Transport		Contract D1133			
Exploration Associates						Borehole 119A/B20(1 of 3)			

SJ78SW 123

Sampling					Strata			
Drill Run	TCR (SCR)	Casing (RQD)	Date/ Water	SPT N FI	Description	Depth (Thickness)	Level	Legend
10.50			31/07	5	(See previous sheet - SANDSTONE and SILTSTONE).			
	97% (67%)	(48%)		NI 10 NI				
13.50				5	13.00m to 13.80m: blue-grey thinly laminated fine, medium and coarse grained SANDSTONE, weak to moderately weak. 13.80m to 13.85m: grey thinly laminated mudstone, weak. 13.20m to 13.40m: inclined (60°) open discontinuity.			
	98% (42%)	(20%)		NI 6 NI 6	13.95m to 14.10m: sub-vertical open discontinuity.			
16.50				6	15.00m to 15.10m, 15.40m to 15.50m: sub-vertical open discontinuity.	(17.85)		
	92% (47%)	(29%)		NI 6 NI	15.85m to 16.60m: sub-vertical/inclined open arcuate discontinuities.			
18.40				5	16.30m to 17.00m: grey thinly laminated, micaceous fine grained SANDSTONE, moderate weak. 16.70m to 16.80m: inclined (50°) open discontinuity.			
	100% (42%)	(27%)		NI	17.90m to 18.50m: very weak to weak.			
				5	19.55m to 20.05m: sub-vertical/inclined (60°) open discontinuity.			
<b>Equipment:</b> Light Cable Percussive Rig Top Drive Rotary Rig Borehole Dia (mm) 150 to 6.15m P to 27.00m Casing Dia (mm) 150 to 6.00m 125 to 7.50m					<b>Groundwater</b> No. Struck Behaviour Sealed		Ground Level 65.0 m 00 Coordinates 372440 383099 mE mN Drilled by BH Logged by DJS Checked by SCL	
<b>Remarks</b> See key sheet and appendices for explanations.								
<b>Borehole Record</b>  Exploration Associates					<b>Project</b> A556 (M56 - M6) Improvements Department of Transport		<b>Contract</b> D1133 <b>Borehole</b> 119A/B20 (2 of 3)	

SJ78SW 123

Sampling					Strata				
Drill Run	TCR (SCR)	Casing (RQD)	Date/ Water	SPT N FI	Description	Depth (Thickness)	Level	Legend	
			31707		(See previous sheet - SANDSTONE and SILTSTONE). 20.20m to 20.30m: inclined (60°) open discontinuity.				
21.00				4					
				NI	20.90m to 21.00m: inclined (45°) open discontinuity.				
				4					
	98% (40%)	(28%)		NI	22.50m to 23.20m: sub-vertical open arcuate discontinuity.				
				5					
24.00				NI		24.00	41.00		
				5	Red-brown, grey thinly laminated interlaminated MUDSTONE and SILTSTONE, with occasional grey sandstone, moderate weak, to weak in parts. Apparent bedding sub-horizontal. Closely to medium spaced sub-horizontal discontinuities. (Mercia Mudstone WG 1). [w311].				
				NI					
	95% (60%)	(57%)		4	25.25m to 25.40m, 25.70m to 25.80m: inclined (45°) open discontinuities.				
27.00			7.20 20.00			27.00	38.00		
					End of Borehole.				
<b>Equipment:</b> Light Cable Percussive Rig Top Drive Rotary Rig					<b>Groundwater</b> No. Struck Behaviour Sealed			<b>Ground Level</b> 65.0 m OD Coordinates 372440 mE 383099 mN	
<b>Borehole Dia (mm)</b> 150 to 6.15m P to 27.00m		<b>Casing Dia (mm)</b> 150 to 6.00m 125 to 7.50m				<b>Drilled by</b> BH <b>Logged by</b> DJS <b>Checked by</b> SCL			
<b>Remarks</b>  See key sheet and appendices for explanations.									
<b>Borehole Record</b>					<b>Project</b> A556 (M56 - M6) Improvements Department of Transport			<b>Contract</b> D1133	
 <b>Exploration Associates</b>								<b>Borehole</b> 119A/B20 (3 of 3)	

SJ78SW 143

Sampling					Strata			
Depth	Type	Casing Depth	Date/Water	SPT N (Cu)	Description	Depth (Thickness)	Level	Legend
			06/08 1991 DRY		TOPSOIL**[a].	G.L. (0.40)	56.60	
0.45	D				Firm red-brown occasionally mottled light grey-brown sandy CLAY with a little fine, medium and coarse gravel and occasional small sand pockets. [Glacial Soil e61]. At 1.10m: slightly fissured.	0.40	56.20	
0.65-1.10	U	NIL		(74)				
1.10	D				Below 1.45m: mottling absent.			
1.45	D				Below 2.55m: becoming firm to stiff and very silty in places.			
1.75-2.20	SD	1.50		7		(2.85)		
2.55	D				Medium dense brown silty to very silty fine SAND, with occasional thin laminae of soft brown very silty clay. [e11].			
2.80-3.25	U	1.50				3.25	53.35	
3.25	D				Firm to stiff red-brown slightly sandy CLAY with a little to some sub-rounded to sub-angular fine, medium and coarse gravel, and rare comminuted shell debris. [e61].			
3.45	D							
3.65-4.10	SD	3.00		26				
4.00-4.65	B				Below 7.45m: gravel including coal.			
4.65-5.10	SD	4.50		26		(3.15)		
5.25-6.00	B				Firm to stiff red-brown thinly to thickly laminated very silty CLAY with occasional silt laminae and thin bands. [e5].			
6.00-6.45	SD	5.75		27		6.40	50.20	
6.75	D				(See next page - stiff CLAY).			
7.00-7.45	U	7.00				9.05	47.55	
7.45	D							
8.20	D							
8.45-8.90	SD	7.25		20				
9.05	D							
9.25-9.70	U	9.20						
9.70	D							
9.95	D							
Equipment: Light Cable Percussive Rig Top Drive Rotary Rig					Groundwater No. Struck Behaviour	Sealed	Ground Level Coordinates	56.6 m OD 372690 383869 mE mN
Borehole Dia (mm) 150 to 13.37m PWF to 40.80m		Casing Dia (mm) 150 to 14.75m 125 to 16.30m			Drilled by KP BH Logged by IGJ DJS Checked by SCL			
<b>Remarks</b> A little water added to assist boring in places. Piezometer installed; tip at 6.00m, sand response zone from 5.50m to 6.50m.								
See key sheet and appendices for explanations.								
<b>Borehole Record</b>					<b>Project</b> A556 (M56 - M6) Improvement Department of Transport		<b>Contract</b> D1133	
					<b>Exploration Associates</b>		<b>Borehole</b> 129 (1 of 5)	

SJ78SW 143

Sampling				Strata		British Geological Survey		
Depth / Drill Run	Type / TCR(SCR)	Casing (ROD)	Date/ Water	SPT N (Cu)/F1	Description	Depth (Thickness)	Level	Legend
10.35	D		06/08		Stiff red-brown slightly sandy CLAY with a little fine, medium and coarse gravel. [e61].	(0.40) 10.35	46.25	
10.65-11.10	SD	9.75		31	Dense red-brown very silty fine SAND, with occasional laminae of soft red-brown very silty clay. [e11].	(0.85)		
11.10		9.75	DRY 09/08				45.40	
11.20	D		DRY		Firm to stiff red-brown slightly sandy to sandy CLAY with a little fine, medium and coarse gravel including mudstone. [e61].			
11.80	D							
12.05-12.50	U	11.50						
12.50	D							
13.10	D				Below 13.00m: becoming very sandy.	(4.00)		
13.60-13.75	S	13.50		64*/150	At 13.60m: red-brown fine grained sandstone cobbles.			
14.25	D							
14.75-15.20	SD	14.75		99				
15.20-15.60	B				Weathered grey-brown fine grained SANDSTONE. [h4].	15.20	41.40	
15.60-16.00	B				Weathered red-brown SILTSTONE. [h2].	(0.40) 15.60	41.00	
16.37						(0.77)		
16.37				8	Dark red-brown, locally grey-brown, light brown thinly to thickly laminated fine and medium grained SANDSTONE with some interlaminae of red-brown dark red-brown, grey-brown thinly laminated micaceous siltstone and occasional dark red-brown mudstone. Moderate weak to moderate strong locally very weak to weak. Apparent bedding sub-horizontal locally convoluted. Closely spaced sub-horizontal discontinuities. (Mercia Mudstone WG 1). Occasional calcite filled/lined voids (5mm-25mm). Locally mottled [h41].	16.37	40.23	
				NI				
	100% (96%)	(42%)		12	16.80m to 17.30m: predominantly thinly laminated dark red-brown, grey siltstone and mudstone.			
				NI				
18.60				10	16.75m to 16.90m: sub-vertical open discontinuity.			
				NI				
	94% (28%)	(12%)		10	17.80m to 19.80m: predominantly thinly laminated dark red-brown, grey siltstone and mudstone.			
				NI	19.50m to 19.90m: sub-vertical/inclined (60°) open discontinuity.			
Equipment: Light Cable Percussive Rig Top Drive Rotary Rig				Groundwater No. Struck Behaviour		Sealed Ground Level 56.6 m OD Coordinates 372690 383869 mE mN		
Borehole Dia (mm) 150 to 13.37m PWF to 40.80m		Casing Dia (mm) 150 to 14.75m 125 to 16.30m		Drilled by KP BH Logged by IGJ DJS Checked by SCL				
<b>Remarks</b>								
See key sheet and appendices for explanations								
<b>Borehole Record</b>			<b>Project</b> A556 (M56 - M6) Improvement Department of Transport			<b>Contract</b> D1133		
 Exploration Associates						<b>Borehole</b> 129 (2 of 5)		

SJ78SW 143

Sampling					Strata			
Drill Run	TCR (SCR)	Casing (ROD)	Date/Water	SPT N FI	Description	Depth (Thickness)	Level	Legend
20.40	98% (66%)	(34%)	09/08	6	(See previous sheet - SANDSTONE). 20.00m to 20.15m: interconnected calcite lined voids (5mm-10mm) associated with sub-vertical tight discontinuity.			
				12				
				5				
				NI				
				8				
22.80	100% (83%)	(38%)		6	22.20m to 22.50m: inclined (75°) open discontinuity.			
				12				
				NI				
				8				
				NI				
25.80	98% (71%)	(30%)		8	24.10m to 24.25m: sub-vertical open discontinuity.			
				NI				
				8				
				12				
				6				
28.80				NI	25.55m to 25.60m: sub-vertical open discontinuity.			
				10				
				NI				
				10				
				NI				
				6	26.25m: calcite lined voids (50mm).			
				NI				
				10				
				NI				
				6				
				NI	26.80m to 26.95m: inclined (60°) open discontinuity.			
				10				
				NI				
				10				
				NI				
				6	27.30m to 28.80m: predominantly grey-green thinly laminated mudstone and siltstone.			
				NI				
				10				
				NI				
				18				
				NI	Below 28.80m: dark red-brown, thinly laminated mudstone and siltstone laminae.			
				10				
				NI				
				18				
				NI				
				5	29.50m to 29.65m: sub-vertical/inclined (60°) open stepped discontinuity.			
Equipment: Light Cable Percussive Rig Top Drive Rotary Rig					Groundwater No. Struck Behaviour	Sealed	Ground Level Coordinates	56.6 m OD 372690 mE 383869 mN
Borehole Dia (mm) 150 to 13.37m PWF to 40.80m		Casing Dia (mm) 150 to 14.75m 125 to 16.30m						
<b>Remarks</b>  See key sheet and appendices for explanations.								
<b>Borehole Record</b>					<b>Project</b> A556 (M56 - M6) Improvement Department of Transport		<b>Contract</b> D1133	
 <b>Exploration Associates</b>							<b>Borehole</b> 129 (3 of 5)	

SJ78SW 143

Sampling				Strata				
Drill Run	TCR (SCR)	Casing (RQD)	Date/ Water	SPT N Fl	Description	Depth (Thickness)	Level	Legend
31.80	97% (70%)	(56%)	09/08	NI	(See previous sheet - SANDSTONE). 30.10m to 30.25m: sub-vertical open discontinuity.			
				5				
				NI				
				10				
				NI				
				12				
				8				
				NI				
				8				
				12				
34.80	99% (79%)	(45%)	09/08	NI	32.95m to 33.05m: sub-vertical open discontinuity.			
				8				
				NI				
				8				
				12				
				6				
				NI				
				6				
				NI				
				6				
37.80	100% (84%)	(45%)	09/08	6	Grey-green thinly laminated interlaminated SILTSTONE and MUDSTONE, moderate weak, locally weak. Apparent bedding sub-horizontal. Closely spaced sub-horizontal discontinuities. (Mercia Mudstone WG I). [h21].	35.30	21.30	XXXXXX
				NI				
				6				
				NI				
				6				
				NI				
				6				
				NI				
				6				
				3		Grey, red-brown very thin to thinly bedded fine and medium grained SANDSTONE, moderate weak to moderate strong, locally weak. Apparent bedding sub-horizontal. Closely to medium spaced discontinuities. (Mercia Mudstone WG I). [h41]. 37.25m to 37.35m: occasionally calcite lined voids (1mm-5mm).	37.25	19.35
15								
10								
15								
10								
NI								
6								
97% (53%)	(49%)	09/08	NI					
6								

Equipment: Light Cable Percussive Rig Top Drive Rotary Rig	Groundwater No. Struck Behaviour	Sealed	Ground Level Coordinates	56.6 m 00 372690 383869 mE mN
Borehole Dia (mm) 150 to 13.37m PWF to 40.80m	Casing Dia (mm) 150 to 14.75m 125 to 16.30m		Drilled by Logged by Checked by	KP BH IGJ DJS SCL
<b>Remarks</b> See key sheet and appendices for explanations.				
<b>Borehole Record</b>		<b>Project</b> A556 (M56 - M6) Improvement Department of Transport		<b>Contract</b> D1133
 Exploration Associates				<b>Borehole</b> 129 (4 of 5)

SJ78SW 143

Sampling					Strata				
Drill Run	TCR (SCR)	Casing (RQD)	Date/ Water	SPT N Fl	Description	Depth (Thickness)	Level	Legend	
			09/08		(See previous sheet - SANDSTONE).				
40.80		16.30	20.00	NJ 6	End of Borehole.	40.80	15.80		
<b>Equipment:</b> Light Cable Percussive Rig Top Drive Rotary Rig					<b>Groundwater</b> No. Struck Behaviour		Sealed Ground Level Coordinates 56.6 m OD 372690 mE 383869 mN		
Borehole Dia (mm) 150 to 13.37m PWF to 40.80m		Casing Dia (mm) 150 to 14.75m 125 to 16.30m							Drilled by KP BH Logged by IGJ DJS Checked by SCL
<b>Remarks</b>  See key sheet and appendices for explanations.									
<b>Borehole Record</b>				<b>Project</b> A556 (M56 - M6) Improvement Department of Transport			<b>Contract</b> D1133		
<b>Exploration Associates</b>							<b>Borehole</b> 129 (5 of 5)		

SJ78SW 149

Sampling					Strata			
Depth	Type	Casing Depth	Date/Water	SPT N (Cu)	Description	Depth (Thickness)	Level	Legend
			22/09 1991 DRY		TOPSOIL**	G.L. (0.70)	54.8	
1.00-1.45	SDB	NIL		11	Loose grey-brown clayey fine and medium SAND. [Glacial soil e21]	0.70	54.10	
2.00-2.45	SDB	2.00		5				
3.00-3.45	SDB	3.00		2	Below 3.00m: red-brown, very loose.	(5.50)		
4.00-4.50	SDB	4.00		1				
5.00-5.45	SD	5.00		3	Below 5.00m: with pockets of dark brown clay.			
6.00-6.45	SB	6.00		1		6.20	48.60	
7.50-7.95	SD	7.50		16	Firm to stiff dark brown thinly laminated CLAY. [e5]	(4.20)		
9.00-9.45	SD	9.00		13				
Equipment: Light Cable Percussive Rig					Groundwater		Ground Level 54.80m OD	
Borehole Dia (mm) 150 to 22.00m 125 to 36.00m					No. Struck Behaviour		Coordinates 372989 mE 384290 mN	
Casing Dia (mm) 150 to 22.00m					1 5.50 Rose to 4.30m after 20 minutes 2 15.00 Rose to 14.10m after 20 minutes		Sealed 10.50	
Drilled by KT					Checked by SCL			
Logged by DJS								
<b>Remarks</b> Rotary open hole drilling between 22.00m and 36.00m.								
See key sheet and appendices for explanations.								
<b>Borehole Record</b>					<b>Project</b>		<b>Contract</b>	
Exploration Associates					A556 (M56 - M6) Improvement Department of Transport		D1133	
							<b>Borehole</b> 133 (1 of 4)	

SJ78SW 149

Sampling				Strata				
Depth	Type	Casing Depth	Date/ Water	SPT N (Cu)	Description	Depth (Thickness)	Level	Legend
10.50-10.45	SDB	10.50	22/09	21	(See previous sheet - CLAY)	10.40	44.40	
11.00		1.00 11.00	DRY 27/08 DRY		Medium dense and dense light brown fine and medium SAND with a little sub-rounded fine gravel. [e13]			
12.00-12.45	SDB	12.00		33				
13.50-13.95	SDB	13.50		39	Below 13.50m: with occasional coal fragments.			
15.00-15.45	SDB	15.00		27				
16.50-16.95	SDB	16.50		47		(10.70)		
18.00-18.45	SDB	18.00		53	Below 18.00m: very dense, with occasional cobbles.			
19.50-19.95	SDB	19.50		17	Below 19.50m: medium dense.			
Equipment: Light Cable Percussive Rig				Groundwater		Sealed		Ground Level 54.80m
Borehole Dia (mm) 150 to 22.00m 125 to 36.00m				Casing Dia (mm) 150 to 22.00m				Coordinates 372989 mE 384290 mN
Remarks				No. Struck Behaviour		Drilled by KT Logged by DJS Checked by SCL		
See key sheet and appendices for explanations.				Project		Contract		
Borehole Record				A556 (M56 - M6) Improvement Department of Transport		D1133		
						Borehole		133 (2 of 4)






 No. 41. 12 26NE/2 108  
**SJ78SW/7**  
 SECTION OF Borehole at Broom Cottage Bucklow Hill  
 Maps: One-inch 80 NE (N.S. 96) Six-inch Class 26 NE County Sheshire  
 Height above O.D. \_\_\_\_\_ Latitude 53° 21' 24" Longitude 2° 25' 15"  
 Communicated by Messrs Thos. Matthews, Ltd. Date of Sinking 1923  
 Made by J. Hall, Esq. Dip of Strata \_\_\_\_\_  
Water level at 19 ft.

Well down to  
 Sandstone  
 " red  
 Grey marl  
 Red marl to sand.

Thickness.		Depth from Surface.		T/m	D/m
ft.	in.	ft.	in.		
		30			9.14
6	6	36	6		11.13
11	6	48			14.63
10		58			17.68
23		81			24.69

See SJ78SW/5 - Water Dept. assume this is a continuation of that record.

No. 46

26NE/230/108

S178SW/7

SECTION OF Borehole at Broom Cottage, Bucklow Hill

Maps: One-inch 80 NE (N.S. 96) Six-inch Class 26 NE County Cheshire

Height above O.D. \_\_\_\_\_ Latitude 53° 21' 24" Longitude 2° 25' 15"

Communicated by Messrs Tho. Matthews, Ltd. Date of Sinking 1933

Made by J. Hall, Esq. Dip of Strata \_\_\_\_\_

Water level at 19 ft.

	Thickness		Depth from Surface	
	ft.	in.	ft.	in.
Well down to Sandstone			30	
Shearwell Set Group { "Keuper Sandstone" } red	6	6	36	6
	11	6	48	
Grey marl	10		58	
Red marl & sand.	23		81	

Record of the deepening of 17SE/6  
 taken on 17SE/E 6/11/1956

Jic 2/5/78

Copied from water records 2/5/78 - they believe this is a continuation of 5578SW/5; but one record it is an independent unwatered record. (5578SW/7)

8  
 SJ 78 SW/S SJ 7206 8600 98/88  
 178E/S  
 (21) Wt. 5000—S.23 2000 6/23 Gp. 147 M.R.Co.Ltd.  
 SECTION OF Borehole at L. A. Cleveport Exp. SJ 78/56  
Broom Cottage near Smethley Hill, 4 miles from Attleborough.  
 Maps: One-inch 996 Six-inch \_\_\_\_\_ County \_\_\_\_\_  
 Height above O.D. \_\_\_\_\_ Latitude \_\_\_\_\_ Longitude \_\_\_\_\_  
 Communicated by J. H. M. Hatters Ltd. Date of sinking 11<sup>th</sup> Nov. 1910.  
12<sup>th</sup> Dec. 1910.  
 Made by \_\_\_\_\_ Dip of Strata \_\_\_\_\_

		Thickness.		Depth from Surface.	
Drift Mercia Mudstone Group "Sherwood ? sandstone Group"	Soil	1	-	1	-
	Loam clay	2	3	3	3
	Stiff red clay	4	-	7	3
	Sandy red sand	7	6	14	9
	Fluffy grey rock.	2	-	16	9
	Red sandstone.	13	3	30	-
Water level 15ft. Filled in, situated in the garden east of the courtyard. OD c 175. Visited and sited on check 1750 ft. 11/16 1956 Deepened in 1923 See next sheet P.T.O.					

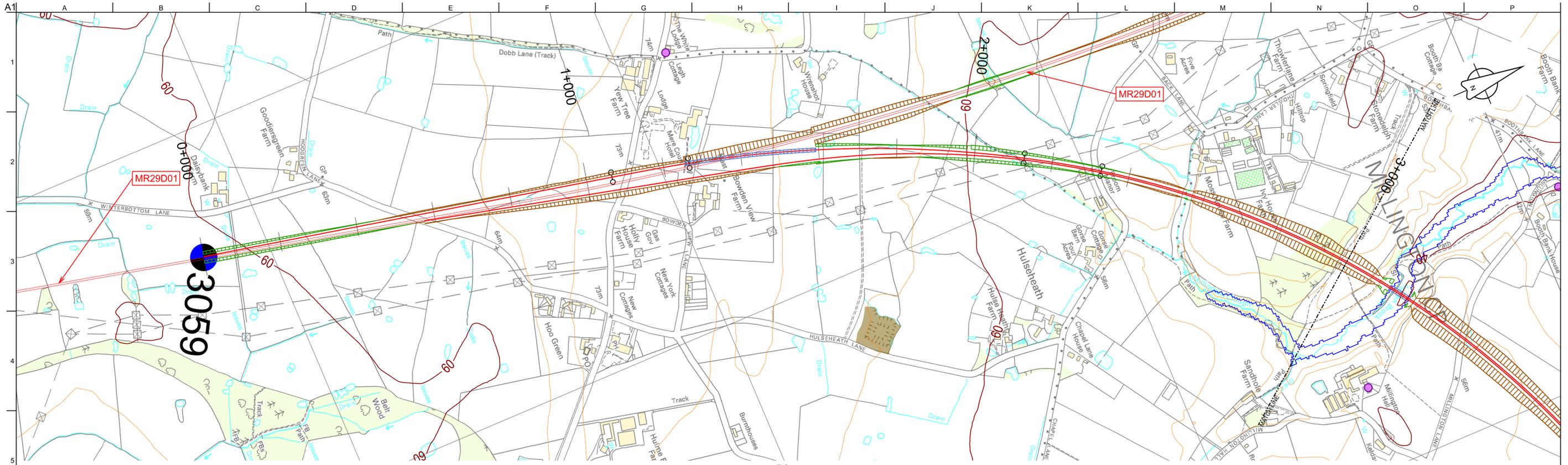
SJ78SW 122

Sampling				Strata			Depth (Thickness)	Level	Legend	
Drill Run	TCR (SCR)	Casing (RQD)	Date/ Water	FI	Description					
			07/08 1991		TOPSOIL** [a].		G.L.	67.20		
					Brown medium SAND**	0.30	66.90			
					Red-brown very weak sandy marl becoming stronger with depth.	(1.00) 1.30	65.90			
3.50							(2.20)			
				NI	Red-brown, grey thinly laminated SILTSTONE, micaceous in part, locally grading to grey thinly laminated fine grained sandstone. Weak to moderate weak. Apparent bedding sub-horizontal. Very closely to closely, locally medium spaced sub-horizontal discontinuities (Mercia Mudstone UG 1). [h21].			63.70		
				10						
				NI						
	98% (24%)	(6%)		10						
				NI						
				10	5.30m to 5.75m: grey-green micaceous siltstone grading to fine grained sandstone. Numerous voids (1mm-5mm).					
6.00					6.10m to 6.30m, 6.50m to 6.60m: sub-vertical open discontinuities with black staining on faces.					
				NI	Below 7.00m: occasional grey-green reduction spots. 7.00m to 7.60m: sub-vertical open discontinuity with black staining of faces. 7.60m to 7.80m, 7.90m to 8.25m: inclined (60°) open discontinuity.					
	98% (23%)	(20%)								
				5						
9.00										
				20	9.40m to 10.00m: grey-green micaceous siltstone grading to fine grained sandstone.					
Equipment: Top Drive Rotary Rig				Groundwater			Ground Level 67.2 m 00			
Borehole Dia (mm) PWF to 11.00m				No. Struck Behaviour			Coordinates 372420		mE	
Casing Dia (mm) 150 to 3.50m				Sealed			382940		mN	
							Drilled by PH			
							Logged by DJS			
							Checked by SCL			
<b>Remarks</b> GL to 3.50m open hole drilling.										
See key sheet and appendices for explanations.										
<b>Borehole Record</b>				<b>Project</b>			<b>Contract</b>			
				A556 (M56 - M6) Improvement Department of Transport			D1133			
				<b>Exploration Associates</b>			<b>Borehole</b>			
							119R (1 of 2)			

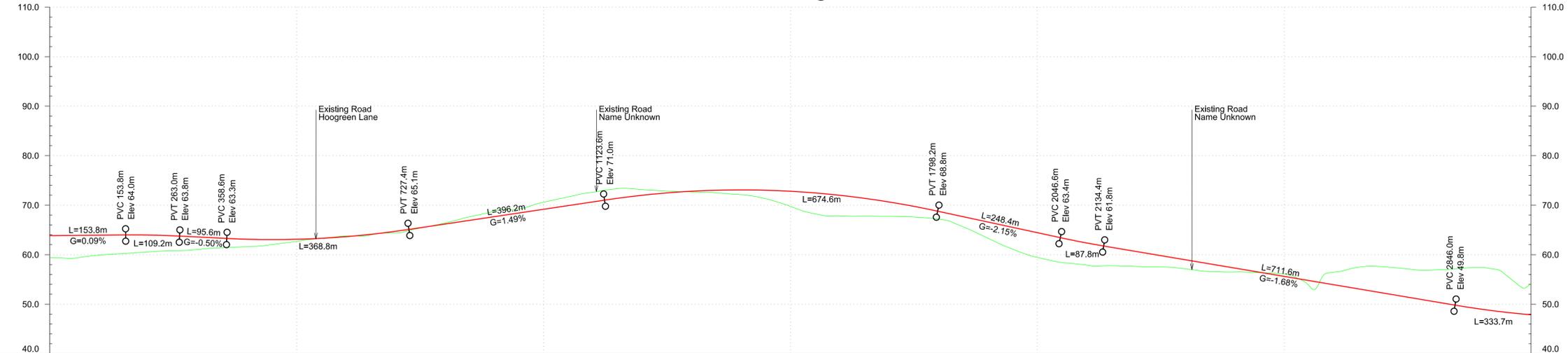
SJ78SW 122

Sampling					Strata			
Drill Run	TCR (SCR)	Casing (RQD)	Date/Water	FI	Description	Depth (Thickness)	Level	Legend
	(50%)	(18%)	07/08	N1	(See previous sheet - SILTSTONE).			XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX
11.00		3.50	10.80	15	10.95m to 11.00m: grey-green micaceous siltstone grading to fine grained sandstone.	11.00	56.20	
					End of Borehole.			
Equipment: Top Drive Rotary Rig					Groundwater No. Struck Behaviour	Sealed	Ground Level Coordinates	67.2 m OD 372420 382940 mE mN
Borehole Dia (mm) PWF to 11.00m		Casing Dia (mm) 150 to 3.50m			Drilled by PH Logged by DJS Checked by SCL			
Remarks								
See key sheet and appendices for explanations.								
Borehole Record					Project		Contract	
 Exploration Associates					A556 (M56 - M6) Improvement Department of Transport		D1133	
							Borehole 119R (2 of 2)	

## APPENDIX 3 Engineering Designs



Plan  
Scale 1:5,000 @ A1



Chainage	0+000	0+100	0+200	0+300	0+400	0+500	0+600	0+700	0+800	0+900	1+000	1+100	1+200	1+300	1+400	1+500	1+600	1+700	1+800	1+900	2+000	2+100	2+200	2+300	2+400	2+500	2+600	2+700	2+800	2+900	3+000		
Horizontal Alignment	L=1065.4m										TL=200.1m		R=3000.0m L=862.1m						TL=200.0m		R=2304.0m L=2965.2m												
Vertical Alignment	L=153.8m G=0.09%		L=109.2m R=18500m		L=95.6m G=-0.50%		L=368.8m R=18500m				L=396.2m G=1.49%		L=674.6m R=18500m				L=248.4m G=-2.15%		L=87.8m R=18500m		L=711.6m G=-1.68%		L=333.7m R=18500m										
Existing Ground Level	59.4	59.9	60.6	61.1	61.6	62.7	63.8	64.4	65.4	66.8	70.6	72.6	73.1	72.7	72.1	69.8	67.8	67.7	67.2	63.3	59.4	57.9	57.6	57.1	56.5	56.1	56.5	57.6	56.9	57.4	54.1		
Proposed Track Level	63.8	63.9	64.0	63.6	63.1	63.1	63.6	64.7	66.2	67.7	69.2	70.7	72.0	72.8	73.1	72.8	72.0	70.6	68.7	66.6	64.4	62.4	60.7	59.0	57.3	55.6	53.9	52.3	50.6	49.0	47.9		
Cut and Fill	+4.4	+4.0	+3.4	+2.5	+1.5	+0.4	-0.2	+0.3	-0.2	-1.1	-1.4	-1.9	-1.1	+0.1	+1.0	+3.0	+4.2	+2.9	+1.5	+3.3	+5.0	+4.5	+3.1	+1.9	+0.8	-0.5	-2.6	-5.3	-6.3	-8.4	-6.2		
Maximum Speed	230 km/h																																

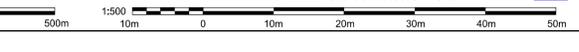
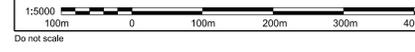
Profile  
Scale H:1:5,000 V:1:500 @ A1

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- Notes**
- Ground level has been derived from 'LIDAR' digital terrain model
  - Engineered footprint uses 1:2.5 earthwork slopes
  - Viaducts assumed across all flood plain locations
  - Earthworks assumed between +/- 15m 'rail to ground' level differences
  - Retained cut assumed for -15m to -22m 'rail to ground' level differences
  - Tunnel portal locations are indicative and based on a limiting 'rail to ground' difference of 22m

- Alignment Design Legend**
- Alignment Centreline
  - Tangent Point
  - Cutting
  - Embankment
  - Viaduct
  - Tunnel
  - Major Contour ; 20m intervals
  - Minor Contour ; 5m intervals

- Environmental Features Legend**
- Historical Battlefields
  - Special Areas of Conservation
  - Special Protection Areas
  - SSSI
  - National Nature Reserves
  - Scheduled Ancient Monuments
  - National Park
  - Park and Gardens
  - Source Protection Zone
  - Area of Outstanding Natural Beauty
  - Ramsar
  - Listed Building Grade I
  - Listed Building Grade II
  - Listed Building Grade II
  - Active Landfill Site
  - Historical Landfill Site
  - In-alienable Land Status
  - Flood Risk Zones



P1	13.12.11	MM	RC	TW
Issue	Date	By	Chkd	Appd



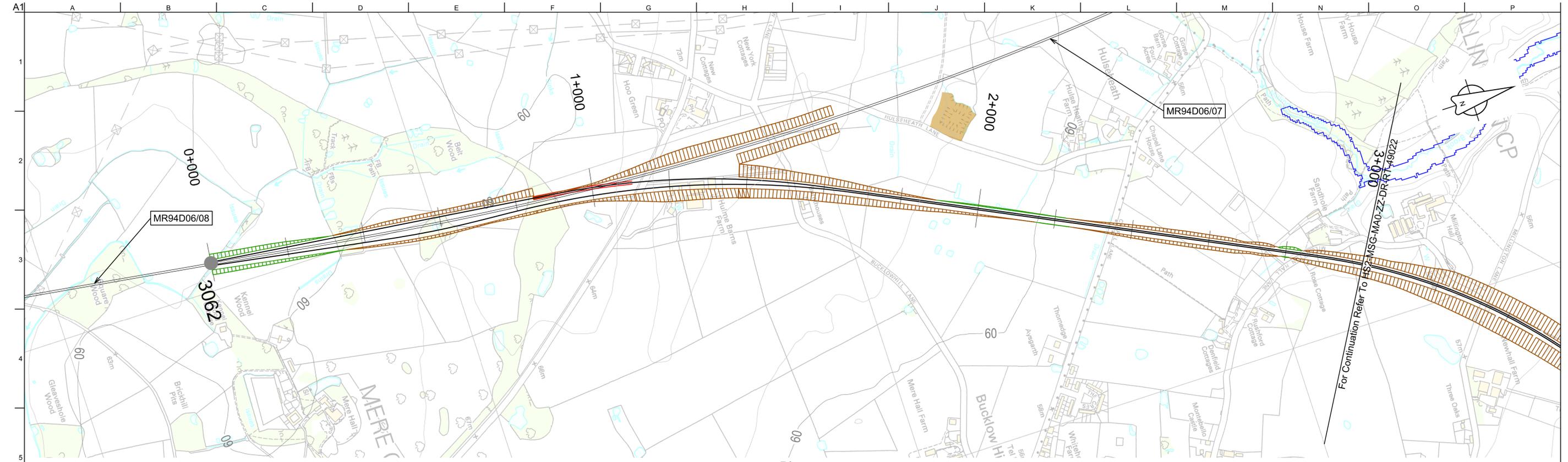
Job Title  
High Speed 2  
West Midlands to Manchester

Scale at A1  
1:5000  
Discipline  
Railway Track

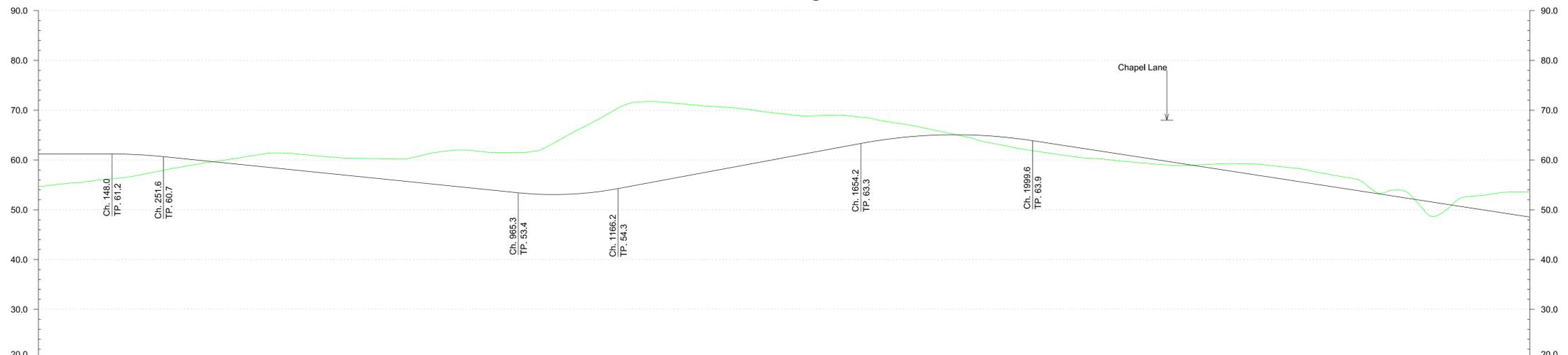


Drawing Title  
Phase 3  
Station Approach Route MA90D01  
Plan and Profile

Drawing Status  
S0  
Job No  
277592  
Drawing No  
HS2-MSG-MA0-ZZ-DR-RT-49011  
Issue  
P1



Plan  
Scale 1:5,000 @ A1



Chainage	0+000	0+100	0+200	0+300	0+400	0+500	0+600	0+700	0+800	0+900	1+000	1+100	1+200	1+300	1+400	1+500	1+600	1+700	1+800	1+900	2+000	2+100	2+200	2+300	2+400	2+500	2+600	2+700	2+800	2+900	3+000		
Horizontal Alignment	L=843.8m										TL=120.0m		R=2050.0m L=563.5m				TL=120.0m		L=1165.3m										TL=160.0m R=1504.0m L=2090.8m				
Vertical Alignment	L=148.0m G=0.00%		L=103.6m R=10200m		L=713.6m G=-1.02%				L=200.9m R=7000m		L=488.0m G=1.85%				L=345.4m R=10200m		L=2580.9m G=-1.53%																
Existing Ground Level	54.6	55.7	56.9	58.8	60.4	61.4	60.5	60.2	61.5	61.6	61.8	66.8	71.6	71.2	70.5	69.2	69.0	67.8	66.0	63.7	61.8	60.4	59.6	58.9	59.3	56.6	57.0	53.3	48.8	52.8	53.6		
Proposed Track Level	61.2	61.2	61.1	60.2	59.2	58.1	57.1	56.1	55.1	54.1	53.2	53.3	54.9	56.7	58.6	60.5	62.3	64.1	65.0	64.9	63.9	62.3	60.8	59.3	57.7	56.2	54.7	53.1	51.6	50.1	48.5		
Cut and Fill	+6.6	+5.5	+4.2	+1.4	-1.2	-3.3	-3.4	-4.1	-6.4	-7.5	-8.6	-13.5	-16.7	-14.5	-11.9	-8.7	-6.7	-3.7	-1.0	+1.2	+2.1	+1.9	+1.2	+0.4	-1.6	-2.4	-2.3	-0.2	+2.8	-2.7	-5.1		
Maximum Speed	170 km/h																																

Profile  
Scale H:1:5,000 V:1:500 @ A1

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Notes

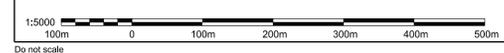
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- Earthworks assumed between +/- 15m 'rail to ground' level differences
- Retained cut assumed for -15m to -22m 'rail to ground' level differences
- Tunnel portal locations are indicative and based on a limiting 'rail to ground' difference of 22m

Alignment Design Legend

- Alignment Centreline
- Cutting
- Embankment
- Viaduct
- Tunnel
- Major Contour
- Minor Contour
- Node

Key Environmental Features Legend

- World Heritage Site
- Ramsar
- Special Areas of Conservation
- Special Protection Areas
- SSSI
- Area of Outstanding Natural Beauty
- National Nature Reserve
- National Park
- Scheduled Monument
- Registered Parks and Gardens
- Historical Battlefields
- Listed Grade I
- Listed Grade II\*
- Listed Grade II\*\*
- Flood Zone 2



P2	20.01.12	MM	RC	TW
P1	13.12.11	MM	RC	TW
Issue	Date	By	Chkd	Appd



Client  
High Speed 2  
West Midlands to Manchester

Scale at A1  
1:5000  
Discipline  
Railway Track

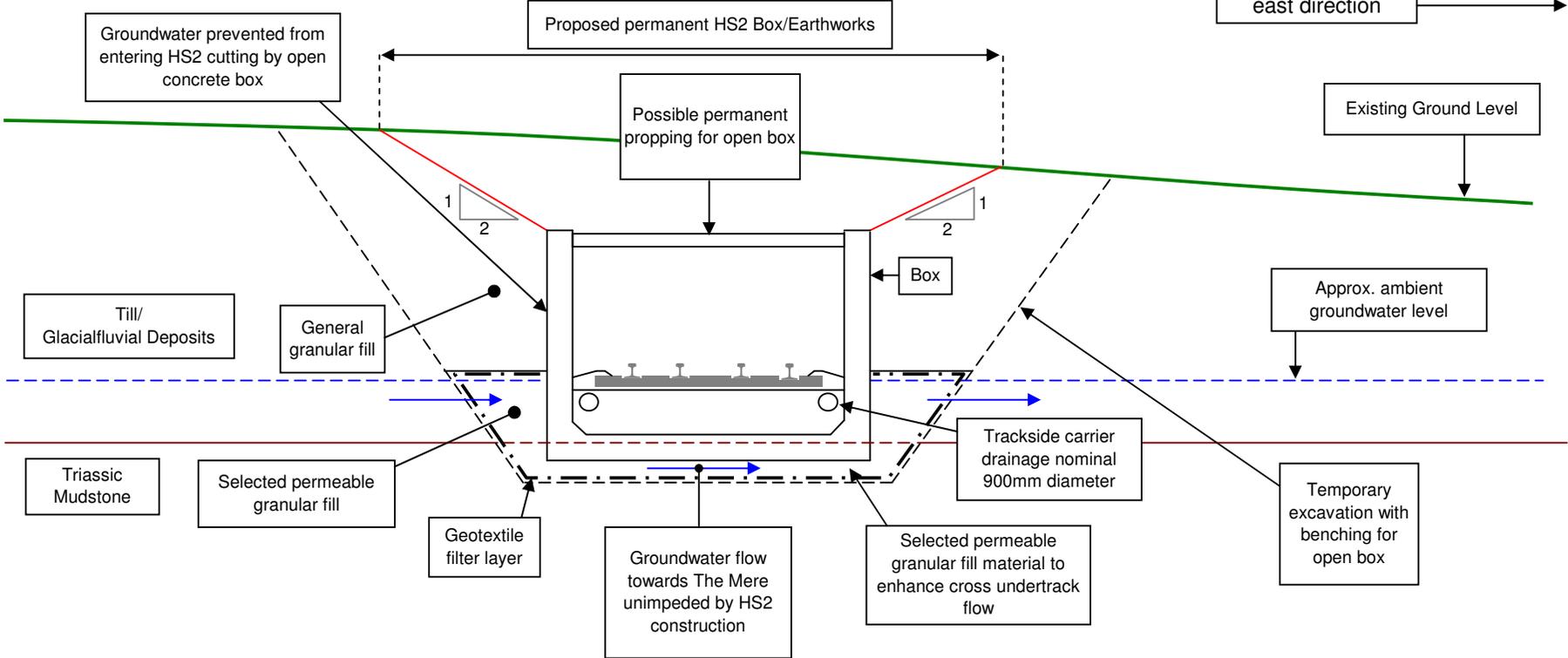


Drawing Title  
Station Approach Route MA90D02  
Plan and Profile  
Sheet 1 of 3  
Drawing Status  
S2  
Job No  
277592  
Drawing No  
HS2-MSG-MA0-ZZ-DR-RT-49021  
Issue  
P2

**NB: Not to Scale  
For concept only**

Hoo Green  
west direction

The Mere, Mere  
east direction



Till/  
Glacialfluvial Deposits

General  
granular fill

Triassic  
Mudstone

Selected permeable  
granular fill

Geotextile  
filter layer

Groundwater flow  
towards The Mere  
unimpeded by HS2  
construction

Selected permeable  
granular fill material to  
enhance cross undertrack  
flow

Trackside carrier  
drainage nominal  
900mm diameter

Approx. ambient  
groundwater level

Temporary  
excavation with  
benching for  
open box

**Schematic Cross Section across HS2 west of The Mere, Mere  
(Option to provide groundwater continuity)**







High Speed Two (HS2) Limited  
Two Snowhill  
Snow Hill Queensway  
Birmingham B4 6GA

08081 434 434  
[HS2Enquiries@hs2.org.uk](mailto:HS2Enquiries@hs2.org.uk)