M42 Junction 6 Development Consent Order

Scheme Number TR010027

6.3 Environmental Statement Appendix 14.2(a) Bickenhill Meadows SSSI – Preliminary Hydrological Investigation Technical Note

Planning Act 2008

Rule 5(2)(a)

The Infrastructure Planning (Examination Procedure) Rules 2010

July 2019

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning
(Examination Procedure) Rules 2010

M42 Junction 6

Development Consent Order 202[ ]

Environmental Statement Appendix 14.2(a) – Bickenhill Meadows SSSI – Preliminary Hydrological Investigation Technical Note

Regulation Number	Rule 5(2)(b)
Planning Inspectorate Scheme Reference	TR010027
Document Reference	6.1
Author	M42 Junction 6 Development Consent Order Team and Highways England

Version	Date	Status of Version
1	July 2019	Submitted for Deadline 3

M42 JUNCTION 6 IMPROVEMENT

BICKENHILL MEADOWS SITE OF SPECIAL SCIENTIFIC INTEREST – HYDROLOGICAL INVESTIGATION TECHNICAL NOTE (V9.1)

Prepared for: HIGHWAYS ENGLAND

Prepared by: AECOM

Project number: 60543032

Quality information

Prepared by	Checked by	Approved by
Tim Jones BSc (Hon) PhD Senior Water Scientist	Owen Tucker BSc (Hon) MSc CEnv MCIWEM Principal Environmental Scientist Philip Smart BSc MSc C Geol FGS Technical Director, Hydrogeology	Jamie Gleave MLPM (Hons) CEnv CSci MIEMA MIEnvSc Associate Director Graeme Cowling CEnv Principal Environmental Consultant

Revision History

Revision	Revision date	Details	Authorized	Position
Version 0	13.02.2018	Original Version	Jamie Gleave	Associate Director
Version 1	09.08.2018	Update – new data	Jamie Gleave	Associate Director
Version 2	15.08.2018	Update – new data	Jamie Gleave	Associate Director
Version 3	20.08.2018 21.08.2018	Update – new data	Jamie Gleave Graeme Cowling	Associate Director Principal Consultant
Version 4	13.09.2018	Update – new data	Jamie Gleave Graeme Cowling	Associate Director Principal Consultant
Version 5	05.10.2018	Update – new data	Jamie Gleave Graeme Cowling	Associate Director Principal Consultant
Version 6	10.10.2018	Update – new data	Jamie Gleave Graeme Cowling	Associate Director Principal Consultant
Version 7	04.12.2018	DCO Version	Jamie Gleave Graeme Cowling	Associate Director Principal Consultant
Version 8	06.03.2019	Update for NE meeting	Jamie Gleave Graeme Cowling	Associate Director Principal Consultant
Version 9.1	01/07/2019	Update – new mitigation proposal	Jamie Gleave Graeme Cowling	Associate Director Principal Consultant

Distribution List

# Hard Copies	PDF Required	Association / Company Name

Prepared by AECOM, AECOM House, 179 Moss Lane, Altrincham, WA15 8FH, UK (www.aecom.com)

Project Number: **60543032**

Certain statements made in the Report that are not historical facts may constitute estimates, projections or other forward-looking statements and even though they are based on reasonable assumptions as of the date of the Report, such forward-looking statements by their nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted.

AECOM specifically does not guarantee or warrant any estimate or projections contained in this Report. Unless otherwise stated in this Report, the assessments made assume that the sites and facilities will continue to be used for their current purpose without significant changes.

FOIA Disclaimer AECOM Limited considers that the following constitutes exempt information on grounds of confidentiality and commercially sensitive information under the terms of the Freedom of Information Act 2000, which shall not be disclosed to third parties. The enclosed information is not to be made available to the public for at least six years from the end of the project, unless specifically agreed otherwise.

Any specific enquiries about what may be commercially sensitive or queries about disclosure should be directed to **ian.bamforth@aecom.com.** We would be grateful to be informed of all requests by third parties for information contained in this document.

Table of Contents

Figures

M42 Junction 6 Improvement Scheme – Bickenhill Meadows SSSI Hydrological Investigation

1. Introduction

1.1 The M42 Junction 6 Improvement (the Scheme) provides connections between the national motorway network and the A45 Coventry Road, which provides strategic access to Birmingham to the west and Coventry to the east. Current congestion and journey reliability issues on the M42 and at Junction 6 are causing severe delays on parts of the strategic road network, as the junction does not have sufficient capacity to accommodate the predicted growth in traffic associated with future planned development in the area.

1.2 The Scheme has been developed by Highways England to provide a solution to improve junction capacity, support economic growth, improve access, and ensure the safe and reliable operation of the network.

1.3 The Scheme is currently being subject to a process of Environmental Impact Assessment (EIA), the design of which includes the following key components and works.

- A new junction approximately 1.8km south of the existing Junction 6 off the M42 (referred to as M42 Junction 5A).
- A new 2.4km long dual carriageway link road between M42 Junction 5A and Clock Interchange, with a free flow slip road to the A45 Coventry Road.
- Capacity and junction improvements at Clock Interchange.
- New free flow links between the A45 and M42 motorway at M42 Junction 6.
- The realignment and modification of the B4438 Catherine-de-Barnes Lane, Clock Lane and St. Peters Lane west of the M42 motorway, and of Eastway and the Middle Bickenhill Loop north east of M42 Junction 6.
- Modifications to the location and spacing of emergency refuge areas, overhead gantries and message signing along the M42 motorway.
- Modifications to the Warwickshire Gaelic Athletic Association (Páirc nah Éireann) sports facility.

1.4 A Ground Investigation has been undertaken to establish the existing ground conditions that would underlie key areas of the Scheme, and to obtain data for use in the Environmental Impact Assessment.

1.5 The proposed mainline link road is positioned below the flight path control zones of Birmingham Airport, and much of the dual carriageway is in cutting (up to 10m depth) in order to lower the road and thereby provide visual screening and noise attenuation benefits; however, construction of these earthworks has the potential to disrupt groundwater flows in the area.

1.6 The EIA process has so far identified that the new mainline link road may also have a potential adverse impact on Bickenhill Meadows Site of Special Scientific Interest (SSSI), which consists of two separate units located either side of the new mainline link road. The SSSI includes areas of wet woodland and wet meadows that support a range of plants and other species. The cutting and associated works are also in close proximity (within 300 m) of streams that flow through each SSSI unit, which may be impacted during the construction and operation phases.

1.7 Accordingly, the processes for maintaining the hydrology of the two SSSI units needs to be established in order to identify and understand the potential impacts of the Scheme on the SSSI, such that appropriate mitigation measures for any likely significant effects can be identified and, where possible, incorporated into its design. In particular, the importance of rainfall, groundwater, nearby streams and localised flooding needs to be investigated.

1.8 This Technical Note reports the outcomes of a hydrological investigation of the two SSSI units. It considers the soil and geological ground conditions from available data sources, the topography around the SSSI by reviewing LiDAR and contour data, and reports on the observations made during site visits (including one attended by Natural England) and monitoring. Based on preliminary findings, this Technical Note also considers the potential effects of the cutting and loss of surface water catchment, describing the scope of additional ground and field investigations that have been undertaken in liaison with Natural England. The findings of the investigation are reported and developed into a conceptual model of each SSSI Unit, and potential mitigation and compensation measures are also discussed.

2. Mainline Link Road

2.1 The current general arrangement for the mainline link road is shown in Figure 1, set within its local context.

2.2 From M42 Junction 5A, the mainline link road would initially travel north westwards through open fields to the north of Hampton Lane Farm, where it would cross a number of public rights of way. A roundabout would be constructed (Barber's Coppice Roundabout) south of the SSSI which would provide a tie-in from the existing Catherine-de-Barnes Lane (both in a north and southbound direction) to the new mainline link road.

2.3 As the new mainline link road continues north, it would cross Catherine-de-Barnes Lane approximately 70m south of the T-junction of Shadowbrook Lane. Approximately 500m north of the crossing point with Catherine-de-Barnes Lane, a second local roundabout (Bickenhill Roundabout) would be constructed to provide a north and south tie-in with Catherine-de-Barnes Lane and St Peters Lane. Between these two local roundabouts, Catherine-de-Barnes would be realigned at its furthest point approximately 20m west of its current alignment.

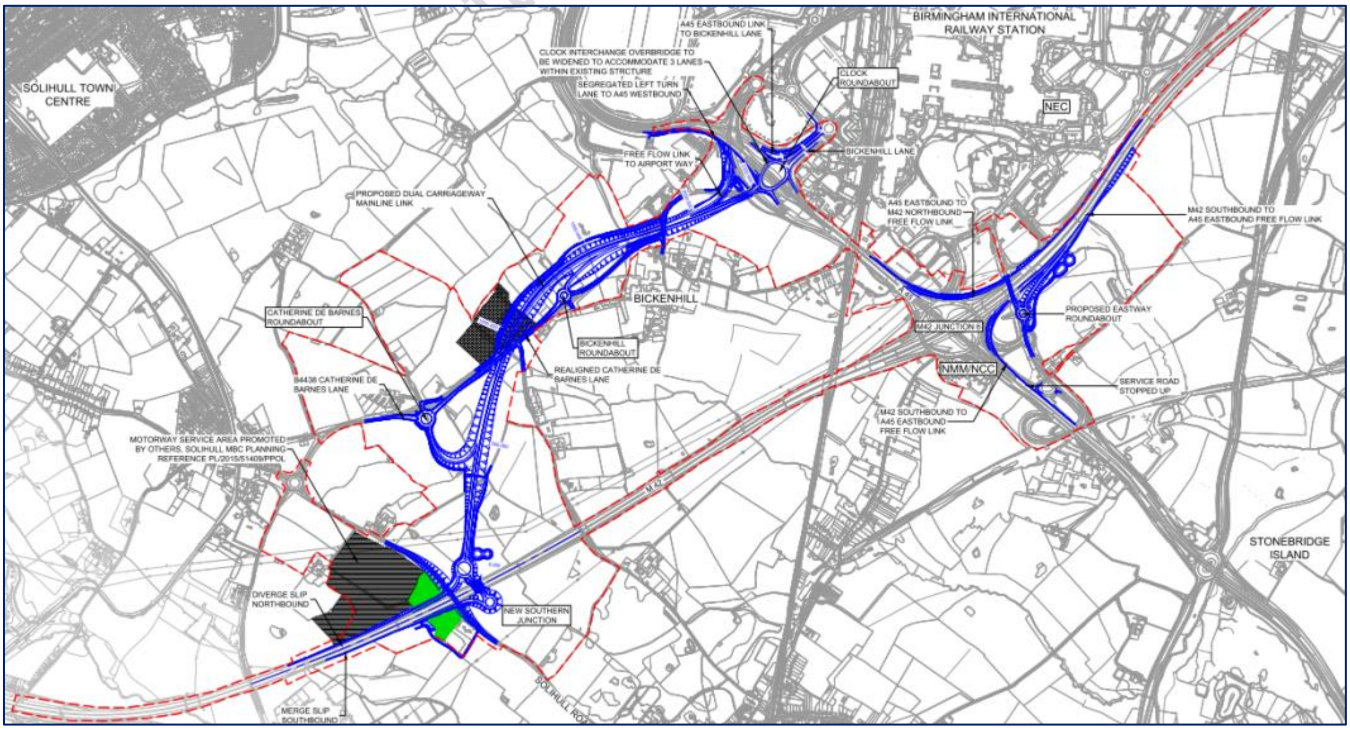


Figure 1: M42 Junction 6 Improvements – General Arrangement
(source: extract from drawing HE551485-ACM-HGN-M42_GEN_ZZ_ZZ-DR-CH-0012 P02.3)

2.4 Figure 2 shows the Scheme in relation in the SSSI units.

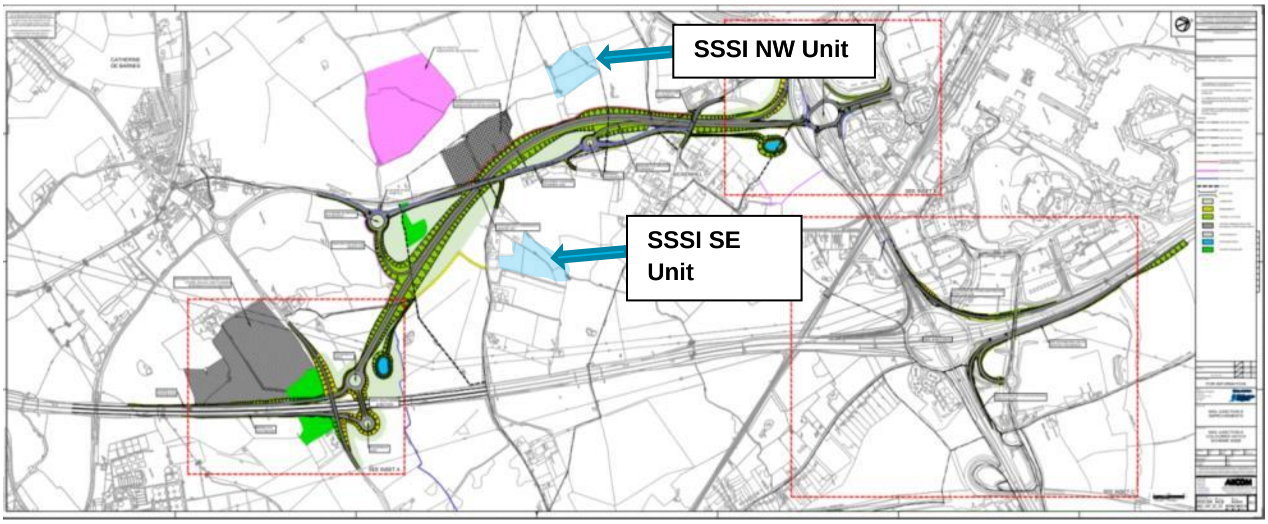


Figure 2: M42 Junction 6 design in relation to Bickenhill Meadows SSSI units (note that this is an earlier design). Figure 1 shows the latest Design Fix (3C).

3. Bickenhill Meadows SSSI Designation

3.1 Bickenhill Meadows SSSI is split between two units, located either side of Catherine-de-Barnes Lane (centred on approximate national grid references SP182822 and SP188816) as shown in Figure 2 and on Ordnance Survey mapping in Figure 3. The total area designated covers 7.2 hectares and was notified in 1991. The northwest unit is known as the 'First Castle Meadow Unit' (hereafter referred to as 'NW Unit') and the southeast unit is known as 'Shadowbrook Meadows Unit' (hereafter referred to as 'SE Unit').

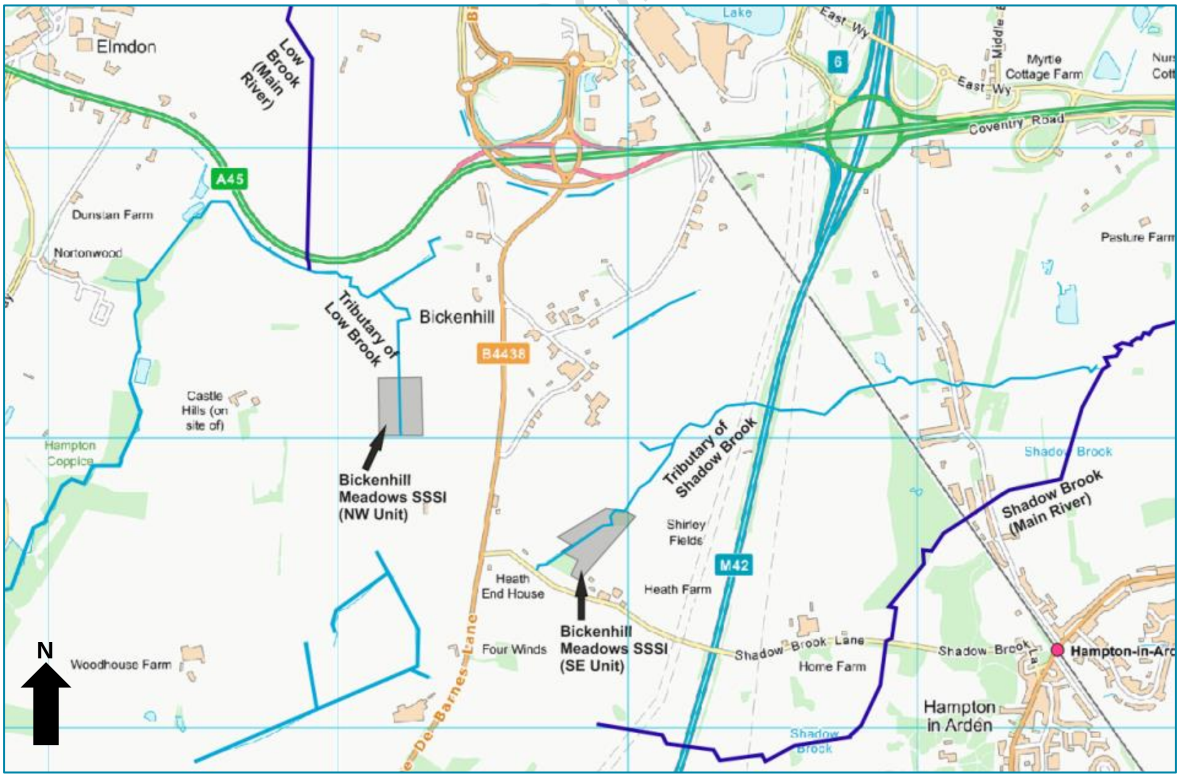


Figure 3. Location of the Bickenhill Meadows SSSI units, to west of the M42 Junction 6. (source: Ordnance Survey © Crown copyright and database rights 2018).

3.2 The Natural England citation[1] for the SSSI is as follows.

[1] https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S1002847

"Bickenhill Meadows consists of two groups of fields comprising species-rich grassland situated to the south and west of the village of Bickenhill on predominantly neutral soils overlying Keuper Marl.

The meadows comprise one of the richest grassland floras in the county with good examples of both meadow foxtail (Alopecurus pratensis), great burnet (Sanguisorba officinalis), flood meadow and common knapweed (Centaurea nigra), crested dog's-tail (Cynosurus cristatus) meadow and pasture. Both grassland types have declined very severely nationally in the 20th century due to agricultural improvement. The West Midlands Region contains a major part of the national resource of the common knapweed – crested dog's-tail grassland type which is typically associated with level topography, loam or clay soils, moderately free drainage and the retention of traditional farming methods with small fields. There is a complex pattern of vegetation resulting from local variations in topography and drainage, such as the ridge and furrow pattern, evident in some of the fields. This has led to the development of mosaics where the main vegetation types intermingle, as well as to areas where each type can be recognised.

Further interest is provided by wetter areas characterised by rushes Juncus spp., sedges Carex spp. and tall herbs such as meadowsweet (Filipendula ulmaria) and great burnet. Both groups of meadows have streams and there is a good range of tree and shrub species in the hedgerows around the fields".

3.3 Both units of the SSSI have a status of 'Unfavourable – Recovering'. However, the Natural England condition notes indicate that the southeastern SSSI shows a good cover of desirable species and may move to favourable in the near future.

3.4 Natural England's Management Principles for the site includes the following information with regard to drainage, "*For both the damper pastures and meadows, regular and careful maintenance of surface drainage including ditches and drains can be essential to prevent adverse changes in the plant composition of the sward. Deepening of surface drainage should be avoided.*"

3.5 From the available information on the SSSI it is clear that the plant species in the wet meadows and woodland areas within the SSSI units require wet ground conditions, although subtle changes in topography and local features (such as the local ditches and spoil heaps from past clearing of them) exert an influence on the botanical communities and distinctive zones of MG4 (wetter) and MG5 (drier) plant communities according to the National Vegetation Classification (NVC). It is also not evident from Natural England's SSSI designation and management principles, or through consultation with Natural England and the Warwickshire Wildlife Trust (WWT), whether the maintenance of wet conditions in the SSSI is primarily dependent on surface water or groundwater inflow from the surrounding areas.

4. Shadowbrook Meadows Local Nature Reserve

4.1 The southeastern Unit is wholly encompassed by the larger Shadowbrook Meadows Local Nature Reserve (LNR), which is owned and managed by WWT. The WWT website[2] describes the site as follows:

"*The site contains old meadows and pasture with a stream and wet woodland. The small stream runs through the reserve and sumptuous hedgerows divide the site into two dry meadows, on the eastern side, with two wet meadows to the west. Unfertilised, unsprayed and unploughed, the meadows' diversity has been maintained over centuries by the unaltered, traditional haycutting and grazing regime*".

[2] Warwickshire Wildlife Trust – Shadowbrook Meadows website, http://www.warwickshirewildlifetrust.org.uk/reserves/shadowbrook-meadows, accessed 15/8/18.

5. Bickenhill Meadows SSSI / Shadowbrook Meadows LNR Site Visit Report

5.1 The Bickenhill Meadows SSSI was initially visited on 18 January 2018 in dry conditions but following a week of occasional heavy rain showers and some light snow and sleet showers. It was subsequently visited in spring with representatives of Natural England on 26 April 2018 in a period of prevailing dry conditions, and again on 2 May 2018 following 12 hours of heavy rain showers, which had resulted in some waterlogging of the surface. The NW Unit was visited during wintry showers on the 28 February 2018 and with Natural England on 26 April 2018 in fine weather. Numerous further visits have been made to both units between the summer of 2018 and summer of 2019.

Southeast (SE) SSSI Unit / Shadowbrook Meadows LNR

5.2 The southeastern unit consists of four fields (three of which are in the SSSI boundary) and wet woodland at the far north of the site, and (along with the LNR) covers 4.4ha. The stream that flows through the centre of the site (from southwest to northeast) is a tributary of Shadow Brook. It meets Shadow Brook to the east of the M42 approximately 2km downstream at NGR SP 20625 82231. The dry meadows are to the east of the site, and wet meadows are to the west. General views of the wet meadows are shown in Photos 1 to 6 under different conditions.

5.3 The topography of the site is generally level, with a gentle rise in elevation away from the tributary of Shadow Brook, which flows through the approximate centre of the site. The wet meadow to the north of the brook is relatively flat and may have been the route of the former watercourse prior to digging of the new brook course to the south and the ephemeral ditch to the north (which collects runoff from the steeper hillside slopes but is essentially a soakaway).

5.4 Along the edge of the brook there is a slight rise in the elevation that may be a relic of digging out or maintaining the brook. From here north the land gently falls before rising towards the ditch along the northern boundary of the SSSI. Within this general topographic form are isolated depressions that form part of a complex ridge and furrow pattern extending across the site, and which are a relic of historic ploughing practices. This is very subtle with only small changes in elevation of the order of tens of centimeters, but sufficient enough to result in significant changes in plant communities as depicted by the varying position of MG4 and MG5 plant communities. Ground elevation decreases slightly to the northeast as the stream flows downslope, but the overall gradient across the site is minor.

5.5 To the south of the brook, the ground rises more steeply away from the watercourse and the plant communities appear to be less diverse and well developed. A gas main runs east-west across this field, the route indicated by a line of flushes suggesting that soil hydrology has been locally affected. Due to the intervening presence of the brook, the elevation of this field, and the angle of the slope, it is unlikely to be affected by the Scheme.

5.6 There is a small pond towards the centre of the southern field of the LNR site (but not within the SSSI) with emergent reed vegetation and which is surrounded by a stock proof fence (see Photo 2). The origins of the pond are not known, but when observed in very wet conditions a ‘trickle’ of water flowed from the pond and overland to the north to ultimately meet the tributary of Shadow Brook, possibly as a result of any undersoil drainage being blocked. During the late summer of 2018 this pond was completely dry.






Photo 1 (top left) and Photo 2 (top right) Wet meadow fields at Bickenhill Meadows SSSI SE Unit / Shadowbrook Meadows LNR in cold/wet conditions; Photo 3 (middle left) Wet meadow fields at Bickenhill Meadows SSSI SE Unit in warm/dry conditions; Photo 4 (middle right) and Photo 5 (bottom left) Bickenhill Meadows SSSI SE Unit in warm/dry conditions; Photo 6 (bottom right) Bickenhill Meadows SSSI SE unit southern field after a prolonged period of hot summer weather.

5.7 The source of the tributary of Shadow Brook is mapped by Ordnance Survey as being immediately north of Shadowbrook Lane to the south of the SE Unit. Here lateral ephemeral drainage ditches from the road coalesce and flow north beneath the caravan park site and emerge at the southern border of the SSSI. There is a pond on the opposite (south) side of Shadowbrook Lane to the mapped source of the stream, which collects water from the adjacent road and agricultural drainage from the arable field opposite the LNR. This field includes a small ditch of around 0.5m width, which flows from Catherine-de-Barnes Lane in a northeasterly direction towards the LNR and SSSI. Catherine-de-Barnes Lane marks the watershed boundary, and all surface water in this upper section of the SSSI's catchment is expected to be channeled towards this agricultural ditch and collects in the pond adjacent to Shadowbrook Lane, which is a natural focal point for drainage to collect. Although there was no obvious culvert beneath the road it is believed that runoff finds its way under Shadowbrook Lane either through unknown drainage network or subsurface flow. Significant amounts of standing water have been observed in the ditches either side of Shadowbrook Lane after heavy rainfall in winter and spring and potentially indicate impeded flow beneath the road, presumably due to siltation and blockage by large woody debris and decomposing organic matter. In summary, it appears that the brook is likely to be rain fed, receiving drainage also from surrounding agricultural land and Shadowbrook Lane. There may also be drainage from the small caravan park site under which the brook flows prior to emerging in the SSSI.

5.8 Given its small size, intermittent and generally low flows, the brook is expected to suffer from water quality issues typical of an arable catchment, plus drainage from local roads and potentially other sources, such as runoff from the caravan site.

5.9 There is also an ephemeral drainage ditch bordering the northwest of the site (Photo 7), which varies between 1m and 1.5m wide. This was largely dry on the majority of site visits, with some ponded water in places of 1-2cm depth adjacent to the upper wet meadow. However, when observed after heavy rain there was obvious flow in the ditch, which presumably was sourced from runoff from the adjacent arable field which slopes significantly down to the SSSI. As the ditch enters the alder woodland at the northern extent of the SSSI there was a small amount of flow even during the drier site visits, which drains into the tributary of Shadow Brook (approximate NGR SP 18950 81743), see Photo 8.

Photo 7 (left) Ponded water in agricultural drainage ditch at NW border of SE Unit; Photo 8 (right) confluence of the tributary of Shadow Brook and the drainage ditch within the alder woodland; Photo 9. Furrows and depressions saturated with water following rainfall in meadow field of SE Unit.

5.10 Within the SE Unit the tributary of Shadow Brook is very straight and could have initially been an agricultural drainage ditch. It is around 0.5m wide and water depth was in the region of 3-5cm when observed on the site visits on the 2 May 2018 (Photos 10 and 11). The bed was generally covered by accumulations of fine sediment (and leaf litter in the autumn), although some small accumulations of gravel of 4-5mm in diameter were also evident.

5.11 Towards the centre of the SE Unit the brook is culverted under a grassed land bridge through a plastic pipe of around 400mm diameter (Photo 12). Upstream the culvert is partially buried, and there is potential for impoundment of flow during extreme rainfall events, which may result in occasional flooding of the immediate grasslands, although there was no evidence of this. Several blockages across the stream from woody debris and accumulations of leaves were observed during the site visits, which again could cause localised impoundment of flows and encourage local out of bank events. Connectivity to the surrounding floodplain is good in some sections, particularly on the left bank in the northern field. However, the stream is not considered significant enough in size to cause widespread out of bank events across the grasslands and woodland, and Natural England and WWT are not aware of any widespread flooding at the site resulting from out of bank stream flows. However, the brook may locally support groundwater levels in the close vicinity of the channel, and it is possible that soil on either side has been compacted in places due to the past placing of dredgings, and this may influence soil hydrology on the upslope side by helping to maintain wetter ground conditions.

5.12 In the northeastern (wet) field of the SE Unit, the ridge and furrow topography gives rise to diverse ecological communities. The furrows tend to be saturated and support grassland species designated as MG4 under the National Vegetation Classification (NVC). MG4 represents a nationally rare flood meadow community. Characteristic species include greater burnet (*Sanguisobra officinalis*) and meadowsweet (*Filipendula ulmaria*). The ridges are drier and support MG5 neutral grassland species with assemblages of English crested dog's tail (*Cynosurus cristatus*) and common knapweed (*Centaurea nigra*), amongst others. Subtle changes in colour across the wet meadow, shown in Photo 1, indicate the changes in vegetation across the site.

5.13 When the SE Unit was observed following heavy rainfall on 2 May 2018 the entire site was extremely wet, with most grassland areas appearing to be fully saturated (Photo 9). All furrows and depressions that were observed during the visit contained surface water, including in the generally drier meadow fields. This observational evidence indicates that the moisture source for the wet grasslands is most probably rainwater, which is slow to drain away due to the poor permeability of the surface layers.



Photo 10 (left) and Photo 11 (centre): Tributary of Shadow Brook within the wet woodland. Photo 12: (right) Culvert exit downstream of the grassed land bridge.

Northwest (NW) SSSI Unit

5.14 The NW Unit is a small, roughly square grassland area of 2.7ha, bordered on all sides by a scrub and woodland margin (Photo 13). A tributary of Low Brook flows from south to north and divides the field approximately in half, with the topography rising away from the tributary gently on both sides initially, becoming steeper further afield. The brook itself is surrounded by intermittent hedgerow vegetation. Immediately south of the site is a historic landfill site of raised elevation, from which groundwater (of unknown quality) may flow out towards the SSSI, as indicated by iron staining seeping from the embankment.

5.15 The watercourse appears to emanate from numerous ephemeral drainage ditches which flow around the elevated historic landfill area and coalesce at the south of the site to then flow north through the SSSI. A further drainage ditch flows north along the western boundary of the site. As the watercourse flows north through the SSSI unit it widens out into a very silted marshland area, with little discernable surface water flow (Photo 14), before reverting to a well-defined stream of up to 2.5m wide (Photo 15) which has generally good floodplain connectivity within the SSSI, and emergent macrophytic vegetation in places. The watercourse is not considered of sufficient size to cause significant flooding of the adjacent fields.



Photo 13 (left), Photo 14 (centre) and Photo 15 (right). Bickenhill Meadows SSSI NW Unit.

5.16 Vegetation patterns on the eastern side of the SSSI indicate that there may be an isolated wetter area just upslope of the tributary of Low Brook towards the centre of the site. This is indicated by a slightly raised area with a distinct and 'spongey' vegetation assemblage, which is different in character from the surrounding communities of MG4 grasslands (including great burnet (*Sanguisorba officinalis*) and meadowsweet (*Filipendula ulmaria*) and MG5 grasslands (including knapweed (*Centaurea nigra*)) that are found across the eastern field of the site. The wetter ground conditions may also be influenced by dredged material placed in a bund along the eastern bank, which may be compacting the soil below and reducing permeability.

5.17 The western field has a generally drier and more uniform character than the eastern field (Photo 16), and is at a slightly greater elevation than the eastern field. The spatial distribution of the MG4 and MG5 grasslands across both fields is a likely consequence of local variability in moisture content in the upper 30-40 cm of soil, with tussocks and ridges across the site providing slightly drier conditions than localised depressions and troughs.

Photo 16 (left) – eastern field within the NW Unit showing the fringing blackthorn trees.

Photo 17 (right) tributary of Low Brook immediately north of the SE Unit boundary looking towards Birmingham Airport.

5.18 As the tributary of Low Brook flows out of the SSSI to the north of the site, the watercourse becomes a perfectly straight (artificially straightened), deeply incised drainage channel with a width of around 1m (see Photo 17). This flows north to Low Brook, which is then culverted beneath the Birmingham Airport runway.

6. Ground Condition and Soils

6.1 According to the British Geological Survey's Geology of Britain website (http://mapapps.bgs.ac.uk/geologyofbritain3d/) the bedrock geology beneath both SSSI units is Sidmouth Mudstone Formation (Mercia Mudstone) (Figure 4). No superficial deposits are recorded below the SE Unit, while alluvium (clay, silt, sand and gravel) is mapped around the stream through the NW Unit (Figure 5).

6.2 The alluvium deposits at the NW Unit are Secondary 'A' aquifer. The Sidmouth Mudstone Formation is classified as Secondary 'B' aquifer. Secondary A aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. Secondary B aquifers are predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

6.3 Borehole records collected from historic ground investigations undertaken during the development of the M42 motorway in the 1970s and 1980s showed that groundwater was generally encountered within 10m of the ground surface adjacent to the M42 at Junction 6. The nearest borehole records for the NW Unit shows a depth to groundwater of 6.75m at the western extent of the SSSI (within 50m of the NW corner of the SSSI), as recorded in 1978 (reference SP18SE/511)[3], and the borehole log indicates sand and gravel pockets within clay to a depth of 4.7m. Another borehole approximately 130m to the south of the SSSI had a depth to water of 3.0m, also in 1978 (reference SP18SE/510)[4]. The borehole log indicated sandy clay and gravel to a depth of 1.3m, with stiffer clay below to a depth of 5.8m, underlain by mudstone.

6.4 Further ground investigations were undertaken to the north of the NW Unit in 2011 in relation to the Birmingham Airport runway extension and re-routing of the A45[5]. The nearest borehole was located approximately 250m north of the SSSI unit, adjacent to the tributary of Low Brook (i.e. towards the valley bottom). This borehole (reference CP26) indicated slightly gravelly sandy clay with gravelly sand lenses to 2.2m, underlain by Mercia Mudstone, with groundwater struck at 4.2m depth (in October 2011). A borehole approximately 380m north of the SSSI (reference CPRC31) recorded slightly sandy clay to 1.65m underlain by Mercia Mudstone. No groundwater was encountered in October 2011.

6.5 There are no historic borehole records in the immediate vicinity of the SE Unit. The nearest is 340m to the east of the site (SP18SE/26B) and was drilled as part of the ground investigation for the M42 in 1970. This borehole had a depth to water of 11.05m. The borehole log indicates that the upper layers consisted of silty clay (weathered mudstone), with lumps of hard mudstone apparent from 4.45m depth, and weathered mudstone extending to the borehole base at 13.55m.

6.6 According to the Environment Agency there are no groundwater abstractions within 3km of either SSSI unit. Solihull Metropolitan Borough Council has confirmed that there are five known Private Water Supplies within 2km of the site, although exact locations have not been provided.

6.7 No springs are marked on current Ordnance Survey mapping in the immediate vicinity of the SSSI units, or on historical mapping that is available online. The nearest spring is marked ('issues' on Ordnance Survey mapping) approximately 500m to the southeast of the SE Unit at the source of Shadow Brook. When visited on site on 27 October 2017, Shadow Brook was completely dry at

[3] British Geological survey, Geology of Britain website, available at http://mapapps.bgs.ac.uk/geologyofbritain3d/index.html (accessed 20/5/18)
[4] British Geological survey, Geology of Britain website, available at http://mapapps.bgs.ac.uk/geologyofbritain3d/index.html (accessed 20/5/18)
[5] Birmingham Airport (December 2011) Factual Report on Ground Investigation for the Proposed Runway Extension at Birmingham Airport,

its source and along its channel until east of the M42. This suggests that there may be low groundwater levels, or that there may only be an ephemeral groundwater input to the stream at times of high groundwater level conditions. While several pockets of sand and gravel that could contain groundwater are mapped in the area, particularly on higher ground, these do not extend to the SSSIs, although this may simply due to a lack of available information in the BGS records. A ground investigation for the Scheme has been undertaken to help clarify the full spatial location of the sand and gravel pockets, and this is discussed further later in the report.

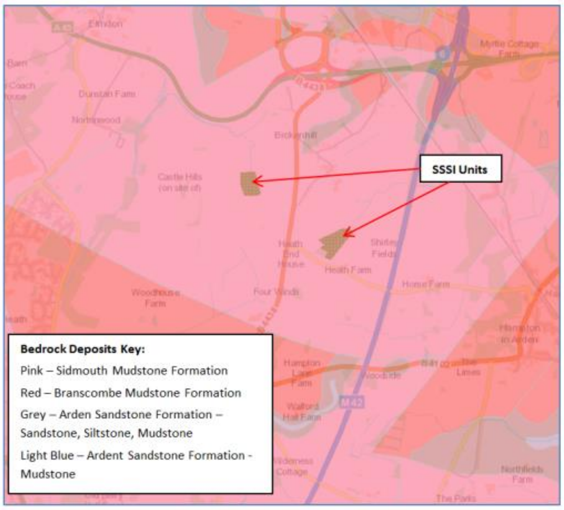


Figure 4. Bedrock deposits in the area around Bickenhill Meadows SSSI (source: British Geological Survey Geoindex website, http://www.bgs.ac.uk/geoindex).

Figure 5. Superficial deposits in the area around Bickenhill Meadows SSSI (source: British Geological Survey Geoindex website, http://www.bgs.ac.uk/geoindex).

6.8 Cranfield University's Soilscapes website (http://www.landis.org.uk/soilscapes/) indicates that the soil across the study area, including both SSSI units, is slowly permeable seasonally wet slightly acid base-rich loamy and clayey soils. Habitats typically associated with such soils are seasonally wet pastures and woodlands.

7. Topographic Survey

7.1 LiDAR topographic data has been obtained from the UK Government's Open Data website (https://data.gov.uk/) for the area covering the two SSSI units. This is shown in Figure 6 overlain onto Ordnance Survey Mapping. The surrounding topography is also shown in contour form in Figure 7. Areas of the highest elevation (shown as pale green shading in Figure 6) are located: i) immediately to the east of the NW Unit; ii) at Bickenhill village; iii) at Catherine-de-Barnes Lane north of the Shadowbrook Lane junction; and iv) close to Four Winds to the south of the SE Unit. Areas of progressively lower elevation are found along the streams that flow through each SSSI (yellow to light brown to dark brown shading).

7.2 Around the SE Unit the topography gently declines in elevation from the east, south and west towards the tributary of Shadow Brook, which has gentle valley slopes surrounding it as it flows to the northeast. Similarly, the NW Unit has slopes falling away from the east, south and west, with a gentle valley forming to the north as the stream in the SSSI flows towards Low Brook. A series of topographic sections have been derived from the LiDAR data. The section lines are indicated and labelled in Figure 6, and are all presented in Annex A.

7.3 It is clear from the sections that there is a general decline in elevation from east to west towards the NW Unit (sections A-C). This is essentially a valley side to the tributary of Low Brook. As the new dual carriageway would be located to the east of the NW SSSI (see Figures 1 and 2) there is potential for flow pathways between the Scheme and the downslope SSSI. If construction and operational runoff was not properly controlled, and appropriate mitigation measures not put into place, then there could be adverse impacts to habitats and water quality within the SSSI unit from this runoff. However, the Scheme includes mitigation for all potential adverse impacts from road drainage and spillage incidents during construction and operation.

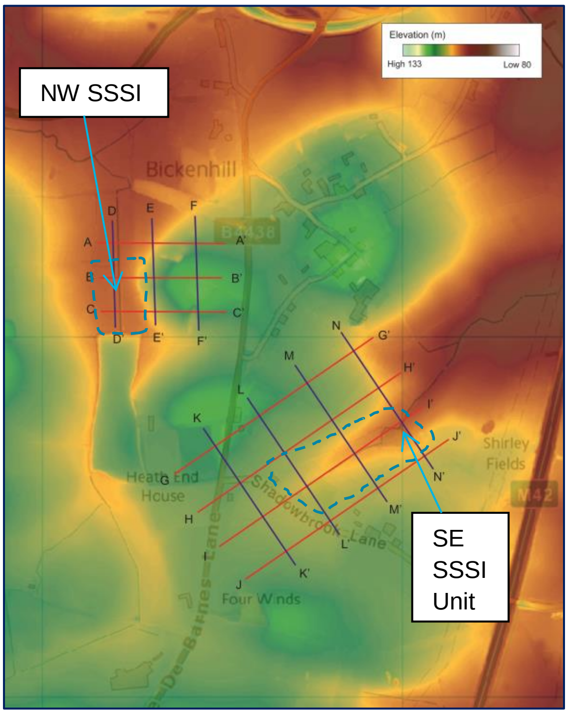


Figure 6. LiDAR data (source: UK open data website) overlain on Ordnance Survey data (crown copyright and database rights 2018 Ordnance Survey). Solid lines indicate locations of topographic sections, as shown in Annex A. Dashed lines indicate approximate SSSI locations. The figure shows a surface water divide between the two sites running NE-SW.

7.4 There is also a decline in elevation from south to north towards the NW Unit (sections D-F). This includes a field directly south of the SSSI unit which is elevated in comparison to the surrounding land, and is a former landfill site.

7.5 The topographic long sections for the SE Unit (sections G-J) indicate a general decline in elevation from the south of Shadowbrook Lane towards the SSSI, while the cross sections (sections K-N) indicate gentle valley slopes rising each side of the watercourse. As designs indicate that the new dual carriageway will cross Catherine-de-Barnes Lane just south of the Shadowbrook Lane junction, and will continue in a southeast direction (Figure 8), there is potential for surface water flows between the Scheme and the SSSI unit.

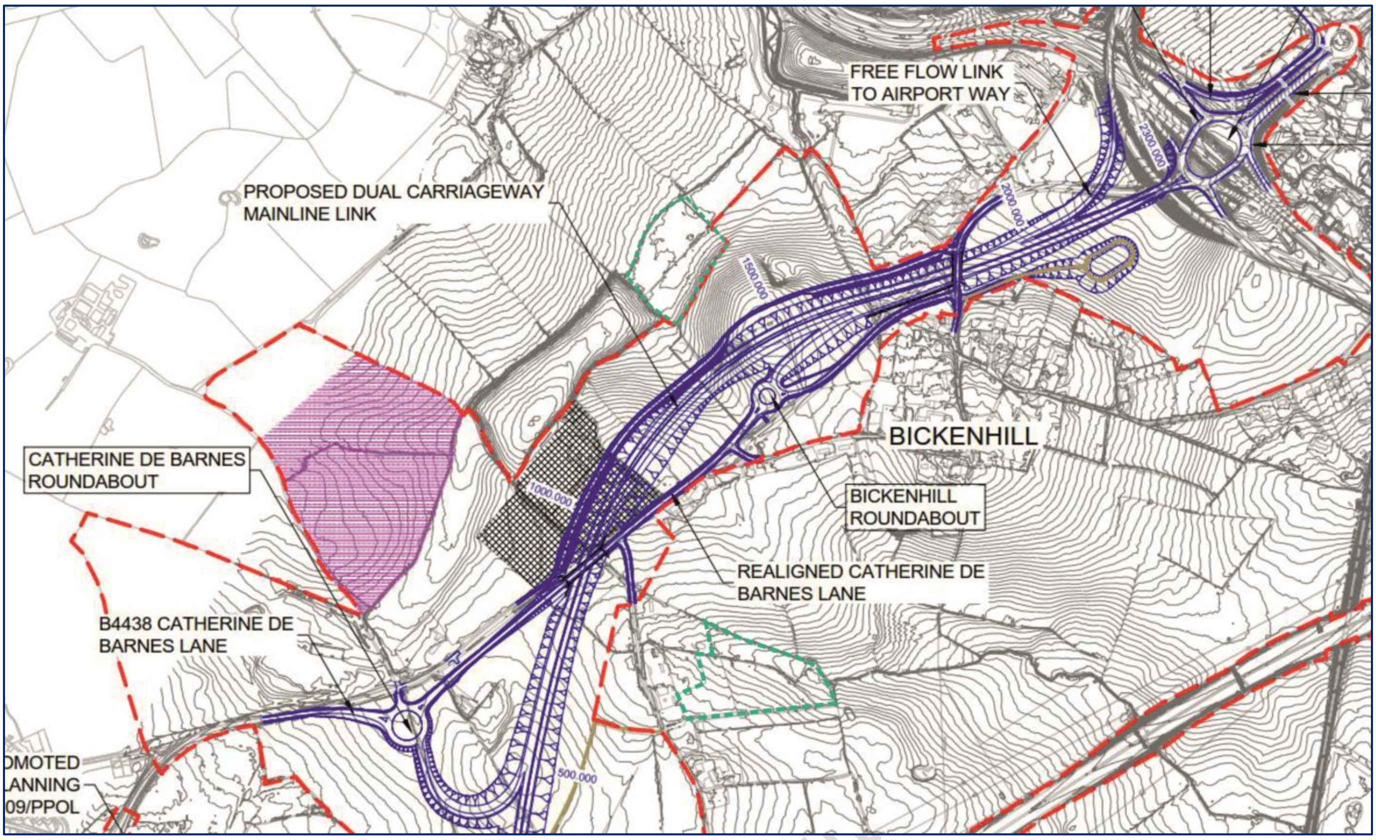


Figure 7. Contour map to show topography surrounding the two SSSI units. SSSI units are outlined in a green dashed line, with the Scheme red line boundary shown in red (which has since been modified). Contours were derived from topographic survey undertaken at PCF Stage 2 for the Scheme.

7.6 In Figure 8, the surface water catchments for each SSSI unit have been derived from the LiDAR data. The NW Unit has a noticeably larger catchment than the SE Unit, and extends a considerable distance to the southwest where it is interrupted by the Grand Union Canal near Catherine-de-Barnes. On the basis of the approximate road alignment shown in Figure 8, the proportion of the catchments that is lost below the footprint of the road and is cut off from the catchment due to the new mainline link road for each SSSI unit would be 4.7% for the NW Unit and 21.4% for the SE Unit, based on Design Fix 3C.

7.7 The site observations and topographic investigation of LiDAR data suggest that surface water flows are important contributors to the habitats in the two SSSI units, particularly in the close vicinity of the channels. However, significant flooding of the units is very unlikely and it is more likely that rainfall combined with the ridge and furrow topography and localised hillslope runoff is the most significant source of water controlling the hydrology of the wet meadows. The role of groundwater flow is uncertain.

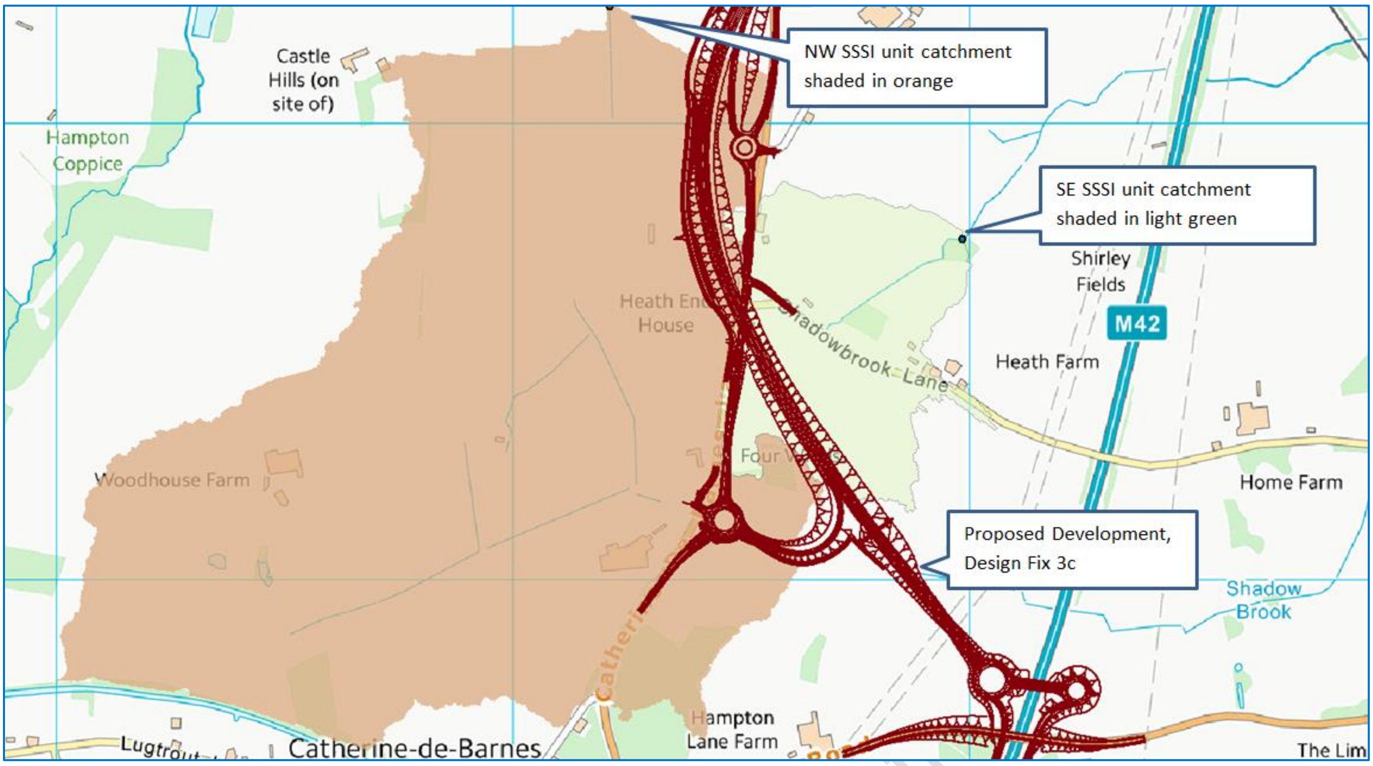


Figure 8. Catchment boundaries as determined from GIS catchment analysis, with the Design Fix 3C road alignment overlain in red.

8. Ground Investigation

8.1 The main Ground Investigation undertaken as part of the Scheme provided some understanding of groundwater levels across the area, but did not initially include investigations in the immediate vicinity of the SSSI units and determination of the extent to which groundwater levels may intersect with the wet meadows and woodlands.

8.2 The design of the new mainline link road indicates that in places the cuttings will have a depth of up to 10 m below existing ground level. Adjacent to the SE Unit, the cutting would have depths varying between 5 and 8m below existing ground level, while adjacent to the NW Unit depths would be between 0 and 9m lower than existing levels. The potential for drawdown of groundwater is thought to be greatest where the cutting will intersect patches of glacial sands and gravel and Arden Sandstone. There are no mapped Arden Sandstone outcrops adjacent to the SSSIs that would be impacted by the cutting (see Figure 4), but there are deposits of glacial sands and gravels as indicated in Figure 9 and 10. Dewatering of these deposits due to the road could impact on lateral groundwater flow towards the SSSIs, and it remains a possibility that they are more extensive than current mapping suggests. While there is potential for drawdown in areas of Mercia Mudstone, the impact is likely to be much reduced in comparison to the areas of sand and gravel deposits.

8.3 Given that groundwater in the area has historically been within 10m of the surface, and that in places the cutting is to be up to 10m deep, there is some potential for disruption of groundwater flows. While groundwater flow is not currently considered to be the primary source of water maintaining wet conditions and streamflow in the SSSI units, it is not ruled out as having a contributory role, particularly if the sands and gravels are more spatially extensive than mapped. As such, the relationship between groundwater levels at the site of the proposed road and at the two SSSI units required greater understanding to determine whether the cutting would have any impact. To achieve this, the main Ground Investigation for the Scheme was extended to take account of the SSSI units.

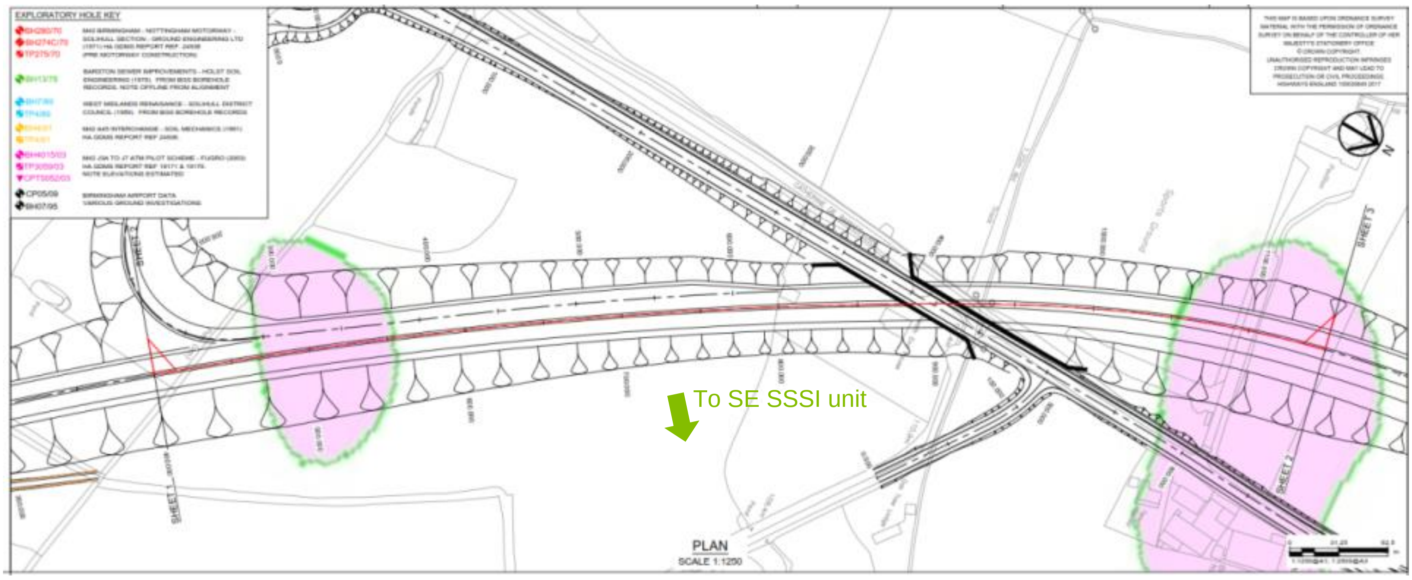


Figure 9. Location of Glacial Sands and Gravels along the new mainline link road (shown by Pink shading), in the vicinity of the southeastern SSSI unit.

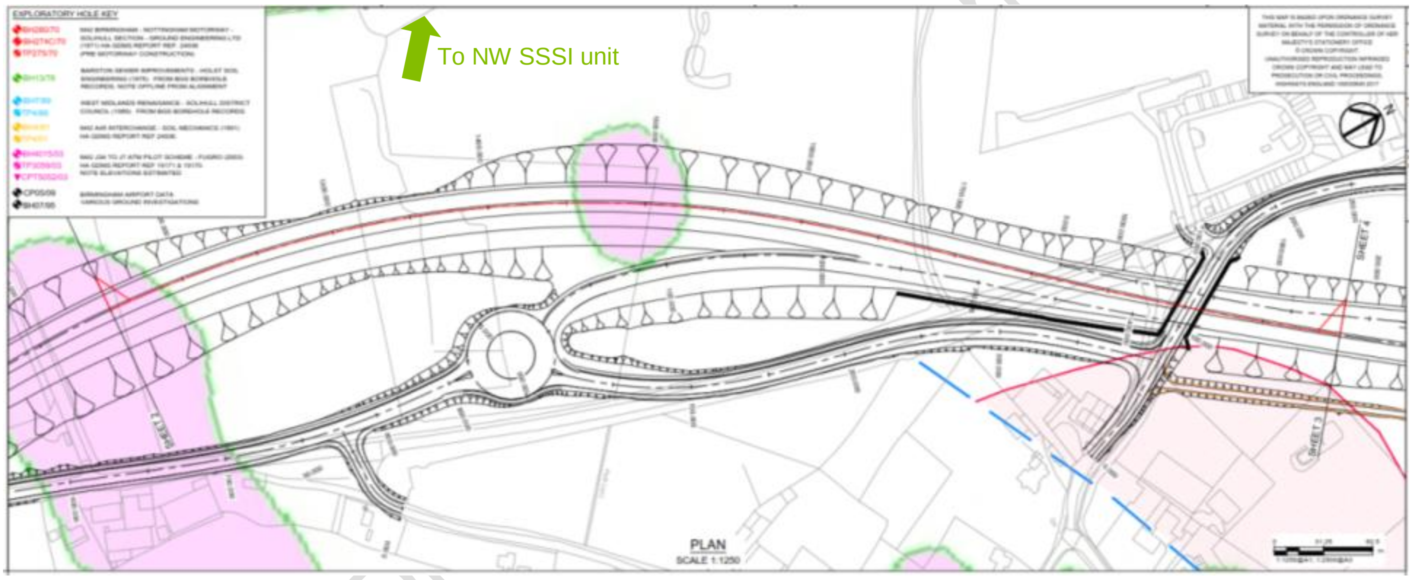


Figure 10. Location of Glacial Sands and Gravels along the new mainline link road (shown by Pink shading), in the vicinity of the NW SSSI unit.

8.4 Figure 11A and 11B show the location of the Ground Investigation works in and around the SSSI units, which were completed in October 2018. The works now include boreholes around the periphery of both SSSI units and within the SSSI units. Those on the periphery of the units are window samples with a standpipe installation to allow monitoring of groundwater levels over time. The standpipes terminate on proving the surface of the Mercia Mudstone Formation. The boreholes within the SSSI units are not long-term installations for monitoring, but have been included to prove the underlying geology and provide a snapshot of groundwater conditions that can be related to the levels around the periphery of the sites.

8.5 The monitoring of groundwater levels around the periphery of the SSSIs was proposed to help understand the groundwater dependence of the two SSSI units, and hence the likelihood of any adverse impact from the Scheme that would need to be mitigated.

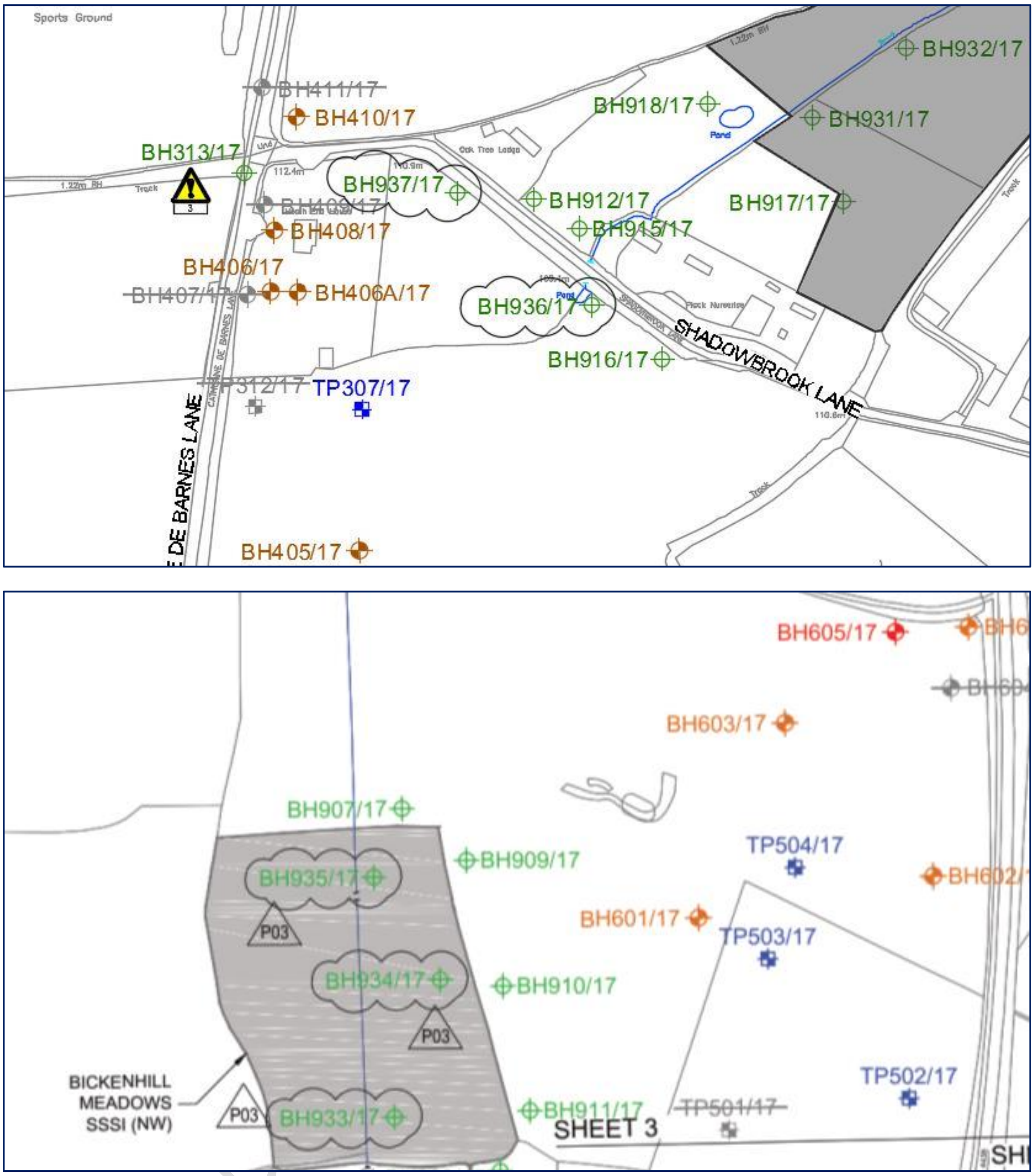


Figure 11A (top) and 11B (bottom) Ground Investigation locations – extended to include the SSSI units. Red – cable percussion boreholes; orange – rotary coring boreholes; green – window sample; blue – trial pit.

9. Soil Saturation Monitoring

9.1 During site visits undertaken to the SE Unit following heavy rainfall events, it has been apparent that rainfall can periodically accumulate on the ground surface and be slow to drain away. This is particularly the case in depressions and furrows across the site. This supports the assertion that maintenance of wet ground conditions required for many of the grassland species may be rainwater fed to a large extent, perhaps supported by localised out of bank flows very close to the stream, and/or limited groundwater flows from any surrounding glacial sand and gravel deposits. These glacial deposits may act somewhat like a sponge, filling with groundwater in response to rainfall. In the wet meadow at the SE Unit, it appears that the MG4 species are more successful in the saturated furrows across the site, while MG5 species are more successful on the slightly elevated and therefore drier ridges.

9.2 To better understand the variability in soil saturation and the time it takes the SSSI sites to drain following heavy rainfall, it was agreed in discussions with Natural England (on site on 26 April

2018) to install a series of dipwells on the wet meadow field at the SE Unit and within the NW Unit. Using these dipwells, soil water levels and conductivity would then be monitored on a fortnightly basis to build an understanding of subsurface moisture conditions, and whether they are indeed largely rainwater fed. While less than twelve months of monitoring is available at the time of writing (June 2019), the monitoring is to be continued for at least two years post submission (as per the Register of Environmental Actions and Commitments (REAC)), with Natural England kept informed with data and technical interpretation. The mitigation presented in the Environmental Statement for the SSSI has been updated for this revised version of the Technical Note (version 9.1). It is further anticipated that monitoring will continue through the construction phase of the Scheme and into the initial years of operation to gather further baseline data and to help evaluate any impacts on the two SSSI units should they occur, subject to continued landowner and Natural England consent.

9.3 Prior to land owner consent being granted for installation of dipwells at the two SSSI units, ground conditions at both sites were inspected visually every fortnight through the summer of 2018. The streams through both sites had dried up by 1 July 2018 and the pond immediately outside the SE Unit had dried up by mid-August (13 August 2018). At both sites the grass was also straw-like in colour and wilting by late July, and no ground moisture was apparent on any visit between July and early September 2018. As such, if dipwells had already been installed earlier in the summer of 2018, there is a strong likelihood that they would have been dry throughout the period (between mid-May and September) due to the especially dry summer conditions.

9.4 Dipwells were installed in the SE Unit on 13-14 August 2018 (see Figure 12A for locations and Photo 18 for an example). A total of 10 dipwells were installed, covering MG4 grassland, MG5 grassland and transitional grassland areas. The dipwells were prefabricated from a perforated plastic pipe of 32 mm diameter. They were sealed above ground to prevent rainwater from filling the pipe. The plastic pipe is perforated at regular intervals along its length on all sides, to allow throughflow of soil water, and to allow equilibration to be achieved with the surrounding water table.

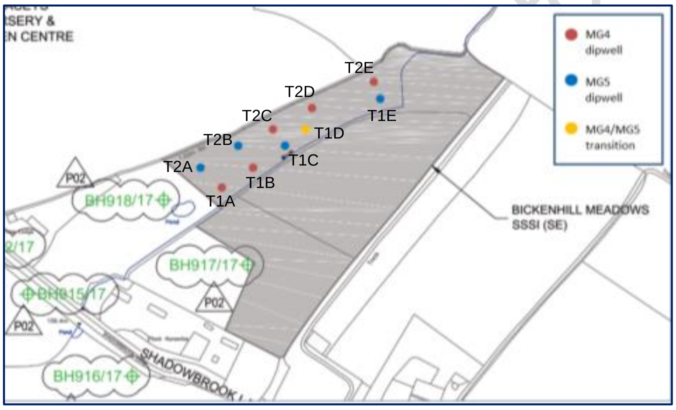


Figure 12A. Locations of dipwells installed in the wet meadow field at the SE Unit

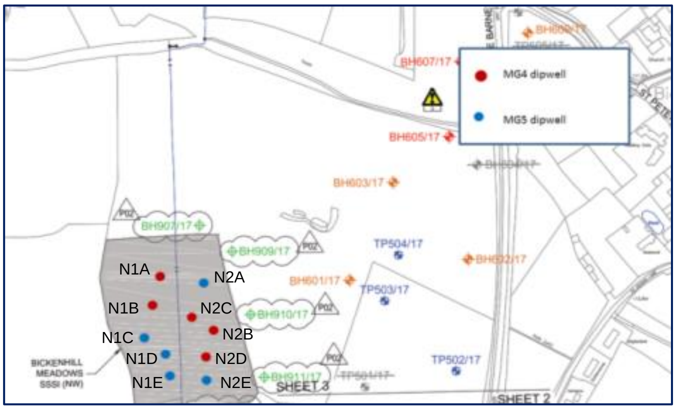


Figure 12B. Locations of dipwells in the NW Unit.

9.5 Of the 10 dipwells installed at the SE Unit, six were installed to a depth of 90 cm and four to a depth of 50-60 cm (due to difficulty penetrating the substratum with hand held soil augering equipment). Environment Agency Ecohydrological Guidelines[6] for MG4 grasslands suggest an indicative target mean water table depth range from 35 cm depth in winter to 70 cm depth in summer, and so ordinarily the installed dipwells should be of sufficient depth to monitor the water table for these grasslands. Soil conditions beneath the site were variable, with a mix of upper dark brown sandy silt layers and stiff dark grey clay layers generally encountered to around 50cm

[6] Environment Agency (2004) Protective and Enhancing Wetlands: Ecohydrological Guidelines for Lowland Wetland Plant Communities.

depth. Light grey and orange sand layers and gravel layers were commonly found beneath this, including isolated pockets of large cobbles (mix of rounded and angular cobbles, 10-20 cm diameter), as well as some layers of blue-grey clay. A full description of the soils encountered during augering at each dipwell as well as further details on location and depth are described in Annex B.

9.6 The dipwells in the NW Unit were installed on 5-6 September 2018 (see Figure 12B for locations, and an example in Photo 19). Despite sporadic rainfall in the period since the installation of the SE unit dipwells, the ground conditions at the NW unit remained extremely dry with no groundwater encountered during augering of any of the holes. In total, 4 dipwells were installed to 90 cm depth, two to 70 cm depth, and additional dipwells to 66 cm, 60 cm, 50 cm and 43 cm depth. The shallower depths of some dipwells are a result of impenetrable stiff clay layers being encountered. In general, the top soil at the NW Unit was up to 20 cm to 40 cm depth below ground, before trending to extremely stiff, dark grey clay to the base of the dipwells. The main exceptions were the two dipwells towards the centre of the eastern half of the SSSI, where sand and gravel layers were encountered at depths below 50 cm. Further details are described in Annex B.

9.7 The dipwells have been monitored fortnightly since installation to capture water table recharge in response to rainfall. The regular measurement of water levels is undertaken using a dip tape inserted into the pipe. Conductivity is measured in selected dipwells using a Hanna Instruments conductivity meter, when enough water accumulates to enable measurement. One dipwell at each site has also been fitted with a water level data logger to allow continuous measurement of soil water levels.

9.8 Rainfall data from the nearest Environment Agency meteorological stations at Coleshill, Saltley and Tudor Grange are regularly obtained to compare with the water level record.

Photo 18. Dipwell T2-D at the SE SSSI unit.

Photo 19. Dipwell N2-B on the NW SSSI unit.

10. Ground Investigation Results at the SSSIs

10.1 The boreholes shown in the SE SSSI and immediate periphery in Figure 11A were installed in July 2018. The boreholes in the immediate periphery of the NW Unit (Figure 11B) also were installed in July 2018, and those inside the NW Unit in September 2018. Additional boreholes on the periphery of the SE Unit were installed in October 2018.

10.2 A summary of the preliminary results is given in Table 1.

Table 1 Ground Investigation findings for the SE and NW SSSI units and periphery. [For borehole locations refer to Figure 11a and 11b].

Borehole	Geology Summary	Groundwater strike
SE SSSI		
BH932 (within SSSI)	4m depth - gravelly sand to 0.8m, very sandy clay to 2.25m, sandy clay with weak mudstone fragments to 4m.	Water strike at 2.25m rising to 2.18m after 20 minutes.
BH931 (within SSSI)	3m depth – gravelly sand to 0.8m, sandy slightly gravelly clay to 1.2m, silty clay to 3m.	Water strike at 1.96m rising to 1.8m after 20 minutes.
BH917 (within SSSI)	3m depth – gravelly sand to 0.8m, slightly sandy slightly gravelly clay to 1.75m, sandy clay to 3.0m	Water strike at 2.19m.
BH918 (within nature reserve but not SSSI)	3m depth – fine to coarse sand with some gravel to 1.15m, sandy clay to 1.5m, gravelly fine to coarse sand to 3m.	Water strike at 1.48m.
BH912 (within nature reserve but not SSSI)	4m depth – gravelly sand to 0.8m, sandy slightly gravelly clay to 1.5m, sand to 1.6m, sandy clay to 2.10m, slightly sandy slightly gravelly clay to 2.6m including extremely weak mudstone, sandy clay to 4m.	Water strike at 2.6m, rising to 1.74m after 20 minutes.
BH915A (within nature reserve but not SSSI)	6.4m depth – gravelly fine to coarse sand to 0.8m, sandy gravelly clay to 3.10m, sandy clay to 5.0m, fine to coarse sand to 5.6m, sandy clay to 6.1m, clay tending to extremely weak mudstone to 6.4m	Water strike at 3.10m, rising to 1.8m after 40 minutes.
BH916 (SW periphery, outside of SSSI and LNR, opposite side of Shadowbrook Lane)	6.0m depth – gravelly silty sand to 1.8m, slightly gravelly silty clay to 2.5m, sandy silty clay to 3.5m, interlaminated sandy silt to 4.0m, clay to 5.0m, Mercia Mudstone to 6.0m.	Water strike at 4.0m
BH936 (SW periphery, outside of LNR, opposite side of Shadowbrook Lane)	6.0m depth – sandy slightly gravelly clay to 0.35m, slightly gravelly sandy clay to 2.3, Mercia Mudstone to 6.0m.	Water strike at 1.6m
BH937 (SW periphery, outside of LNR, opposite side of Shadowbrook Lane)	4.0m depth – slightly sandy slightly gravelly clay to 0.5m, slightly sandy slightly gravelly silt to 1.0m, sandy clay 1.7m, slightly clayey sand to 2.3m, slightly gravelly very sandy clay to 4.0m	No water strike
BH410 (western periphery, outside of SSSI and LNR, adjacent to Catherine-de-Barnes Lane.	25.0m depth – gravelly clay to 0.6m, sandy gravelly clay to 3.0m, Mercia Mudstone to 25.0m.	Water strike at 11.3m
NW SSSI		
BH933 (within SSSI)	2.65m depth – sandy gravelly clay to 0.2m, very stiff clay to 0.4m, silt clay to 0.9m, sandy gravelly clay to 1.1m, gravelly silty clay to 1.2m, gravelly silt to 1.5m, Mercia Mudstone to 2.65m.	Water strike at 1.40m.
BH934 (within SSSI)	2.0m depth – stiff slightly gravelly clay to 0.2m, sandy gravelly clay to 1.3m and Mercia Mudstone to 2.0m.	No water strike
BH935 (within SSSI)	2.1m depth – slightly gravelly clay to 0.15m, slightly sandy clayey gravel to 0.9m, gravelly sandy clay to 1.10m, grey sandy clay to 1.3m, sand to 1.4m, Mercia Mudstone to 2.1m.	No water strike
BH907 (northern periphery of SSSI)	2.0m depth – slightly sandy slightly gravelly clay to 0.6m, Mercia Mudstone to 2.0m	No water strike
BH909 (eastern periphery of SSSI)	2.3m depth - slightly sandy slightly gravelly clay to 0.6m, Mercia Mudstone to 2.3m	No water strike
BH910 (eastern periphery of SSSI)	2.7m depth - slightly sandy slightly gravelly clay to 0.6m, Mercia Mudstone to 2.7m	No water strike
BH911 (eastern periphery of SSSI)	2.0m depth - slightly sandy slightly gravelly clay to 0.5m, Mercia Mudstone to 2.0m	No water strike

11. National Vegetation Classification (NVC) Surveys

11.1 A Phase 2 NVC survey was undertaken of the identified homogenous stands of grassland vegetation within the Bickenhill Meadows SSSI in summer 2018. The survey followed the standard published methodology (Rodwell, 2006)[7] and comprised recording a minimum of five quadrats in each identified grassland type and at least one in each parcel of each grassland type. Following this, the data sets identified were matched to the published grassland community types using the keys provided in Rodwell (1992)[8] and using the software TABLEFIT[9]. The survey was undertaken on the 27 June and the 7 August 2018.

11.2 The vegetation in all the fields on the days of the survey was tall and coarse and because of this appeared uniform with the subtle changes in ground level apparent earlier in the year masked by the dense growth.

11.3 The SE Unit comprises three fields separated by a small watercourse (dry on the day of the survey); two of the fields are on the eastern side and the third on the western side. A fourth field is not within the SSSI but along with the fields in the SSSI is managed as a nature reserve by Warwickshire Wildlife Trust.

11.4 The two fields on the eastern side slope down to the watercourse and the vegetation on the day of the survey was grass dominated (tall and lodging in places) and dry (Photo 20 and 21). Yorkshire fog (*Holcus lanatus*) was abundant with other grasses such as cock's foot (*Dactylis glomerata*), common bent (*Agrostis capillaris*), red fescue (*Festuca rubra*), crested dog's tail (*Cynosurus cristatus*) and meadow fescue (*Schedonorus pratensis*). A range of generally common forbs were recorded and included ribwort plantain (*Plantago lanceolata*), common knapweed (*Centaurea nigra*), bird's foot trefoil (*Lotus corniculatus*) and red clover (*Trifolium pratense*). Less common species included yellow rattle (*Rhinanthus minor*) and tormentil (*Potentilla erecta*).

Photo 20 (left) and Photo 21 (right), typical vegetation in the SE SSSI unit eastern fields.

11.5 Seven quadrats were recorded in the two fields, as they were uniform in appearance and structure. The data obtained was run through TABLEFIT and the goodness of fit to the NVC community type MG5; *Cynosurus cristatus - Centaurea nigra* was around 83% and classed as very good fit. The second best fit was to the MG5a *Lathyrus pratensis* sub-community type.

11.6 The field within the SE Unit on the western side of the watercourse was generally flat but with an apparent rise towards the northern boundary; the grasses did not dominate to the degree they did

[7] Rodwell, J. S. (2006) National Vegetation Classification; Users' Handbook. Joint Nature Conservation Committee, Peterborough
[8] Rodwell, J. S. (ed.) 1992. British Plant Communities. Volume 3. Grassland and montane communities. Cambridge University Press.
[9] Hill (2015) TABLEFIT Version 2; A program to identify types of vegetation by measuring goodness-of-fit to association tables. Centre of Ecology and Hydrology, Wallingford

in the dry fields and there were patches of meadowsweet (*Filipendula ulmaria*) and great burnet (*Sanguisorba* officinalis) (Photo 22 and 23). Meadowsweet and other wetland species such as wild angelica (*Angelica sylvestris*) seemed to be more frequent towards the watercourse where the vegetation was taller and coarser. Interesting species recorded here were betony (*Stachys officinalis*) and tormentil (*Potentilla erecta*). It has been reported that meadow thistle (*Cirsium dissectum*) is also present but this was not found during the current survey.

Photo 22 (left) and Photo 23 (right), typical vegetation in the SE SSSI unit wet meadow field.

11.7 Five quadrats were recorded in this western field and along with the data collected from similar vegetation recorded in the NW section of the SSSI (described below) were run through TABLEFIT. The goodness-of-fit to the NVC community type MG4; *Alopecurus pratensis* – *Sanguisorba officinalis* was around 63% and classed as a fair fit. Any variation in the vegetation from topographical variation was masked by the tall growth and a better understanding of this would be obtained once the field has been cut. This will provide information on the relationship of the community boundaries to topography, depth to water and ditch levels, and enable the communities to be tied with soils information to determine the mechanism whereby any vegetation changes are driven.

11.8 The NW Unit comprises two fields separated by a small, ephemeral watercourse, which was dry on the day of the survey. The western field appeared to be uniform in structure and was generally a mix of patches of larger forbs such as great burnet (*Sanguisorba officinalis*) and meadowsweet (*Filipendula ulmaria*), and grasses with a range of smaller forbs including several legumes scrambling through the vegetation (Photo 24 and Photo 25). This field appeared to be more diverse than the corresponding field in the SE Unit and here saw-wort (*Serratula tinctoria*), quaking grass (*Briza media*) and devil's bit scabious (*Succisa pratensis*) were recorded in addition to the more typical and commoner forb species. When visited in August 2018, tufted hair grass (*Deschampsia cespitosa*) was the dominant species in this field.

Photo 24 (left) and Photo 25 (right), typical vegetation in the NW SSSI unit western field.

11.9 Five quadrats were recorded in the field and along with the data collected from similar vegetation recorded in the SE SSSI unit were run through TABLEFIT. The goodness-of-fit to the NVC community type MG4; *Alopecurus pratensis* – *Sanguisorba officinalis* was around 63% and classed as a fair fit.

11.10 The eastern field of the NW Unit was only visited in August 2018 and had much coarser vegetation and the dominant grass across large areas was tufted hair grass (*Deschampsia cespitosa*) but with meadowsweet and great burnet also frequent throughout the field. Sedges appeared to be more common in this field and included hairy sedge (*Carex hirta*), false fox sedge (*Carex otrubae*), common sedge (*Carex nigra*) and tufted sedge (*Carex acuta*). Otherwise it was very similar to the western field (Photos 26 and 27).

Photo 26 (left) and Photo 27 (right), typical vegetation in the NW SSSI unit eastern field.

11.11 Part way along the western boundary of the field, there was a distinctive change in vegetation and whilst this will have to be shown by survey, it appeared to be delineated by a low spot, possibly linked to the ditch and was demarked by young alders (*Alnus glutinosa*). The vegetation here was dominated by tall rushes including soft rush (*Juncus effusus*), hard rush (*Juncus inflexus*) and sharp flowered rush (*Juncus acutiflorus*), along with sedges with abundant great hairy willowherb (*Epilobium hirsutum*) and in the wettest areas patches of fool's watercress (*Apium nodiflorum*). This is the area considered to be a potential spring in the preceding discussion (Photo 27 and Photo 28).

Photo 27 (left) and Photo 28 (right), typical vegetation in the distinct wetter area within the NW SSSI unit eastern field.

11.12 Five quadrats were recorded in this area and the data was run through TABLEFIT. The goodness-of-fit to the NVC community type OV26; *Epilobium hirsutum* community was around 58% and classed as a fair fit. A similar fit was obtained from the MG9 community; *Holcus lanatus-Deschampsia cespitosa* grassland. This community is found in area where the ground is seasonally waterlogged and can be found in association with MG4 grassland but is not usually as species diverse and is tolerant of less free draining soils.

11.13 It is clear from the surveys that the two dry grassland fields in the SE Unit fit closely to the MG5 community type and that for the most part, the wetter field in the SE unit and the two fields in the NW unit fit to the MG4 community type. Within the wetter fields, there may be localised variation as picked up by the walkovers earlier in 2018 but by summer the tall vegetation was masking much of this variation.

12. Conceptual Model

12.1 The baseline information described in this Technical Note, along with the extended Ground Investigation results[10], vegetation surveys (described in Section 11) and further observations of subsurface conditions derived during dipwell installation have informed the development of a conceptual model of each SSSI unit. The purpose of the conceptual model is to illustrate the hydrological processes that have been observed or inferred from the collated evidence in order to better understand how the two SSSI units maintain suitable conditions to support the sensitive grassland species contained within. The two conceptual models are presented in Annex C. The following provides an explanation to accompany the two conceptual models.

Southeast SSSI Unit

12.2 The SE Unit (see Figure 13) consists of a wet meadow field to the west (hereafter referred to as the 'wet meadow'), two dry meadow fields to the east (hereafter referred to collectively as the 'dry meadow'), and wet alder woodland in the northeast of the site. The wet meadow and dry meadow are separated by a small watercourse with a ditch-like character, which is a tributary of Shadow Brook (hereafter referred to as the 'central watercourse'). A further ditch is located on the northwestern boundary of the site (hereafter known the 'northern ditch'). Both are ephemeral but would flow towards the northeast of the Unit where they combine and continue north as a tributary of the Shadow Brook. The central watercourse was observed to flow between around November 2017 to May 2018, and then again from November 2018. No regular flow has ever been observed in the northern ditch, where water tends to pond, and it is believed to act more like a

[10] Socotec, 2018, Factual Report on Ground Investigation, Report E8005-18

soakaway into the underlying sand deposit with flow along the watercourse restricted to short periods following extremely heavy or persistent rainfall.

12.3 The ground elevation generally rises either side of the central watercourse, but more steeply on the eastern side. A review of topographical information shows that there is in fact a low point running through the wet meadow, most likely along the original course of the central watercourse. This continues into the alder woodland to the north. The wet meadow also has a historic ridge and furrow micro-topography from past agricultural practices, which are absent in the dry meadow, which is important for the flora that develops in each area.

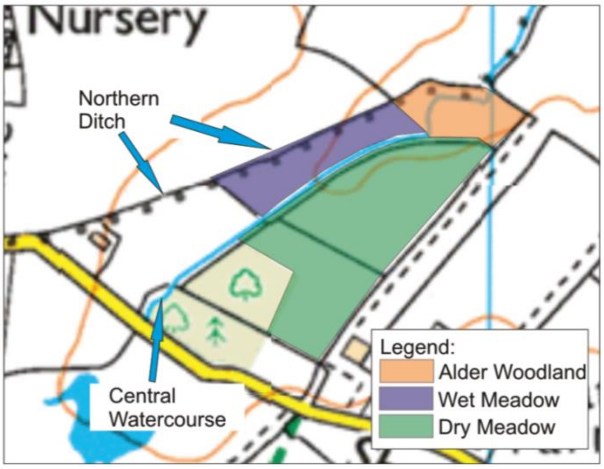


Figure 13 Distinct areas within the SE SSSI Unit, namely the alder woodland, wet meadow and dry meadow areas.

12.4 The geological logs for the boreholes, probeholes and trial pits on and in the vicinity of the SE Unit, show that across much of the area there is a surface layer of sand between 0.8m and 1.15m thick. This is typically underlain by a layer of sandy clay, resting on the Mercia Mudstone. In some of the ground investigation boreholes a second thin sand layer has been proved below the sandy clay layer. The results of the Ground Investigation indicate that there is a ‘butterfly-shaped bowl’ of mixed superficial deposits that reaches up to 6m thickness below ground level, and which is centred on the Shadowbrook Meadows Nature Reserve, immediately SW of the SSSI (see Figures 14A and 14B). From this central point the superficial deposits extend across the SSSI to the northeast where thicknesses of up to 3m were recorded, and west/southwest into the arable field where thinner deposits of around 1.2m were recorded adjacent to Catherine-de-Barnes Lane (Figures 14A and 14B).

12.5 The superficial deposits are able to support groundwater and therefore provide a local water source to the surrounding grassland communities. Boreholes within the SSSI in the late summer 2018, after a prolonged period of dry weather, indicated groundwater levels between 1.8 - 2.25m below ground level (BGL), while much shallower levels would be expected in winter and spring. The bowl of superficial deposits is surrounded by, and underlain by, low permeability Mercia Mudstone (where deeper water strikes were generally recorded e.g. over 11m BGL in BH410 adjacent to Catherine-de-Barnes Lane). Figure 14A shows the likely contours of the surface of the Mercia Mudstone, and indicates that it is present at a shallow depth in the vicinity of the proposed road alignment at approximately 110m AOD (2m BGL). The surface of the Mercia Mudstone falls to the north east and at Shadowbrook Lane is at a level of 102.84m AOD (6.1m BGL). Groundwater flows through the more permeable units (i.e. the sand and gravel) in the superficial deposits above the Mercia Mudstone, generally following the topography of the land towards the SE Unit and the northeast. As such, the SSSI receives groundwater flows from the east, south and west, and this ultimately flows towards the north-eastern area of the SSSI in the wet alder woodland. Estimated groundwater contours for the wet meadow are plotted in Figure 15 based on dipwell monitored data, and show that the flow of groundwater in the superficial deposits is towards the northeast. The central watercourse in the SE Unit is ephemeral, but may provide a contribution to the supply of water for recharging the thicker superficial deposits beneath the SSSI unit during the late autumn-winter-spring period when it has been observed as flowing. It is likely that the central watercourse is in connectivity with the superficial deposits due to the shallow depth below ground level and the possible flow from groundwater to the watercourse at the downslope extent of the SSSI unit.

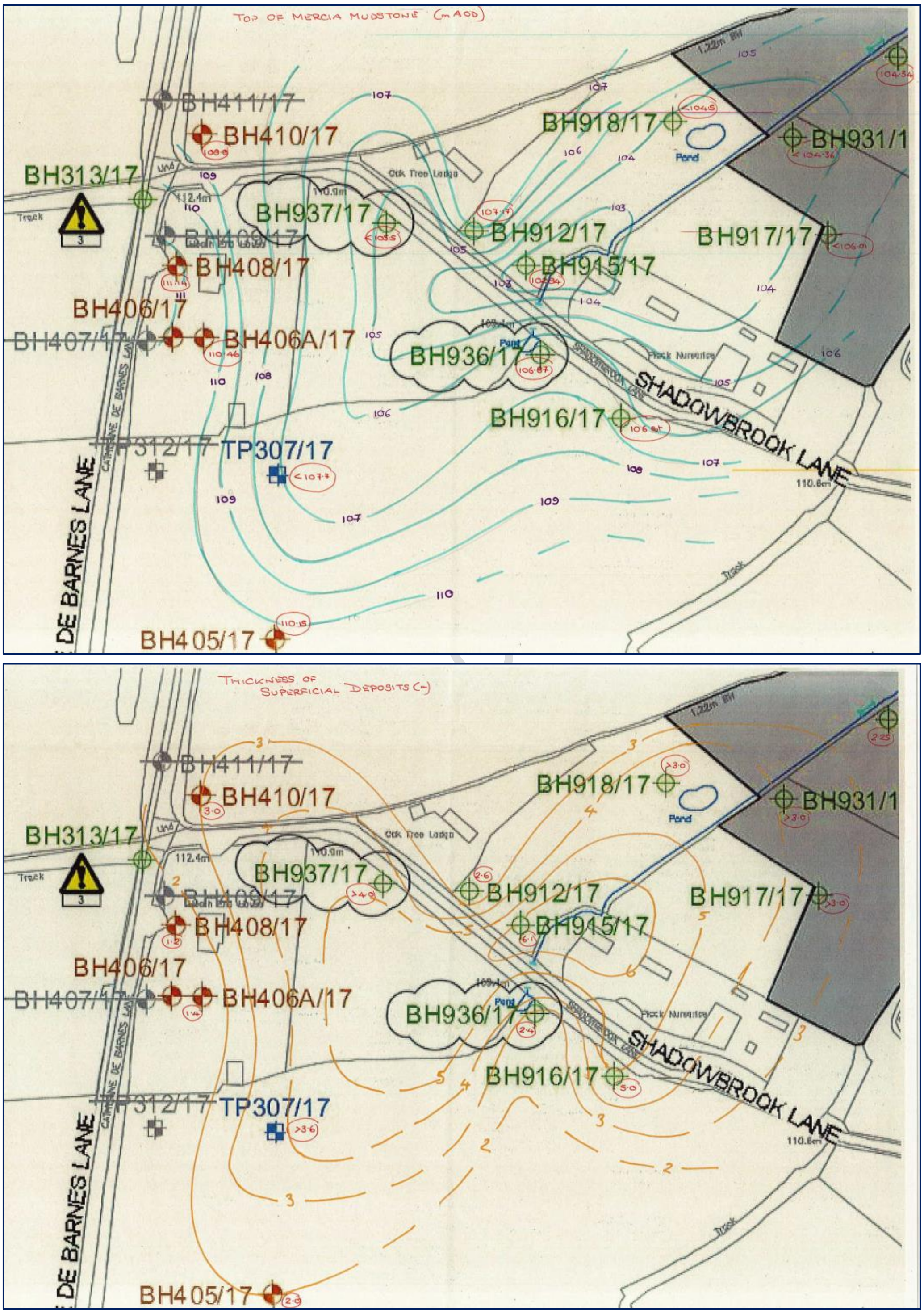


Figure 14A (top) Contours showing top of the Mercia Mudstone (m AOD) and 14B (bottom) Contours showing thickness of superficial deposits (m). Plots are based on available information (November 2018).

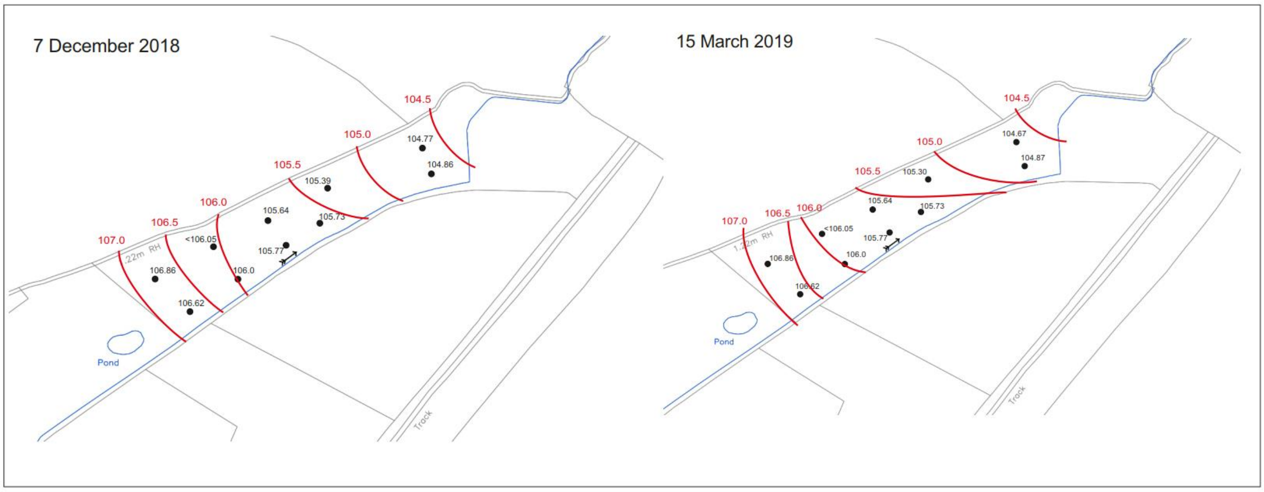


Figure 15 Estimated groundwater level contours based on dipwell monitoring of the wet meadow at the SE SSSI Unit (contours for 7 December 2018 and 15 March 2019). Groundwater flows towards the northeast and the wet alder woodland.

12.6 The superficial sands, clays and gravels across the SE Unit and the surrounding area are thought to allow drainage through to the Mercia Mudstone, at which point water will tend to flow laterally over these less permeable deposits to the northeast and ultimately out of the SSSI at its lowest point. More constant streamflow has been observed in the central watercourse at this location in the SSSI than elsewhere, presumably because it is supported by the lateral groundwater flow from the superficial deposits at this low point. During the late autumn-winter-spring period the water table is expected to generally be high due to greater amounts of rainfall and low rates of evapotranspiration, resulting in the predominant recharging of groundwater in the superficial deposits at a rate that exceeds flows to the northeast. Due to the permeability of the superficial deposits, surface saturation and surface water ponding is expected to be limited to the periods immediately following heavy rainfall when the infiltration capacity is exceeded. However, a high water table may also encourage saturation of the upper soil layers during rainfall events, especially in the spring when monthly rainfall amounts may be at their lowest.

12.7 The central watercourse will also help to prevent over-saturation of the surface layers by draining away excess water. The flows in this ephemeral watercourse are thought be maintained from a mix of subsurface flow pathways and occasional surface runoff during periods when surrounding soils are fully saturated. It is possible that in extreme rainfall and runoff events, the central watercourse may overtop and cause very localised out of bank floods (which are unlikely to spread fully across the wet meadow noting that along part of the ditch is a shallow earth bund likely created when the channel was dug or last cleared out), although this is expected to be a rare occurrence and the WWT were unaware of this ever occurring. The northern ditch (see Figure 13) may occasionally flow following receipt of surface water runoff and sub-surface egress from the arable field that rises away to the north and west of the SSSI. This ditch is usually ponded and may act as an infiltration trench providing some additional recharge to the wet meadow field through the surface sand layer.

12.8 MG4 grasslands are typically found in the furrows across the wet meadow field of the SSSI. According to 'Ecohydrological Guidelines for Lowland Wetland Plant Communities Final Report (Environment Agency, December 2004) MG4 grasslands are dependent on wet conditions being maintained in the surface layers through winter and spring, but are relatively intolerant of flooding and prolonged saturation. MG5 grasslands typically occur in drier locations and so tend to be located on the ridges across the wet meadow field and across the eastern dry meadow. It is likely that the normal water table in winter and spring is generally just below the ground surface, rising frequently and quickly in response to rainfall events to temporarily intersect the furrows, but rarely if ever with the ridges. The water table intersection of furrows will be short-lived as the water drains away through the permeable soils and upper superficial deposits. It is therefore important that these superficial deposits are adequately recharged over late autumn to early spring to ensure that the water table is maintained in the optimum zone during the late spring period when the grassland plant communities establish.

12.9 The dry meadow field has a greater relief than the wet meadow, and so rainwater is encouraged to drain more rapidly away downslope towards the central watercourse and therefore fails to maintain a sufficiently high water table for MG4 communities. There is also an absence of furrows and depressions which reduces the potential for the hydrological conditions seen on the wet meadow where MG4 communities have developed. As a result, the dry meadow is wholly dominated by MG5 grasslands. A Cadent gas pipeline is orientated southwest to northeast through the dry meadow field. This may cause some interruption of groundwater flows from the east of the SSSI with potential for preferential flow to occur northeast along the pipeline's backfill material. There was some evidence of a change in plant types along the route of this gas main during a site visit in April 2018, although no significant difference in grass species across the Site was observed when the NVC survey was undertaken in the summer, suggesting that the effect may be seasonal and insufficient to provide MG4 plants a sufficient competitive advantage over MG5 species.

12.10 In the summer and autumn, when there is typically reduced rainfall and greater evapotranspiration rates, the water table beneath the SSSI is lowered (i.e. to more than 90cm BGL as observed from dipwell monitoring in late summer 2018, and dry ditches). However, although the water table is generally deeper than the furrows in the wet meadow, the grassland communities may be supported through the drier summer months by deeper groundwater in the superficial deposits rising by capillary action to the root zone. This may be important for sustaining the plant communities across the SSSI, but is less important in determining the mix of species and grassland types.

Potential Impact of the Scheme on the Hydrology of the SE Unit

i. Geology and Groundwater flow

12.11 The geometry and orientation of the 'bowl' of superficial deposits (Figures 14A and 14B) that underlie the SE Unit thin out in a westerly direction towards the new mainline link road. Along the new mainline link road, the superficial deposits are generally less than 2 m thick and consist principally of clay rather than the more permeable sands and gravels that promote infiltration and storage of water. There is no evidence that the cutting will intersect significant thicknesses of sand or gravel, which could provide an existing source and pathway for groundwater recharge to the SSSI. The majority of the cutting will intersect the low permeability Mercia Mudstone. As it is considered that the cutting will not intersect permeable superficial deposits which could provide groundwater to the SSSI, it is concluded that the cutting will not have a significant impact on groundwater flows to the SE Unit.

12.12 While interception of groundwater inflows by the cutting is considered insignificant, the route of the new mainline link road will result in the severance and loss (beneath the Scheme footprint) of approximately one fifth[11] of the surface water catchment to the whole SE Unit (based on interrogation of LiDAR data described above – see Figure 8). However, it is only the wet meadow (see Figure 13) which contains MG4 grasslands that are sensitive to changes in the sites hydrology that could occur from this catchment area loss (due to the reliance of the MG4 grasses on specific ground moisture conditions during their establishment in the spring). The NVC vegetation survey (AECOM, 2018) indicated that MG4 plant communities were not present in the

[11] Catchment area based on the latest design 3c (October 2018).

remainder of the SE SSSI unit, which were instead closer matched to MG5 and MG5a communities.

ii. Surface Water Catchment Analysis

12.13 A more detailed catchment analysis has been undertaken to better understand the parts of the SE SSSI unit catchment that drain to the wet and dry meadows. The approach taken was to use the software Micro Drainage which enables analysis of overland flow routes using topographical data to more accurately determine the catchment areas to specific areas of interest. Freely available LiDAR data was imported into the software and was used in conjunction with topographic survey data that has been obtained for the Scheme to create a Digital Terrain Model (DTM). Water is then applied to the DTM to identify flow pathways, which are depicted by vector arrows. The LiDAR data used is 2 m resolution with a vertical accuracy of +/-15 cm root mean square error (RMSE). The margin for error is therefore considered low.

12.14 The detailed existing catchment analysis mapping for the SE SSSI unit is presented in Annex D. This shows the existing sub-catchments defined using the Micro Drainage software. The mapping shows the sub-catchment draining directly to the wet meadow field (‘Catchment A’ as indicated by the light blue shading in Annex D) (i.e. land where surface water runoff would flow towards the wet meadow based on topography), with ‘Catchments B and C’ (as indicated by the green and orange shading in Annex D) draining to the dry meadow fields, which are dominated by MG5/5a grasslands and the central watercourse.

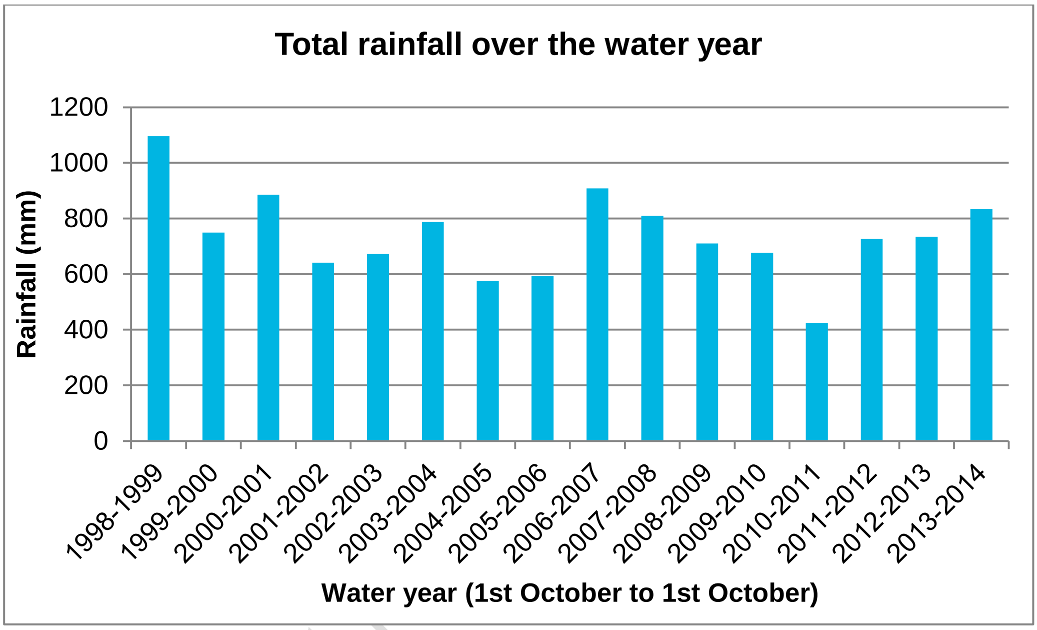
12.15 The catchment analysis has been repeated for the proposed situation following construction of the Scheme, and is shown in Annex E. Analysis of the existing areas of the total and sub-catchments has shown that the catchment area of the wet meadow (Catchment A) is 90,251 m^2. With the construction of the Scheme the area of sub-catchment A would reduce slightly to 87,010 m^2 (Annex E). This represents a 3.6% decrease in the direct catchment to the wet meadow field. The catchment area of the remainder of the SSSI (i.e. areas where MG5 grasses are dominant, catchment B plus catchment C) is 145,486 m^2. With the Scheme this reduces to 107,027 m^2, a 26.4% reduction in catchment area. However, since these dry meadow fields are not sensitive to hydrological changes in ground conditions this is not considered to cause an adverse impact.

12.16 The catchment plans in Annex D and E show that the vast majority of the surface water serving the wet meadow field (Catchment A) is derived from the arable field to the north. Surface water generally flows southeast from this field to the wet meadow. Much of the surface water runoff (by overland flow or infiltration through the soil) may gather in the northern ditch at the SE SSSI unit, from where it infiltrates into the sands and gravels in the wet meadow to the south. The Micro Drainage analysis also indicated a topographic low point through the center of the wet meadow field. This low point may have been the original alignment of the central watercourse, before being historically realigned for land drainage and agricultural purposes. This low area also encourages surface water runoff from Catchment A (see Annex D) to flow along the wet meadow rather than to the central ditch and vice versa. A shallow bund along the edge of the central ditch and any compaction of soils beneath may also contribute to reduced connectivity between the central watercourse and the wet meadow. There may be some infiltration into the wet meadow from the central watercourse (which is mainly fed from the south and west), but the extent of this is expected to be limited given its small size and that it has been observed to be frequently dry.

12.17 The Micro Drainage catchment analysis further indicates that the vast majority of the catchment area that is disconnected by the Scheme drains to the dry meadow fields of the SSSI (rather than the wet meadow) or towards Shadow Brook Lane, under which it is conveyed through a culvert into the central watercourse. As mentioned above there may be a limited amount of recharge from this ephemeral watercourse to the wet meadow, but the majority of water conveyed through the watercourse would typically flow towards the northeast and Shadow Brook rather than infiltrating into the subsurface horizons.

iii. Volumetric Rainfall Analysis – Annual Estimates

12.18 To determine the potential volumetric impact to the wet meadow from losing 3.6% of its surface water catchment, the long term rainfall record for the area obtained from the Environment Agency's Coleshill rain gauge at SP 21102 86956 has been analysed (see Annex F). The rainfall record is shown in Figure 16A and 16B for the 16 year period between 1998 and 2014 (this is the full period for which full water year data is available from this station). The rainfall total for water years (Figure 16A) ranges from 424mm to 1,095mm per year, with an average of 739mm per year. There is clearly significant year-on-year variability in rainfall inputs to the SSSIs and their catchment, and it appears that the loss of 3.6% of the wet meadow's water catchment would fall well within this range of natural fluctuations in water availability from rainfall.



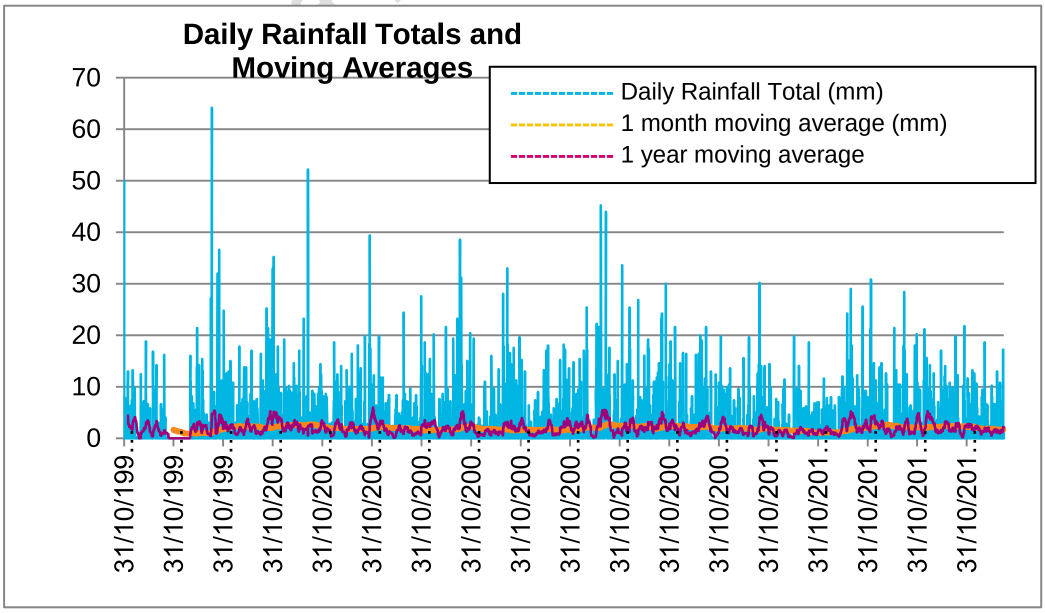


Figure 16A (top) Rainfall total for water years at Coleshill rain gauge (1998-2014); and 16B (bottom) Daily rainfall totals and moving averages at Coleshill rain gauge (1998-2014). Data provided by the Environment Agency.

12.19 More detailed investigation has been undertaken into the expected volumetric surface water losses due to implementation of the Scheme, using the Wallingford Hydrosolutions Revitalised Flood Hydrograph Model (ReFH2) Calibration Utility tool. This is a model that simulates surface water runoff and enables users to calibrate the parameters and initial conditions of the ReFH and ReFH2 rural models using observed event rainfall and flow datasets. The ReFH and ReFH2 methods takes into account:

- A *loss model* whereby effective rainfall is evaluated sequentially during a storm and if soil storage is filled, runoff will equal 100%. The new model requires an estimate of the initial soil moisture content (*Cini*);
- A *routing model* which uses an instantaneous unit hydrograph (IUH) and scales this to each catchment by area and time to peak (Tp) of the hydrograph;
- A *baseflow model*, that works on the assumption that the input to the baseflow reservoir is related to the rate of surface water runoff.

12.20 Each of the three models above influence the total amount of water that will reach the SSSI. Further details on the methodology are described in Annex F.

12.21 This modelling approach was then used to determine an estimate of the percentage of total rainfall that runs off from the catchment as surface water flow, using a design rainfall event (100 year return period, 4.25 hour event). This analysis indicates the percentage of total rainfall that contributes surface water to the SSSI is 25%.

12.22 Analysis was then undertaken into the total expected annual volumetric loss of water from the wet meadow, due to 3.6% of the surface water catchment being isolated or lost beneath the Scheme footprint. The analysis indicates that for the average water year (based on the Coleshill rainfall record 1998-2014) approximately 636 m^3 of water would be lost from the wet meadow due to the new mainline link road. Using the wettest year in the rainfall record (2011-2012) the loss would be approximately 1,136 m^3, and the using the driest year in the record the loss would be approximately 347 m^3. The range of volumetric losses between wet and dry years indicates that natural variability in rainfall quantities supplying the wet meadow catchment is substantial, and consequently the annual variability in surface water supply to recharge the superficial deposits beneath the SSSI also fluctuates markedly.

12.23 Although the loss of a small portion of the wet meadow surface catchment does not cause a volumetric loss of surface water greater than would be expected from year-on-year natural variability, the rainfall record does not include a run of consecutive dry years that would enable longer term resilience to be determined, although particularly dry years, such as 2010-2011 (Figure 16A), have occurred in isolation. In addition, although Figure 16B shows that while the number of days of heavy rainfall greater than 30mm / day has declined between 1997 and 2014, the longer term averages (monthly and yearly) appear less affected and remain stable, implying no obvious long term trend of declining rainfall that could be exacerbated by the loss of an area of the wet meadows catchment (Figure 16B).

iv. Volumetric Rainfall Analysis – Design Storm Estimates

12.24 An alternative methodology to estimating the annual volumes of runoff potentially lost to the wet meadow using historical rainfall data (as described above and in Annex F), is to determine volumetric water lost during a series of shorter design storms. This can be achieved using the aforementioned software Micro Drainage. Micro Drainage analysis is widely applied across the water industry for design and modelling of surface water and waste water systems. As such it is considered an appropriate tool for this analysis. As a deterministic model tool it is reliant on input data and does not give output regarding error margins. There may be a degree of observational error in the rainfall record used for the analysis, but as the same rainfall is applied to all scenarios this is not considered significant.

12.25 A series of design storms (360 minute winter storms at the 1 in 5 year, 1 in 30 year and 1 in 100 year return periods) have therefore been applied to the wet meadow catchment to determine the existing volumetric discharge during design storms, and then compared to the volumetric discharge when the Scheme is built (in the absence of mitigation). Table 2 indicates that for the 1 in 5 year, 1 in 30 year and 1 in 100 year design storms (duration 360 minutes), in the absence of mitigation, the loss of surface water catchment from the wet meadow field causes a reduction in volume of rainwater that reaches the wet meadow of 3.6%, consistent with the lost catchment area.

Table 2 Design storm discharge volume analysis for the 'wet meadow' catchment without mitigation at the 1 in 5 year, 1 in 30 year and 1 in 100 year return periods.

Pre-Development - Existing Conditions		Post Development – without mitigation		
Storm Return Period	**Discharge Volume (m^3)**	**Storm Return Period**	**Discharge Volume (m^3)**	**% Change in Performance from Existing Condition**
1 in 5 Year	1246.904	1 in 5 Year	1202.14	-3.6%
1 in 30 Year	1880.107	1 in 30 Year	1812.537	-3.6%
1 in 100 Year	2537.311	1 in 100 Year	2446.318	-3.6%

12.26 Construction of the Scheme will cause a slight loss of water supply to the wet meadow (as determined using historical rainfall data and design storm analysis). As the effect of reduced volumetric surface water inputs to the wet meadow field over a period of several dry years is not known, and to take account of our imperfect knowledge of how groundwater levels respond over the long term and all the factors that influence this, mitigation is proposed to ensure that a compensatory supply of water is available should it be needed to avoid any long term adverse impact to the wet meadow of the SE SSSI Unit.

Northwest SSSI Unit

12.27 The NW Unit consists of two grassland meadow fields separated by an ephemeral watercourse with a ditch-like character that flows north through the site to eventually reach Low Brook. The elevation of both fields rises relatively rapidly away from the watercourse and both contain a series of ridges and furrows which support both MG4 and MG5 grasslands.

12.28 The Ground Investigation indicates that Mercia Mudstone is located at a shallow depth of between 0.5 and 0.6m BGL to the east of the Site between the new mainline link road and the SSSI boundary, but is slightly deeper beneath the SSSI itself (i.e. up to 1.4m BGL). Similar to the SE Unit, the Ground Investigation thus implies that there is also a 'bowl' of thicker superficial deposits across the NW Unit surrounded by shallower Mercia Mudstone, but that the thickness of the superficial deposits is much less than what is found at the SE Unit. The shallow Mercia Mudstone around the periphery of the NW Unit and between it and the cutting for the new mainline link road suggests that there is not a significant groundwater pathway that would be interrupted by the Scheme.

12.29 In the winter and spring, because the Mercia Mudstone is relatively shallow and has a low permeability, it will not require much rainfall to cause a high water table to develop in the overlying deposits beneath the NW Unit. The greater amount of stiff clay substrate within the superficial deposits across this SSSI unit also impedes infiltration and encourages frequent saturation of the near surface soil layers, particularly in hollows and depressions. There may be pockets of sands and gravels with improved drainage, but in general infiltration is expected to be slow. Due to the thinner superficial deposits rainwater recharge onto these slowly permeable upper substrate layers is considered to be the principal mechanism supporting the higher water table during the winter and spring. As in the SE Unit, MG4 grasses occupy the depressions and furrows across the Site, which are periodically, but not permanently, saturated. MG5 grass species tend to occupy the more elevated and drier ridges which are less regularly saturated.

12.30 The ephemeral central watercourse helps prevent over-saturation of the grassland communities by draining away excess water, although there is a relatively pronounced artificial bund along sections of the bank on both sides, which will block overland flow and sub-surface flow (by compacting the soil beneath and making it less permeable). A particularly wet area is located behind the bund towards the centre of the eastern field, and this has a distinct vegetation community (classified as NVC OV26/MG9), including young alders and rushes. This area has a discrete substrata with more sands and gravels noted during dipwell installation than at adjacent locations. The combination of the more permeable substrata and the adjacent bund downslope means that this area acts like a sump, retaining groundwater and surface water runoff and resulting in a different vegetation community than elsewhere on the SSSI unit. There is no evidence that this feature is supported by a spring, that it extends outside the boundary of the SSSI, or that it is supported by groundwater flows from further east. As the mainline link road cutting to the east is predominantly in the impermeable Mercia Mudstone, it is predicted that the Scheme will not influence the hydrogeology of this localised feature.

12.31 In the summer and autumn when there are higher evapotranspiration rates and lower amounts of rainfall, the water table within the SSSI will be depressed towards the surface of the Mercia Mudstone. With no significant groundwater flow contributing to this SSSI unit, the water table is reliant on rainfall recharge. Sub-irrigation and capillary rise through the thin superficial deposits above the Mercia Mudstone may provide some moisture to the root zone, but the water table is likely to be low throughout this period, other than the area with the OV26/MG9 plant communities.

Potential Impact of the Scheme on the Hydrology of the NW SSSI Unit

12.32 Due to the shallow Mercia Mudstone deposits between the new mainline link road and the SSSI, there is no significant groundwater pathway between the two that would be disturbed by construction of the cutting. A maximum of 5% of the surface water catchment to the east would be cut off by the Scheme and under the footprint of the new road, but this area is not well connected to the site other than through limited surface and sub-surface flows, and is not likely to significantly influence the flows along the central watercourse which drains from the south/southwest. The Site is also underlain only by relatively thin superficial deposits, containing more clay than found across the SE Unit, which also suggests that rainfall is the predominant factor controlling hydrological conditions on the Site that are suitable for the formation of the grass communities that are found.

12.33 There is also no evidence that the particularly wet area with distinct vegetation in the eastern field has a hydrogeological connection that extends beyond the SSSI, or that any disruption would be caused to this feature by the proposed road cutting. Instead, this feature appears to be a consequence of an isolated pocket of more abundant sand and gravel holding water that is impounded by the artificial bund, which inhibits drainage to the watercourse.

Overall, it is considered that based on the available data it is unlikely that the Scheme would have any significant adverse effects on the hydrology of the NW Unit, and thus no mitigation measures are needed to protect the hydrology of this SSSI unit from the road construction. However, the dipwell monitoring is to be continued to ensure that this is the case, and as per the Register of Environmental Actions and Commitments (REAC).

Limitations to development of the conceptual models (SE and NW SSSI Units)

12.34 The conceptual models presented here are based on the best available data at the time of writing in June 2019. Monitoring of groundwater levels is ongoing for the boreholes that are located around the periphery of the SSSIs, and for the dipwells that have been installed within the SSSIs. It is anticipated these will support the initial interpretations which indicate that rainwater recharge is the dominant mechanism driving water table levels in both SSSI units, albeit with the hydrology of the SE SSSI also potentially being supported by some subsurface flows. Initial monitoring data gathered to date currently reflects only the late summer 2018 to late spring 2019 seasons. If additional monitoring requires any changes to the interpretation in this technical note a revision will be issued.

12.35 Based on the current data, the disruption of groundwater flows is expected to be insignificant at the SE Unit, and so mitigation is focused on mitigating the loss of the surface water catchment in order to replicate the natural recharge that surface water provides. As above, if additional monitoring requires any changes to the interpretation in this technical note a revision will be issued.

13 Interim Monitoring Results

13.1 Ten dipwells were installed in the wet meadow at the SE SSSI unit on 13-14 August 2018 (see Figure 12A for locations and Photo 18 for an example), and ten dipwells were installed in the NW unit on 5-6 September 2018 (see Figure 12B for locations, and an example in Photo 19). Since the installation, a water level logger has been operational in one dipwell within each SSSI, recording water table depth at 15 minute intervals. The remaining dipwells have been monitored for water table depth, pH and conductivity on a fortnightly basis.

13.2 To enable analysis of water table data depth against rainfall, the Environment Agency has provided precipitation data for Saltley (SP0091508801) and Tudor Grange (SP0147307886) meteorological stations for the period January 2018 through to April 2019. The Tudor Grange gauge has been used for analysis given its closer proximity to the SSSI units (4.75 km to the SE unit).

13.3 Figure 17 shows the continuous water table level data for dipwell T1C from the SE SSSI unit and dipwell N2B from the NW SSSI Unit plotted against daily rainfall totals from Tudor Grange.

13.4 Key observations are listed below.

- Water table level at both SSSI units shows an almost immediate response to heavy rainfall events.
- Dipwells were all dry until early October 2018 when water levels rose in a stepped fashion, receding after each large rainfall event but to shallower depths.
- From early December 2018 water levels rose above 0.4m BGL at both sites between rainfall event, which has been interpreted as the superficial deposits having been fully ‘recharged’. The water table remained around the optimum mean spring water depth of 0.45 m BGL (as described in the Environment Agency Ecohydrological Guidelines) for the remainder of the current monitoring record to May 2019.
- Both SSSI units responded similarly to rainfall, although once recharged the SE SSSI units appears to exhibit a ‘flashier’ hydrological response to rainfall, with a more rapid recession of water tables levels in comparison to the NW SSSI unit. This is likely due to the more widespread clay substrata in the NW SSSI unit which impedes drainage to a greater degree (thereby maintaining water levels more consistently) than at the SE SSSI unit that is underlain by more permeable sands, gravels and cobbles.
- At the SE SSSI unit the central watercourse was observed to contain ponded water for the first time in the monitored period on 8/11/18 and was first observed to be flowing on

7/12/18. This is around the same time as the superficial deposits beneath the site were ‘recharged’ and suggests that infiltration from the watercourse has a limited role in replenishing groundwater levels, and if anything it may be that the rising groundwater levels have resulted in supporting flow in the ditch.

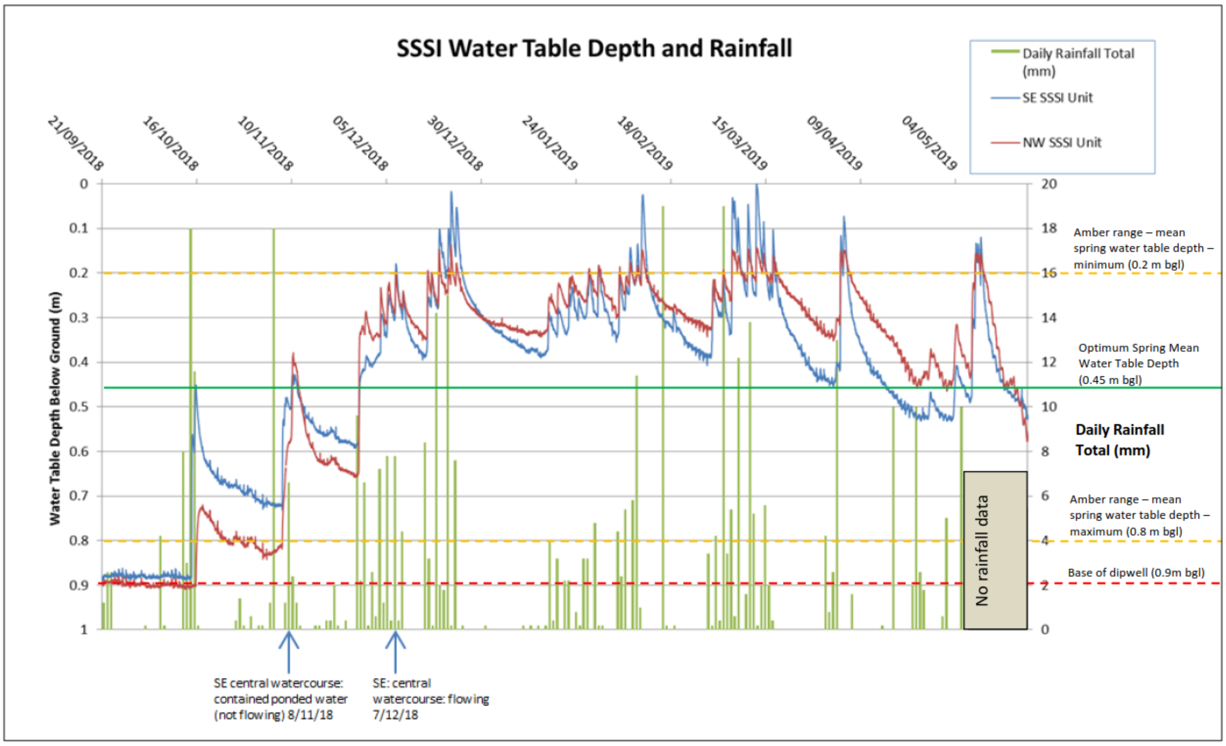


Figure 17 Rainfall total for Tudor Grange plotted against water table depth for the northwest and southeast SSSI unit data (dipwells N2B and T1C). Also shown are the optimum spring mean water table depth for MG4 grasslands (0.45 m bgl), and the ‘amber’ minimum and maximum range (i.e. the water level which if experienced most years will result in a change in the community) as described in the Environment Agency Ecohydrological Guidelines[12].

13.5 For the SE SSSI unit all dipwells (data not shown) follow a generally similar pattern of level variation in response to rainfall. Initial analysis of dipwell position, water level variation, substrate conditions, and water quality (i.e. pH and electrical conductivity) do not show any obvious relationships. However, some additional observations have been possible:

- Dipwells T1E and T2E (see Figure 12 for locations) are the furthest north of the dipwells on the site, and are also at the lowest point of the site. As such, they were the first to accumulate water following the summer, and always have amongst the highest water table levels. Both also have a layer of clay below the silty topsoil, which restricts the rate of seepage to the underlying mudstone thereby further supporting higher water table levels at this point.
- Dipwells T2B and T2C are relatively shallow and only extend to 0.45 m and 0.5 m below ground level respectively. T2B has only once had water in it, and T2C has only twice recorded water. This indicates a drier area of the site. Both are underlain by sand which means that water is likely to drain through to the lower levels quicker than in areas underlain by clay.

[12] Environment Agency (2004) Protective and Enhancing Wetlands: Ecohydrological Guidelines for Lowland Wetland Plant Communities.

- There is no clear relationship between water table depth and predominant type of grassland (MG4/MG5), although this variable is difficult to accurately measure. While the highest mean average water table (for occasions when water has been recorded in the dipwells) might be expected in areas of MG4 grasslands, this is actually found at dipwell T2A which is on the MG5 grassland. Dipwell T2D has the lowest mean average and is in a transitional MG4/MG5 area. These grassland types are spatially variable across the site, with non-distinct boundaries, meaning that clear grassland zonation is difficult to determine.
- Electrical conductivity measurements collected from dipwells T1A, T1E and T2D vary widely from 0.25 mS/cm to 2.49 mS/cm. There is no clear relationship between water table depth and electrical conductivity from the initial period of data collection;
- pH measurements collected from dipwells T1A, T1E and T2D pH values are circum-neutral. There is no clear relationship between water table depth and pH from the initial period of data collection.

13.6 For the NW SSSI unit (data not shown) the following additional observations can be made at this stage:

- As at the SE SSSI unit, all dipwells follow a generally similar pattern of level variation in response to rainfall except N2C. The water table reached the surface at N2C in early December 2018 and has remained at the same level through to May 2019. N2C is in the wet area identified in the conceptual model, where there is a distinct substrata (more sands and gravels than elsewhere), which is located behind a bund which acts to retain water.
- The mean average water level for MG4 grasslands (0.25 m) is higher than for MG5 grasslands (0.39 m) at this site (for periods when dipwells have contained water), although there is still substantial overlap between the two grassland types in terms of their range and mean.
- Electrical conductivity data measured from dipwells N1A, N2C and N2E varied from 0.15 mS/cm to 1.43 mS/cm. There is no clear relationship between water table depth and electrical conductivity.
- pH measured from dipwells N1A, N2C and N2E show that pH values are circum-neutral. There is no clear relationship between water table depth and pH.

14 Summary of Findings

14.1 The NW SSSI unit appears to be dependent on direct rainwater recharge to maintain its water table at a suitably high level in the winter and spring to support the development of MG4 grass communities. Low permeability Mercia Mudstone is at shallow depth around the periphery of the site and would prevent any significant groundwater flow between the location of the new mainline link road and the SSSI unit. Superficial deposits are also thinner than across the SE Unit with greater amounts of lower permeable clay and limited sands and gravels, which help to reduce infiltration and maintain surface saturation. Around 5% of the surface water catchment will be cut off by the development but this is considered unlikely to significantly alter the flow in the watercourse that flows occasionally through the NW SSSI unit, as this portion of the catchment is not well connected to the SSSI unit (with the main flow pathway being subsurface flow).

14.2 The SE SSSI unit has thicker and more extensive superficial deposits which stretch out in a wide ‘bowl’ around the site. There will be groundwater movement within the granular layers in these thicker superficial deposits, which will generally flow into the SSSI from the south, north, and west and then out towards the northeast. The water table at the Site is maintained through winter and spring by a combination of rainwater recharge, infiltration from the northern ditch, limited groundwater flows from elsewhere in the catchment, and potentially some recharge from infiltration from the central watercourse. Analysis of the thickness and spatial extent of the superficial deposits indicates that they thin out towards the new mainline link road cutting. There is no evidence that the proposed cutting will intersect significant thicknesses of sand or gravel in the thin superficial deposits at this location, which could be contributing to groundwater recharge of the SSSI. The majority of the cutting will instead intersect the low permeability Mercia Mudstone, and so it is concluded that the cutting will have negligible impacts on the hydrogeological conditions of the SSSI.

14.3 Furthermore, although around one fifth of the surface water catchment to the west of the mainline link road and beneath the Scheme footprint will be lost or cut off, it has been shown that the majority of this flows towards the dry meadows where MG5 grass communities that are less sensitive to ground hydrological conditions dominate. A 3.6% loss to the surface water catchment of the wet meadow field containing MG4 grasses is predicted, as well as potentially reduced recharge from the central watercourse. While the amount of water lost could be within that expected with natural climatic variability ‘year on year’, it cannot be confirmed that this would not have consequences for the sensitive grassland species in a given year or over a number of consecutive ‘drier’ years in terms of depressing the water table to the extent that surface conditions become drier, especially in the spring. There is also an inherent uncertainty in this assessment from data limitations. Due to this uncertainty it is proposed that mitigation is provided for the wet meadow in the SE SSSI unit. This is discussed in Section 15.

15 Mitigation Hierarchy and Options Considered

15.1 During the site meeting with Natural England on 26 April 2018 (minutes from meetings with Natural England provided in Annex G) it was requested that options are presented for the approaches that may be taken in the event that the Scheme results in an adverse effect upon the SSSI. This may be the case at the SE SSSI Unit due to the loss of approximately 3.6% of the surface water catchment to the wet meadow field (and potentially some reduced recharge from the central watercourse).

15.2 A potentially adverse effect would comprise alterations to the type or extent of the grassland communities that are the interest features of the SE SSSI Unit. This may occur as a result of changes to the existing hydrological regime. In the event that an impact to the interest features of the SE SSSI Unit is considered likely then mitigation or compensation may be required. Potential mitigation and compensation options are listed in Table 3 in order of preference with regards to Natural England’s hierarchy of mitigation approach. The three options are:

- Option 1: Maintain the hydrological regime of the SSSI;
- Option 2: Physical changes within the SSSI to extend the existing habitat type;
- Option 3: Establish habitats similar to the interest features, either in land immediately adjacent to the SSSI or at a new site (i.e. compensation).

15.3 All of the potential approaches to achieving Option 1 (i.e. maintaining the hydrological regime) in Table 3 would be informed by ongoing monitoring of the SSSI grasslands and water levels to ensure that they are effective. An outline options appraisal for these various approaches is provided in Table 3, and the three options were discussed with Natural England at a meeting held on 14 March 2019 (See Annex G). In earlier drafts of this ‘live’ Technical Note the options in Table 3 listed were intended to apply to both SSSI units. However, and as discussed above, the conceptual model indicates that the NW SSSI unit is unlikely to be affected by the Scheme, and so ongoing monitoring should be sufficient alone as mitigation. This was agreed with Natural England at the meeting in March 2019.

Table 3 Potential Hydrological Impacts on Bickenhill Meadows SSSI – Mitigation Options Appraisal

Mitigation Option (in order of preference)	Description	Mitigation Type	Design	Third Party and Land Ownership	Planning and Deliverability	Future Maintenance
Option 1 -Maintain the existing hydrological regime of the SSSI.	For the SE unit the ditch on the northwestern border of the site has been identified as the potential means of recharging/reintroducing replacement water to maintain the existing 'natural' water supply that has been interrupted by the cutting. A number of potential water sources to feed this ditch have been identified. These include: 1) Run-off from local roads. 2) The collection and pumping of water to the SSSI units from the severed catchment area and cutting slopes. 3) Borehole pumping. 4) Potable water supply to apply water to the site, either through direct spray application or discharge to ditches and streams.	**Reduction of impact** - Measures to maintain the existing hydrological regime of the SSSI. This may include draining water from local roads to the SSSI, pumping of water across the cutting to replicate the existing natural water supply to the SSSI or an alternative water supply, if one could be identified (potential options to achieve this are discussed below). This is the best outcome for the SSSI as water supply would be maintained.	The recharge ditch to the north west of the SSSI needs to be a continuous means of transferring water in a controlled manner along the boundary of the SSSI. Run-off from Shadowbrook and Catherine-de-Barnes Lanes could be collected and directed to the recharge ditch under gravity. Treatment of water from local roads may require space for SuDS e.g. swales. The pumped option would require new infrastructure (and associated power supplies) to collect water from the catchment area that has been lost and to pump it up to an existing ditch running alongside the SSSI. Borehole pumping could be from shallow or deep aquifers – pump tests would be required but desk study indicates shallow pumping is unfeasible and that deep drilling would be required to reach a viable aquifer. New infrastructure may also be required if potable supply was used, in order to transfer water from the mains to the SSSI (spray application or discharge to watercourses).	All options will require agreement with Natural England (NE) and Warwickshire Wildlife Trust (WWT). The local road network is the responsibility of Solihull Metropolitan Borough Council (SMBC) - all proposals are subject to agreement with SMBC and appropriate treatment/spillage containment measures. The SE unit is below the airport flightpath - airport safe guarding requirements will restrict bodies of open water. The location of new infrastructure is yet to be determined and may require land take currently outside of the application boundary.	Engagement with NE, the EA, and the WWT is key to understand the deliverability of the chosen solution. In summary - they do not want a pumped solution and prefer a passive, low cost "natural" intervention. The ditch is only partly within the current redline (order limits) – general provisions allow Highways England the rights to outfall to ditches and watercourses but this will require negotiations with the land owners/ affected parties. Access would also be required for creating and maintaining all of the proposed systems. The continuity, ownership, current maintenance regime and control of the ditch are uncertain. The application boundary and Scheme description could potentially require amendment to ensure any infrastructure associated with the pumped solution could be constructed, operated and access provided for long term maintenance purposes. The potable water supply option is unlikely to require works outside of the application boundary.	A new pumping network and recharge trench would need to be regularly maintained with access provided. Drains, pumps and chambers in the verge of the mainline link road will require cleaning and maintaining – this will require maintenance laybys or lane closures which will negatively impact on customers. For pumped solutions, the pumps will not operate continuously – they will only operate between Autumn and Spring, leading to pump reliability issues meaning that a spare pump would need to be maintained at all times. Maintenance is unlikely to be required for the potable water supply option, but this is likely to require regular direct interventions from WWT and NE.
Option 2 Physical changes within the SSSI to extend the existing habitat types.	This would involve carefully planned and localised changes to the topography of the SSSI, and would be based on detailed modelling of the existing vegetation communities. As an example, the approach could seek to extend the topographical variations (such as deeper depressions and furrows) that have established the existing pattern of vegetation communities, to compensate for potential reduction in groundwater and surface water inflows.	**Offsetting impact** - Physical changes within the SSSI to extend the existing habitat types. This would involve carefully planned and localised changes to the topography of the SSSI, and would be based on detailed modelling of the existing vegetation communities. As an example, the approach could seek to extend the topographical variations (such as deeper depressions and furrows) that have established the existing pattern of vegetation communities, to compensate for potential reduction in groundwater and surface water inflows.	Unlikely to require any changes to the infrastructure design. A detailed Habitat Enhancement Plan would need to be prepared.	The greatest opportunity would be on the NW site that is owned by Birmingham Airport Limited (BAL). There may be some options for the SE Unit that is owned and managed by WWT, although less so. Other landowners may be affected. Both BAL and WWT (as well as NE) would need to be consulted on the Habitat Enhancement Plan to ensure it can be agreed and delivered.	The current application boundary incorporates the extents of land designated within the boundary of the SSSI, within which it is expected that these measures could be delivered and managed without requiring additional land beyond that already identified. Scheme description would need to be amended to incorporate these measures. Although works may be of a soft nature, the use of some equipment and small plant cannot be ruled out. This would require Assent from NE and permission from the landowners. Experience with BAL to date is that this may not be straight forward and could even be objected to or require acceptance of unreasonable levels of liability.	It would be expected that any changes to the SSSIs would need to be carefully monitored for 3+ years.
Option 3 - Establish habitats similar to the interest features, either in land immediately adjacent to the SSSI or at a new site.	This would include creating a parcel of land with a varied topography and a related hydrological regime, and establishing grassland using green hay from the SSSI.	**Offsetting impact** - Establish habitats similar to the interest features in land immediately adjacent to the SSSI (or otherwise at another location entirely). The aim would be to create a parcel of land with a varied topography and a related hydrological regime, and to establish grassland using green hay from the SSSI. This is an offsetting solution and so is the worst case for the existing SSSI.	The conditions of the SSSI would be re-created, ideally from land parcels flanking the brooks in/out of the SSSI, while avoiding significant risk of impacts from the proposed road. Requires careful design, alterations to topography and specialised planting in consultation with NE. A detailed Habitat Management Plan would likely be required to demonstrate to the relevant bodies how these habitats would be established and managed in the long term.	Discussions with landowners would need to be advanced, as their land would either need to be secured by way of prior agreed purchase to implement these measures, or via the DCO as essential land take for mitigation purposes. With regards to the NW Unit, and assuming some tasks will require the use of equipment and plant, discussions with BAL would be required to understand any safeguarding issues that may limit how the work is undertaken.	The application boundary and Scheme description would need to be amended to ensure this mitigation could be implemented. Although works may be of a soft nature, the use of some equipment and small plant cannot be ruled out. Permission will be required from the landowners. Experience with BAL to date is that this may not be straight forward and could even be objected to or require acceptance of unreasonable levels of liability.	Maintenance of site would be undertaken on an annual basis under a management / legal agreement that would be needed in perpetuity. This could be adopted by the land-owner or a third party via the legal agreement

15.4 A mitigation option further to those listed in Table 3 was previously proposed in discussion with Natural England. This was to implement measures to re-store natural flow along streams flowing through the SSSI units by re-routing each stream through the low point of each valley and restoring a more natural planform. However, there are limitations as to what could be done within the order limits, and after further consideration and appraisal of the conceptual model it is thought that improved drainage could potentially adversely affect the SSSI units by causing the sites to dry out further. As such, the option has not been included in the options appraisal.

15.5 With regards to the SE SSSI Unit, a number of potential water sources have been considered to achieve Option 1 (i.e. maintaining the hydrological regime of the SSSI). These various water supplies could be directed to the northern ditch adjacent to the wet meadow, which has been identified as a potential means of recharging/reintroducing replacement water to maintain the existing 'natural' water supply that has been interrupted by the cutting. Each of the potential water sources to feed this ditch and thereby implement Option 1 are discussed further below:

Source 1 Run-off from Catherine-de-Barnes Lane (plus adjacent greenfield runoff)

15.6 Based on assessments to date, Source 1 is likely to be delivered via a passive gravity fed system (with appropriate treatment as required) and is currently considered the most sustainable solution. A design has been produced which uses road run-off from the realigned Catherine-de-Barnes Lane (4,875 m^2 of which 4,086 m^2 is from impermeable surfaces such as the road and 789 m^2 from more permeable areas such as the soft verge) and greenfield runoff from adjacent fields (7,103 m^2), both of which are collected and delivered to the northern ditch of the SSSI via a conveyance swale. The greenfield area is within the control of Highway's England and if require legal instruments could be created to ensure this area is maintained as a contributing area to the SE SSSI Unit in perpetuity. The ditch should then act as a recharge trench, enabling replenishment of the wet meadow's water table. If water is not being retained long enough within the ditch it could be reprofiled to create more exaggerated pools or semi-porous log dams could be installed using natural materials, all with the intention of keeping water in the ditch for longer to maximise infiltration. The proposed solution is shown in Annex H.

15.7 The design storm analysis of volumetric water loss from the wet meadow due to the Scheme, undertaken using Micro Drainage software (see results in Table 2 earlier), has been repeated for this new potential mitigation solution, but now incorporating the water supplied from the re-aligned Catherine-de-Barnes Lane and greenfield areas as mitigation.

15.8 Once the gravity-fed mitigation solution is applied there is a surplus of water reaching the wet meadow in comparison to existing conditions. At the 1 in 5 year storm there is an increase in volume of 7.7% reaching the wet meadow, and 7.5% for the 1 in 30 year storm, and 7.0% for the 1 in 100 year storm (see Table 4). Although there remains some uncertainty regarding the contribution of groundwater flow and infiltration from the central watercourse, and some of the water supplied may not infiltrate and might flow along the ditch, there is a buffer in the volumes of water available. Natural England have also previously expressed a preference for excess water to reach the wet meadow rather than too little water, as any water reaching the site can be managed and drained if necessary. Monitoring of the mitigation would be necessary for optimisation and to ensure not too much water is being provided. If infiltration needs to be encouraged further, small informal log dams using natural materials could be provided across the northern ditch and the bed deepened in places to encourage water to pool.

Table 4 Design storm discharge volume analysis for the 'wet meadow' catchment without mitigation and with implementation of the gravity-fed solution (Option 1), at the 1 in 5 year, 1 in 30 year and 1 in 100 year return periods.

Scenario (i.e. mitigation or not)	Pre-Development - Existing Conditions		Performance Post Construction of Road		
	Storm Return Period	Discharge Volume (m^3)	Storm Return Period	Discharge Volume (m^3)	% Change in Performance from Existing Condition
No Mitigation	1 in 5 Year	1246.904	1 in 5 Year	1202.14	-3.6%
Mitigation			1 in 5 Year	1342.783	7.7%
No Mitigation	1 in 30 Year	1880.107	1 in 30 Year	1812.537	-3.6%
Mitigation			1 in 30 Year	2020.915	7.5%
No Mitigation	1 in 100 Year	2537.311	1 in 100 Year	2446.318	-3.6%
Mitigation			1 in 100 Year	2716.062	7.0%

15.9 While there is an increase in volumetric water supply to the wet meadow following implementation of the gravity-fed solution, this should not increase flood risk downstream along the central watercourse as the mainline road cutting will result in a reduction on catchment area to the SSSI overall. As discussed above, reduced volumetric water supply to the dry meadow field is not considered to have an adverse impact given the different hydrological tolerances of the MG5 species in this part of the SSSI unit.

15.10 Overall, this passive gravity fed mitigation approach is favoured as it provides a surplus of water to the wet meadow, and is a passive, sustainable solution with limited maintenance requirements. Should the approach be implemented, then vegetation and water table monitoring would be maintained for at least 2 years post construction as set out in the REAC to ensure that no adverse impacts occurred. However, the length of the monitoring would need to be agreed with Natural England and a longer period may be required. A Bickenhill SE SSSI Unit Monitoring and Hydrological Mitigation Management Plan is proposed and will be secured through an appropriate requirement in a future draft of the DCO. It will also be necessary for the greenfield land that contributes runoff to be protected from any future development to ensure this mitigation is secured in perpetuity.

Source 2 The collection and pumping of water to the SSSI units from the severed catchment area and cutting slopes

15.10 The DCO application included a pumped mitigation solution. This solution would collect all water lost to the proposed mainline link road to the SE SSSI Unit. The design principles of the pumped solution consist of a collection drain on the western slope of the new link road cutting to intercept surface water flows that would otherwise have drained towards the SE SSSI Unit. The collection drain would discharge to a sealed collection sump, from where water would be pumped and/or captured from an alternative water source(s) to an appropriate water feature in the vicinity of Bickenhill Meadows SSSI SE Unit. The proposed design is shown in Annex I. Again, this feature would act as a recharge trench, from which water would drain through to the sand, gravel and clay deposits in the upper layers of the substrata within the SE SSSI Unit.

15.11 Using this pumped approach 11% of the surface water catchment (of the entire SE SSSI Unit) that is cut off from the SE SSSI Unit can be reconnected, but the 10% of catchment falling under the Scheme footprint would be lost from the SE SSSI unit. To further mitigate for this loss, the proposed collection drains could be extended north and south to collect greater amounts of water from the west of the proposed new mainline link road, and thereby compensate for the loss beneath the Scheme footprint. Another option would be an alternative supply of water that could be pumped toward the recharge trench adjacent to the SE Unit from the wetland that is proposed to attenuate road runoff from the Scheme to the north of junction 5 of the M42. A pumped solution of this type should maintain surface water flows to the SE SSSI Unit. However, it is a less sustainable approach than using road run-off and would require frequent maintenance of the pumps and would create liability issues. As such it is not the preferred solution. Annex I shows one potential pumped solution, and other alternative sources of water for a pumped solution could be explored if such an option was progressed.

Source 3 Borehole pumping

15.12 For Source 3, the possibility of installing a compensation borehole has also been considered. A borehole into the shallow superficial sands and gravels above the Mercia Mudstone is not feasible as water in these layers is required by the sensitive grassland species, and so removal of any water from these layers could amplify any potential adverse effects on the SE SSSI Unit. A deep compensation borehole into the Sherwood Sandstone which underlies the Mercia Mudstone is a possibility as it is a major aquifer, although it has not been exploited for water supply at the site or in the vicinity. As the surface of the Sherwood Sandstone is over 150m deep (and may be >200m deep), extraction would not impact on the surface features of the SE SSSI Unit. However, there are substantial costs involved with installation of a borehole and pumping regime to exploit groundwater at such great depths. There would also be long term pumping and maintenance requirements, which mean that this option provides no benefit over the proposed use of a collection drain for surface water and pump to transfer the water to the existing ditch at the site.

Source 4 Potable water supply

15.13 For Source 4, an alternative option to maintain the hydrological regime of the SE SSSI Unit may be to use a potable water supply to recharge the site, either by direct spraying or through discharge to the existing ditch and tributary of Shadow Brook. While such an approach would ultimately achieve the same outcome as the gravity solution, it would require direct application of the water to the field or ditches, whereas the gravity solution is passive system requiring routine maintenance but no direct ongoing action once correctly established. The advantages of using a potable supply would include that no long term maintenance and inspection of pumps would be required indefinitely, and the approach is not susceptible to equipment failure. The system may also only have to operate at key times of the year when the sensitive grasslands require high water tables, particularly late winter and early spring. On the other hand, such a solution would require direct interventions by Warwickshire Wildlife Trust and Natural England rather than being passive, and ultimately using treated water for irrigation is not the most sustainable use of potable water.

16 Consideration of Margins of Error

16.1 Two alternative methods for assessing the impact of the catchment area loss to the wet meadow field of the SE SSSI Unit have been undertaken to provide greater assurance of the accuracy of the assessment. Both methods are based on data and assumptions which can give rise to margins of error, and this is discussed in this section.

16.2 The first method (see Annex F) estimates the impact of the change in catchment area with the Scheme on the annual water budget to the wet meadow field by determining the proportion of rainfall that would be available per year (i.e. total rainfall and runoff co-efficient) and then applying a reduction based on the reduction in catchment area with the Scheme. This was repeated for average, dry and wet years to provide a range of annual volumetric losses. The results were also put into the context of the long term rainfall record to highlight whether or not the predicted change was within the experienced 'year on year' natural variation.

16.3 The second method uses the modelling software Micro Drainage to predict the percentage reduction of available water to the wet meadow field by analysing the effect of the reduction in catchment area under a number of different design rainfall events (i.e. 1 in 5 year, 1 in 30 year and 1 in 100 year return periods). Although this method only gives a volume of water that is lost for each event, it provides a means of checking the approach taken in Annex F.

16.4 Both methods require analysis of the impact of the Scheme on the catchment areas derived using Micro Drainage software and open-source Lidar data to create a Digital Terrain Model (DTM). The Lidar data is based on 2 m spatial resolution and a vertical accuracy of +/- 15 cm root mean square, and thus the margin of error from this data source is considered to be low. Topographical survey information has also been used to reduce the error and ensure that the existing highway drainage network layout was taken into account. The total and sub-catchment areas for the wet and dry meadow fields have been drawn manually based on the vector outputs from the Micro Drainage software and it is possible that small errors have occurred. However, similarly to the DTM, these errors are considered to be small and insignificant.

16.5 For the first method that is presented in Annex F, neither the calibration tool or the ReFH boundary unit give any output regarding error. This is because they are deterministic model tools. The ReFH2 loss model, routing model, and baseflow model all influence the amount of water reaching the SSSI. An indication of how accurately the model reflects different hydrological parameters in reality can be gleaned from the factorial standard error (fse) (i.e. the standard deviation of a data set) and the co-efficient of determination (r^2), where an r^2 of 1 means the model explains all variation, and an r^2 of 0 that the model does not explain any of the variation. Fse and r^2 for the parameters used in the method described in Annex F are provided below:

- Loss model parameter *Cmax* is estimated based on catchment descriptors *BFIHOST* and *PROPWET*. Details of the derivation and utility of the various catchment descriptors are given in full in Volume 5 of the Flood Estimation Handbook (FEH). In summary, *BFIHOST* is the base flow index and is a measure of catchment responsiveness derived using the 29-class Hydrology Of Soil Types (HOST) classification. *PROPWET* is a catchment wetness index (PROPortion of time soils are WET), developed for the Flood Estimation Handbook, and provides a measure of the proportion of time that catchment soils are defined as wet (in this context, when soil moisture deficits are less than 6mm). *PROPWET* values range from over 80% in the wettest catchments to less than 20% in the driest parts of the country. From the ReFH handbook, the factorial standard error (fse) for the loss model parameter *Cmax* is 1.61 and the coefficient of determination (r^2) is 0.55.

- The routing model parameter *Tp* is estimated based on catchment descriptors *PROPWET* (described above), *DPLBAR* (mean of distances between each node on the Integrated Hydrological Digital Terrain Model grid and the catchment outlet, in kilometres; this is used to characterise catchment size and configuration), *DPSBAR* (a landform descriptor (mean Drainage Path Slope) which provides an index of overall catchment steepness) and *URBEXT1990* (index of suburban and urban land cover). From the ReFH handbook, the fse for the routing model parameter is 1.31 and the r^2 is 0.81.

- The baseflow model parameters are:
  - Baseflow Lag (BL), which is estimated based on catchment descriptors BFIHOST, DPLBAR, PROPWET and URBEXT1990 (all described above). From the ReFH handbook, the fse is 2.03 and the r^2 is 0.41; and
  - Baseflow Recharge (BR), which is estimated based on catchment descriptors BFIHOST and PROPWET (both described above). From the ReFH handbook, the fse is 2.04 and the r^2 is 0.34.

16.6 In addition to the above, the *Cini* value is also used in the hydrological analysis. The *Cini* value describes the initial soil moisture content and evapotranspiration potential and was calculated by the software from observed rainfall data and an estimate of typical countrywide evaporation rates with a sinusoidal annual profile. Rainfall data may include some error based on recording accuracy, representativeness of actual catchment (nearest we could get data for), and areal reduction factor. Error margins are not available for the rainfall or countrywide evaporation rates. There could also be other errors associated with the accuracy of source data maps used to define catchment descriptors through generalisations.

16.7 Regarding the second method used to analyse the impact of the catchment losses on the SE unit of the SSSI, the main source would be from the rainfall data that is used. Rainfall data from the Flood Studies Report (FSR) was used and the FEH did not have data for this site. The FSR was published in the mid-1970s and uses rainfall from 1941 – 1970, whereas the FEH was published in 1999 and uses rainfall from a dataset between 1961 - 1990. The FEH has a more recent dataset and uses a larger rainfall record for generating the methodology. However, as this method is comparing two situations with the same rainfall data to determine a percentage reduction, rather than estimation of changes in annual water budgets, it is unlikely that this data set would lead to a significant error in the outcome.

16.8 The second method also requires an estimation of the availability of water to compensate for the loss of catchment area. When estimating the availability of water for mitigation, runoff co-efficient of 0.9 for impermeable road surfaces and 0.25 for greenfield areas has been used. The runoff co-efficient for greenfield land is consistent with the estimation of water supply as determined in the method presented in Annex F. It is possible that under very warm weather conditions the runoff co-efficient from road surfaces may reduce slightly due to increase evaporation, but these is likely to occur for only short periods of the year.

16.9 Overall, there are a number of potential sources of uncertainty in this assessment relating to potential error in the standard data sets used by hydrological software and methods, rainfall records and Lidar. Errors may also occur from the assumptions made or from data processing and analysis of outputs. Given the wide range of different sources of error including of third party data it is very difficult to quantify a specific error margin for the entire assessment with any certainty. It is partly for this reason why two separate methods have been used to determine the likely impact of the catchment loss on the wet meadow of the SE SSSI Unit, as well placing the results in the context of year or year variation in rainfall (and therefore natural water supply). Annual volumetric losses have been estimated for average, dry and wet years, and it is expected that any error would be well within the extreme boundaries set by the dry and wet year results.

16.10 It is important that any mitigation solution for the reduction in contributing catchment area to the wet meadow of the SE SSSI Unit has the potential to provide more than the estimated average annual water budget loss. This is because there remains some uncertainty in the assessment as described herein. This is mainly with regard to the potential contribution from groundwater flow and infiltration from the central stream, which although likely to be small and insignificant remain unquantified. Future monitoring of the habitat condition of the wet meadow field following application of a mitigation solution would be needed to optimise the solution and ensure that only sufficient water is applied.

17. Bickenhill SE SSSI Unit Monitoring and Hydrological Mitigation Management Plan

17.1 Long term monitoring of plant communities and the water table in the context of annual climate changes and land management activities is important to understand how changes in the catchment area affect the condition of the SE SSSI Unit. Published information on optimum conditions for MG4 grasses and the data collected and evaluated for this assessment have been used to determine the likely significance of any impact of the Scheme and to inform the development of a preferred mitigation solution. This gravity-fed solution is preferred to the previous pumped solution that was described in the original DCO application and Environmental Statement as it will be more sustainable and at less risk of equipment failure.

17.2 The preferred solution has been designed to provide more water than has been estimated to be lost by the change in catchment area supplying the wet meadow of the SE SSSI Unit. However, ensuring that the wet meadow received the right amount of water is complicated and thus it is important that the implementation of the mitigation solution is accompanied by a programme of monitoring. The scope of this monitoring will be set out in a Bickenhill SE SSSI Unit Monitoring and Hydrological Mitigation Management Plan, that will be secured through a suitably worded requirement of the next DCO draft. It is expected that this will include a requirement for further monitoring of the groundwater table and the spatial extent and condition of grass plant communities across the site. This will be agreed with Natural England and the Warwickshire Wildlife Trust. Information on any changes to the management of the site will also be required from Natural England and the Warwickshire Wildlife Trust.

17.3 Using the data collected changes in the condition of the wet meadow following construction of the Scheme could be evaluated including the effectiveness of the mitigation proposed. It will be necessary to agree with Natural England and the Warwickshire Wildlife Trust measures for how any adverse change would be determined, in the context of year on year weather patterns and other potential influences. The monitoring would be linked to management actions that could be implemented to optimize the mitigation by either enhancing the supply (i.e. by encouraging retention in the northern ditch) or reducing the supply, should this be necessary. Finally, should it be determined that insufficient water is being provided and that a more fundamental resolution is required to improving retention along the northern ditch, other sources of water as discussed in this Technical Note or compensation mitigation will need to be considered.

18 Conclusions

18.1 It has been predicted that the Scheme will not have adverse effects on the Bickenhill Meadows SSSI NW Unit's hydrology, and so no embedded mitigation measures have been proposed for this unit within the DCO application, as agreed with Natural England.

18.2 It has been determined that the Bickenhill Meadows SE Unit will lose around one fifth of the surface water catchment to the west of the new mainline link road and beneath the Scheme footprint. The majority of this surface water loss would ordinarily drain towards the 'dry meadow' MG5 grassland fields within the SSSI, or the central watercourse. Only approximately 3.6% of the surface water catchment to the wet meadow field would be lost due to construction of the Scheme, although there may be a small additional effect from the loss of any recharge provided by the central watercourse (although this is expected to be minimal). While the amount of water lost could be within that expected with natural climatic variability 'year on year', it cannot be ruled out that this would not have consequences for the sensitive grassland species in a given year or over a number of consecutive 'drier' years in terms of depressing the water table to the extent that surface conditions become drier, especially in the spring.

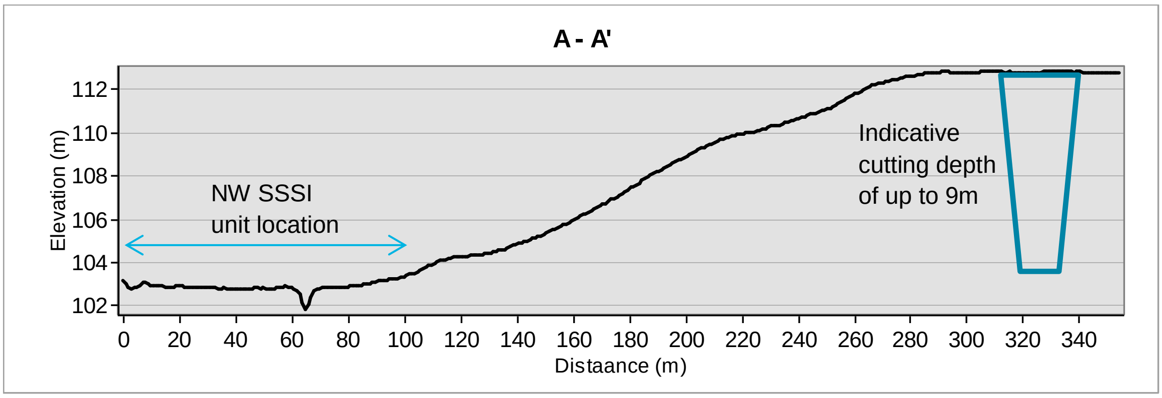
18.3 A number of options have been considered for mitigating the loss of the surface water catchment, including use of run-off from the re-aligned Catherine-de-Barnes Lane (plus adjacent greenfield runoff), developing a pumped solution, groundwater abstraction, and potable water supply to convey water towards the SSSI. The first of these is currently the preferred solution due to its passive, sustainable nature and an initial design has been produced. This design shows that surface water-runoff from the re-aligned Catherine-de-Barnes Lane and greenfield areas would be routed to the northern ditch bordering the northwest margin of the wet meadow field, via a swale that would provide treatment of contaminants in road runoff. The ditch would then act as a recharge trench from which water would infiltrate into the sands and gravels in the wet meadow field.

18.4 Without mitigation, analysis of the historic rainfall record indicates a loss of 3.6% of water supply to the wet meadow due to the Scheme, and design storm analysis (1 in 5 year, 1 in 30 year and 1 in 100 year) similarly shows a 3.6% loss by volume. With implementation of the gravity-fed solution there would be an increase in volume of water supplied to the wet meadow of ~7% compared to existing conditions. It is recommended that the adopted mitigation solution (which is to be embedded mitigation for the Scheme as per Chapter 5 of the Environmental Statement) has the potential to provide more water than estimated to be lost from the annual water budget of the wet meadow to allow for any underestimation due to potential errors and the assumptions used in the assessment. Monitoring of the SE SSSI units conservation status and the operation of the mitigation will be needed to ensure only sufficient water is provided. Monitoring requirements for both SSSI units are outlined in the Register of Environmental Actions and Commitments for the DCO application. However, we are now also proposing that a Bickenhill SE SSSI Unit Monitoring and Hydrological Mitigation Management Plan is also prepared, and the next draft of the DCO will include a requirement for this.

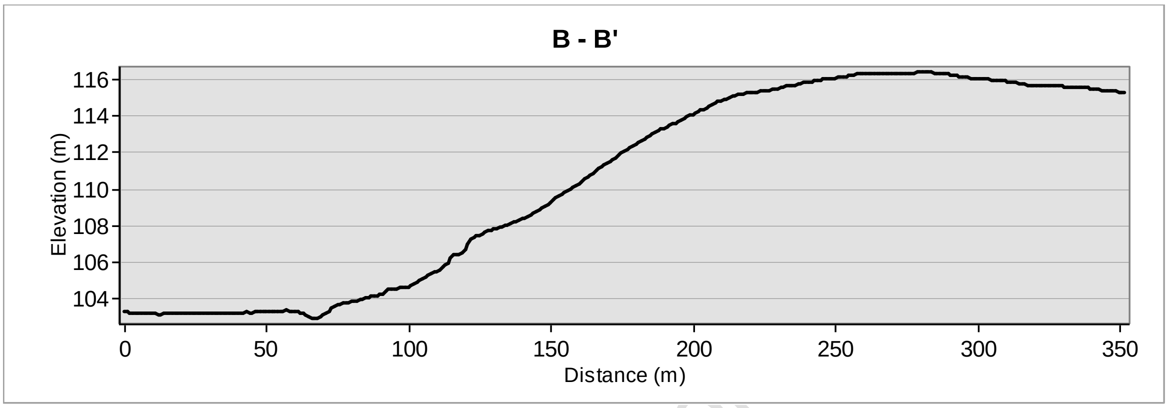
18.5 Finally, it is proposed that the vegetation communities are monitored at both sites during construction and during initial operation of the Scheme to ensure that there is no detrimental impact resulting from the Scheme. This will be augmented by the continued monitoring of water table levels. Should any adverse effects be discovered then further mitigation would need to be implemented.

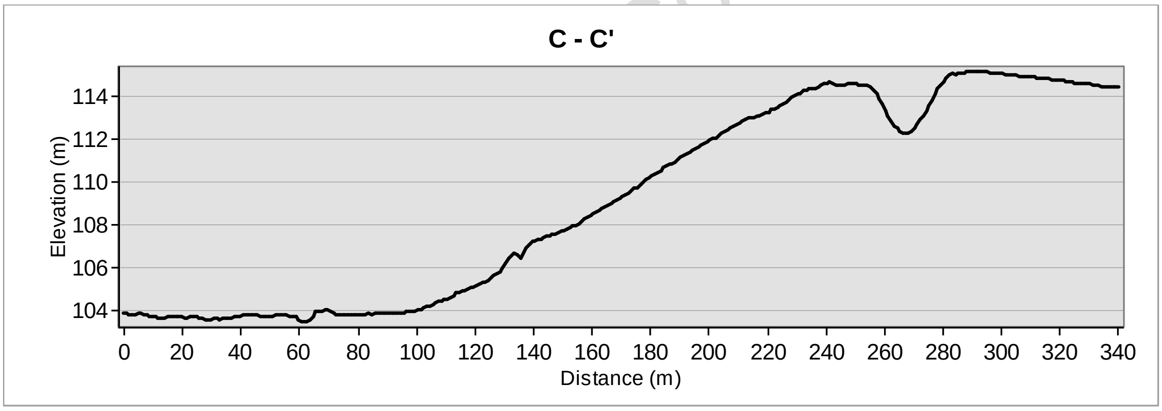
Annex A: Sections

NW SSSI unit

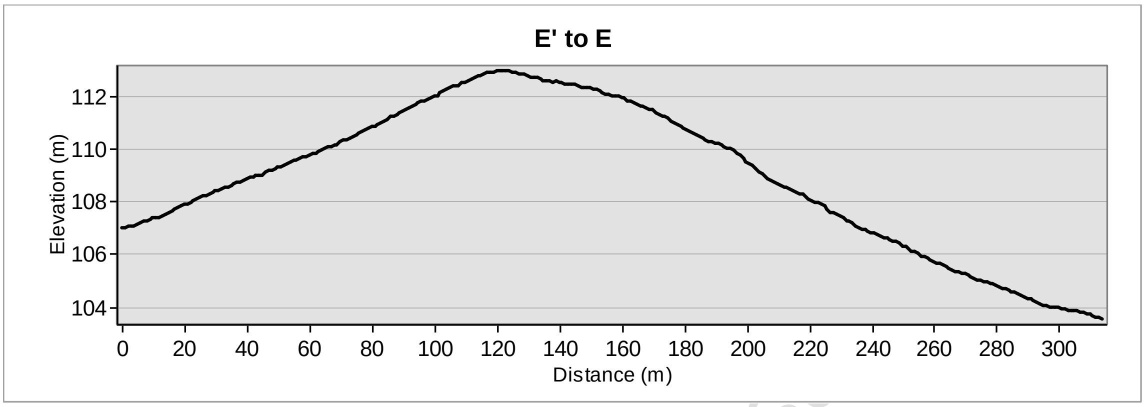


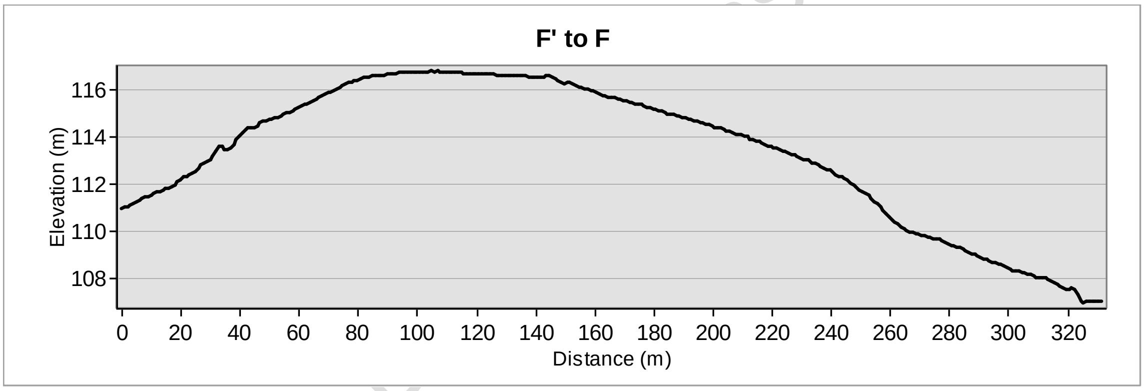
Note. Indicative cutting of up to 9m depth shown in blue.



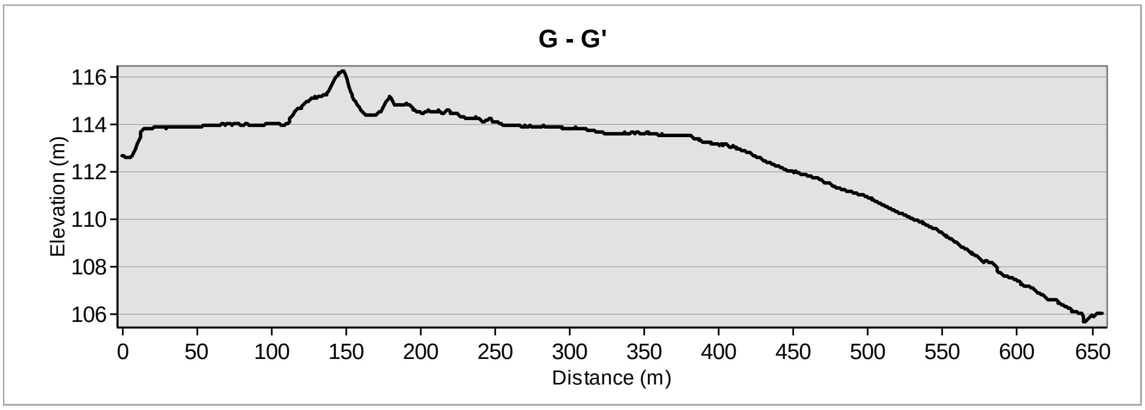


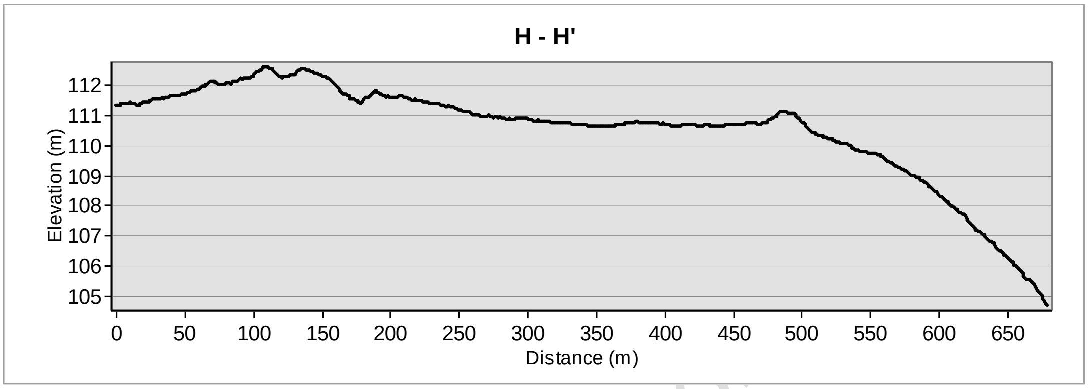

D' to D
Eleavation (m)
Distance (m)
103.8
103.6
103.4
103.2
103
102.8
102.6
102.4
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280

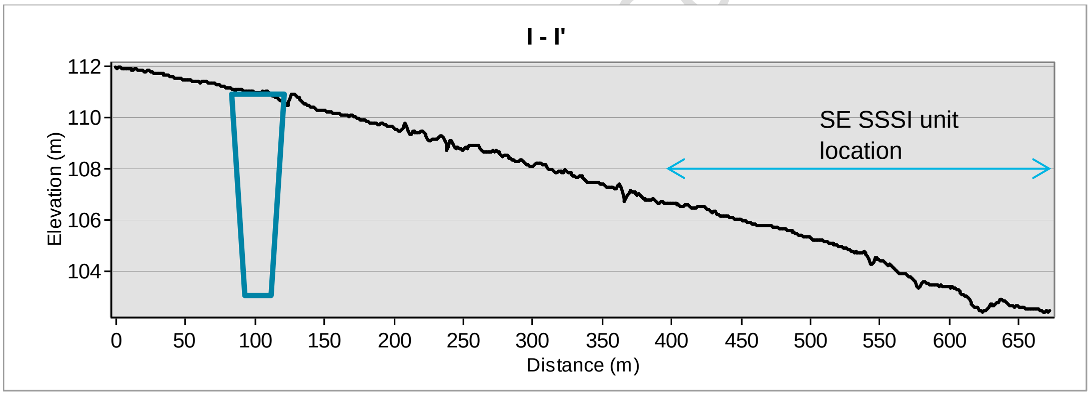

E' to E
Elevation (m)
Distance (m)
112
110
108
106
104
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300


F' to F
Elevation (m)
Distance (m)
116
114
112
110
108
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320

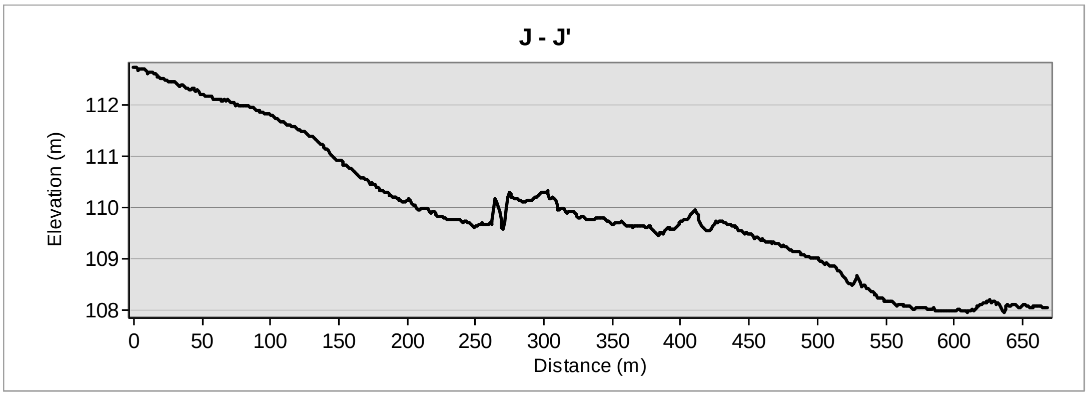
SE SSSI unit

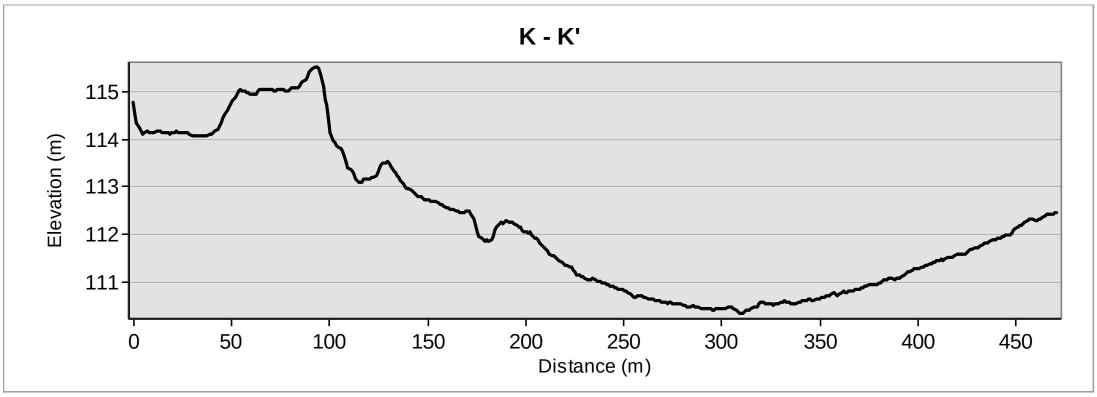


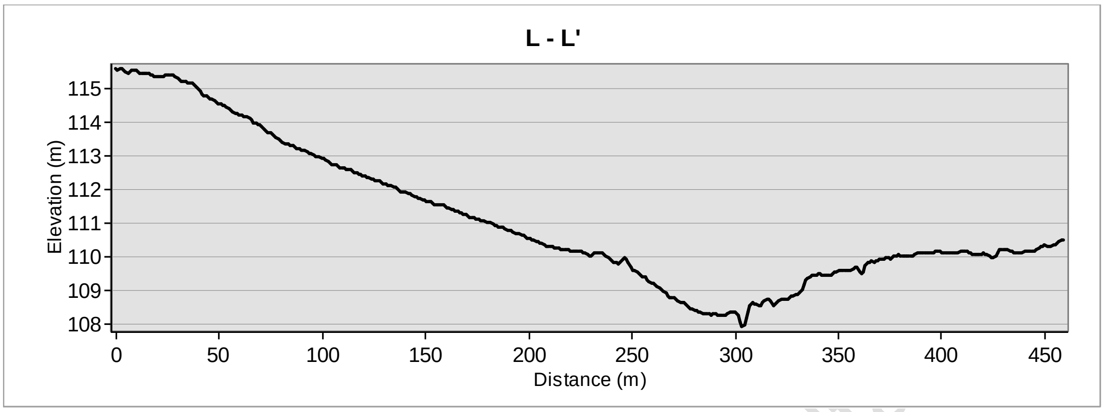


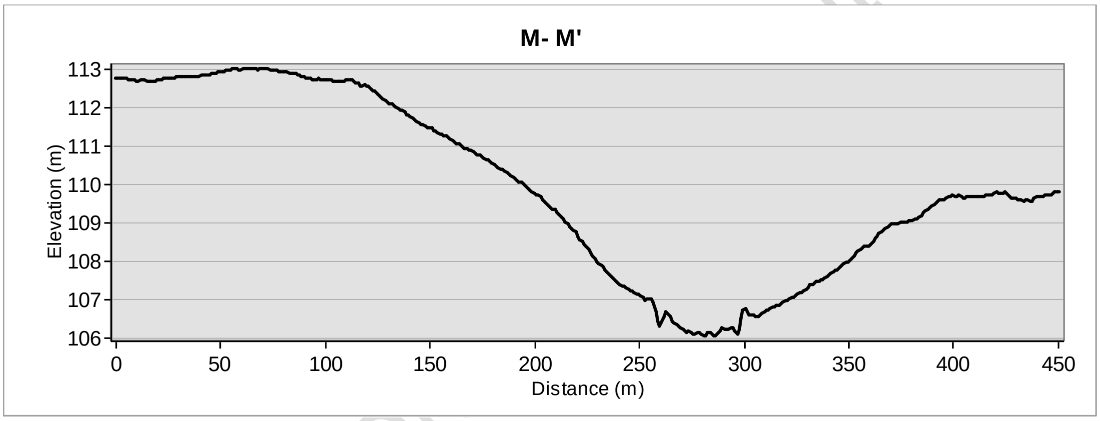


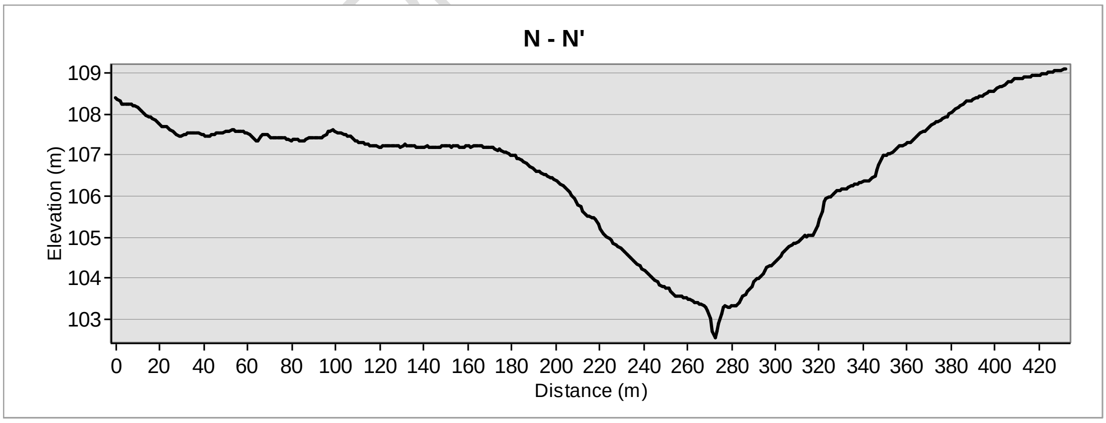
Note. Indicative cutting of up to 8m depth shown in blue in this topographic section.




K - K'
Elevation (m)
111
112
113
114
115
0 50 100 150 200 250 300 350 400 450
Distance (m)


L - L'
Elevation (m)
108
109
110
111
112
113
114
115
0 50 100 150 200 250 300 350 400 450
Distance (m)


M- M'
Elevation (m)
106
107
108
109
110
111
112
113
0 50 100 150 200 250 300 350 400 450
Distance (m)


N - N'
Elevation (m)
103
104
105
106
107
108
109
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420
Distance (m)

Annex B: Dipwell Details and Soil Description

Table A1 Location, depth, soil description and initial data from the dipwell installation and monitoring (SE SSSI – part A)

SE SSSI															
Site	**Latitude, Longitude**	**Soil Description / Notes**	**Depth (m)**	**Ground level (m AOD)**	**Grassland**	**Manual/Logger**	**14/08/2018**	**16/08/2018**	**31/08/2018**	**13/09/2018**	**25/09/2018**	**12/10/2018**	**25/10/2018**	**08/11/2018**	**21/11/2018**
T1A	52.432467, -1.724967	Top soil silty sand dark brown to light brown, semi-fibrous. Gradual transition to lighter grey sand less fibrous and becoming much drier at 50cm, where it ws not possible to penetrate with handheld equipment.	0.50	106.86	MG4	Manual	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.23	0.38
T1B	52.4326, -1.72465	Topsoil is dark grey semi-fibrous fine silt continuing to 35cm depth, then trending to stiff dark grey (mottled with brown) clay without roots which continues to 45cm depth. Sandy clay from 45cm-50cm with some large cobbles up to 10cm diameter. This layer could not be penetrated.	0.90	106.41	MG4	Manual	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.59
T1C	52.432733, -1.72425	Dark brown silty sand with a few small cobbles and slightly moist to 45-50cm, here it becomes a drier, greyer layer of silty sand. At 80cm becomes dark grey-black slightly mottled moist sand, and at 90cm black sandy clay. Various cobbles (mix of rounded and angular) throughout the 90cm, from 2-7cm diameter.	0.90	106.04	MG5	Logger	Dry	Dry	Dry	Dry	Dry	Dry	0.78	0.6	0.69
T1D	52.432817, -1.72415	Dark brown silty sand with abundant cobbles (mix of rounded and angular), semi-fibrous to 40-50cm. Then transitions to sandy clay with a fewer, larger cobbles. Sand becomes light grey/white from 55cm before transitioning to orange. Becomes more clay dominated and mottled from 80cm.	0.90	105.93	MG4/MG5 transition	Manual	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.68
T1E	52.43305, -1.7231	Brown sandy silt topsoil to 20cm, before becoming greyish mottled clay with brown specks. Surface of ground much damper her compared to elsewhere with more clay near the surface. Hit light grey pure sand at 55cm turning to orange sand at 60cm. Became moister again at around 75cm.	0.90	105.00	MG5	Manual	Dry	Dry	0.88	Dry	0.87	0.88	0.55	0.23	0.39
T2A	52.432583, -1.7251	Grey to brown dry silty sand, semi-fibrous, compact to 35cm. Drier, greyer, semi-fibrous compact coarse sand from 35-46cm	0.50	106.91	MG5	Manual	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
T2B	52.432717, -1.72475	Brown silty sand, very dry and containing cobbles (3-5cm). Extremely compact sand at 45cm, requires chisel to penetrate.	0.45	106.46	MG5	Manual	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
T2C	52.432817, -1.724333	Dark brown silty sand, very dry and semi-fibrous to 30cm, before tranisitoning to compact and very solid sand that could not be penetrated.	0.50	106.13	MG4	Manual	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
T2D	52.432933, -1.724033	Brown silty sand topsoil, dry and semi-fibrous. Distinct layer of large rounded cobbles of 5-12cm diameter at 30-40cm depth. Then becomes dark brown sand at 55cm. Gradually becomes clayey at 70cm, this is blue grey clay mottled with brown strands and very cobbly.	0.90	105.79	MG4/MG5 boundary	Manual	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.83	0.57
T2E	52.433133, -1.723183	Brown sandy silt, semi-fibrous, dry with big cobbles (rounded and up to 10cm diamter) to 25-30cm where it becomes clayey. Trends to light grey coarse sand at 45cm, still with cobbles (4-5cm diameter). At 65cm transitions to light grey sand with cobbles and then to silvery blue sandy clay from 75cm.	0.90	104.89	MG4	Manual	Dry	Dry	0.86	Dry	0.82	0.8	0.58	0.27	0.42

Table A1 Location, depth, soil description and initial data from the dipwell installation and monitoring (SE SSSI – part B)

SE SSSI																	
Site	**Soil Description / Notes**	**Depth (m)**	**07/12/2018**	**18/12/2018**	**04/01/2019**	**14/01/2019**	**01/02/2019**	**15/02/2019**	**01/03/2019**	**15/03/2019**	**29/03/2019**	**12/04/2019**	**25/04/2019**	**12/05/2019**	**25/05/2019**	**07/06/2019**	**21/06/2019**
T1A	Top soil silty sand dark brown to light brown, semi-fibrous. Gradual transition to lighter grey sand less fibrous and becoming much drier at 50cm, where it ws not possible to penetrate with handheld equipment.	0.50	0.07	0.36	0.46	0.48	0.38	0.35	0.26	0.24	0.45	0.4	Dry	0.00	Dry	Dry	0.42
T1B	Topsoil is dark grey semi-fibrous fine silt continuing to 35cm depth, then trending to stiff dark grey (mottled with brown) clay without roots which continues to 45cm depth. Sandy clay from 45cm-50cm with some large cobbles up to 10cm diameter. This layer could not be penetrated.	0.90	0.3	0.39	Dry	0.55	0.44	0.48	0.47	0.4	0.57	0.56	0.65	0.48	0.66	Dry	0.49
T1C	Dark brown silty sand with a few small cobbles and slightly moist to 45-50cm, here it becomes a drier, greyer layer of silty sand. At 80cm becomes dark grey-black slightly mottled moist sand, and at 90cm black sandy clay. Various cobbles (mix of rounded and angular) throughout the 90cm, from 2-7cm diameter.	0.90	0.24	0.36	0.45	0.48	0.39	0.06	0.28	0.23	0.52	0.52	0.61	0.17	0.65	0.76	0.48
T1D	Dark brown silty sand with abundant cobbles (mix of rounded and angular), semi-fibrous to 40-50cm. Then transitions to sandy clay with a fewer, larger cobbles. Sand becomes light grey/white from 55cm before transitioning to orange. Becomes more clay dominated and mottled from 80cm.	0.90	0.17	0.25	0.37	0.41	0.3	0.31	0.23	0.17	0.46	0.43	0.57	0.01	0.57	0.66	0.40
T1E	Brown sandy silt topsoil to 20cm, before becoming greyish mottled clay with brown specks. Surface of ground much damper her compared to elsewhere with more clay near the surface. Hit light grey pure sand at 55cm turning to orange sand at 60cm. Became moister again at around 75cm.	0.90	0.14	0.19	0.22	0.23	0.18	0.36	0.13	0.13	0.2	0.2	0.36	0.00	0.43	0.51	0.10
T2A	Grey to brown dry silty sand, semi-fibrous, compact to 35cm. Drier, greyer, semi-fibrous compact coarse sand from 35-46cm	0.50	0.15	0.28	0.36	0.39	0.2	0.18	0.06	0.04	0.18	0.16	0.34	0.03	Dry	Dry	0.18
T2B	Brown silty sand, very dry and containing cobbles (3-5cm). Extremely compact sand at 45cm, requires chisel to penetrate.	0.45	0.40	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
T2C	Dark brown silty sand, very dry and semi-fibrous to 30cm, before tranisitoning to compact and very solid sand that could not be penetrated.	0.50	0.40	Dry	Dry	Dry	Dry	Dry	Dry	0.46	Dry	Dry	Dry	Dry	Dry	Dry	Dry
T2D	Brown silty sand topsoil, dry and semi-fibrous. Distinct layer of large rounded cobbles of 5-12cm diameter at 30-40cm depth. Then becomes dark brown sand at 55cm. Gradually becomes clayey at 70cm, this is blue grey clay mottled with brown strands and very cobbly.	0.90	0.41	0.48	0.52	0.52	0.52	0.51	0.52	0.5	0.54	0.54	0.54	0.51	0.62	0.72	0.56
T2E	Brown sandy silt, semi-fibrous, dry with big cobbles (rounded and up to 10cm diamter) to 25-30cm where it becomes clayey. Trends to light grey coarse sand at 45cm, still with cobbles (4-5cm diameter). At 65cm transitions to light grey sand with cobbles and then to silvery blue sandy clay from 75cm.	0.90	0.03	0.2	0.3	0.34	0.21	0.21	0.13	0.13	0.29	0.26	0.39	0.04	0.51	0.51	0.23

Table A1 Location, depth, soil description and initial data from the dipwell installation and monitoring – continued (NW SSSI – part A)

NW SSSI																
Site	**Latitude, Longitude**	**Soil Description / Notes**	**Depth (m)**	**Grassland**	**Manual/Logger**	**14/08/2018**	**16/08/2018**	**31/08/2018**	**13/09/2018**	**25/09/2018**	**12/10/2018**	**25/10/2018**	**08/11/2018**	**21/11/2018**	**07/12/2018**	**18/12/2018**
N1A	52.436970, -1.7336798	Topsoil is dry, dark brown semi-fibrous fine silt continuing to 40cm depth, then trending to stiff dark grey silty clay without roots. Small cobbles of maximum 3-4cm in diameter at 45cm depth, then trending to lighter grey clay towards the base of the dipwell at 70cm.	0.70	MG4	Manual	n/a	n/a	n/a	Dry	Dry	Dry	0.53	0.38	0.5	0.19	0.15
N1B	52.436772, -1.7337987	Topsoil is dry, dark brown semi-fibrous fine silt continuing to 35cm depth, then trending to stiff dark grey (mottled with brown) clay without roots which continues to 45cm depth. Sandy clay from 45cm-50cm depth with some large cobbles up to 10cm diameter. This layer could not be penetrated.	0.50	MG4	Manual	n/a	n/a	n/a	Dry	Dry	Dry	Dry	0.35	Dry	0.11	0.15
N1C	52.436503, -1.7339474	Topsoil is dry, dark brown semi-fibrous fine silt with cobbles of 3-4 cm in diameter. Topsoil transitions to red-brown sandy clay at 25cm, which continues through to the base of the dipwell at 90cm. Some cobbles of up to 5cm diameter found throughout the sandy clay.	0.90	MG5	Manual	n/a	n/a	n/a	Dry	Dry	Dry	0.82	0.53	0.51	0.14	0.35
N1D	52.436349, -1.7337130	Topsoil is dry, dark brown semi-fibrous fine silt with cobbles of 3-4 cm in diameter. Topsoil transitions to very stiff, mottled grey-brown clay at 30cm. The clay continues but contains angular cobbles of up to 7-8cm diameter from 60cm, with an impenetrable layer (potentially a very large rock) at 70cm depth.	0.70	MG5	Manual	n/a	n/a	n/a	Dry	Dry	Dry	0.57	0.35	0.52	0.22	0.2
N1E	52.436169, -1.7336258	Topsoil is dry, dark brown semi-fibrous fine silt with cobbles of 3-4 cm in diameter. Transitions to extremely stiff thick dark grey-brown clay at 20cm, which continues to the base at 60cm, which was a solid impenetrable layer.	0.60	MG5	Manual	n/a	n/a	n/a	Dry	Dry	0.48	Dry	0.24	0.4	0.08	0.14
N2A	52.436950, -1.7330327	Topsoil is dry, dark brown semi-fibrous fine silt with some angular cobbles of 4-5cm diameter. At 15cm depth it transitions to a stiff, dry, dark brown clay layer. This continues to 60cm depth where there is dark brown sandy clay which is extremely stiff. This continues to the base at 90cm.	0.90	MG5	Manual	n/a	n/a	n/a	Dry	0.975	Dry	0.7	0.71	0.72	0.26	0.43
N2B	52.436527, -1.7329470	Topsoil is dry, dark brown semi-fibrous fine silt. At 25cm depth it transitions to a stiff semi-moist, dark brown clay layer. From 32cm depth there are small infrequent gravel stones of less than 1cm diameter. These gravels are increasingly frequent from 50cm and increase in size to between 2-5cm in diameter. Clay transitions to light grey fine sandy clay from 60cm, with increasingly coarse sand at 75-80cm. From 80cm-90cm the sand content decreases and there is light grey stiff clay.	0.90	MG4	Logger	n/a	n/a	n/a	Dry	Dry	Dry	0.82	0.65	0.64	0.19	0.27
N2C	52.436663, -1.7332404	Topsoil is semi-moist, dark brown semi-fibrous fine silt. Transitions to moist mottled grey clay at 24cm depth with red lines along root lines. Small gravels appearing from 30cm depth, around 2-3cm in diameter. Larger gravels from 40cm, with a mix varying between 1 and 10cm diameter.More sand gradually mixed with the clay before it transitions to blue sandy clay with gravel at 50cm depth. At 60cm depth there is another blue clay section without sands and gravels, before becoming increasingly sandy again from 75cm. It remains semi-moist blue sandy clay until the base at 90cm.	0.90	MG4	Manual	n/a	n/a	n/a	Dry	0.79	0.88	0.48	0.12	0.2	0.00	0.00
N2D	52.436312, -1.7330807	Topsoil is dry, dark brown semi-fibrous very fine silt. Transitions to extremely stiff thick dark grey-brown clay at 10cm. This continues to 43cm which was the base of the dipwell due to a hardened layer (which could be rock) that could not be penetrated.	0.43	MG4	Manual	n/a	n/a	n/a	Dry	Dry	Dry	Dry	0.28	Dry	0.14	0.24
N2E	52.436105, -1.7330966	Topsoil is dry, dark brown semi-fibrous very fine silt. Transitions to extremely stiff thick dark grey-brown clay at 15cm. Clay changes to light grey at 60cm, and continues to the base of the dipwell where it was too hardened and compact to break through.	0.66	MG5	Manual	n/a	n/a	n/a	Dry	0.74	0.54	0.49	0.32	0.41	0.10	0.33

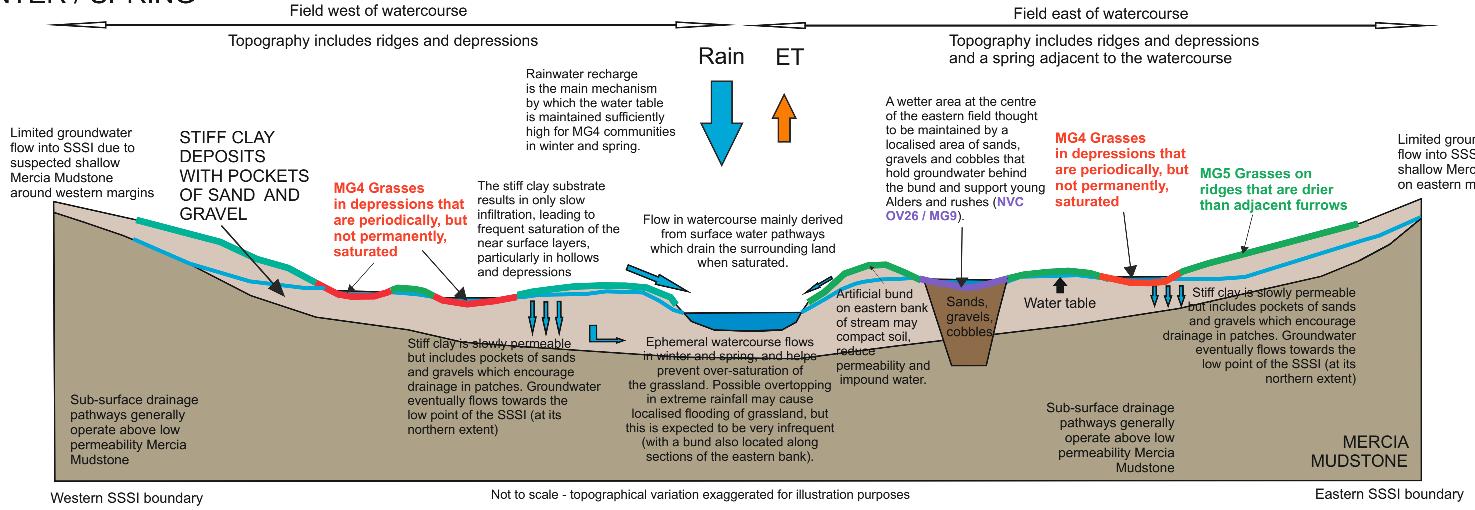
Table A1 Location, depth, soil description and initial data from the dipwell installation and monitoring – continued (NW SSSI – part B)

NW SSSI																
Site	Latitude, Longitude	Soil Description / Notes	04/01/2019	14/01/2019	01/02/2019	15/02/2019	01/03/2019	15/03/2019	29/03/2019	12/04/2019	25/04/2019	12/05/2019	25/05/2019	07/06/2019	21/06/2019
N1A	52.436970, -1.7336798	Topsoil is dry, dark brown semi-fibrous fine silt continuing to 40cm depth, then trending to stiff dark grey silty clay without roots. Small cobbles of maximum 3-4cm in diameter at 45cm depth, then trending to lighter grey clay towards the base of the dipwell at 70cm.	0.36	Dry	0.21	0.23	0.19	0.13	0.34	No access	0.47	0.16	0.53	Dry	0.28
N1B	52.436772, -1.7337987	Topsoil is dry, dark brown semi-fibrous fine silt continuing to 35cm depth, then trending to stiff dark grey (mottled with brown) clay without roots which continues to 45cm depth. Sandy clay from 45cm-50cm depth with some large cobbles up to 10cm diameter. This layer could not be penetrated.	0.29	0.37	0.14	0.11	0.11	0.03	0.23	No access	0.43	0.12	Dry	Dry	0.17
N1C	52.436503, -1.7339474	Topsoil is dry, dark brown semi-fibrous fine silt with cobbles of 3-4 cm in diameter. Topsoil transitions to red-brown sandy clay at 25cm, which continues through to the base of the dipwell at 90cm. Some cobbles of up to 5cm diameter found throughout the sandy clay.	0.59	0.57	0.46	0.41	0.51	0.1	0.52	No access	0.52	0.41	0.55	0.75	0.53
N1D	52.436349, -1.7337130	Topsoil is dry, dark brown semi-fibrous fine silt with cobbles of 3-4 cm in diameter. Topsoil transitions to very stiff, mottled grey-brown clay at 30cm. The clay continues but contains angular cobbles of up to 7-8cm diameter from 60cm, with an impenetrable layer (potentially a very large rock) at 70cm depth.	0.36	0.48	0.23	0.2	0.22	0.11	0.34	No access	0.49	0.13	0.54	Dry	0.28
N1E	52.436169, -1.7336258	Topsoil is dry, dark brown semi-fibrous fine silt with cobbles of 3-4 cm in diameter. Transitions to extremely stiff thick dark grey-brown clay at 20cm, which continues to the base at 60cm, which was a solid impenetrable layer.	0.28	0.36	0.18	0.14	0.14	0.05	0.31	No access	0.43	0.06	0.48	0.56	0.20
N2A	52.436950, -1.7330327	Topsoil is dry, dark brown semi-fibrous fine silt with some angular cobbles of 4-5cm diameter. At 15cm depth it transitions to a stiff, dry, dark brown clay layer. This continues to 60cm depth where there is dark brown sandy clay which is extremely stiff. This continues to the base at 90cm.	0.56	0.57	0.47	0.43	0.48	0.23	0.49	No access	0.55	0.44	0.63	0.67	0.59
N2B	52.436527, -1.7329470	Topsoil is dry, dark brown semi-fibrous fine silt. At 25cm depth it transitions to a stiff semi-moist, dark brown clay layer. From 32cm depth there are small infrequent gravel stones of less than 1cm diameter. These gravels are increasingly frequent from 50cm and increase in size to between 2-5cm in diameter. Clay transitions to light grey fine sandy clay from 60cm, with increasingly coarse sand at 75-80cm. From 80cm-90cm the sand content decreases and there is light grey stiff clay.	0.34	0.35	0.28	0.28	0.23	0.21	0.33	No access	0.45	0.17	0.61	0.7	0.38
N2C	52.436663, -1.7332404	Topsoil is semi-moist, dark brown semi-fibrous fine silt. Transitions to moist mottled grey clay at 24cm depth with red lines along root lines. Small gravels appearing from 30cm depth, around 2-3cm in diameter. Larger gravels from 40cm, with a mix varying between 1 and 10cm diameter.More sand gradually mixed with the clay before it transitions to blue sandy clay with gravel at 50cm depth. At 60cm depth there is another blue clay section without sands and gravels, before becoming increasingly sandy again from 75cm. It remains semi-moist blue sandy clay until the base at 90cm.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	No access	0.00	0.00	0.03	0.11	0.00
N2D	52.436312, -1.7330807	Topsoil is dry, dark brown semi-fibrous very fine silt. Transitions to extremely stiff thick dark grey-brown clay at 10cm. This continues to 43cm which was the base of the dipwell due to a hardened layer (which could be rock) that could not be penetrated.	0.22	0.27	0.14	0.15	0.1	0.06	0.17	No access	0.35	0.04	Dry	Dry	0.15
N2E	52.436105, -1.7330966	Topsoil is dry, dark brown semi-fibrous very fine silt. Transitions to extremely stiff thick dark grey-brown clay at 15cm. Clay changes to light grey at 60cm, and continues to the base of the dipwell where it was too hardened and compact to break through.	0.37	0.38	0.24	0.25	0.2	0.12	0.28	No access	0.32	0.08	0.46	0.46	0.22

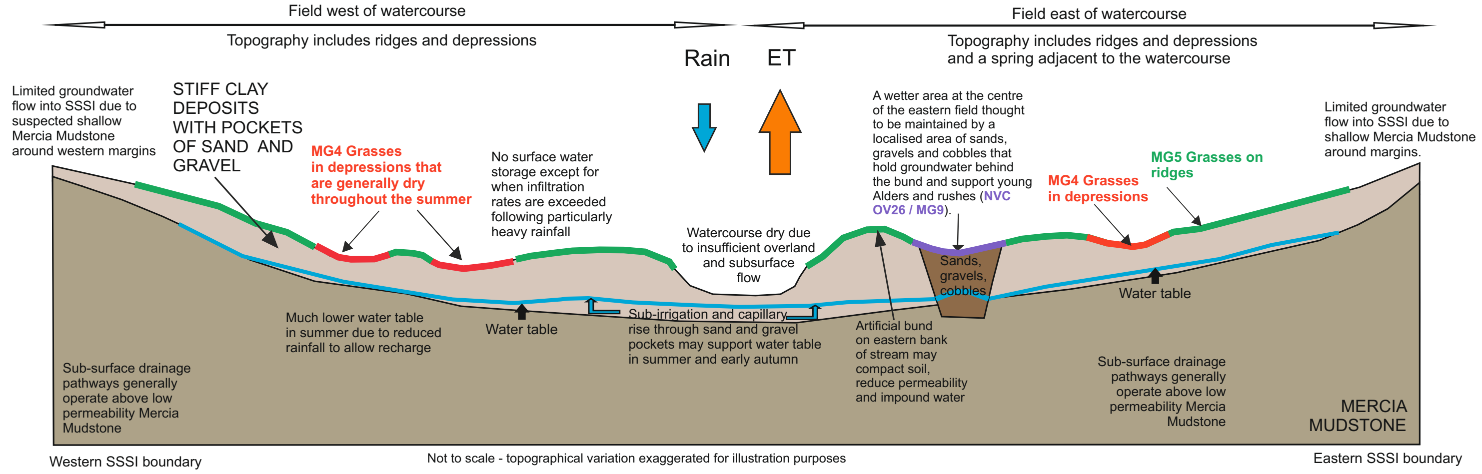
Annex C: Conceptual Models

A. NW SSSI CONCEPTUAL MODEL

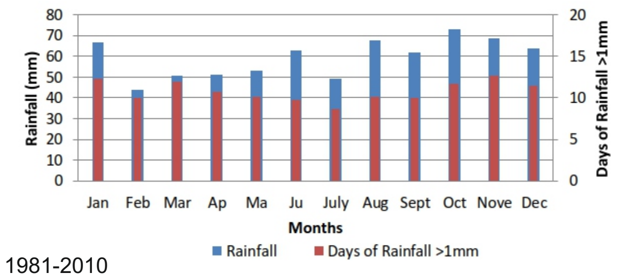
WINTER / SPRING



SUMMER / AUTUMN



C. COLESHILL RAINFALL



1981-2010

NW SSSI - EASTERN FIELD

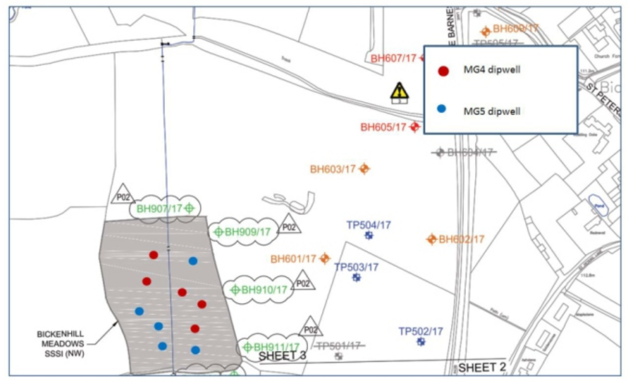
July 2018

D. CATCHMENT LOSS

NW SSSI - CENTRAL DITCHCOURSE

February 2018

E. DIPWELL MONITORING LOCATIONS

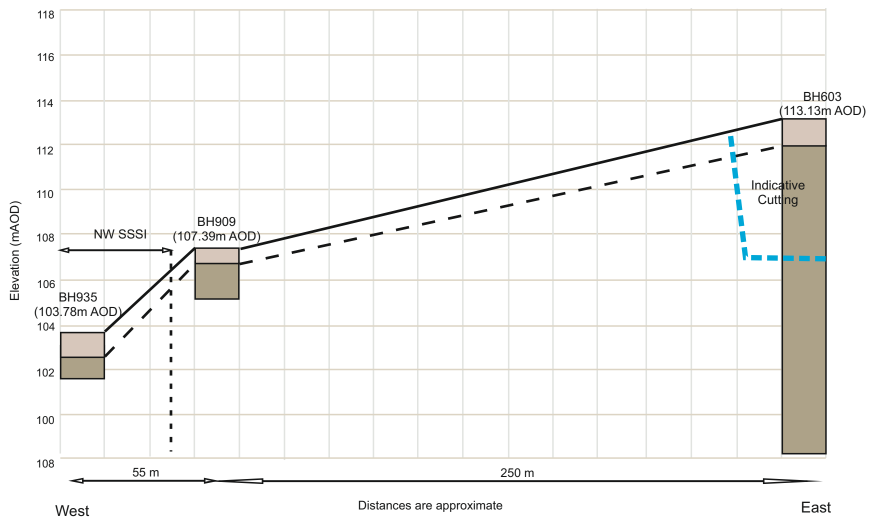


CONCEPTUAL MODEL & CROSS SECTION LEGEND

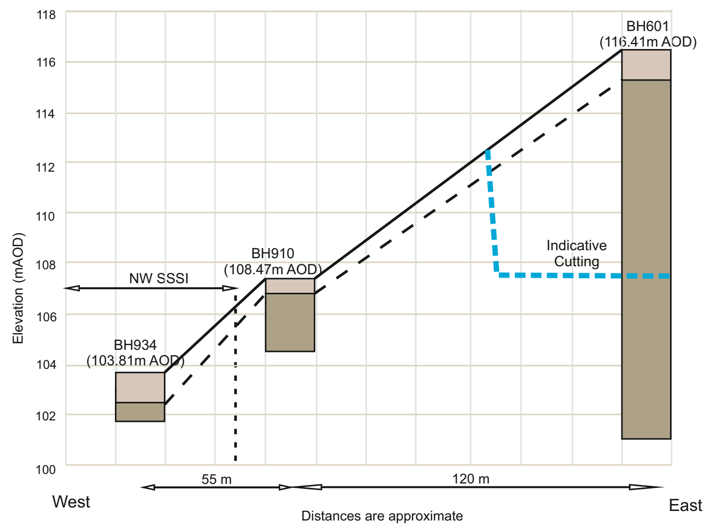
- Mercia Mudstone
- Superficial Clays
- Wetter Area Supported by Sands and Gravels
- MG5 Community
- MG4 Community
- MG9/OV26 Community
- Flow Direction
- Water Table

B. NW SSSI GEOLOGY CROSS SECTIONS

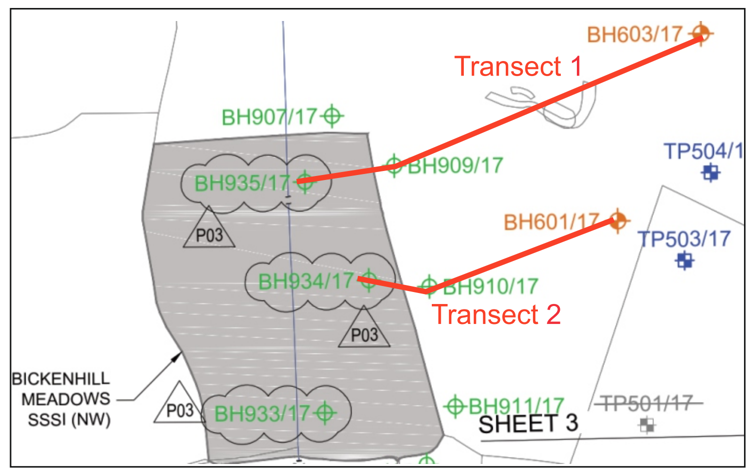
Transect 1



Transect 2



GI & TRANSECT LOCATIONS



Purpose of Issue: PURPOSE OF ISSUE	Project Title: M42 JUNCTION 6 IMPROVEMENT	Drawing Title: ANNEX C: BICKENHILL MEADOWS NW SSSI UNIT CONCEPTUAL MODEL
Client: Highways England, 2 Colmore Square, Birmingham. B4 6BN. Working on behalf of highways england		

Designed	Drawn	Checked	Approved	Date
TJ	TJ	OT	GC	03/10/18

Internal Project No: 60543032	Suitability
Scale @ A3: NA	Zone: X

THIS DOCUMENT HAS BEEN PREPARED PURSUANT TO AND SUBJECT TO THE TERMS OF AECOM'S APPOINTMENT BY ITS CLIENT. AECOM ACCEPTS NO LIABILITY FOR ANY USE OF THIS DOCUMENT OTHER THAN BY ITS ORIGINAL CLIENT OR FOLLOWING AECOM'S EXPRESS AGREEMENT TO SUCH USE, AND ONLY FOR THE PURPOSES FOR WHICH IT WAS PREPARED AND PROVIDED.

AECOM
Victoria Square House
Victoria Square
Birmingham
B2 4AJ

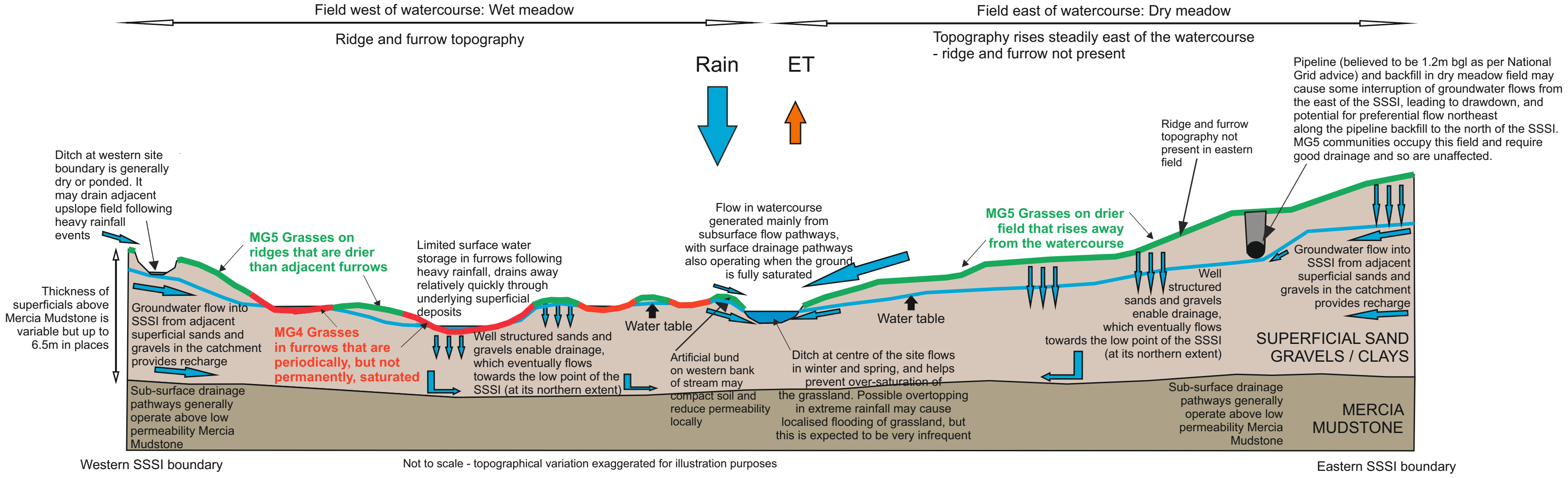
AECOM Infrastructure & Environment UK Limited
Registered in England Registered number: 880328
Registered office: Midpoint, Alencon Link, Basingstoke, Hampshire RG21 7PP

Drawing Number
Highways England Pin | Originator | Volume
HE551485 -ACM -EGN
M42_SW_ZZ_ZZ DR_HD_002
Location | Type | Role | Number

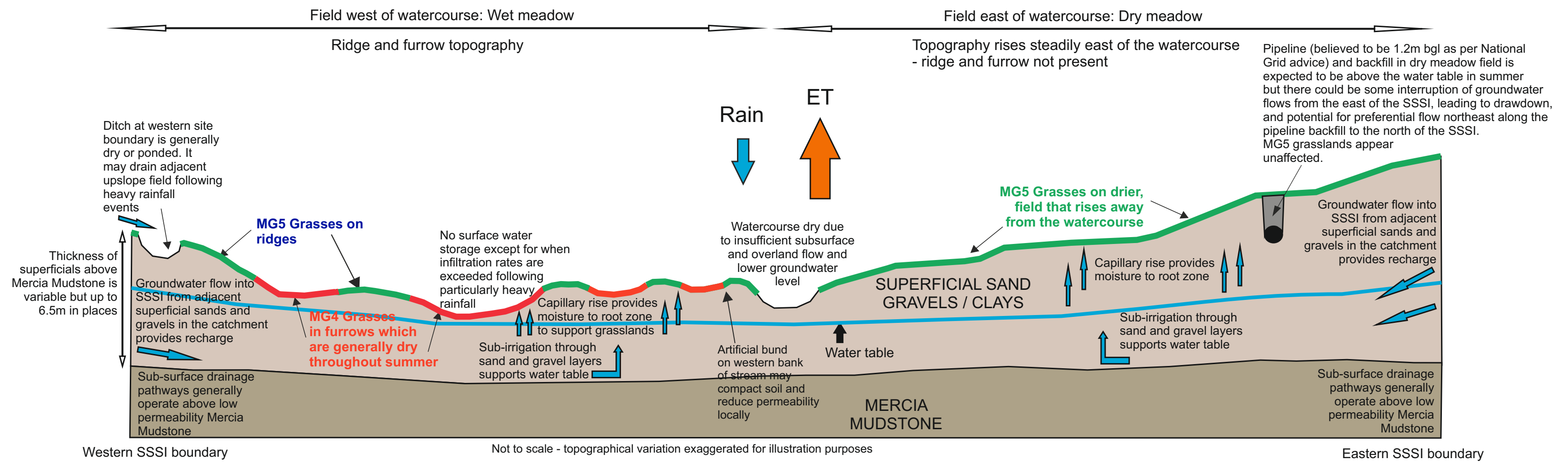
Rev
P01

A. SE SSSI CONCEPTUAL MODEL

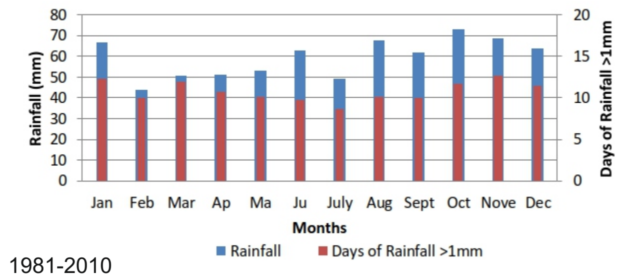
WINTER / SPRING



SUMMER / AUTUMN



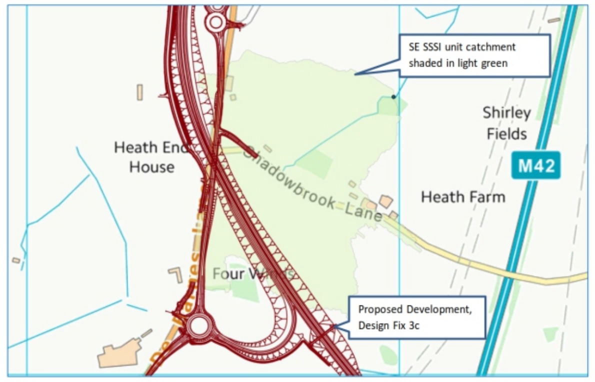
C. COLESHILL RAINFALL



1981-2010

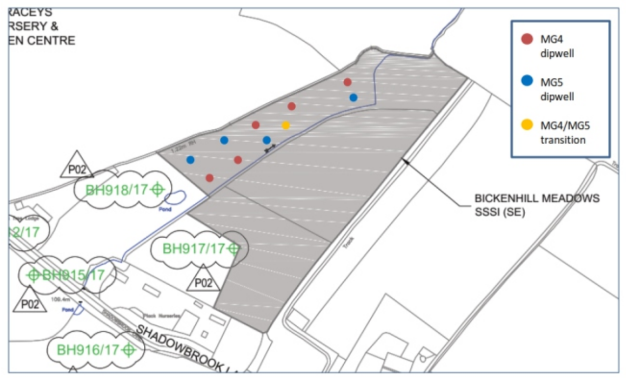
WET MEADOW - SE SSSI

D. CATCHMENT LOSS

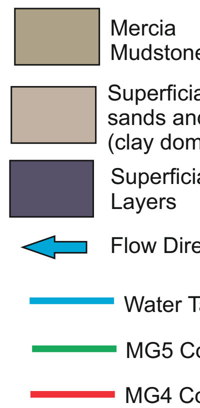


CENTRAL DITCHCOURSE - SE SSSI

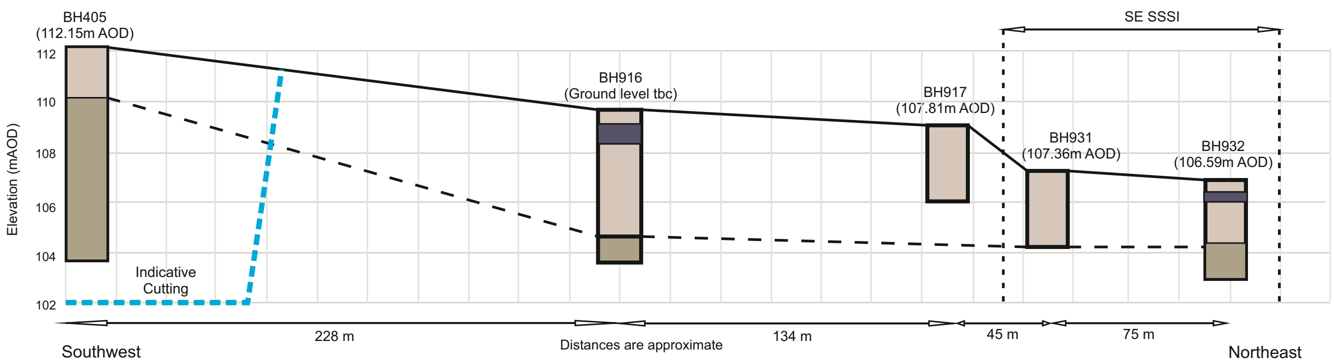
E. DIPWELL MONITORING LOCATIONS

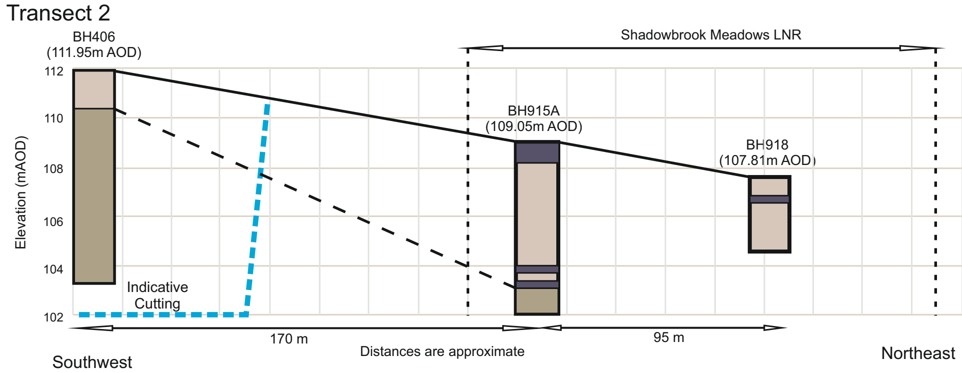


CONCEPTUAL MODEL & CROSS SECTION LEGEND

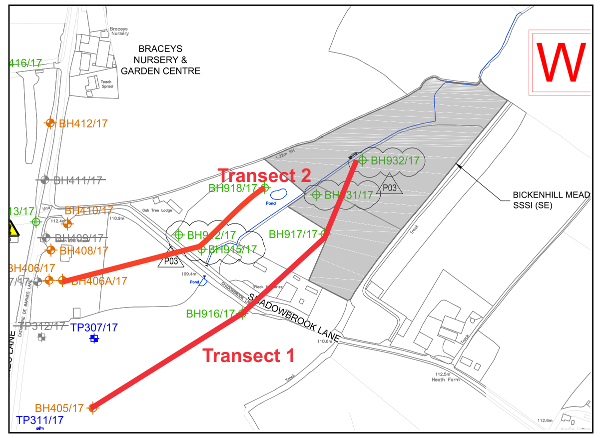


B. SE SSSI GEOLOGY CROSS SECTIONS





GI & TRANSECT LOCATIONS



Purpose of Issue: PURPOSE OF ISSUE	Project Title: M42 JUNCTION 6 IMPROVEMENT	Drawing Title: ANNEX C: BICKENHILL MEADOWS SE SSSI UNIT CONCEPTUAL MODEL
Client: Highways England, 2 Colmore Square, Birmingham. B4 6BN. Working on behalf of highways england		

Designed	Drawn	Checked	Approved	Date
TJ	TJ	OT	GC	03/10/18

Internal Project No	Suitability
60543032	
Scale @ A3: NA	Zone: X

THIS DOCUMENT HAS BEEN PREPARED PURSUANT TO AND SUBJECT TO THE TERMS OF AECOM'S APPOINTMENT BY ITS CLIENT. AECOM ACCEPTS NO LIABILITY FOR ANY USE OF THIS DOCUMENT OTHER THAN BY ITS ORIGINAL CLIENT OR FOLLOWING AECOM'S EXPRESS AGREEMENT TO SUCH USE, AND ONLY FOR THE PURPOSES FOR WHICH IT WAS PREPARED AND PROVIDED.

AECOM
Victoria Square House
Victoria Square
Birmingham
B2 4AJ

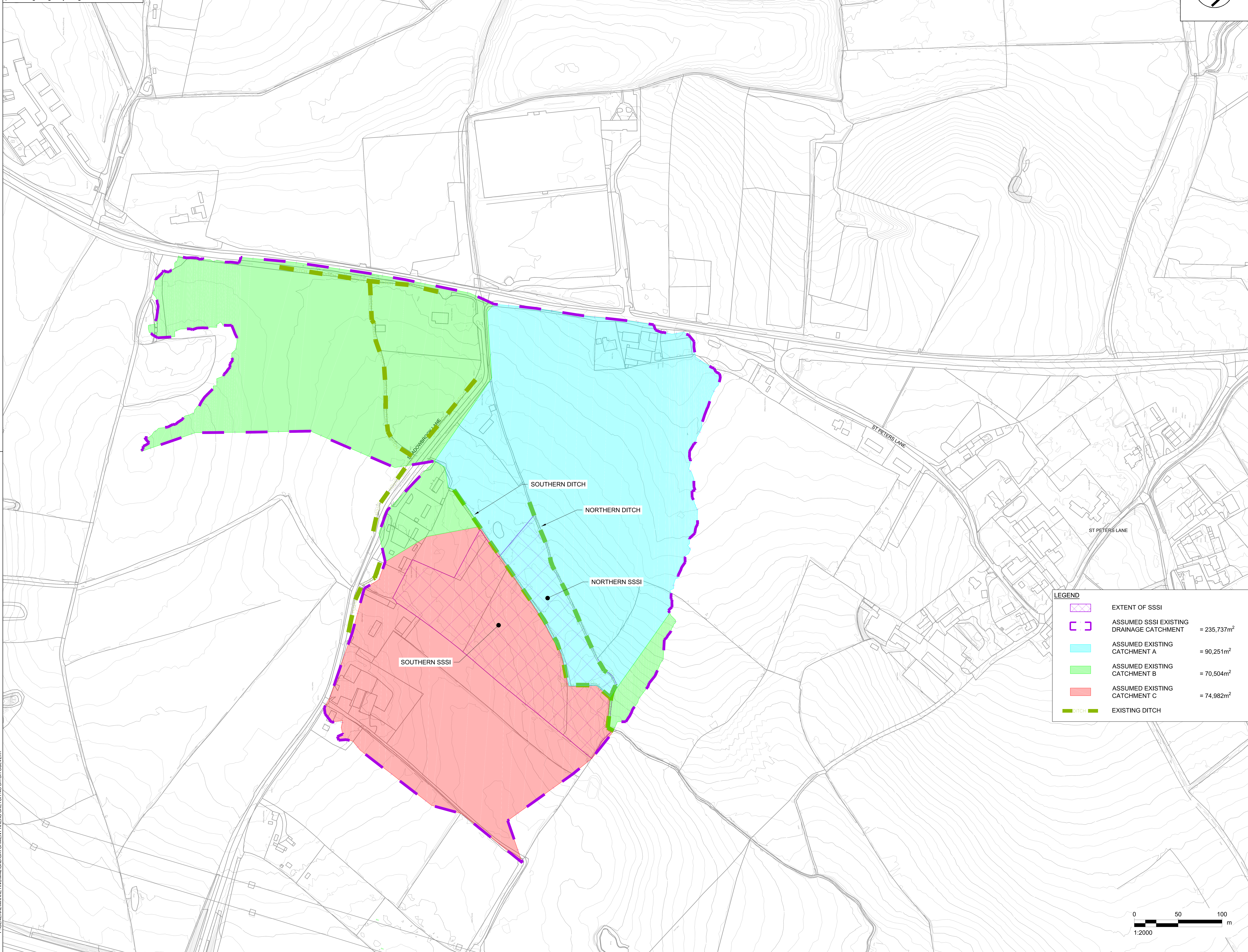
AECOM

AECOM Infrastructure & Environment UK Limited
Registered in England Registered number: 880328
Registered office: Midpoint, Alencon Link, Basingstoke, Hampshire RG21 7PP

Drawing Number
Highways England Pin | Originator | Volume
HE551485 -ACM -EGN
M42_SW_ZZ_ZZ DR_HD_001
Location | Type | Role | Number

Rev
P01

Annex D: Detailed SE SSSI Unit Catchments: Existing



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

IT IS ASSUMED THAT ALL WORKS ON THIS DRAWING WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROPRIATE METHOD STATEMENT.

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT.

EXCEPTIONAL RISKS RELATING TO THE WORKS ASSOCIATED WITH THIS DRAWING ARE IDENTIFIED BELOW.

CONSTRUCTION

MAINTENANCE / OPERATION / DECOMMISSIONING / DEMOLITION

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTATION.
2. DO NOT SCALE FROM THIS DRAWING, USE ONLY PRINTED DIMENSIONS.
3. ALL DIMENSIONS IN METRES, ALL CHAINAGES, LEVELS AND COORDINATES ARE IN METRES UNLESS DEFINED OTHERWISE.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE PROJECT HEALTH & SAFETY FILE FOR ANY IDENTIFIED POTENTIAL RISKS.

KEYPLAN

Revision Details	By / Check	Date	Suffix

Purpose of issue

FOR INFORMATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
B4 6BN

Working on behalf of highways england

Project Title

M42 JUNCTION 6 IMPROVEMENT

Drawing Title

ANNEX D: BICKENHILL MEADOWS SSSI SE UNIT EXISTING CATCHMENT AREAS

Designed	Drawn	Checked	Approved	Date
MH	MH			29/03/19

Internal Project No.	Suitability
60543032	S2
Scale @ A1	Zone
1:2000	M42

AECOM
Royal Court
Basil Close
Chesterfield
Tel01246 209221
Fax01246 209229
www.aecom.com

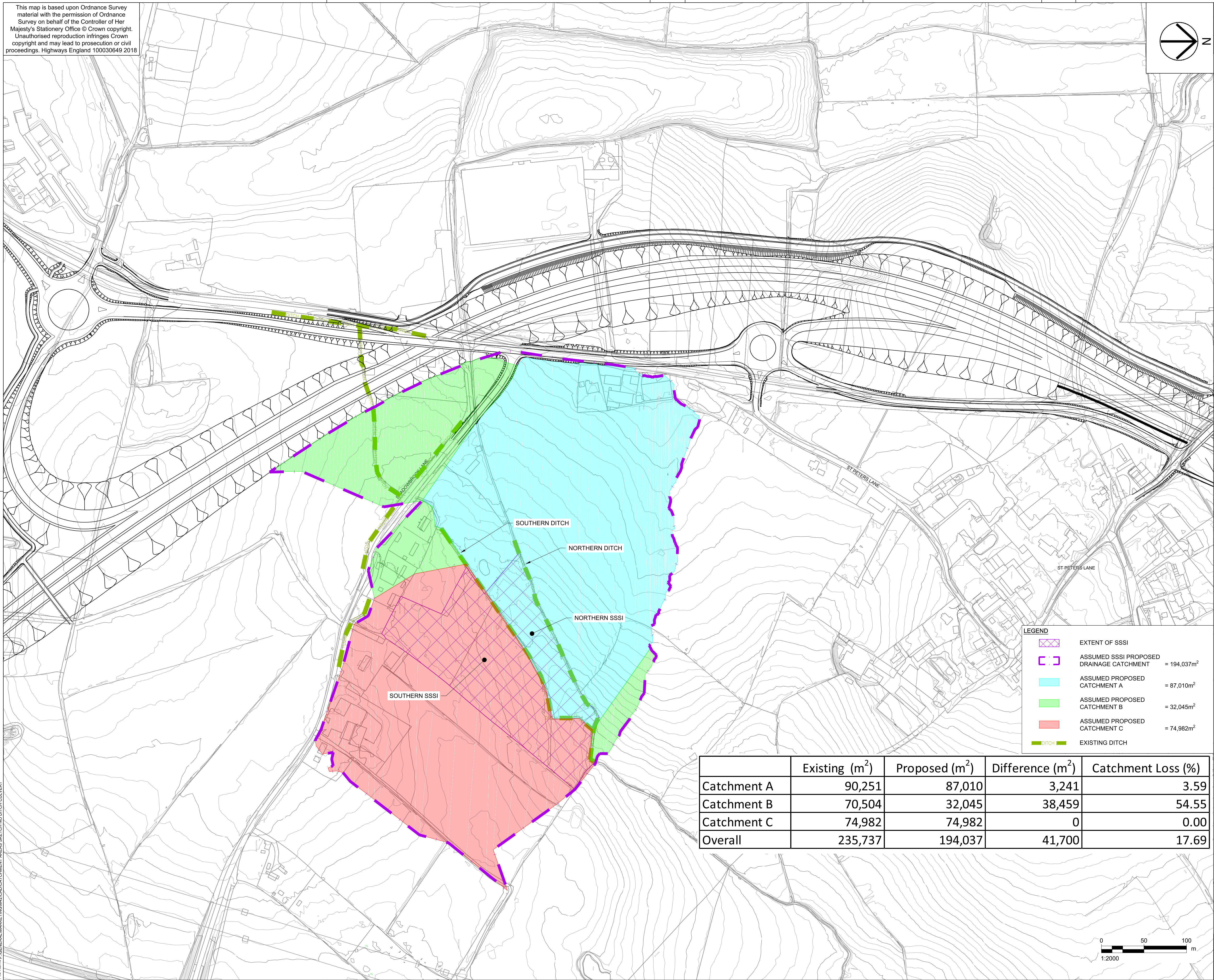
AECOM Infrastructure & Environment UK Limited
Registered in England Registered number: 880328
Registered office: Scott House, Alencon Link, Basingstoke, Hampshire RG21 7PP

Drawing Number
Highways England PIN | Originator | Volume
HE551485 -ACM -HGN -
M42_GEN_ZZ_ZZ -DR-SK-****
Location | Type | Role | Number

Rev
P01

Plot Date : 29 March 2019 12:02:04
File Name F:\GENERAL\MARKETING\M42\CAD\CATCHMENT AREAS SKETCH NO DITCH CULVERT

Annex E: Detailed SE SSSI Unit Catchments: Proposed



	Existing (m^2)	Proposed (m^2)	Difference (m^2)	Catchment Loss (%)
Catchment A	90,251	87,010	3,241	3.59
Catchment B	70,504	32,045	38,459	54.55
Catchment C	74,982	74,982	0	0.00
Overall	235,737	194,037	41,700	17.69

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

IT IS ASSUMED THAT ALL WORKS ON THIS DRAWING WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROPRIATE METHOD STATEMENT.

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT.

EXCEPTIONAL RISKS RELATING TO THE WORKS ASSOCIATED WITH THIS DRAWING ARE IDENTIFIED BELOW.

CONSTRUCTION

MAINTENANCE / OPERATION / DECOMMISSIONING / DEMOLITION

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTATION.
2. DO NOT SCALE FROM THIS DRAWING, USE ONLY PRINTED DIMENSIONS.
3. ALL DIMENSIONS IN METRES, ALL CHAINAGES, LEVELS AND COORDINATES ARE IN METRES UNLESS DEFINED OTHERWISE.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE PROJECT HEALTH & SAFETY FILE FOR ANY IDENTIFIED POTENTIAL RISKS.

KEYPLAN

Revision Details	By / Check	Date	Suffix

Purpose of issue

FOR INFORMATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
B4 6BN

Working on behalf of highways england

Project Title

M42 JUNCTION 6 IMPROVEMENT

Drawing Title

ANNEX E BICKENHILL MEADOWS SSSI SHADOWBROOK MEADOWS PROPOSED CATCHMENT AREAS

Designed	Drawn	Checked	Approved	Date
MH	MH			29/03/19

Internal Project No.	Suitability
60543032	S2
Scale @ A1	**Zone**
1:2000	M42

AECOM
Royal Court
Basil Close
Chesterfield
Tel01246 209221
Fax01246 209229
www.aecom.com

AECOM Infrastructure & Environment UK Limited
Registered in England Registered number: 880328
Registered office: Scott House, Alencon Link, Basingstoke, Hampshire RG21 7PP

Drawing Number
Highways England PIN | Originator | Volume
HE551485 -ACM -HGN -
M42_GEN_ZZ_ZZ -DR-SK -****
Location | Type | Role | Number

Rev
P01

Plot Date : 29 March 2019 12:17:36
File Name : [illegible]CATCHMENT AREAS SKETCH NO DITCH CULVERT

Annex F: Hydrological Investigation into catchment loss

AECOM Imagine it. Delivered.

AECOM Limited
5th Floor, 2 City Walk
Leeds LS11 9AR
United Kingdom

T: +44 (0)113 391 6800
aecom.com

Project name:
M42 J6 Improvement Scheme

To:
Tim Jones
Owen Tucker

Project ref:
60543032

Written:
Lucy Rushmer
Checked:
Andrew Heath-Brown

Date:
June 2019

Memo

Subject: Impact of proposed Scheme on Bickenhill Meadows SSSI (Updated June 2019)

SSSI designation

Bickenhill Meadows Site of Special Scientific Interest (SSSI) is a floodplain meadow designated for its rich grassland floras, comprising wet grasslands. Bickenhill Meadow SSSI has a small area of 0.07km^2, of which only the northern section is considered to be 'wet' Despite its small area, the 'wet' part of the SSSI will be susceptible to any reduction in runoff from its contributing catchment area, because it is specifically designated for wet woodland and wet meadows that support a range of plants and other species.

Proposed Scheme

The proposed route of the M42 J6 Improvement Scheme will create a new cutting which will intercept 3.6% of the surface water catchment draining towards the 'wet' SSSI. The hydrological catchment within which the SSSI lies, which contributes water to the SSSI, is approximately 0.090km^2. This catchment will be reduced to 0.087km^2 after the road is built.

A 3.6% reduction in catchment area may be significant considering the small area of the catchment and the SSSI, and could therefore have serious consequences for the wet grassland species that this SSSI supports.

Study aim

A qualitative desk study has been undertaken to determine:

- the likely impact of the catchment loss to the SSSI;
- how significant the catchment loss is for the SSSI;
- whether this loss in catchment area is within the range of natural variability of rainfall;
- the amount of surface water that might be lost through construction of the road.

Catchment characteristics

The SSSI is located in an area which is dominated by Sidmouth mudstone bedrock geology and is overlain by glaciofluvial deposits of sand, gravels and clay. The Standard Percentage Runoff (SPRHOST) value taken from the FEH Catchment Descriptors is 41%; and a Base Flow Index (BFIHOST) of 0.318. Both SPR and BFI are derived from the Hydrology of Soils Types classification, which groups soil types by hydrological properties, and in particularly their ability to transmit water both vertically and horizontally[13]. It is a rural catchment.

The topography of the SSSI is generally level, with a gentle rise in elevation away from the tributary of Shadow Brook, which flows through the approximate centre of the site. The surrounding catchment has steeper hillside slopes.

Geology and soil characteristics

The SPRHOST, BFIHOST, geology and superficial deposits indicate that there is a high amount of water that runs off the land due to relatively impermeable geology and soils. The mudstone has impermeable properties because the extremely fine-grained clast sizes mean that the rock is not porous or permeable, so little water will percolate into the rocks and soils. The fine grained, hard and cohesive properties of the clay superficial deposits also inhibit water percolation through the rocks and soils. The well-structured sands and gravels enable drainage, which eventually flows towards the low point of the SSSI.

Therefore there is evidence to suggest that the majority of rain that falls on the catchment upstream of the SSSI will run off the surrounding land and contribute to the watercourse that flows into the SSSI. Little water is lost by percolating through the soils and contributing to the water table underground.

Therefore a small reduction in catchment area is unlikely to have a significant impact on the amount of surface water reaching the SSSI.

Surface water map

According to the Environment Agency's flood risk map from surface water[14], the SSSI lies in an area which is at high risk of flooding from surface water (Figure 1). **High risk** from surface water means that each year this area has a chance of flooding from surface water of greater than 3.3% (1 in 30 year return period). Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding. This implies that surface water flows off the land and down into the valley which causes surface water ponding along the watercourse that flows through the SSSI. Therefore a small reduction in catchment area is unlikely to have a significant impact on the amount of surface water reaching the SSSI.

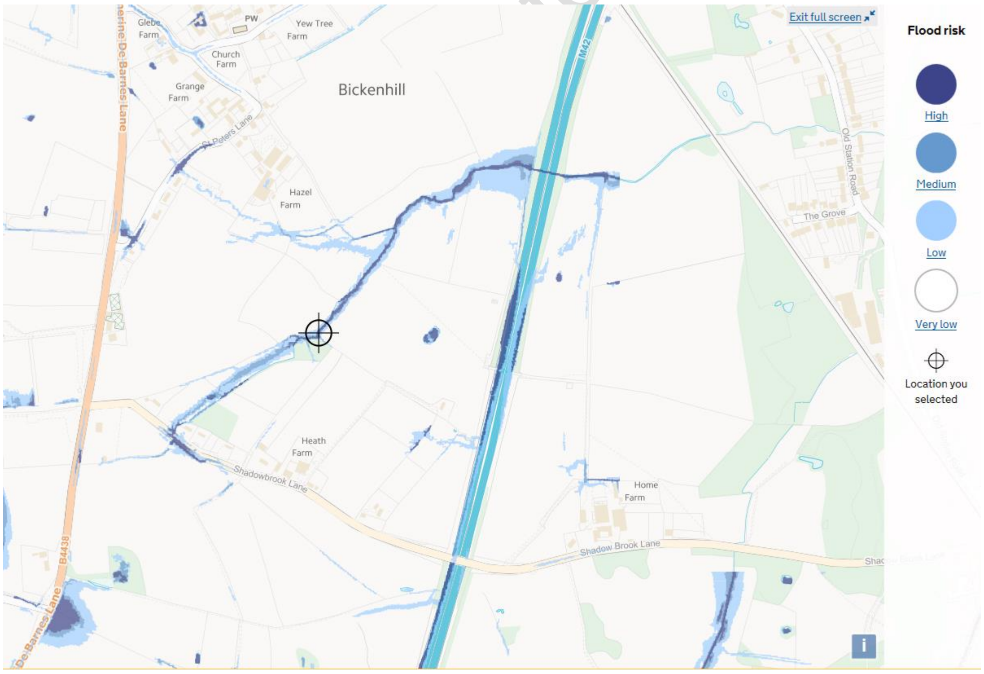


Figure 1: Environment Agency's flood risk map from surface water for the SSSI

---

[13] https://www.ceh.ac.uk/services/hydrology-soil-types-1km-grid
[14] https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

The loss in catchment area is small, but considering the initial small catchment area this could potentially have a significant impact on the amount of water reaching the SSSI. However the geology and soil characteristics indicate that little water will percolate into the rocks and soils, therefore there is a relatively high amount of runoff from the surrounding catchment into the watercourse that flows through the SSSI. Therefore, the loss in catchment area will not significantly impact the amount of water reaching the SSSI.

Topography (LiDAR)

Analysis of the LiDAR data overlain with the catchment area of the SSSI indicates that the majority of the land surrounding the SSSI is relatively high, and the SSSI lies in a flat bottomed valley (Figure 2). The topography of the site is generally level, with a gentle rise in elevation away from the tributary of Shadow Brook, which flows through the approximate centre of the site. Therefore the total area of the catchment contributes flow to the SSSI through runoff from the surrounding hillslopes, and overland flow along the valley bottom, which then flows into the SSSI. The amount of water reaching the SSSI is maximised by the topography of the catchment surrounding the SSSI, therefore the reduction in the catchment area is going to have negligible impact on the SSSI.

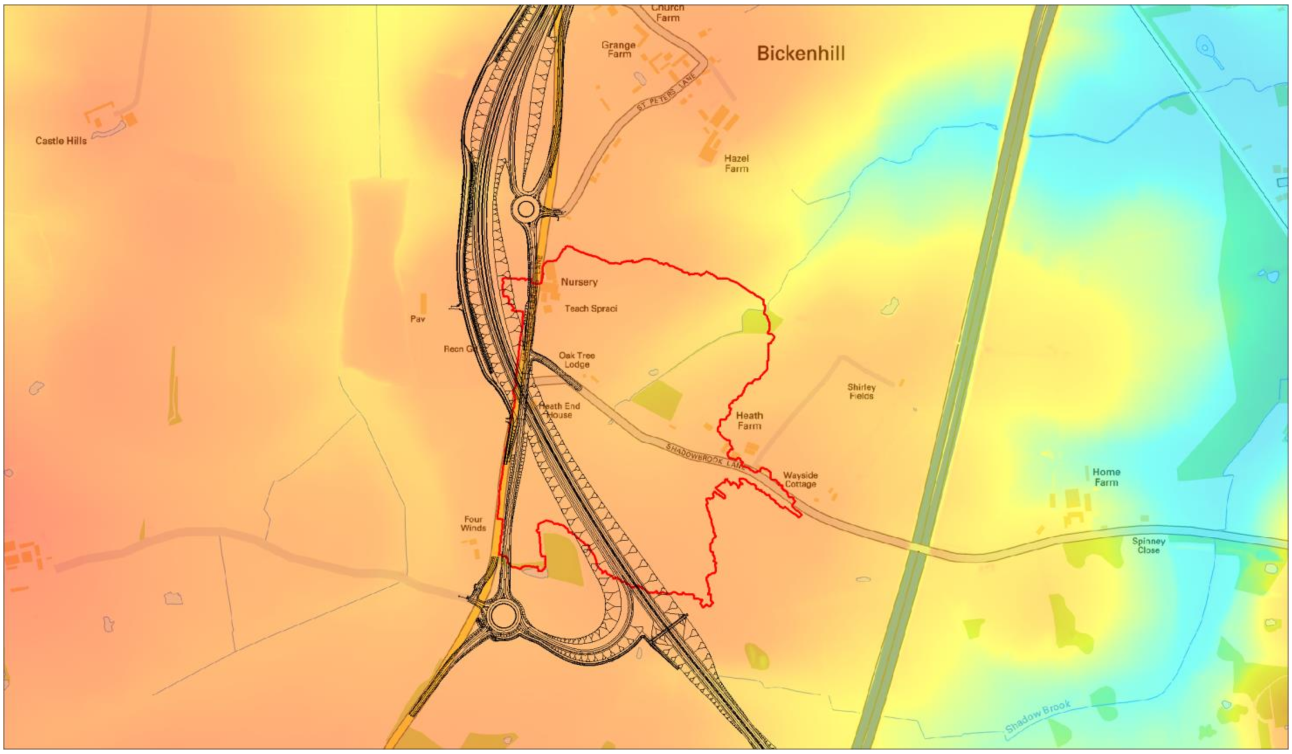


Figure 2: LiDAR data showing the elevation of land in the catchment area contributing to the SSSI

Rainfall

Rainfall data from the nearest gauge has been analysed. There is a rainfall gauge located at Coleshill, approximately 7km north west of the site. Daily rainfall totals have been analysed to determine if there is an annual pattern of rainfall (wet and dry years). Figure 3 shows the daily total rainfall between 1998 and 2015 from the Coleshill rain gauge.

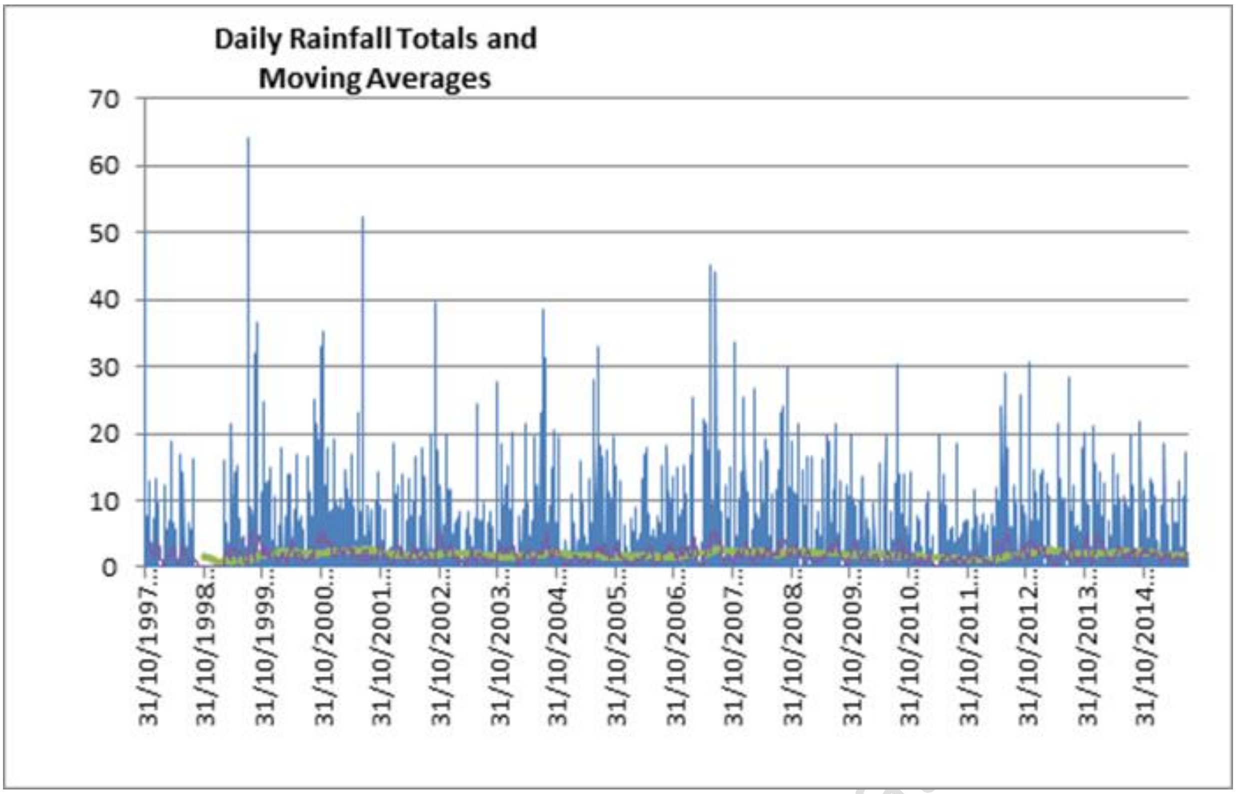


Figure 3: Daily total and moving averages of rainfall data from the Coleshill rain gauge

Figure 3 shows a variation of rainfall over time within close proximity to the site. Some natural variation in rainfall (as with any climatic conditions) is to be expected.

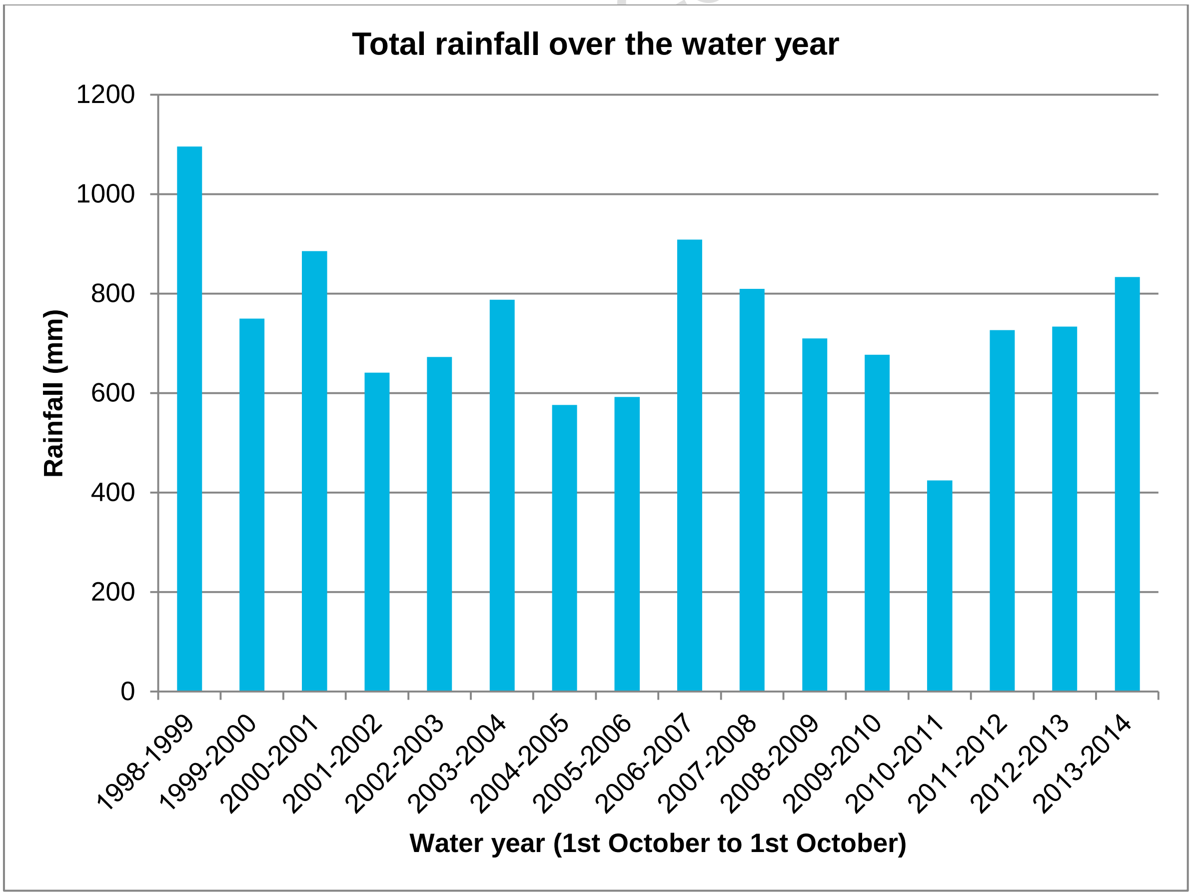


Figure 4: Rainfall total over water years (1st October to 1st October) from the Coleshill rain gauge

Rainfall data from the Coleshill gauge has been analysed further by water year, which runs from 1st October one year to 30th September the following year, to determine if there are any wet/dry patterns over the period of record (Figure 4). It can be seen that the water year 1998-1999 is the wettest, and that the water year 2010-2011 is the driest, within the period of record (Figure 4). This equates to a 672mm variation between the highest and lowest rainfall amount in any given water year. This is a significant variation in rainfall over the record.

This data illustrates that there are natural variations in rainfall in the vicinity of the SSSI. We can therefore make an assumption that the SSSI functions through these natural variations in rainfall, and it is part of the natural variation in climate in the area.

Therefore if the area of the catchment which contributes water to the SSSI is reduced, it is highly likely that the SSSI will continue to function effectively, especially given the small nature of the area change. Therefore the reduction in the catchment area is going to have negligible impact on the SSSI.

Catchment runoff analysis

Loss analysis

In order to estimate the amount of surface water that may be lost through the construction of the road, rainfall data from the Coleshill rain gauge has been analysed using the ReFH2 Calibration Utility tool. The ReFH2 Calibration Utility tool enables users to calibrate the parameters and initial conditions of the ReFH and ReFH2 rural models using observed event rainfall and flow datasets.

The ReFH and ReFH2 methods takes into account a loss model, a routing model and a baseflow model, which all influence the total amount of water that will reach the SSSI.

The Cini parameter, which describes the initial soil moisture content (mm) at the commencement of a runoff event, can provide an indication of the catchment's ability to produce runoff from rainfall input. As such, the ReFH2 Calibration Utility tool was used to estimate the average Cini value for each water year in the gauged rainfall record, as well as an overall average Cini value. The tool estimates the Cini value taking into account natural variability in rainfall, as well as long term average annual trends for evapotranspiration losses.

A ReFH boundary was set up, and populated with FEH Web Service catchment descriptors were imported for the SSSI catchment.

This boundary was generated using the following parameters:

- Overriding the ReFH2 design package value with the average Cini value determined from the gauged data;
- Using a random return period – 100 years in this instance; and
- Using a time step and duration recommended by ISIS – 4.25hr duration and 0.25hr time step.

The boundary calculates the flow hydrograph from the design rainfall profile, applying a loss factor to determine net rainfall, and convoluting the associated unit hydrograph to generate the design event quick/ surface runoff hydrograph. A separate baseflow component is then added to determine the full event hydrograph. The boundary enables volumetric analysis of rainfall and runoff from the catchment. Therefore, the results were used to estimate the percentage of surface water runoff that will reach the SSSI.

Note that the return period and duration of the event have a limited impact on the loss percentage.

Rainfall-runoff volumetric analysis

In order to assess annual volumes of quick/surface runoff reaching the SSSI, the average loss percentage needed to be applied to the rainfall input volume. Daily total rainfall data recorded by the Coleshill rain gauge was used to estimate the average annual rainfall depth. This was then multiplied by the catchment area to calculate an estimate of average annual rainfall volume. Finally, the volume of surface water runoff was estimated by multiplying the average annual rainfall volume by the calculated percentage of surface water runoff (as detailed above).

Verification

The rainfall-runoff percentage and volumetric loss analysis was verified using daily flow data from the NRFA Cole at Coleshill river gauge (station number 28066). Based on the mean gauged daily flow record for this river gauge, the total volume of runoff was calculated for a random water year within the record. The Standard Average Annual Rainfall (SAAR) value applicable to the catchment upstream of the river gauge (686mm) was multiplied by the catchment area to get a typical annual rainfall volume input. Division of the annual runoff volume by the annual rainfall volume gave a similar surface water runoff percentage (approximately 20%), to that estimated using the method described above for the ungauged catchment draining to the SSSI.

Results

Loss analysis

Of particular interest is the change in surface water flow as a result of the construction of the road. The percentage of total rainfall that runs off the catchment as surface water flow was estimated by dividing the total volume of quick runoff by the total volume of rainfall, based on an example 'design' event as described above. This calculation illustrates that the percentage of total rainfall that contributes surface water to the SSSI is 25%.

Table 1: Calculation of loss percentage (based on average Cini and a 100-year, 4.25-hour design event)

	Area (km^2)	Total volume of rainfall (m^3)	Total volume of surface water runoff (m^3)	Percentage of rainfall contributing surface water to SSSI (%)
Existing catchment	0.090	3,527	867	25%

Rainfall-runoff volumetric analysis

An average annual rainfall of 739mm was estimated from the daily total rainfall recorded by the rain gauge located at Coleshill. The volume of surface water runoff was estimated by multiplying the average annual rainfall by the catchment area, and then by the calculated loss percentage, to determine the annual surface water runoff volume contributing to the SSSI.

Completing this calculation using the catchment area before and after construction of the road provided an estimation of the change in surface water runoff volume due to construction of the road over a water-year.

This analysis indicates that, based on average annual rainfall, potentially 599m^3 of surface water may be lost through construction of the road over a year, as shown in Table 2. This equates to a 3.6% reduction in surface water runoff volume that will reach the SSSI.

Table 2: Average volume of surface water flow to the SSSI comparison following road development

	Area (km^2)	Percentage of rainfall contributing surface water to SSSI (%)	Average total rainfall depth over a water year (mm)	Average total rainfall volume over a water year (m^3)	Volume of surface water runoff over water year (m^3)
Before road	0.090	25	739	66,705	16,676
After road	0.087	25	739	64,309	16,077
Difference	0.003	-	-		599
Percentage difference	-3.6%	-	-		-3.6%

These calculations are based on the following assumptions or factors:

- All of the catchment area contributes surface water to the SSSI;
- The nearest, local gauged rainfall data (located at Coleshill, which is 7km away from Bickenhill) provides a representative estimate of average annual rainfall;
- Any baseflow contribution made to the SSSI are relatively negligible in comparison to surface runoff; and
- Local variations in evapotranspiration rates do not significantly affect runoff volumes (as mentioned previously, the ReFH2 Calibration Utility tool does take evapotranspiration into consideration over the course of the water year, when estimating the initial soil moisture content (Cini)).

'Wet' Years and 'Dry' Years

The same calculation was completed for 'wet' year and a 'dry' year, by identifying the annual rainfall of the wettest and driest years, amongst the gauged rainfall record.

The wettest water year in the record was identified as 1998-1999 with a total annual rainfall of 1095mm.The driest water year in the record was identified as 2010-2011 with a total annual rainfall of 428mm.

Table 3 and Table 4 demonstrate the change in surface water runoff based on the wettest and the driest water years on record respectively. In both wet and dry years, there is still a 3.6% reduction in surface water that will reach the SSSI following construction of the road. However, the volumetric contributions are different (this is controlled by the rainfall input only).

Table 3: Change in the volume of surface water during a representative wet water year

	Area (km^2)	Percentage of rainfall contributing surface water to SSSI (%)	Average total rainfall depth over a water year (mm)	Average total rainfall volume over a water year (m^3)	Volume of surface water runoff over water year (m^3)
Before road	0.090	25	1095	98,906	24,363
After road	0.087	25	1095	95,354	23,489
Difference	0.003	-	-		873
Percentage difference	-3.6%	-	-		-3.6%

Table 4: Change in the volume of surface water during a representative dry water year

	Area (km^2)	Percentage of rainfall contributing surface water to SSSI (%)	Average total rainfall depth over a water year (mm)	Average total rainfall volume over a water year (m^3)	Volume of surface water runoff over water year (m^3)
Before road	0.090	25	424	38,303	9,435
After road	0.087	25	424	36,927	9,096
Difference	0.003	-	-		338
Percentage difference	-3.6%	-	-		-3.6%

Conclusions

The analysis estimates that there will be a 3.6% reduction in surface water that will reach the 'wet meadow' of the SE SSSI Unit following through construction of the road over an average water year. This corresponds with the reduction in contributing catchment area. There may be some variation on this value associated with flow path accumulation variation within the original catchment area – more detailed modelling would be required to assess this further.

Following construction of the road, the loss in catchment area is small. However, considering the initial small catchment area this could potentially have a significant impact on the amount of water reaching the wet meadow of the SE SSSI Unit..

It is recommended that mitigation measures are implemented to minimise the impact of any reduction in surface water reaching the wet meadow of the SE SSSI Unit, once the new road Scheme has been built.

Annex G: Natural England Meeting Minutes

M42 Junction 6 Improvement Scheme
Stakeholder meeting notes

Meeting:	Meeting with Natural England to discuss EIA scope and mitigation measures.
Date:	16th April 2018
Venue:	Natural England Lateral 8 City Walk Leeds West Yorkshire LS11 9AT
Meeting notes by:	Jamie Gleave
Attendees:	Jamie Gleave (JG) [EIA] — AECOM Graeme Cowling (GC) [EIA] — AECOM Marcus Wainwright-Hicks (MWH) [Biodiversity] — AECOM Tim Jones (TJ) [Hydrology] — AECOM Ian Bamforth (IB) [AECOM PM] — AECOM James Hemingway (JHW) [Integration Lead] — AECOM Jeremy Truscott (JT) [Biodiversity] — AECOM James Hughes (JH) [Lead Adviser] — Natural England Robert Powell (RP) [Species] — Natural England Mike Robinson (MR) [Bickenhill SSSI Officer] — Natural England Grady McClean (GM) [Air Quality and Transport] — Natural England
Apologies:	Ian Butterfield (IB) [Hydrology] — Natural England
Numbers attending:	11

Comment		Action / Owner
1.0	**Introductions**	
1.1	JH opened the meeting with introductions, and IB briefly explained the purpose and objectives of the meeting.	-
1.2	JH noted that he would be leaving his current role to provide NE advice to the HS2 project. GM would be the key contact for the project going forward.	
2.0	**Presentation**	
2.1	IB presented an overview of the M42 Junction 6 Improvement Scheme to all attendees, and summarised: the history of the scheme; constraints affecting the scheme design; the objectives and key components of the scheme; design development and public consultation undertaken since the Preferred Route Announcement; key programme dates; and next steps for the scheme.	-
2.2	GC provided an update on the EIA process being undertaken, including the programme and status of environmental surveys, sampling and monitoring currently being progressed as part of the scheme. The scheme target is to submit our planning application in August 2018.	-
2.3	GC noted that views and opinions were being sought from Natural England through the meeting on specific matters relating to the assessment and mitigation of environmental effects within the topics of landscape, biodiversity, and road drainage and the water environment.	-
3.0	**Landscape**	
3.1	GC explained that the extent to which the scheme can be environmentally optimised and/or mitigated using landscaping is likely to be constrained by the operational safety requirements and safeguarding of areas stipulated by the CAA and Birmingham Airport. Subject to further discussion with these parties, the location, form and extent of planting may be limited by these factors and considerations.	-
3.2	IB noted that airport safeguarding requirements were also influencing the project drainage strategy as the airport had requested that open water bodies were not included in the design to mitigate the risk of bird strikes. Drainage discussions are currently on going with Environment Agency.	-
3.3	Discussions moved to the ancient woodland at Aspbury's Copse, located adjacent to the M42 motorway corridor. GC clarified that the design of the southern junction would result in the partial loss of woodland edge planting at this location, and set out Highways England's proposal to compensate for this loss. Highways England is proposing to plant an area of land adjacent (contiguous) to Aspbury's Copse at a ratio of 3:1, with affected soils translocated into this area.	-
3.4	JH stated that Natural England could not provide Highways England with a conclusive decision regarding the ancient woodland loss and the acceptability of their compensation proposals at the current time, and referred back to their standing advice. JH acknowledged the urgency of providing a response, and agreed to take the matter up with colleagues that have a specific interest in these matters.	JH
3.5	MWH highlighted that any approach to mitigation of Aspbury's Copse will need to give regard to lichens and fungi present, as some species are of regional importance. This would likely be dealt with as part of a management plan and may include measures such as the retention of deadwood.	
3.6	GC highlighted that Highways England is aware that separate discussions are currently being undertaken between the promoters of the proposed Motorway Service Area and Natural England regarding the status of Aspbury's Copse and the 'validity' of its ancient woodland designation. GC confirmed that, for the purposes of this scheme, Highways England are continuing to treat Aspbury's Copse as ancient woodland and are assessing its impacts and effects accordingly.	
3.7	IB noted that departures from standards were being adopted for the proposed M42 junction to reduce the overall impact on Aspbury's Copse, as a design that is fully compliant with current highway standards would result in a greater loss of this resource. IB further noted that Highways England has sought to rationalise the design for their new M42 junction design with that being developed by the promoters of the proposed Motorway Service Area, the planning application for which was submitted in 2015 and remains undetermined.	

3.8	GC outlined the broad approach to landscape mitigation across the scheme, and highlighted this is currently focused on the planting of hedgerows and woodland species, the latter focused around the new M42 junction to achieve landscape integration and provide a degree of visual screening for properties close by and more distant views from Hampton-in-Arden.	
3.9	GC noted that the Civil Aviation Authority and Birmingham Airport constraints have informed the extent to which hedgerow and tree planting forms part of the mitigated design, and that discussions are ongoing with these parties to fully establish what will be acceptable in landscaping terms.	
3.10	RP queried whether Highways England has engaged with the local authorities regarding mitigation. GC confirmed that they have spoken with Solihull Metropolitan Borough Council and local wildlife groups as part of the EIA process, but the intention was to speak with Natural England first on the matter of ancient woodland compensation to obtain their views as the statutory body on such matters.	
3.11	IB explained how Highways England is allowing for compensation measures in the scheme design, noting that this is being achieved through the identification of sufficient land beyond the scheme footprint which will be contain within the Order Limits (red line boundary).	
3.12	RP enquired as to whether Barber's Coppice, a further stand of ancient woodland located to the west of the M42 motorway, would be affected by the scheme. GC confirmed that Barber's Coppice falls outside the scheme extents and that no works are planned to be undertaken within this woodland.	
3.13	JH noted that he was aware of legislative provisions that could be used to protect trees with a Tree Preservation Order by way of a planning condition, and said this may be of benefit to the scheme. JH agreed to look into this further and provide Highways England with information.	JH
3.14	JH enquired as to whether the scheme will still affect the Gaelic Athletic Association recreational grounds. IB confirmed that the relationship between the scheme and this facility was explored as part of the recent statutory consultation exercise, and that discussions between Highways England and the Association are continuing on the matter.	
4.0	**Biodiversity**	
4.1	MWH provided a summary of the ecological survey work undertaken in the intervening months since Highways England last engaged Natural England to agree the scope of surveys on the scheme.	
4.2	MWH noted that the area associated with the scheme is under intensive agricultural management, and that some of the historic surveys are being repeated this year to confirm species presence or absence.	
4.3	MWH explained the rationale for scoping out the need for any further survey work in relation to reptiles, dormice and water vole. This has been based upon: the updated survey results; absence of local records; and/or poor quality of available habitat.	
4.4	In relation to birds, MWH confirmed that wintering bird surveys had not identified any significant bird populations associated with the site or immediate area, and that the ongoing breeding bird surveys have so far recorded species typical of the farmland habitats present. Barn owl has been noted, with no evidence of breeding recorded.	
4.5	In respect of badgers, MWH indicated that bait marking was largely complete and suggested the presence of two separate clans, with one territorial boundary corresponding to the Catherine-de-Barnes Road.	
4.6	MWH confirmed that updated botanical (Phase-1 & NVC), GCN, otter and bat survey work would be completed where appropriate, and that the Phase 1 botanical surveys will reaffirm the extent and nature of site habitats.	
4.7	MWH noted that land access limitations have constrained the progression of certain surveys this year. GC highlighted that Highways England has undertaken extensive engagement with landowners to try and secure land access via a dedicated stakeholder engagement team, but that some landowners have not granted access. JH enquired as to whether Natural England could help with facilitating access, particularly with landowners that currently operate under their agricultural management schemes. IB thanked JH for the offer, but noted that some landowners are not allowing survey access due to financial payments or	

	compensation being sought in advance via their appointed land agents. This is due in part to the influence of HS2 and payment levels HS2 has made for similar access arrangements.	
4.8	RP enquired about the status and findings of the ongoing bat surveys. JT advised that Highways England had agreed via email the scope of bat surveys for 2018, and that this year's surveys have commenced (where access permits) in line with that scope. JT then explained the relationship between some of the bat transects and the scheme components, and noted that tree climbing and transects were undertaken last year as part of the survey effort. The areas and levels of bat activity identified through transects undertaken in 2017 were briefly discussed, as was the relationship of the transect routes with existing woodland blocks. JT noted that the assessments of habitat and roosting suitability of adjacent woodland blocks would be updated, and that bat tree surveys would continue were access was permitted.	
4.9	JT noted that one building purchased by Highways England is to be demolished (Heath End House). Bat surveys at this property have been undertaken, which have confirmed presence, albeit not significant but an additional species to that recorded through other survey methods across the site. Where access permits, assessments will be undertaken of any other building or structure within the scheme boundary and buffer zone.	
4.10	RP enquired as to what work is being undertaken on the six bat transects. JT confirmed that transect No. 3 and No. 6 could realistically be dropped from further survey due to their distance from the scheme, and that transect No. 4 could be extended slightly to then pick up the area associated with the new M42 junction previously within transect No.6. It was agreed that there was benefit in retaining the 4 transect routes rather than re-route these to make full use of the data collected up to date and allow comparisons to be made.	
4.11	On discussing survey methods, JT noted that 8 static detectors would be put out at appropriate locations where the proposed link road would cross linear features within the landscape, and would remain in place for a minimum of 5 nights per month from May- October.	
4.12	RP enquired about how the ongoing bat surveys would be accommodated in the programme, given that the Development Consent Order application is being submitted in August 2018. JT noted that bat surveys will continue from May through to October 2018, and that additional data would be submitted as supplementary information prior to the start of application examination (assumed December 2018).	
4.13	MWH highlighted that potential effects on the Bickenhill Meadows SSSI is an important consideration for the biodiversity assessment, and there is a need to fully understand the hydrological factors that influence the conditions of this site.	
4.14	MWH noted that the Air Quality assessment is ongoing and will take account of sensitive ecological receptors and sites.	
4.15	RP enquired about the possible location(s) for the construction compound, in terms of any ecological considerations. JHW indicated on a plan the potential location for the main construction compound, the details of which are subject to further input from Highways England's appointed buildability contractor.	
4.16	GC noted that Highways England has recently adopted a "No Net Loss" biodiversity metric, and that their intention is to apply this on the scheme. JH expressed a preference to see the application of the DEFRA metric on the scheme, which aspires to achieving a "Net Gain" in biodiversity rather than avoiding a loss. GC agreed to send JH information on the Highways England metric, and JH agreed to review this and liaise with his colleagues in Natural England and provide a response on its potential application.	GC & JH
5.0	**Road Drainage and the Water Environment**	
5.1	TJ noted that ongoing studies into road drainage are considering the hydrology of the area associated with the scheme, particularly in respect of the two Bickenhill Meadows SSSI units.	
5.2	TJ explained that boreholes (window sampling) are currently planned to be undertaken within the Bickenhill Meadows SSSI to establish and understand the groundwater relationship. TJ noted these works will be carried out in accordance with an appropriate working methodology. MR expressed an interest in this	TJ

	methodology, and TJ agreed to forward this to MR for consideration.	
5.3	TJ explored the potential to have a conjoined site visit to the Bickenhill Meadows SSSI, in order to discuss the feature and its relationship to the hydrological environmental and the scheme. GC agreed to send out invites to progress this site visit.	GC
5.4	TJ noted that discussions ongoing with the airport re: attenuation ponds, and other appropriate forms of mitigation to attenuate road runoff. TJ noted that there are failures already so any new solutions would provide betterment.	
6.0	**Any Other Business**	
6.1	GC summarised the key actions arising from the meeting, and agreed to distribute everybody's contact details alongside the draft meeting minutes. IB agreed to circulate the slides from the presentation with the meeting minutes.	GC & IB
6.2	Contact details for attendees are provided below. IB confirmed that Graeme Cowling and Jamie Gleave would be the primary contact for environmental matters on the project.	

Attendee Contact Details:

Jamie Gleave	jamie.gleave@aecom.com
Graeme Cowling	graeme.cowling@aecom.com
Marcus Wainwright-Hicks	Marcus.wainwrighthicks@aecom.com
Tim Jones	timothy.jones1@aecom.com
Ian Bamforth	ian.bamforth@aecom.com
James Hemingway	james.hemingway@aecom.com
Jeremy Truscott	jeremy.truscott@aecom.com
James Hughes	james.hughes@naturalengland.org.uk
Robert Powell	robert.powell@naturalengland.org.uk
Mike Robinson	mike.robinson@naturalengland.org.uk
Grady McClean	grady.mcclean@naturalengland.org.uk
Ian Butterfield	ian.butterfield@naturalengland.org.uk

Enc. PDF of the project presentation.

Regional Investment Programme

M42 Junction 6 Improvement

Natural England

April 2018

M42 J6 Improvement Scheme

Agenda

- Introductions and Apologies
- Project Overview
- Proposed Delivery Time Line
- Environmental Assessment
- Future Meetings
- Next Steps
- Questions and Close

highways england

M42 J6 Improvement Scheme

Project Overview

- Scheme History
- Contextual Overview
- Scheme Objectives
- Design Development from PRA to Public Consultation
- Public Consultation Responses
- Post Consultation Design

highways england

M42 J6 Improvement Scheme

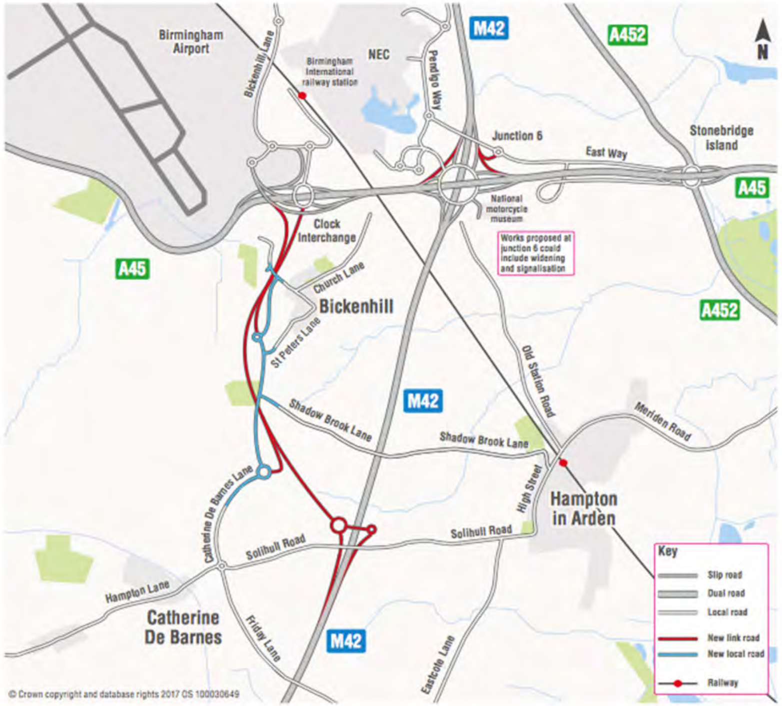
Scheme History

- 2014 Roads Investment Strategy
- 25 year plan to create a ‘smoother, smarter and sustainable’ strategic road network
- Roads Period 1 2015/16 to 2019/20
- Options Identification Phase
  - Commenced 2016
  - Consultation December 2016-January 2017
  - Preferred Route Announcement 7 August 2017
- Key Documents www.roads.highways.gov.uk/projects/m42-junction-6-improvement/
  - Scheme Assessment Report and Technical Appraisal Report
  - Consultation Report
  - Preferred Route Announcement

highways england

M42 J6 Improvement Scheme

Contextual Overview

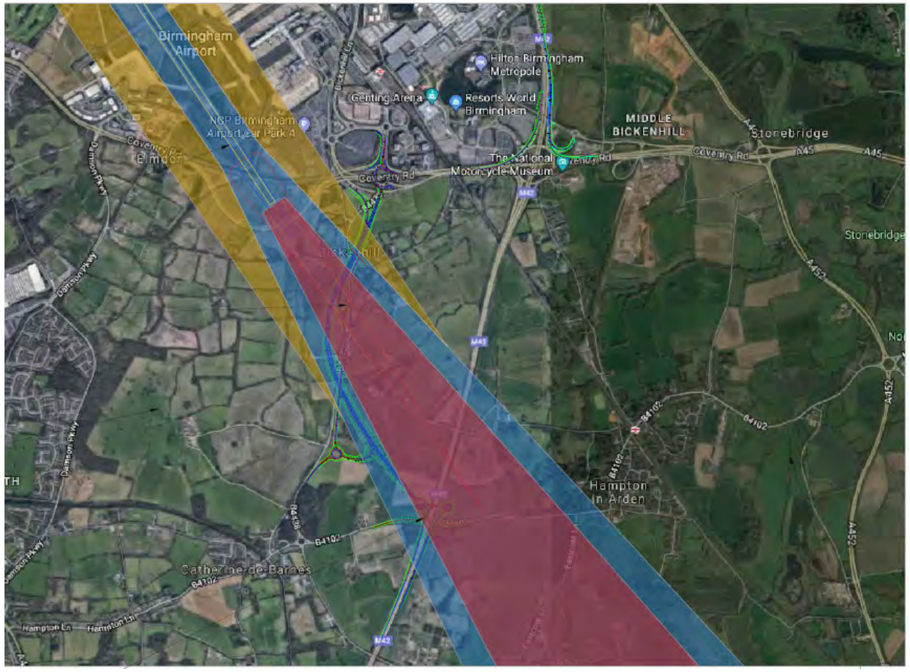


- Major Road Corridors M42 N-S A45 E-W
  - A45 connects Birmingham to Coventry
  - Soihull
- North of A45 Corridor
  - Birmingham Airport, NEC, Resorts World, Birmingham International Railway Station, Jaguar Land Rover and Birmingham Business Park.
- South of A45
  - Merdian Gap Green Belt
  - Solihull, Catherine de Barnes, Hampton in Arden and Bickenhill
- Future Developments
  - HS2 Birmingham Interchange Station
  - UK Central
  - Birmingham Airport Expansion
  - Motorway Service Area

highways england

M42 J6 Improvement Scheme

Contextual Overview



KEY

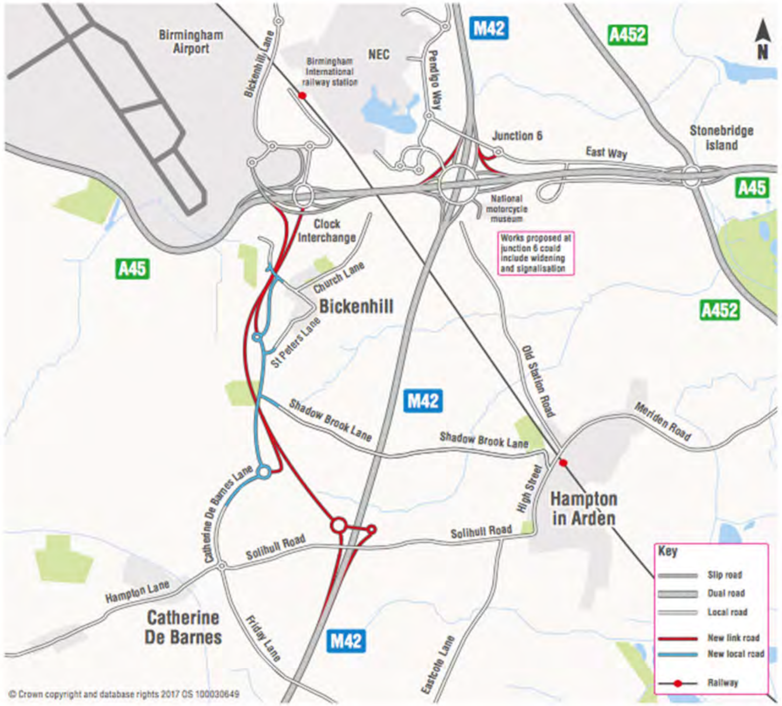
- APPROACH SURFACE
- TAKE OFF FLIGHT PATH & TAKE OFF CLIMB SURFACE (TOFP)
- TRANSITIONAL SURFACE

- Key Environmental Constraints
  - Meridan Gap Green Belt
  - Aspbury's Copse and Barbers Coppice Scheduled Ancient Woodland
  - Bickenhill Meadows SSSI
  - River Blythe SSSI
- Airport Constrains
  - CAA Safeguarding Surfaces
  - Influencing the wider scheme design and mitigation strategy
  - Limits on infrastructure heights during and post construction
  - Bird management-open water restrictions subject on going discussions with airport and EA.

highways england

M42 J6 Improvement Scheme

Contextual Overview



New Southern Junction and M42 Works

- New Junction 5a constructed south of Junction 6

New Link Road

- 2.4km D2AP link road from Junction 5a to Clock Interchange
- Deep cutting to minimise impact on the Green Belt
- Realignment of local B4438 Catherine de Barnes Lane
- New slip road to Airport Way to access Birmingham Airport

Clock Interchange

- Circulatory carriageway widened to 3 lanes
- Full signalisation

M42 Junction 6 Capacity Improvements

- Free flow link road provided from A45 WB to M42 NB
- Free flow link road provided from M42 SB to A45 WB.

highways england

M42 J6 Improvement Scheme

Scheme Objectives

- Current levels of congestion are having a serious effect on communities and businesses in the area and would constrain future development.

- Department for Transport – Road Investment Strategy

  M42: Junction 6 (Birmingham Airport) – "comprehensive upgrade of the M42 junction near Birmingham Airport, allowing better movement of traffic on and off the A45, supporting access to the airport and preparing capacity for the new HS2 station."

- Improving the M42 junction 6 will:
  - Promote safe and reliable operation of the wider corridor
  - Increase capacity of the junction
  - Improve access to key businesses
  - Support future economic growth businesses

M42 J6 Improvement Scheme

Design Development PRA to Public Consultation

- Initial Preliminary Design August to November 2017
- Consultation Preparation November 2017 to January 2018
  - Validate PRA Design
  - Initial preliminary design
  - Early meeting with key stakeholders including NE 16 August 2017
  - Engagement with Planning Inspectorate
  - Scoping Report October 17
  - Scoping Opinion December 17
  - NE Scoping Response December 17
  - Consultation Notices December 17/Jan 18
  - Preliminary Environmental Information Report January 18
- Consultation January 2018 to March 2018

highways england

M42 J6 Improvement Scheme

Public Consultation Responses

- Statutory consultation commenced on 9 January 2018 and closed on 9 March 2018.
- 2000 letters land owners, interested parties, residents, businesses and stakeholders.
- Adverts, Posters, Flyers and Press together with social media campaigns.
- Held 7 consultation events.
- Approximately 275 responses to consultation.
- Scheme Specific Issues
    - Provision for cyclists walkers and equestrians
    - Impacts on Bickenhill
    - Access and local road arrangements, including junction types
    - Environmental impacts including noise and air quality
    - North facing slip roads at Junction 5a
- Non-Scheme Specific Issues
    - Impacts of HS2
    - Proposed Motorway Service Area at Catherine de Barnes/Junction 5a
    - Local transport provision-buses

highways england

M42 J6 Improvement Scheme

Post Consultation Design

Scheme Development next steps

- Consultation January 2018 to March 2018
- Post Consultation Design January 2018-April 2018
- Environmental Assessment April 2018 to June 2018
- Application Preparation March 2018 to July 2018

highways england

M42 J6 Improvement Scheme

Proposed Delivery Time Line

• Preferred Route Announcement	7th August 17
• Preliminary Design	Spring 17 – Summer 18
• Statutory Consultation	January 2018
• DCO Formal Application	August 2018
• DCO Examination Starts	December 2018
• DCO Examination Ends	June 2019
• PINS Recommendation	September 2019
• SoS Decision	December 2019
• Challenge	January 2020
• Start of Works	Early 2020
• Open to Traffic	2023

highways england

M42 J6 Improvement Scheme

Environmental Assessment Update

- Update on Environmental Impact Assessment
- Landscape Assessment
- Biodiversity Assessment
- Road Drainage and the Water Environment Assessment

M42 J6 Improvement Scheme

Environmental Impact Assessment Key Points

- ES Impact Assessment and Mitigation
  - Guidance, best practice and legal requirements will have already been considered prior to impact identification.
  - The ES will therefore focus on any additional mitigation measures that have been identified to further mitigate impacts; and
  - Any enhancement measures to be provided as a result of the scheme.

- Likely Significance of Effect
  - Highways England has agreed with PINS that pre- and post-mitigation effects will only be presented where we have identified a need for additional mitigation measures – this is to demonstrate their effectiveness.
  - If our embedded and standard measures have already mitigated an impact to an acceptable level, we simply report the effect of the impact.

highways england

M42 J6 Improvement Scheme

Landscape Assessment

- Impacts on ancient woodland (Aspburys Copse) and mitigation solutions
  - Certain criteria of its designation are currently being queried
  - The M42 scheme's current anticipated loss: 1,946 m^2 to the west and 1,342 m^2 to the east = total 3,288 m^2
  - Proposed Mitigation is focussed on soil translocation and an appropriate level of compensation planting

M42 J6 Improvement Scheme

- Approach to landscape and visual mitigation
  - Proposed Replanting 1:3

M42 J6 Improvement Scheme

- Approach to landscape and visual mitigation
  - Replanting and Screening Strategy

highways england

M42 J6 Improvement Scheme

- Approach to landscape and visual mitigation
  - Replanting and Screening Strategy

M42 J6 Improvement Scheme

- Approach to landscape and visual mitigation
  - Replanting and Screening Strategy

M42 J6 Improvement Scheme

Biodiversity Assessment

- Agreement on the surveys to be scoped in/ out of the assessment
- Bat survey methods
- The scheme will adopt the Highways England No Net Loss Biodiversity Calculator
- Assessment of effects on designated sites (including air quality effects)
- Approach to ecological mitigation

M42 J6 Improvement Scheme

Road Drainage and Water Environment Assessment

- Hydrological impacts on Bickenhill Meadows SSSI
- Highways drainage solutions
- Approach to hydrological mitigation

M42 J6 Improvement Scheme

Anticipated Outcomes

- Review of actions captured
- Agree position on replanting ratio of loss to ancient woodland
- Statement of Common Grounds
- Agreement of Non-Objection; and
- Agree any further meetings/ discussions with timeframes

Thank You

Questions & Comments

M42 Junction 6 Improvement Scheme
Stakeholder meeting notes

Meeting:	Meeting with Natural England to update the organisation on the status of the scheme, and to discuss specific matters relating to: Bickenhill Meadows SSSI; Aspbury's Copse; Biodiversity offsetting; species licencing; and mitigation.
Date:	18th September 2018 – 1:00pm
Venue:	AECOM 12 Regan Way Chetwynd Business Park Chilwell Nottinghamshire NG9 6RZ
Meeting notes by:	Jamie Gleave
Attendees:	Jamie Gleave (JG) [EIA] — AECOM Graeme Cowling (GC) [EIA] — AECOM Marcus Wainwright-Hicks (MWH) [Biodiversity] — AECOM Jeremy Truscott (JT) [Biodiversity] — AECOM Tim Jones (TJ) [Hydrology] — AECOM Owen Tucker (OT) [Hydrology] — AECOM Susie Murray (SM) — Natural England Paul Horswill (PH) — Natural England Mike Robinson (MR) — Natural England Emma Goldberg (EG) — Natural England Ian Butterfield (IB) — Natural England
Apologies:	None.
Numbers attending:	11

Comment		Action / Owner
1.0	**Introductions**	
1.1	GC opened the meeting with introductions and set out the purpose of the meeting.	-
1.2	GC presented an overview of the status of the M42 Junction 6 Improvement scheme. This identified the key design changes made since last meeting Natural England in April 2018, summarised the work being undertaken as part of the environmental impact assessment, and set out the approach to mitigation being adopted on the scheme.	
1.3	GC confirmed to attendees that Highways England plans to submit the Development Consent Order application for the scheme in later November 2018.	
2.0	**Environmental Mitigation and Design Considerations**	
2.1	GC explained that the approach to environmental mitigation across the scheme has been influenced by the restrictions imposed by Birmingham Airport's safeguarding zone, which coincides with much of the land required to construct, operate and maintain the scheme. This constraint has limited the extent to which landscaping can be used to visually screen and contain the scheme in views, and to provide ecological mitigation/offsetting.	
2.2	OT stated that ponds have been avoided in the Drainage Strategy due to their potential to attract birds (thereby increasing the potential for bird strike within the safeguarding zone); however alternative SuDS measures including swales and wetlands have been included.	
2.3	GC noted that the vast majority of the scheme will be unlit.	
2.4	SM queried whether consultation had been undertaken with Warwickshire Wildlife Trust. GC confirmed that a meeting was planned with the Trust, and that meetings had also been undertaken with Solihull Metropolitan Borough Council.	
3.0	**Habitats Regulations Assessment**	
3.1	GC had circulated a copy of the draft Habitats Regulations Assessment: No Significant Effects Report to SM in advance of the meeting. SM noted that she had reviewed this, and confirmed that Natural England was in agreement with the findings of the screening exercise in that there would be no requirement for an Appropriate Assessment.	
4.0	**Biodiversity Assessment: Overview**	
4.1	MWH presented a summary of the biodiversity assessment being progressed as part of the environmental impact assessment process, highlighting the findings of baseline surveys and the designated sites, habitats and species that are predicted to experience impacts from the scheme.	
4.2	SM queried why the River Blythe SSSI and Coleshill and Bannerly Pools SSSI were not included in the assessment. MWH clarified that the assessment has not predicted any effects on either of these receptors.	
4.3	MR queried whether the scheme will result in water quality effects on the River Blythe SSSI, given that all local watercourses flow into this waterbody. OT clarified that none of the scheme road outfalls discharge directly to the Blythe. There are outfalls to its tributaries (Hollywell Brook and Shadow Brook), and for these the water quality risk assessments undertaken have shown that these would be considered priority outfalls by Highways England. This scheme includes various design measures to treat road runoff and provide greater spillage containment which represents a significant improvement over the existing situation, as there is currently no known treatment of road runoff or spillage containment and the M42 is a heavily trafficked road.	

4.4	MWH confirmed that Great Crested Newt connectivity would not be severed by the scheme, as all ponds and habitats are located to the east of the proposed new link road.	
4.5	MWH noted that some surveys (e.g. aquatics and reptiles) are still ongoing.	
4.6	MWH stated that reptiles had originally been scoped out of the biodiversity assessment, but that these have been partially surveyed whilst undertaking other surveys where land access has been granted.	
5.0	**Protected Species Licencing and Ecological Mitigation**	
5.1	MWH stated that the project is looking to submit draft licences to Natural England around the end of October 2018. PH noted that Natural England would need to review the raw data and information relating to any access limitations encountered, alongside the draft licences. MWH noted that the intention is to provide Natural England with a focused report to support the review and evaluation of the draft licences; this would only identify areas where presence of a legal constraint from species has been confirmed, such as a bat roost (i.e. not where an absence of species was noted). Attendees were in agreement that this was an appropriate approach to take to support the draft licences.	
5.2	MWH noted that Letters of No Impediment would be required from Natural England for submitting as part of the Development Consent Order application in November 2018. PH was content that, subject to the required information being submitted, Natural England could meet these timeframes.	
5.3	MWH presented the proposed mitigation measures for licence and non-licence species. A combination of design-based measures (embedded mitigation) and construction-based measures (standard measures) are being proposed to mitigate adverse effects on species, the exact location of which has yet to be determined due to ongoing assessment and landowner engagement.	
5.4	PH noted that Natural England was comfortable with the inclusion of a badger tunnel as a means of restoring the connectivity of badger setts and habitats that would be severed by the new link road. MWH agreed to share the confidential findings of the badger surveys with PH in advance of submitting a draft licence for this species.	MWH
5.5	GC set out the purpose and content of the Bird Strike Management Plan that has been produced following engagement with Birmingham Airport, noting that conventional measures will be used to reduce the risk of birds conflicting with flight paths.	
5.6	JT and MWH staed that the precise form and location of bat mitigation had yet to be determined; however, both noted that bat boxes would likely be the preferred solution (as opposed to any free standing structures). Potential sites for mitigation were discussed, and the possibility of siting these in land under the control of Warwickshire Wildlife Trust and within Bickenhill Meadows SSSI was mentioned. PH agreed with this approach, subject to a review of the final survey findings and impact assessments, and agreed to return to AECOM (MWH) on the level of commitment and certainty that Natural England would require to inform licencing.	PH
5.7	MWH identified the ponds that have confirmed Great Crested Newt presence, and explained the precautionary approach to mitigation. PH agreed with the approach to licencing for this species.	
6.0	**Biodiversity Offsetting and Net Gain**	
6.1	MWH introduced the approach to biodiversity offsetting on the Scheme, and shared information on the integrated approach to landscaping and biodiversity mitigation/enhancement. GC noted that the plans shared reflect an earlier design position, and that these are now being refined to account for the changes noted in his presentation at the start of the meeting.	
6.2	MWH confirmed that the DEFRA metric has been applied across the Scheme to establish the extent of habitat loss, and to calculate the area and type of habitat required to offset this loss – the objective being to achieve an overall net gain in	

	biodiversity. MWH confirmed that the Warwickshire metric for biodiversity off-setting would not be used in the case of this DCO application	
6.3	IB queried how biodiversity mitigation and enhancement measures intend to be secured on the Scheme. JG responded by stating that a separate report (Biodiversity Offsetting Report) is being prepared as part of the Development Consent Order application documentation, which will present all the work relating to biodiversity offsetting and will set out the mechanisms for securing such measures.	
7.0	**Ancient Woodland (Aspbury's Copse)**	
7.1	GC noted that a Technical Note covering the proposed approach to mitigating effects associated with landtake within the Ancient Woodland at Aspbury's Copse had been circulated to Natural England for consideration. GC highlighted that the design of the scheme in this location has included departures from standards to minimise the extent of permanent landtake required within Aspbury's Copse.	
7.2	MWH outlined the approach to the translocation of soils at Aspbury's Copse, and the area and extent of contiguous replanting proposed.	
7.3	EG queried the allocated area for soil translocation and compensation, and enquired as to whether a soil survey had been undertaken. GC noted that a project-wide soil survey is planned for October 2018.	
7.4	EG requested that the title of the Technical Note be adjusted to reflect that the translocation of Ancient Woodland relates to the soils.	
7.5	EG queried whether the proposals for Aspbury's Copse have been included in any wider biodiversity offsetting calculations. MWH confirmed that as irreplaceable habitat the proposed soil translocation and planting for loss of ancient woodland was not being factored into the calculation, which is in accordance with the DEFRA biodiversity offsetting metric being applied on the scheme.	
7.6	EG noted that high levels of air pollution at Aspbury's Copse are high. MWH noted that the air quality assessment has recorded a local reduction in pollutant levels at this location with the operational Scheme in place, and JG explained that this was attributable to traffic flows on the M42 motorway being displaced onto proposed M42 Junction 5A and new link road.	
7.7	SM and EG confirmed that Natural England has no objection to the approach to soil translocation at Aspbury's Copse, or the location of the compensation planting. SM did, however, emphasise that Natural England's preference is to include planting where feasible on the Scheme. JG noted this, and confirmed that the approach to landscaping has worked within the constraints imposed by the safeguarding zone and that opportunities have been harnessed, where possible, to plant earthwork cuttings and take severed/redundant land parcels for mitigation.	
7.8	SM queried the rationale for why the proposed M42 Junction 5A is located partly within the Ancient Woodland. GC clarified that a detailed options appraisal had been undertaken over time to determine the optimum location of the new junction, taking into account engineering requirements and design standards. JG informed SM that the Environmental Statement will provide a narrative on the historic studies and decision-making that has informed the Scheme design, and referred SM to the Scheme Assessment Report which is available on Highways England's website: https://highwaysengland.co.uk/projects/m42-junction-6-improvement/	
7.9	GC noted that the design work for the Ancient Woodland is reliant on receipt of the revised digital polygon of its boundaries. SM confirmed this will be forwarded to GC as soon as it becomes available.	SM
8.0	**Bickenhill Meadows SSSI**	
8.1	OT presented an overview of the ground investigation, monitoring, design and assessment work undertaken to date regarding Bickenhill Meadows SSSI, in order to better understand the underlying geology, hydrogeology, the potential for the Scheme to affect groundwater flows/levels, and to try and establish whether the SSSI's grassland communities at critical times are more sensitive to	

	groundwater levels or rainfall.	
8.2	TJ noted that he has been visiting the SSSI regularly since land access had been granted, and that the conditions at the site had been recorded as part of the process of dipwell installation (to monitor groundwater levels).	
8.3	OT presented the emerging findings of the studies into the SSSI which were summarised on the presentation slides and detailed in the Version 4 of the Technical Note AECOM has produced. The ground investigations undertaken around the periphery of the north west unit have not encountered groundwater, and have confirmed that Mercia Mudstone is found at a shallow depth of circa 0.5m. Investigations within and surrounding the south east unit encountered water at differing depths, and confirmed that there are thicker deposits of superficial geology consisting of a mixture of sand, gravel and clay. Dipwells have been installed but as yet only limited recordings of water in them had been recorded	
8.4	OT described the emerging conceptual model that has been developed as part of the ongoing studies. Although boreholes within the SSSI are yet to be completed, the results of boreholes just to the east indicated that the north west unit is separated from the cutting by the less permeable Mercia Mudstone that is also at a higher elevation. As there are no significant superficial deposits or shallow groundwater, it is unlikely that the road cutting would intercept or cause the draw-down of any groundwater. Based on this information, it is considered unlikely that the Scheme would affect groundwater flows associated with this unit.	
8.5	For the south east unit, OT noted that we are working to two hypotheses: 1. That an isolated bowl of mixed superficial deposits exists across the unit, that are surrounded by permeable Mercia Mudstone (which would render no significant effect); or 2. A narrow trench of mixed superficial deposits exists between the unit and Catherine-de-Barnes Lane, for which the groundwater flows could be affected by the proposed road cutting (it has been calculated that around 14 % [*correction from the meeting where 12% may have been mentioned*] of the catchment might be affected but no estimates of what this means in terms of water resource has not yet been undertaken).	
8.6	OT explained the approach being taken for mitigation of any potential effects on the south east unit. As the potential for effects on groundwater flows and the SSSI grassland communities has yet to be determined, a series of precautionary mitigation solutions is being developed, focused on the avoidance and reduction of impact consistent with the mitigation hierarchy agreed with NE.	
8.7	OT tabled an emerging design of a solution that focuses on maintaining the existing hydrological regime of the SSSI. This includes measures to incorporate an impermeable barrier within the earthwork cutting slope (clay lining) to the east, and a means of intercepting groundwater within superficial deposits to the west and pumping water across the cutting to an infiltration system. OT noted that the way in which water would be allowed to infiltrate the ground to the east of the cutting was to be confirmed.	
8.8	OT proposed that the implementation of mitigation could be delivered on a phased approach following various 'triggers'. The first trigger would be when the cutting is exposed and the ground conditions could be examined in detail. The second trigger might be after a period of monitoring to see if there are any changes to the SSSI that cannot be explained by other factors. OT acknowledged that it may be that it is most cost effective to construct the various elements of the pumping/infiltration system as part of the main works so it is available should it be needed. OT noted that dipwell monitoring would continue throughout the examination of the Development Consent Order application, and could potentially continue 2-3 years into operation of the Scheme to assess and interpret the continual 'health' of the SSSI.	
8.9	IB queried whether the proposed baseline monitoring would be sufficient to fully understand how the hydrology of how the site operates, given natural variability including this year's exceptionally dry summer. IB also noted that further understanding is needed of the source of water to the springs within the north west SSSI unit before we can conclude no effect, and noted that there is likely to be a groundwater pathway. IB recommended that the conceptual model needs to	

	be developed further to account for this. Greater clarity was also required over the impact of the gas pipeline in the SE SSSI unit, and whether the pipeline is potentially impacting groundwater flow, given the changes in vegetation observed above the pipeline.	
8.10	IB confirmed that the provisional pumping solution would work as intended, but that this would be an expensive engineered solution which would require more maintenance to ensure it operated properly. IB also noted that it raises a number of issues in relation to monitoring the system and who would be responsible for this indefinitely. IB would prefer if a more innovative passive system could be investigated as an alternative solution, although acknowledged that new infrastructure (i.e. pumps) was probably unavoidable. IB stated that it would not be acceptable to monitor the SSSI and only implement the mitigation if the Site had first been impacted.	OT / TJ
8.11	IB noted that the Scheme would take part of the catchment (approximately 14% and that this possible loss should not be referred to as a small proportion of the catchment as it is over a sixth of the total catchment), and that his preference would be to look at solutions that could 'normalise' this (as whatever solution is progressed it needs to maintain the water within the catchment). IB acknowledged that 'year on year' variation in rainfall may compensate in wet years to an extent for any reduction in catchment but that overtime the loss of part of the catchment could be detrimental to the conservation status and resilience of the SSSI (such as to climate change).	
8.12	IB stated that if an engineered pumping solution were to be implemented as part of the Scheme, Natural England would require assurances that the infrastructure would be financed, maintained and monitored by Highways England in the future. IB suggested that further work be undertaken to identify whether the movement of water and how it is reintroduced back into the ground/SSSI could be an opportunity to provide habitat enhancement and biodiversity benefit (e.g. pond, swale or ditch similar to being proposed elsewhere on the Scheme). OT also noted that there may be an opportunity to use the ephemeral ditch along the northern boundary to the SE Unit.	OT / TJ
8.13	JG sought clarification from Natural England that if such a solution were to form part of the mitigation approach and be submitted as part of the Development Consent Order application, and assuming the necessary assurances were in place, would this be acceptable from a planning perspective. IB confirmed that this would be.	
9.0	**Next Steps**	
9.1	GC outlined the next steps in the process, noting that the environmental impact assessment will be finalised and submitted as part of the Development Consent Order application in November 2018. GC also noted that a targeted round of public consultation is currently live, and that this (alongside securing Letters of No Impediment from Natural England) will feed into the application. Further discussions will then be held post-submission to develop Statements of Common Ground between Highways England and Natural England, to inform the examination process.	
10.0	**Any Other Business**	
10.1	None.	-
	Meeting closed at 4pm	

Enc. PDF of the project presentation.

M42 Junction 6 Improvement Scheme
Stakeholder meeting notes

Meeting:	Meeting with Natural England and the Warwickshire Wildlife Trust to update the organisation on the status of the Scheme, and to discuss specific matters relating to: Bickenhill Meadows SSSI; Aspbury's Copse and Biodiversity offsetting.
Date:	14th March 2019 – 11:00am
Venue:	AECOM Victoria Square Birmingham
Meeting notes by:	Graeme Cowling / Jamie Gleave
Attendees:	Jonathan Pizzey (JP) [HE Senior PM] — AECOM Jamie Gleave (JG) [EIA] — AECOM Graeme Cowling (GC) [EIA] — AECOM Marcus Wainwright-Hicks (MWH) [Biodiversity] — AECOM Tim Jones (TJ) [Hydrology] — AECOM Owen Tucker (OT) [Hydrology] — AECOM Susie Murray (SM) — Natural England Ian Butterfield (IB) — Natural England Marion Bryant (MB) (*by telephone*) — Natural England Annie Ottaway (AO) — Warwickshire Wildlife Trust
Apologies:	Karl Curtis (KC) — Warwickshire Wildlife Trust Mike Robinson (MR) — Natural England
Numbers attending:	10

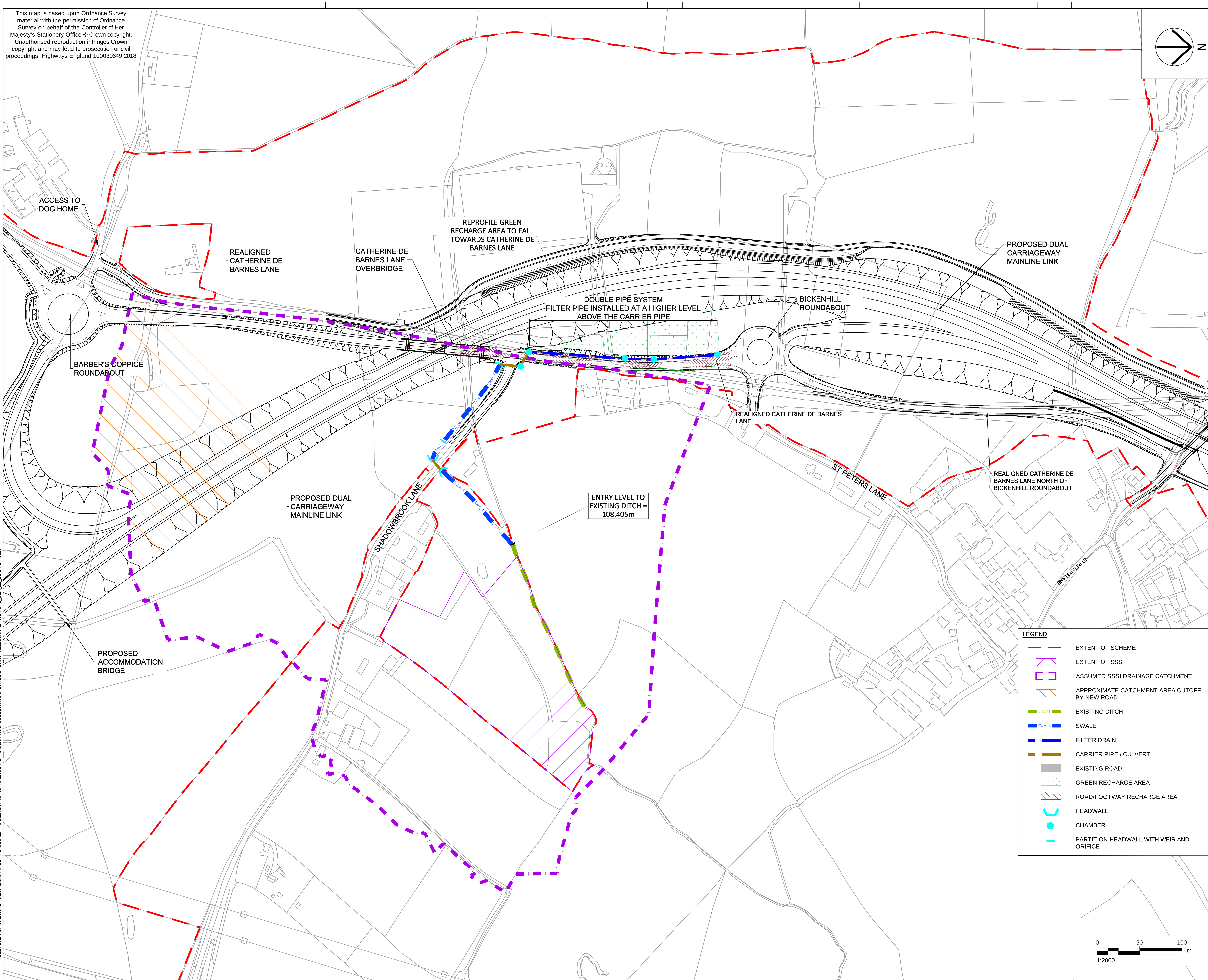
Comment		Action / Owner
1.0	**Introductions**	
1.1	GC opened the meeting with introductions and set out the purpose of the meeting including the desired objectives around the topics noted as **2.0, 3.0** and **4.0**.	
2.0	**Bickenhill Meadows SSSI**	
2.1	OT provided a summary of SSSI data collected to date which now includes data collected and interpreted post DCO finalisation and submission in January 2019.	
2.2	OT informed the room that as part of this data analysis updates to the conceptual model have been progressed. Data from the dipwells strongly suggest that the SSSI is rainwater fed (see attached handout) and that it is likely that the SSSI unit had already recharged at the time of the meeting (14th March 2019) due to rainfall events over the winter period of 2018.	
2.3	OT presented the findings of a microdrainage exercise undertaken to better understand and refine the surface water catchment for the Shadowbrook Meadows unit. This microdrainage exercise presented the direct catchment to the SE unit and initial conclusions reducing the initial c.21% overall catchment lost to the Scheme (as per the DCO submission) to c.2% of the microdrainage catchment. IB requested that level of tolerance of this number be shared with Natural England along with the assumptions of the microdrainage exercise.	
2.4	SM queried whether the conceptual model could bring both groundwater and surface water together to inform the solution. OT responded, noting that AECOM have explored this internally, concluding the quantity of data and the assumptions required to compensate for the data not being available would render the activity too unreliable.	
2.5	ME introduced the 5 options (A – E) considered as solutions, broadly falling into two categories, pumped and passive. ME discussed the merits of all options and explained why Options D and E were discounted (see presentation handout as attached), Natural England and Warwickshire Wildlife Trust accepted the justification for discounting the options and the discussion focussed on the three options progressed for further consideration.	
2.6	ME discussed Options A and B (see presentation handout as attached) and indicated to the meeting that Option C was the Project's current preferred solution, noting that it was a passive system as per previously requested by Natural England which drew water from the Catherine-de-Barnes Road (B4438), where it was accepted around the room minimal treatment would be required of this water prior to entering the SSSI unit.	
2.7	AO noted that Option C drainage/piping provisions cross WWT land where current drainage isn't present. A request was made by AO for AECOM to more clearly delineate the solution if progressed further with commentary for WWT to understand the implications on land ownership and access requirements for maintenance. ME noted this level of detail will be worked up if the Option C is accepted as being the solution to be implemented as part of the Scheme.	
2.8	AO queried what would happen if the passive solution once operational indicated that insufficient water was being fed into the SSSI unit. A general discussion on the issues from an oversupply of water as well as insufficient water was discussed in addition to the viability of installing 'ghost infrastructure' for pumping was explored. AECOM will consider this as the solution is refined further.	
2.9	IB provided his summary of what AECOM have presented to the meeting, which included; the rainfall data strongly indicating that the SSSI is rainfall recharged, the refining of the catchment area and the possible loss of approximately 2% of the microdrainage catchment and the confirmation that the central ditch does not play an integral part of the overall recharge process. Natural England were complementary of the work undertaken to better understand the impacts to the SSSI unit.	

3.0	**Ancient Woodland (Aspbury's Copse)**	
3.1	GC provided an overview of the impact (in terms of area lost to the Scheme) to Aspbury's Copse ancient woodland, and the proposed location and replanting area ratio the project is proposing.	
3.2	SM and MB confirmed that Natural England is content with the location for the benefit of being contiguous to the eastern parcel and for soil translocation.	
3.3	MB noted that notwithstanding the points confirmed within 3.2 above, Natural England are of the opinion that a 3:1 compensation replanting area ratio is considered too low for irreplaceable habitat.	
3.4	SM reiterated MB's statement for the benefit of those within the meeting room and referred back to the latest update the National Planning Policy Framework (NPPF) (2019) provides ancient woodland greater protection and consideration in the planning process.	
3.5	GC clarified that the replanting ratio is on area to allow for the loss of component parts of the ancient woodland and not just tree loss. GC noted the area would allow for far greater replanting of trees (in terms numerical quantity) in addition to targeted soil translocation in the area.	
3.6	IB stated that Natural England were not disputing the area of approximately 1.9 ha for compensation planting but considered the ratio of 3:1 to be insufficient.	
3.7	Natural England accepted the constraints to additional tree planting with regards to airport safeguarding and queried if the project has looked at areas around the western parcel of the ancient woodland. AECOM noted that the Scheme is aiming to maximise woodland planting around Junction 5A in addition to the compensation planting area.	
3.8	Natural England concluded that the organisation was in the process of deciding whether to formally object to the Scheme on the grounds of the compensation planting area being considered too low for irreplaceable habitat. JP accepted this statement and explained Natural England were in the relevant representations period and could provide further formal comment through this process but the desire is to avoid this objection if possible.	
4.0	**Biodiversity Offsetting and Net Gain**	
4.1	MWH provided an update to the offsetting status of the Scheme.	
4.2	GC outlined that Highways England have confirmed the desire to achieve a net gain for the Scheme. GC noted that legal advice the project received prior to submission of the DCO was that the compulsory purchase order (CPO) procedures could not be used to purchase land for non-essential environmental mitigation. As biodiversity net gain for the Scheme is considered non-essential and an aspirational policy, the decision was made by the project to remove the biodiversity offsetting report from the DCO application. SM accepted this explanation.	
4.3	SM queried whether the project has explored opportunities to pay for or contribute towards wildlife programmes to attain a net gain. AO noted that WWT policy is not to accept financial contributions towards current reserve management as this is not additional and therefore does not constitute net gain. WWT do/ have, however, taken on new land with offsetting funding to enhance it.	
4.4	MWH continued to explain the offsetting credits the Scheme is currently achieving and noted that the refining process is ongoing.	
4.5	AECOM noted that the final Biodiversity Offsetting report will be shared with and reviewed by Natural England.	
5.0	**Any Other Business**	

5.1	None.	
Meeting closed at 4pm		

Enc. PDF of the project presentation.

Annex H: Gravity-fed mitigation solution (preferred option)



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

IT IS ASSUMED THAT ALL WORKS ON THIS DRAWING WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROPRIATE METHOD STATEMENT.

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT.

EXCEPTIONAL RISKS RELATING TO THE WORKS ASSOCIATED WITH THIS DRAWING ARE IDENTIFIED BELOW.

CONSTRUCTION

MAINTENANCE / OPERATION / DECOMMISSIONING / DEMOLITION

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTATION.
2. DO NOT SCALE FROM THIS DRAWING, USE ONLY PRINTED DIMENSIONS.
3. ALL DIMENSIONS IN METRES, ALL CHAINAGES, LEVELS AND COORDINATES ARE IN METRES UNLESS DEFINED OTHERWISE.

KEYPLAN

Revision Details	By / Check	Date	Suffix
SUDS AND PIPEWORK ADDED	OM / ME	25-04-19	P02

Purpose of issue

FOR INFORMATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
B4 6BN

Working on behalf of highways england

Project Title

M42 JUNCTION 6 IMPROVEMENT

Drawing Title

ANNEX H: SE SSSI UNIT GRAVITY MITIGATION SOLUTION

Designed	Drawn	Checked	Approved	Date

Internal Project No.	Suitability
60543032	S2
Scale @ A1: 1:2000	Zone: M42

AECOM
Royal Court
Basil Close
Chesterfield
Tel01246 209221
Fax01246 209229
www.aecom.com

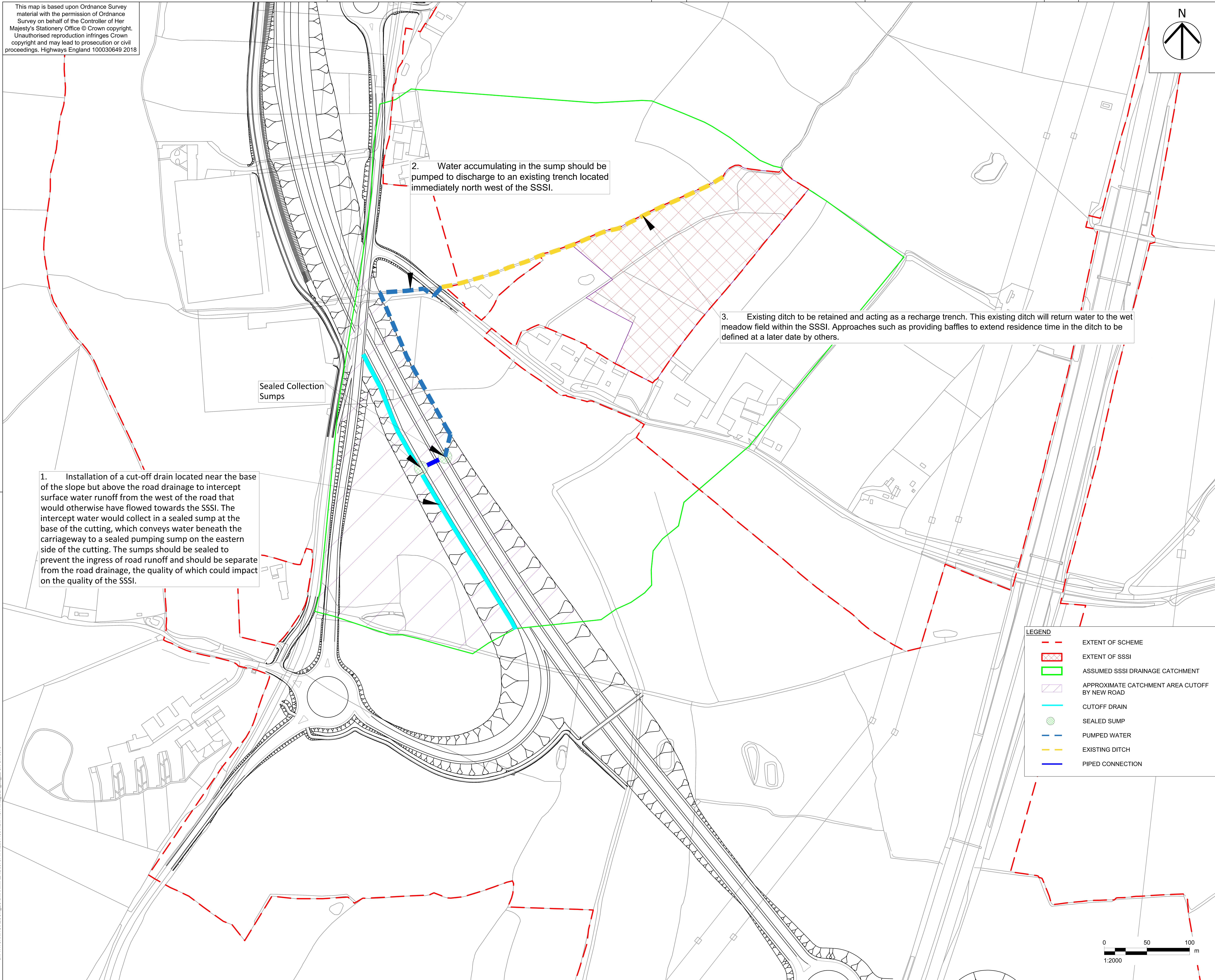
AECOM Infrastructure & Environment UK Limited
Registered in England Registered number: 880328
Registered office: Scott House, Alencon Link, Basingstoke, Hampshire RG21 7PP

Drawing Number
Highways England PIN | Originator | Volume
HE551485 - ACM - HGN -
M42_GEN_ZZ_ZZ - DR - SK - 0100
Location | Type | Role | Number

Rev
P01

Plot Date: 21 June 2019 12:04:59

Annex I: Pumped mitigation solution



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

IT IS ASSUMED THAT ALL WORKS ON THIS DRAWING WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROPRIATE METHOD STATEMENT.

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT.

EXCEPTIONAL RISKS RELATING TO THE WORKS ASSOCIATED WITH THIS DRAWING ARE IDENTIFIED BELOW.

CONSTRUCTION

MAINTENANCE / OPERATION / DECOMMISSIONING / DEMOLITION

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTATION.
2. DO NOT SCALE FROM THIS DRAWING, USE ONLY PRINTED DIMENSIONS.
3. ALL DIMENSIONS IN METRES, ALL CHAINAGES, LEVELS AND COORDINATES ARE IN METRES UNLESS DEFINED OTHERWISE.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE PROJECT HEALTH & SAFETY FILE FOR ANY IDENTIFIED POTENTIAL RISKS.

KEYPLAN

Revision Details	By / Check	Date	Suffix

Purpose of issue

FOR INFORMATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
B4 6BN

Working on behalf of

Project Title

M42 JUNCTION 6 IMPROVEMENT

Drawing Title

ANNEX I: SE SSSI UNIT PUMPED MITIGATION SOLUTION

Designed	Drawn	Checked	Approved	Date
PC	OM			04/12/18

Internal Project No. 60543032	Suitability S2
Scale @ A1 1:2000	Zone M42

THIS DOCUMENT HAS BEEN PREPARED PURSUANT TO AND SUBJECT TO THE TERMS OF AECOM'S APPOINTMENT BY ITS CLIENT. AECOM ACCEPTS NO LIABILITY FOR ANY USE OF THIS DOCUMENT OTHER THAN BY ITS ORIGINAL CLIENT OR FOLLOWING AECOM'S EXPRESS AGREEMENT TO SUCH USE, AND ONLY FOR THE PURPOSES FOR WHICH IT WAS PREPARED AND PROVIDED.

AECOM
Royal Court
Basil Close
Chesterfield
Tel01246 209221
Fax01246 209229
www.aecom.com

AECOM Infrastructure & Environment UK Limited
Registered in England Registered number: 880328
Registered office: Scott House, Alencon Link, Basingstoke, Hampshire RG21 7PP

Drawing Number
Highways England PIN | Originator | Volume
HE551485 -ACM -HGN-
M42_GEN_ZZ_ZZ -DR-SK-0075
Location | Type | Role | Number

Rev
P01

Plot Date : 04 December 2018 15:20:06
File Name C:\PWWORKING\AECOM_EU\OMAR.MIRZA\D0376747\HE551485-ACM-HGN-M42_GEN_ZZ_ZZ-DR-SK-0075

About AECOM

AECOM (NYSE: ACM) is built to deliver a better world. We design, build, finance and operate infrastructure assets for governments, businesses and organizations in more than 150 countries.

As a fully integrated firm, we connect knowledge and experience across our global network of experts to help clients solve their most complex challenges.

From high-performance buildings and infrastructure, to resilient communities and environments, to stable and secure nations, our work is transformative, differentiated and vital. A Fortune 500 firm, AECOM companies had revenue of approximately US$19 billion during the 12 months ended June 30, 2015.

See how we deliver what others can only imagine at aecom.com and @AECOM