M42 Junction 6 Improvement
Scheme Number TR010027
Volume 6
6.1 Environmental Statement
Chapter 14 – Road Drainage and the Water Environment

Regulation 5(2)(a)

Planning Act 2008

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

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Infrastructure Planning

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6.1 Environmental Statement
Chapter 14 Road Drainage and the Water Environment

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Table of contents

List of Tables

14 Road drainage and the water environment

14.1 Competent expert evidence

14.1.1 This chapter presents the results of an assessment of the likely significant effects of the Scheme on road drainage and the water environment. The water environment includes water quality, hydromorphology, groundwater, flood risk and drainage

14.1.2 The competent expert responsible for the assessment is a Principal Consultant who holds the qualifications of BA (Hons) and a MSc in Geography, and is a Chartered Environmentalist and a Member of the Chartered Institution of Water and Environmental Management (CIWEM).

14.1.3 They have 14 years' experience of undertaking environmental impact assessments (EIAs) and environmental management, specialising in water science. This includes river and lake water quality and sediment monitoring and analysis, water EIAs, Water Framework Directive 2006/60/EC (WFD) compliance appraisals, Highways Agency Water Risk Assessment Tool (HAWRAT) assessments, Sustainable Drainage System (SuDS) development and pond optimisation, developing mitigation measures to protect the water environment from construction work.

14.2 Legislative and policy framework

14.2.1 The following legislation, planning policy and guidance documents are of direct relevance to the assessment of effects of the Scheme on road drainage and the water environment is presented in the sections below, as well as the European Union (EU) Directives relevant to the Scheme.

Relevant EU Directives

Water Framework Directive (2000/60/EC)

14.2.2 The WFD [REF 14-1] makes provision for the maintenance and improvement of the ‘ecological and chemical status’ of the water environment, which includes rivers, lakes, wetlands, groundwater, estuaries and coastal waters. The aim is for designated waterbodies to achieve ‘good overall status’. Certain surface waterbodies may be designated as artificial/heavily modified and have less stringent targets to meet, however, these still need to demonstrate ‘good overall potential’. Further detail is given in Appendix 14.1 [**TR010027/APP/6.3**].

14.2.3 A review of the baseline conditions (see section 14.6) confirms that the Scheme has the potential to impact numerous water bodies, and so compliance of the Scheme with the objectives of the WFD designated waterbodies has been considered by the assessment.

Priority Substances Directive (2008/105/EC)

14.2.4 The Priority Substances Directive [REF 14-2] sets out the Environmental Quality Standards (EQS) for substances in surface waters (river, lake, transitional and coastal). It confirmed their designation as priority substances or priority hazardous substances, the latter being a subset of particular concern. Annex I of the Directive tabulates limits on concentrations of priority substances in surface waters. This includes 33 priority substances and eight other pollutants.

14.2.5 The potential effects of the Scheme on the baseline water quality of potentially impacted watercourses (including WFD status for priority or priority hazardous substances) have been considered as part of the assessment presented in this chapter.

Groundwater Daughter Directives (2008/105/EC and 2006/118/EC)

14.2.6 There are currently a number of Directives in place with the aim of protecting groundwater against pollution and deterioration. The WFD and the Groundwater Daughter Directive, which were enacted in 2003 and 2009 respectively, replace the original Directive (80/68/EEC) which was repealed in 2013. The Groundwater Daughter Directive [REF 14-3] introduces procedures for assessing the 'Chemical Status' of groundwater as per the WFD, and protects groundwater by preventing direct discharge of 'hazardous pollutants' and limiting the direct discharge of non-hazardous pollutants.

14.2.7 A review of the baseline conditions (see Section 14.6) confirms that the Scheme has the potential to impact on groundwater quantity or quality, and so this is assessed within this chapter. Compliance with the objectives for the WFD designated groundwater waterbody is also considered in Appendix 14.1 [**TR010027/APP/6.3**].

Floods Directive (2007/60/EC)

14.2.8 The Flood Directive [REF 14-4] makes provision for the assessment of flood risk, mapping its potential impact and planning measures to reduce potential and significant flood risk.

14.2.9 A review of the baseline conditions confirms that the Scheme has the potential to impact on flood risk in the surrounding area. The Flood Risk Assessment (FRA) Appendix 14.4 [**TR010027/APP/6.3**] has assessed the level of risk, and the results of this are reported within this chapter.

Environmental Liability Directive (2004/35/EC)

14.2.10 The Environmental Liability Directive [REF 14-5] aims to ensure those causing damage to the environment (including the water environment) are legally and financially responsible for that damage. The Directive covers environmental damage caused by or resulting from occupational activities to:

a. species and natural habitats protected under the 1992 Habitats Directive and the 1979 Wild Birds Directive;

b. designated WFD water bodies other than effects justified under Article 4.7 of the WFD; and.

c. land contamination that creates a significant risk of harming human health.

14.2.11 A review of the baseline conditions confirms that the Scheme has the potential to cause environmental damage. As such, this impact assessment has been undertaken and mitigation proposed where necessary.

National legislation

14.2.12 The objectives of the EU Directives described above are met through the following UK Legislation:

a. Water Act 2014 [REF 14-6];

b. The Floods and Water Management Act 2010 [REF 14-7];

c. The Land Drainage Act 1991 [REF 14-8];

d. The Water Resources Act 1991 [REF 14-9];

e. The Salmon and Freshwater Fisheries Act 1975 as amended [REF 14-10];

f. The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 [REF 14-11] (superseding the 2003 Regulations) [REF 14-12];

g. The Environmental Permitting (England and Wales) Regulations 2016 [REF 14-13];

h. The Environmental Damage (Prevention and Remediation) Regulations 2015 [REF 14-14];

i. The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 [REF 14-15];

j. The Eels (England and Wales) Regulation 2009 [REF 14-16];

k. The Groundwater (England and Wales) Regulations 2009 [REF 14-17]; and

l. The Control of Pollution (Oil Storage) (England) Regulations 2001 [REF 14-18].

Relevant consents

14.2.13 Main Rivers are a statutory type of watercourse in England and Wales, usually larger streams and rivers but also including some smaller watercourses. In England, Main Rivers are designated by the Department for Environment, Food and Rural Affairs (DEFRA) and works that can affect the flow in them are controlled through water activity permits for flood defence enforced by the Environment Agency (EA) in accordance with the requirements of the Environmental Permitting (England and Wales) Regulations 2016 [REF 14-13] and the Water Resources Act 1991 (as amended) [REF 14-9].

14.2.14 An Environmental Permit (Flood Risk Activity) is required from the EA if a regulated activity is to be undertaken on or near a Main River, on or near a flood defence structure, or in a flood plain. This includes any activity within 8m of the bank of a main river, flood defence structure or culvert on a main river, or activities carried out on the floodplain of a main river, more than 8m from the river bank, culvert or flood defence structure if you do not have planning permission.

14.2.15 Hollywell Brook and Shadow Brook intersect the Order Limits and both are Main Rivers downstream of the M42. For Hollywell Brook the Main River designation begins approximately 30m east of the M42 carriageway, and for Shadow Brook the designation begins approximately 75m east of the M42 carriageway.

14.2.16 An Environment Permit may also be required for the discharge to surface waters or ground of any 'unclean' construction site runoff, again where exemptions do not apply. However, local highways authorities do not require permission from the EA to discharge runoff from highways to Controlled Waters (i.e. all watercourses, canals, lakes, groundwater etc.) under the Highways Act 1980 providing water pollution does not occur.

14.2.17 It may be necessary to obtain an impoundment license for any temporary or permanent structures that can permanently or temporarily change the water level of flow along Main Rivers. This includes dams, sluices, penstocks and retaining walls, and is most likely to apply to the temporary works. Consultation with the National Permitting Service would be required to understand the licences that are required.

14.2.18 Under The Floods and Water Management Act 2010 [REF 14-7] and The Land Drainage Act 1991 [REF 14-8] consent may be required for certain works that may affect the flow in Ordinary Watercourses (i.e. all watercourses that are not Main Rivers) from the Lead Local Flood Authority (LLFA), which in this case is Solihull Metropolitan Borough Council (SMBC).

14.2.19 Applications for these relevant consents are not explicitly included within the Development Consent Order (DCO) application, but will be confirmed with the relevant bodies as outlined in this chapter.

National policy guidance

National Policy Statement for National Networks (NPSNN)

14.2.20 Sections 5.90 - 5.115 and 5.219 - 5.231 of the NPSNN [Ref 14-19] specifically apply to flood risk and water quality respectively, and how impacts on the water environment affect the decision making process.

14.2.21 The NPSNN states that flood risk will not be increased elsewhere as results of a Scheme, and that development is only appropriate in areas at risk of flooding where it can be demonstrated that the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location; and development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning. Priority is given to the use of SuDS.

14.2.22 With regard to water quality, NPSNN states that the Secretary of State should be satisfied that a proposal has had regard to the River Basin Management Plans (RMBPs) and the requirements of the WFD (including Article 4.7 which describes various tests that need to be met to justify new physical modification to a water body when that modification could lead to deterioration or prevent improvement) and its daughter directives.

14.2.23 The requirements of the NPSNN in relation to assessing and mitigating the effects of the Scheme on the water environment have been taken account of in this assessment, in order to identify the likely significant effects that the Secretary of State needs to give due regard to in their decision-making.

National Planning Policy Framework (NPPF)

14.2.24 The NPPF [REF 14-20] contains a number of statements which are relevant to water resources and flood risk. These include: making use of underdeveloped land in mitigating flood risk; taking a proactive approach to mitigating and adapting to climate change taking into account the long-term implications for flood risk, coastal change and water supply; taking full account of flood risk in the planning system including planning for climate change; and that development should not cause unacceptable levels of water pollution and should help improve water quality wherever possible.

14.2.25 The requirements of the NPPF have been taken into account in the assessment, with particular regard given to potential impacts in relation to flood risk and water quality.

National Planning Practice Guidance (NPPG)

14.2.26 NPPG [REF 14-21] provides guidance for local planning authorities on assessing the significance of water environment effects of proposed developments. The guidance highlights that adequate water and wastewater infrastructure is needed to support sustainable development. The assessment presented in this chapter has due regard to this guidance.

Future Water: The government's water strategy for England

14.2.27 The Government's Future Water strategy [REF 14-22] published in June 2011 sets out the Government's long-term vision for water and the framework for water management in England. It aims to permit the supply of secured water supplies whilst ensuring an improved and protected water environment. It includes for sustainable management of the water environment and water quality, to ensure no compromise in environmental quality of future generations.

14.2.28 The assessment presented in this chapter ensures that there is no significant deterioration in quality of the water environment and water quality against the baseline conditions.

Sustainable drainage systems guidance

14.2.29 Planning policy encourages developers to include SuDS in their proposals where practicable. SuDS provide a way to attenuate runoff from a site to the rate agreed with the EA and LLFA to avoid increasing flood risk, but they are also important in reducing the quantities and concentration of diffuse pollutants found in the runoff.

14.2.30 DEFRA have recently published guidance on the use, design and construction of SuDS (Non-statutory technical standards for SuDS, DEFRA (2015)) [REF 14-23]. Current best practice guidance on the planning for and design of SuDS treatment is provided by C753 The SuDS Manual [REF 14-24], DMRB HA 103/06 Vegetated Drainage Systems for Highway Runoff [REF 14-25], and DMRB HD 33/06 Surface and Subsurface Drainage Systems for Highways [REF 14-26].

14.2.31 These various guidance documents have been consulted in the assessment of the Drainage Strategy (Appendix 14.5) [**TR010027/APP/6.3**], to ensure that the Scheme is compliant with best practice.

River Basin Management Plan

14.2.32 River Basin Management Plans (RBMPs) are prepared by the EA for six year cycles and set out how organisations, stakeholders and communities will work together to improve the water environment. The most recent plans were published in 2015 (the second cycle) and will remain in place until after 2021. The waterbodies within the Scheme study area fall under the Tame, Anker and Mease management catchment within the Humber RBMP [REF 14-29]. Further details are given in Appendix 14.1 [**TR010027/APP/6.3**].

Solihull Local Plan: Shaping a Sustainable Future

14.2.33 Relevant policies which relate specifically to the water environment, flood management and SuDS in the Solihull Local Plan [REF 14-28] include:

a. Policy P10 Natural Environment – "The full value and benefits of the natural environment will be taken into account in considering all development proposals". Developers will be expected to incorporate measures to protect, enhance and restore the landscape, unless it is demonstrated that it is unfeasible, disproportionate or unnecessary. Development likely to have an impact on a Site of Special Scientific Interest (SSSI) will be subject to special scrutiny and will be permitted only if the reasons for the development clearly outweigh the nature conservation value of the site and the national policy to safeguard such sites;

b. Policy P11 Water Management – "All new development should have regard to the actions and objectives of appropriate River Basin Management Plans in striving to protect and improve the quality of water bodies in and adjacent to the Borough". The policy goes on to say that, "All new development shall incorporate sustainable drainage systems, unless it is shown to be impractical to do so". With regard to flood risk, the development should "promote the reduction of flood risk by seeking to reinstate the natural floodplain, the de-culverting of watercourses and the limiting of surface water runoff to green field rates via the use of sustainable drainage techniques"; and

c. Policy P15 Securing Design Quality – All development proposals will be expected to achieve good quality, inclusive and sustainable design, including use of using sustainable drainage principles.

14.2.34 SMBC have also produced *A Guide to SuDS and Drainage in Solihull* [REF 14-29]. It aims to provide guidance on the requirements of planning, design and implementation of SuDS in accordance with national and local policy and guidance.

14.2.35 These local plan policies have been addressed through the design-development process set out in Chapter 4 and are considered in this assessment. This has included development of the Drainage Strategy (Appendix 14.5) [**TR010027/APP/6.3**] including utilisation of SuDS where possible, and preparation of a Flood Risk Assessment (Appendix 14.4 [**TR0100027/APP/6.3**]). Special consideration has been given to potential impacts to the Bickenhill Meadows SSSI (Appendix 14.2 [**TR010027/APP/6.3**]).

North Warwickshire Local Plan

14.2.36 The draft North Warwickshire Local Plan (Submission Version) [REF 14-30] contains policies relating to the water environment and flooding.

14.2.37 Although the Scheme does not physically impact any land within this council's boundary, there is potential for the Scheme to have indirect impacts on the water environment through hydrologic connectivity to downstream receptors. Accordingly, relevant policies within this document have been considered in the assessment.

a. Policy LP31: Development Considerations states that development should ensure no net loss of flood storage capacity, and that this should protect the quality and hydrology of ground or surface water sources so as to reduce the risk of pollution of flooding, on site or elsewhere; and

b. Policy LP35: Water Management states that, in line with the WFD, development must not affect ecological status of a waterbody and where appropriate, incorporate measures to improve its ecological value. In addition, water runoff from development must be no more than natural greenfield runoff rates and developments should hold this water back on the development site through high quality SuDS, reducing pollution and flood risk to nearby watercourses.

14.2.38 These requirements have been given due regard in the development of the Flood Risk Assessment (Appendix 14.4 [**TR0100027/APP/6.3**]) and Drainage Strategy (Appendix 14.5 [**TR010027/APP/6.3**]).

14.3 Assessment methodology

Scope of the assessment

14.3.1 A scoping exercise was undertaken in late 2017 to identify the matters to be covered by the road drainage and the water environment assessment and agree the approach with relevant statutory bodies.

14.3.2 The assessment scope was established by comparing preliminary design and land take details for the Scheme with available data, information and records relating to surface water, groundwater, hydromorphology and flood risk.

14.3.3 The outcomes of the scoping exercise were recorded in a Scoping Report, which was consulted upon as part of a formal request to the Planning Inspectorate for a Scoping Opinion. The scoping report included a summary of all assessment work undertaken as part of the design-development of the Scheme up to the point of its publication.

14.3.4 The Inspectorate's Scoping Opinion [REF 14-31] identified a number of overarching EIA and topic-specific matters that were subsequently brought into the overall scope of this assessment. These further considerations are detailed in Appendix 5.3 [**TR010027/APP/6.3**] and include responses to the points raised, and identify where the relevant information is presented within this chapter and elsewhere in this Environmental Statement (ES).

14.3.5 The scoping exercise identified the requirement for a Preliminary WFD assessment, and a detailed site specific FRA (Appendix 14.4 [**TR0100027/APP/6.3**]).

14.3.6 In addition to the matters raised in the scoping opinion [REF 14-31], the final assessment scope has also been shaped by the following:

a. the outcomes of consultation with statutory bodies, non-statutory organisations and other stakeholders with an interest in road drainage and the water environment;

b. design changes made to the Scheme in respect of its form and extent, and the area of land required for its construction and operation; and

c. the outcomes of field surveys undertaken to establish the baseline conditions of the water environment.

14.3.7 Consideration was given to the activities associated with the future maintenance and management of the Scheme, and whether these have the potential to result in significant effects on the water environment. Following a review of the maintenance activities (not including road safety in adverse weather conditions) presented in Chapter 3 The Project, it was concluded that there would be limited potential of such effects to occur, and that these activities are comparable with standard maintenance operations already being undertaken elsewhere on the strategic and local road networks. Accordingly, the effects associated with this phase of the Scheme were scoped out of the assessment and are not considered further.

14.3.8 Following review of the baseline water environment, impacts to the following receptors have been scoped out of the assessment:

a. Grand Union Canal – the canal is located upslope of the Scheme, with a further raised topographic mound located between the southwest extent of the Scheme works and the canal, which would prevent flow between the two. As the canal would not receive surface water or groundwater flows from the Scheme, or highway discharges, it would not be affected and so would not be considered by the impact assessment any further; and

b. Coleshill and Bannerly Pools - these pools are not considered by the assessment in this chapter due to their distance from any physical works and lack of hydrological connectivity to upstream waterbodies that intersect the Scheme.

Assessment guidance

14.3.9 The following guidance has been used to inform the scope and content of the assessment, and to assist the identification and mitigation of likely significant effects. This builds upon the overarching EIA methodology and guidance presented in Chapter 5.

14.3.10 The Design Manual for Roads and Bridges (DMRB) HD 45/09 [REF 14-32] has been used to undertake a qualitative assessment of the potential for impacts on water resources in the area.

Establishment of the baseline conditions

14.3.11 Establishment of the baseline environment has involved reference to existing data sources, consultation with statutory bodies and other organisations, and fieldwork surveys.

Desk studies

14.3.12 This included a review of national and local planning policy, relevant published plans, documents and best practice guidance, and a review of the following data sources:

a. existing scheme information, topographical data, site reports and consultations;

b. online Ordnance Survey (OS) and aerial maps;

c. online historic maps;

d. various websites for data on water quality, water resources, hydrology, climate, geology, soils; and

e. current River Basin Management Plan [REF 14-33], Catchment Abstraction Management Strategy [REF 14-34], and Strategic Flood Risk Assessment [REF 14.35] covering the site.

Consultation

14.3.13 The EA was consulted for information on water quality, resources and biological data for water bodies in the study area. They returned an array of information including information on surface and groundwater abstractions, groundwater aquifer status, surface water quality and ecology data, active discharge consents and the Flood Map for Planning.

14.3.14 SMBC was consulted on the presence of any private water abstractions, and replied that there were five within the study area, although exact coordinates were not provided due to data protection restrictions.

14.3.15 The EA and Birmingham Airport (BA) were consulted on the preliminary drainage strategy for the Scheme at a meeting held on 8 May 2018. The proposals were revised in response to the consultation and updated proposals were accepted by BA on 30 July 2018, and by the EA on 3 August 2018. Further details are given in Appendix 14.5 (Drainage Strategy [**TR010027/APP/6.3**]).

14.3.16 Natural England and the Warwickshire Wildlife Trust have also been consulted on the assessment of the potential hydrological impacts on the Bickenhill Meadows SSSI. Further details are given in Chapter 9 Biodiversity [**TR010027/APP/6.1**] and Appendix 14.2 [Bickenhill Meadows SSSI: Hydrological Investigation Technical Note] [**TR010027/APP/6.3**].

Fieldwork

14.3.17 An initial site walkover was undertaken on 27 October 2017 in fine weather conditions after a period of dry weather, meaning that the watercourses were at low flow conditions. The aim of the site walkover was to allow water receptors in the area to be assessed in terms of their character and morphology, and their connectivity to the Scheme to be considered in terms of the surrounding topography and receptors (for example nearby sites of ecological importance). This has been augmented by subsequent water quality monitoring of Hollywell Brook, Shadow Brook, the tributary of Shadow Brook and the tributary of Low Brook to better understand baseline conditions and provide input data to the quantitative assessment of road runoff impacts. Site visits have been undertaken regularly (and are ongoing fortnightly) to the Bickenhill Meadows SSSI to investigate the hydrology of the sites as described further in Appendix 14.2 [Bickenhill Meadows SSSI: Preliminary Hydrological Investigation Technical Note] [**TR010027/APP/6.3**].

Assessment of routine road runoff and accidental spillages

14.3.18 An assessment of the potential impacts of routine runoff on surface waters was required in order to determine whether this presented an environmental risk and to develop an appropriate mitigation approach. The HAWRAT v1.0 was developed for this purpose and the methodology behind it has been derived from a collaborative research programme undertaken by the Highways Agency (prior to the advent of Highways England) and EA, which investigated the effects of routine road runoff on receiving waters and their ecology. An assessment of the potential impact to water bodies from routine runoff has been undertaken following Method A and Method C from HD45/09 [REF 14-32], which utilises the HAWRAT tool. The assessment determined the need for treatment measures for future road runoff and is presented in full in, Appendix 14.3 [**TR010027/APP/6.3**] and summarised in Section 14.9.

14.3.19 It is also important to assess the risk of a serious road traffic accident that could lead to a serious water pollution incident occurring and for this Method D of HD45/09 [REF 14-32] was used. This method combines various risk factors, including the volume of traffic flows in a 24 hour period, the percentage of heavy goods vehicles, and the risk attributed to different types of road to determine the probability of an accident resulting in a serious pollution incident. The acceptable standard is measured as a return period with 1 in 100 years as the minimum threshold for non-sensitive water environments. This increases to 1 in 200 years for sensitive receptors (for example SSSIs). The assessment determined the need for appropriate spillage containment measures. This is presented in full in Appendix 14.3 [**TR010027/APP/6.3**] and is summarised in Section 14.9.

14.3.20 While the remainder of the ES undertakes the impact assessment with standard and embedded mitigation included, for routine road runoff and accidental spillage risk it is a requirement to determine the extent of potential pollution impact from the Scheme quantitatively in the absence of mitigation, in order to confirm that the proposed mitigation is adequate to ensure no residual effects (as described in HD45/09 [REF 14-32]). Therefore, the impact assessment for these elements is presented in the absence of mitigation, and then with mitigation included.

Importance of the receptor

14.3.21 The significance of potential adverse effects during the construction and occupation phases of development was determined using the guidance and criteria set out in DMRB HD45/09. This was developed for road infrastructure projects, and provides a robust and well tested method by which to predict the significance of effects.

14.3.22 Under this approach, the importance of the receptor (see **Table 14.1** as presented within Section 14.9), and the magnitude of impact (see **Table 14.2**), are determined independently from each other and are then used to determine the overall significance of effect (see **Table 14.3**).

14.3.23 For the purpose of this assessment, receptor 'importance' has been identified rather than receptor 'value' (see **Table 14.1**). This is because when considering the water environment, the availability of dilution means that there can be a difference in the sensitivity and importance of a water body. For example, a small drainage ditch of low conservation value and biodiversity with limited other socio-economic attributes, is very sensitive to impacts, whereas an important regional scale watercourse, that may have conservation interest of international and national significance and support a wider range of important socio-economic uses, is less sensitive by virtue of its ability to assimilate discharges and physical effects. Irrespective of importance, all controlled waters in England are protected by law from being polluted.

Table 14.1 Criteria to determine receptor importance

Value[1]	Type of Receptor			
	Groundwater	Surface Water	Morphology[2]	Flood Risk
Very High	Principal aquifer providing a regionally important resource or supporting site protected under EC and UK habitat legislation SPZ1	EC Designated Salmonid/Cyprinid fishery WFD Class 'High' site protected/designated under EC or UK habitat legislation (SAC, SPA, SSSI, WPZ, Ramsar site, salmonid water)/Species protected by EC legislation	Unmodified, near to or pristine conditions, with well-developed and diverse geomorphic forms and processes characteristic of river type.	Floodplain or defence protecting more than 100 residential properties from flooding
High	Principal aquifer providing locally important resource or supporting river ecosystem SPZ2	WFD Class 'Good' Major Cyprinid Fishery Species protected under EC or UK habitat legislation	Conforms closely to natural, unaltered state and would often exhibit well-developed and diverse geomorphic forms and processes characteristic of river type, with abundant bank side vegetation. Deviates from natural conditions due to direct and/or indirect channel, floodplain, and/or catchment development pressures.	Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding

Value[1]	Type of Receptor			
	Groundwater	Surface Water	Morphology[2]	Flood Risk
Medium	Aquifer providing water for agricultural or industrial use with limited connection to surface water SPZ3	WFD Class 'Moderate'	Shows signs of previous alteration and / or minor flow regulation but still retains some natural features, or may be recovering towards conditions indicative of the higher category.	Floodplain or defence protecting 10 or fewer industrial properties from flooding
Low	Unproductive strata	WFD Class 'Poor'	Substantially modified by past land use, previous engineering works or flow regulation and likely to possess an artificial cross-section (for example trapezoidal) and would probably be deficient in bedforms and bankside vegetation. Could be realigned or channelised with hard bank protection, or culverted and enclosed. May be significantly impounded or abstracted for water resources use. Could be impacted by navigation, with associated high degree of flow regulation and bank protection, and probable strategic need for maintenance dredging. Artificial and minor drains and ditches would fall into this category.	Floodplain with limited constraints and low probability of flooding of residential and industrial properties

Value[1]	Type of Receptor			
	Groundwater	Surface Water	Morphology[2]	Flood Risk
	(1): Professional judgement is applied when assigning an importance category to all water features. The WFD status of a watercourse is not an overriding factor and in many instances it may be appropriate to upgrade a watercourse which is currently at poor or moderate status to a category of higher importance to reflect its overall value in terms of other attributes and WFD targets for the watercourse. Likewise, a watercourse may be below Good Ecological Status, this does not mean that a poorer quality discharge can be emitted. All controlled waters are protected from pollution under the Environmental Permitting (England and Wales) Regulations 2016 and the Water Resources Act 1991 (as amended), and future WFD targets also need to be considered. (2): Based on the water body 'Reach Conservation Status' presently being adopted for HS2 (and developed originally by Atkins) and developed from EA conservation status guidance [REF 14-36, REF 14-37] as HD45/09 does not provide any criteria for morphology [REF 14-32].			

Source: Adapted from HD45/09 (Highways Agency, 2009) [REF 14.32]

Magnitude of impact criteria

14.3.24 The magnitude of impact on the water environment has been established in relation to the extent that the Scheme would directly or indirectly affect the identified water receptors.

14.3.25 The identification of impacts takes account of all embedded and standard mitigation measures described in Section 14.8.

Table 14.2 Criteria to determine magnitude of impact

Magnitude of impact	Description
Major adverse	Results in a loss of attribute and/or quality and integrity of the attribute: Surface water: • Failure of both soluble and sediment-bound pollutants in HAWRAT (Method A, Annex I) and compliance failure with EQS values (Method B) • Calculated risk of pollution from a spillage >2% annually (Spillage Risk Assessment, Method D, Annex I) • Loss or extensive change to a fishery • Loss or extensive change to a designated Nature Conservation Site Groundwater: • Loss of, or extensive change to, an aquifer • Potential high risk of pollution to groundwater from routine runoff – risk score >250 (Groundwater Assessment, Method C, Annex I) • Calculated risk of pollution from spillages >2% annually (Spillage Risk Assessment, Method D, Annex I) • Loss of, or extensive change to, groundwater supported designated wetlands Flood Risk: • Increase in peak flood level (1% annual probability) >100 mm (Hydrological Assessment of Design Floods and Hydraulic Assessment, Methods E and F, Annex I)
Moderate adverse	Results in impact on integrity of attribute, or loss of part of attribute: Surface Water: • Failure of both soluble and sediment-bound pollutants in HAWRAT (Method A, Annex I) but compliance with EQS values (Method B) Calculated risk of pollution from spillages >1% annually and <2% annually • Partial loss in productivity of a fishery Groundwater: • Partial loss or change to an aquifer

Magnitude of impact	Description
	• Potential medium risk of pollution to groundwater from routine runoff – risk score 150-250 • Calculated risk of pollution from spillages >1% annually and <2% annually • Partial loss of the integrity of groundwater supported designated wetlands Flood Risk: • Increase in peak flood level (1% annual probability) >50mm
Minor adverse	Results in some measurable change in attribute's quality or vulnerability: Surface Water: • Failure of either soluble or sediment-bound pollutants in HAWRAT • Calculated risk of pollution from spillages >0.5% annually and <1% annually Groundwater: • Potential low risk of pollution to groundwater from routine runoff – risk score <150 Calculated risk of pollution from spillages >0.5% annually and <1% annually Minor impacts on groundwater supported wetlands Flood Risk: • Increase in peak flood level (1% annual probability) >10mm
Negligible	Results in impact on attribute, but of insufficient magnitude to affect the use or integrity: The Scheme is unlikely to affect the integrity of the water environment. Surface Water: • No risk identified by HAWRAT (Pass both soluble and sediment-bound pollutants) • Risk of pollution from spillages <0.5% Groundwater: • No measurable impact upon an aquifer and risk of pollution from spillages <0.5% Flood Risk: • Negligible change in peak flood level (1% annual probability) <+/- 10mm

Magnitude of impact	Description
Minor beneficial	Results in some beneficial impact on attribute or a reduced risk of negative impact occurring: Surface Water: • HAWRAT assessment of either soluble or sediment-bound pollutants becomes Pass from an existing site where the baseline was a Fail condition • Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually) Groundwater: • Calculated reduction in existing spillage risk by 50% or more to an aquifer (when existing spillage risk <1% annually) Flood Risk: • Reduction in peak flood level (1% annual probability) >10mm
Moderate beneficial	Results in moderate improvement of attribute quality: Surface Water: • HAWRAT assessment of both soluble and sediment-bound pollutants becomes Pass from an existing site where the baseline was a Fail condition • Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually) Groundwater: • Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually) Flood Risk: • Reduction in peak flood level (1% annual probability) >50mm
Major beneficial	Results in major improvement of attribute quality: Surface Water: • Removal of existing polluting discharge, or removing the likelihood of polluting discharges occurring to a watercourse Groundwater: • Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring, Recharge of an aquifer Flood Risk: • Reduction in peak flood level (1% annual probability) >100mm

Source: HD45/09 [Ref 14.32]

Identification of likely significant effects

14.3.26 The significance of effects was determined using the matrix presented in **Table 14.3**. Only those effects of moderate or greater are considered significant.

14.3.27 Where the significance of an effect is represented by two descriptors, for example large/very large within the matrix, professional judgement has been used to determine which of the significance descriptors applies to the effect being assessed.

Table 14.3 Matrix to determine significance of effect

Importance	Magnitude			
	Major	Moderate	Minor	Negligible
Very High	Very large	Large/very large	Moderate/large	Neutral
High	Large/very large	Moderate/large	Slight/moderate	Neutral
Medium	Large	Moderate	Slight	Neutral
Low	Slight/moderate	Slight	Neutral	Neutral

Source: HD45/09 (Highways Agency, 2009) [REF 14-32]

14.3.28 The matrix has been used to guide the identification and assessment of effects on water resources; however, where professional judgement has resulted in a deviation from the thresholds contained in the matrix these are explained within the relevant sections of the chapter and are supported by appropriate evidence and explanation.

14.3.29 Where applicable, the assessment states where adverse or beneficial effects are generated as a result of the Scheme.

Flood risk assessment

14.3.30 An FRA for the Scheme has been prepared in accordance with NPSNN and NPPF requirements, as well as the associated NPPG. The assessment related to flood risk within this chapter draws upon the studies and conclusions made within the FRA. The FRA is provided in Appendix 14.4 [**TR010027/APP/6.3**].

14.3.31 Any effects identified through the FRA, during either the construction or operation phases, were also evaluated and a significance value attributed to each effect in accordance with the methodology outlined in this chapter. This impact assessment only considers the potential impact of the Scheme on flood risk, not the suitability of the development in the context of flood risk acting on the site. For an assessment of the suitability of the Scheme in this location, please refer Appendix 14.4 [**TR0100027/APP/6.3**].

14.3.32 The magnitude of impact was determined based on the criteria in **Table 14.2** taking into account the likelihood of the effect occurring. The likelihood of an effect occurring is based on a scale of certain, likely or unlikely. Likelihood will be considered in the case of water resources only, as likelihood is inherently included within the FRA (Appendix 14.4) [**TR010027/APP/6.3**].

Preliminary WFD assessment

14.3.33 A preliminary WFD (pWFD) assessment was produced based on a combination of desk study and a hydrogeomorphological walkover survey. This has considered whether the Scheme has the potential to cause deterioration in ecological status/potential of waterbodies, whether the Scheme has the potential to prevent waterbodies from meeting their objective of Good Ecological Status/Potential, and whether the Scheme has the potential to prevent or compromise WFD objectives being met in other waterbodies or water dependent protected areas. In undertaking the assessment consideration has been given to the conservation objectives for ecologically sensitive sites, where these might be more stringent. The pWFD assessment is presented in Appendix 14.1 [**TR010027/APP/6.3**].

14.4 Assessment assumptions and limitations

Scheme design and limits of deviation

14.4.1 The assessment has been based on the Scheme description detailed within Chapter 3 The project, and has taken into account the lateral and vertical limits of deviation defined on the Works Plans [**TR010027/APP/2.3**] in order to establish a realistic worst case assessment scenario.

14.4.2 This scenario has identified and reported the effect that any lateral and vertical deviation would realistically give rise to. This has, for example, taken into account the potential for components of the Scheme to be brought into closer proximity to water receptors, and thereby potentially result in a different effect.

14.4.3 Notwithstanding any potential deviation, it is considered all water environment mitigation measures described in Section 14.8 would still be deliverable within the limits of deviation.

Warwickshire Gaelic Athletic Association

14.4.4 Using professional judgement, the illustrative reconfiguration design options for the Warwickshire Gaelic Athletic Association (WGAA) presented in **Figure 3.5a** to **3.5e** [**TR010027/APP/6.2**] were appraised to take account of the variation in the physical extents, pitch layout, buildings, fencing and lighting provision across the options.

14.4.5 The objective of the appraisal was to identify whether one option would potentially give rise to different effects than another, in order to then identify the worst case for the purposes of the assessment presented within this chapter.

14.4.6 The appraisal concluded that the design variation between the options would not be of a level that would result in different types or significance of effect on water environment receptors.

Baseline survey data

14.4.7 The assessment has been undertaken with reference to the baseline data, information and records pertaining to the water quality derived from desk-based sources. These were subsequently validated and enhanced through field surveys where land access was obtained from landowners.

14.4.8 The assessment is based on the best available water quality data provided by the EA, supplemented by monitoring undertaken between November 2017 and May 2018 of the larger watercourses that the new road would drain to. Collection of further data has provided a more robust assessment than using the EA data alone, which did not cover the smaller watercourses in the study area.

14.4.9 The baseline data and records obtained are considered to be representative of the conditions that would exist at the point of commencing Scheme construction, as described in Section 14.6.

Impact assessment and mitigation

14.4.10 Determination of Q95 low flows (i.e. the flow predicted to be exceeded 95% of the time) has been calculated by a desk based exercise using catchment data and Wallingford Hydrosolutions Ltd LowFlows software. These are estimates of the Q95 flow and do not take account of the increasing proportional variability between the natural flow and the artificial influences, such as abstractions, discharges and storage changes as the river flow diminishes. However, this is the most robust data available to inform the assessment.

14.4.11 The channel dimension and gradients used in the HAWRAT assessments are based on estimations made during the site visit and have not been accurately measured in the field. The outcomes of the assessment are such that these field measurements are not considered necessary (as attenuation, treatment and spillage containment is being provided).

14.4.12 The expected treatment performance of different SuDS options are based on advice reported in the DMRB HA33/16 [REF 14-26] and HD103/06 [REF 14-25]. These are estimates and professional judgement has been used when deciding what percentage treatment a particular option may provide, taking into account the design of the SuDS feature and whether it is considered to be ‘optimum’ or ‘sub-optimum’ for whatever reason.

14.4.13 It is assumed in the assessment that all SuDS and drainage networks will be fully maintained and managed as per standard guidance and practice. Requirements for maintenance and management of vegetated drainage systems are described in HD103/06 [REF 14-25].

14.4.14 The routine runoff and spillage risk water quality risk assessment is based on traffic data modelled for the Scheme. Assumptions would be used in this traffic modelling and these are not re-reported in this chapter.

14.5 Study area

14.5.1 For the purposes of the water quality assessment, a study area of approximately 1km around the Order Limits (i.e. the application Order Limits) has been considered, in order to identify surface and ground water bodies that could reasonably be affected by direct impacts associated with the M42 Junction 6 Improvement Scheme. However, since watercourse flow and quality impacts may propagate downstream through hydrological connectivity, where relevant the assessment has also considered a wider study area of up to 2km downstream of the Scheme. As flood risk impact can also impact upstream and downstream, the assessment has also considered a wider study area, where relevant. Professional judgement has been applied to identify the extent to which such features are considered.

14.6 Baseline conditions

14.6.1 Full details of the water environment baseline are provided in Appendix 14.1 [**TR010027/APP/6.3**], with only a brief summary provided herein. Please also refer to **Figure 14.1** [**TR010027/APP/6.2**] for further detail.

14.6.2 The 1km study area contains the following receptors:

a. surface watercourses: River Blythe, Hollywell Brook, Shadow Brook and tributaries, Low Brook and tributaries, the Grand Union Canal, and surface water drainage ditches;

b. the ornamental Pendigo Lake at the National Exhibition Centre (NEC), Coleshill and Bannerly Pools, and numerous smaller ponds across the area, some of which contain Great Crested Newt (GCN);

c. groundwater – Tame Anker Mease – Secondary Combined Groundwater body;

d. hydrologically sensitive ecological sites – Bickenhill Meadows SSSI/ Shadowbrook Meadows Local Nature Reserve; and

e. land at potential risk of flooding from various sources.

14.6.3 No further waterbodies with hydraulic connectivity were identified from Ordnance Survey mapping further to those outlined above, some of which extend outside the 1km study area. For instance, the River Blythe flows around the site, with **Figure 14.1** [**TR010027/APP/6.2**] indicating that in places it flows within the 1km buffer of the Scheme, while elsewhere it flows out with the 2km buffer area of the Scheme.

Topography, rainfall and land use

14.6.4 Topographic data for the study area was obtained from Ordnance Survey (OS) mapping. The study area is gently undulating with elevations being between 90m and 120m above ordnance datum (AOD). There are valleys with low gradients around the various watercourses.

14.6.5 The Scheme crosses an area of predominantly arable agriculture to the east of Solihull. The northern extent of the Scheme borders the NEC site and Birmingham Airport, including associated facilities such as hotels, car parks, fuel stations and landscape features such as the ornamental Pendigo Lake. A railway line crosses the A45 south of Birmingham International Railway Station to the west of the M42 Junction 6. The link road would pass to the west of the village of Bickenhill, with the village of Catherine-de-Barnes being within 1km of the Scheme to the southwest. The Grand Union Canal is located to the southeast of the study area.

14.6.6 Using the Met Office website [REF 14-38], the nearest weather station is located at Coleshill, approximately 6km north of the M42 Junction 6. Based on the available data from this weather station it is estimated that the study area experiences an average of approximately 700mm rainfall per year, with it raining more than 1mm on around 129 days per year.

14.6.7 The same weather station at Coleshill reports that the study area generally gets around 50 days of frost (air) each year distributed evenly across December, January and February, with occasional days of frost in March, April, October and November. Using minimum air temperature as a general indicator of air temperatures, it is clear that the potential for de-icant use on roads would be most likely during November, December, January, February and March.

Surface water features

14.6.8 An initial site visit and walkover was undertaken on 26 October 2017 in dry conditions. Observations taken on this visit plus data from Ordnance Survey mapping and the EA Catchment Data Explorer [REF 14-39] website the following surface water bodies were identified within the 1km study area and are shown in **Figure 14.1** [**TR010027/APP/6.2**]:

a. Hollywell Brook – Main River;

b. Shadow Brook – Main River;

c. River Blythe – Main River & WFD designated;

d. Low Brook – Main River;

e. Tributary of Shadow Brook – Ordinary Watercourse;

f. Tributary of Low Brook – Ordinary Watercourse;

g. Grand Union Canal (Solihull to Birmingham) – WFD designated;

h. Pendigo Lake;

i. Coleshill and Bannerly Pools (SSSI);

j. Several small ponds; and

k. Several field drains and ditches – Ordinary Watercourses.

14.6.9 The attributes of these surface water features in the 1km study area are described within Appendix 14.1 [**TR010027/APP/6.3**], including details of baseline water quality monitoring that has been undertaken.

Surface water resources

14.6.10 The whole of the study area is located within a Nitrate Vulnerable Zone (NVZs) for surface water, as designated in 2017 and shown on DEFRA's multi-agency geographical information for the countryside (MAGIC) map website [REF 14-40].

14.6.11 Data provided by the EA indicate that there are eight discharge consents in the vicinity of the Scheme, and these are shown on **Figure 14.1** [**TR010027/APP/6.2**] and listed in Appendix 14.1 (pWFD assessment) Table 4.4 [**TR010027/APP/6.3**]. These are primarily discharges related to treated sewage effluent from water company and private domestic sources.

14.6.12 There is a medium sized surface water abstraction point north-east of the Scheme, east of Little Packington on the River Blythe, which is used for agriculture or private purposes (see **Figure 14.1** [**TR010027/APP/6.2**]).

14.6.13 There are five private water supplies (PWS) within the study area that are located within SMBC's jurisdiction. However, exact coordinates were not provided by SMBC due to data protection restrictions and so it has not been possible to illustrate these on **Figure 14.1** [**TR010027/APP/6.2**]. The northwest of the study area falls within the jurisdiction of North Warwickshire Borough Council, who have confirmed that there are no PWS within this section of the study area.

14.6.14 The eastern half of the study area to the east of Catherine-de-Barnes Lane and Clock Interchange are in a surface water Drinking Water Protected Area [Ref 14-40]. Drinking Water Protected Areas are, within the WFD, where raw water is abstracted from rivers and reservoirs. Raw water needs to be protected to ensure that it is not polluted, which could lead to additional purification treatment. Action is targeted in these zones to address pollution so that extra treatment of raw water can be avoided.

14.6.15 The eastern half of the study area to the east of Catherine-de-Barnes Lane and Clock Interchange is also in a Drinking Water Safeguard Zone (for Surface Water) [Ref 14-40]. These are catchment areas that influence the water quality of their respective Drinking Water Protected Area, where at risk of failing the drinking water protection objectives.

14.6.16 Refer to Appendix 14.1 [**TR010027/APP/6.3**] for further details on these designations.

Geology, groundwater and soils

14.6.17 According to the British Geological Society website [REF 14-41], the bedrock underlying the site consists predominantly of Sidmouth Formation Mudstone, comprising Mercia Mudstone Formation, Branscombe Mudstone Formation and Arden Sandstone Formation. Areas of Branscombe Mudstone Formation (Mudstone) are mainly to the northeast of the site and around Catherine-de-Barnes. Arden Sandstone Formation (Sandstone, Siltstone, Mudstone) is found in small patches including at the NEC, the immediate east of Bickenhill and south of Catherine-de-Barnes. Superficial deposits are generally sparse in the area, but there are scattered patches of glaciofluvial deposits (sands and gravels), and this is more widespread around Catherine-de-Barnes. Alluvium is found in the immediate vicinity of the larger watercourses. Refer to Chapter 10 Geology and Soils for further details.

14.6.18 According to DEFRA's MAGIC map website [REF 14-40] the bedrock aquifer designation is Secondary B. These 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. These are generally the water-bearing parts of the former non-aquifers. The superficial aquifer designation is a mixture of non-classified and Secondary A aquifer. The designated areas are mainly around the NEC, Catherine-de-Barnes and Hampton in Arden, with other small patches scattered over the site. Secondary A aquifer are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of baseflow to rivers.

14.6.19 According to the Cranfield University's Soilscapes website [REF 14-42] the site is underlain by slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils.

14.6.20 There are no groundwater source protection zones or drinking water safeguard zones for groundwater in the Study Area.

14.6.21 The study area lies within the 'Tame Anker Mease – Secondary Combined' groundwater body (GB40402G990800). Under the 2016 Cycle 2 classification this has an overall water body status of 'Good', with both 'Good' qualitative and 'Good' chemical status [Ref 14-39].

14.6.22 The EA were asked for details of groundwater abstractions up to 1km around the Order Limits. Details were provided of one small sized single groundwater abstraction point within the study area for agricultural processes approximately 1.8km north of Junction 6 along the A452, west of Little Packington (SP2010784932). The abstraction is for a garden centre for direct spray irrigation (labelled A7 on **Figure 14.1** [**TR010027/APP/6.2**]).

14.6.23 Further groundwater abstractions within 500m of the Order Limits are outlined in the Envirocheck Report, and are shown in Appendix 14.1 Table 4.5 (WFD Assessment) [**TR010027/APP/6.3**] and **Figure 14.1** [**TR010027/APP/6.2**]. The majority of the groundwater abstractions provide water for farms and garden nurseries to the northeast of the Order Limits. There is one industrial/commercial abstraction to the south of the Scheme to the northeast of the M6 Junction 5. One abstraction falls within the Order Limits to the north of Hollywell Brook, and this is for general farming and domestic purposes (license 03/28/11/0079).

Pollution incidents

14.6.24 Details of pollution incidents as recorded on the National Incident Reporting System (NIRS) were provided by the EA for the period 2012-2017. Only three incidents of note in terms of the water environment occurred:

a. Barber's Coppice (SP18790 79900), April 2014 – around 200 litres of diesel entered a surface water drain (labelled P1 on **Figure 14.1** [**TR010027/APP/6.2**]). Based on known outfall locations this may have been discharged to the River Blythe ('Source to Cuttle Brook' WFD waterbody);

b. Small pond north of Pendigo Lake (SP19501 83699), January 2015 – report of blue-green algae in the water (labelled P2 on **Figure 14.1** [**TR010027/APP/6.2**]); and

c. Arden Landfill, Diddington Hill (SP20533 82770), January 2015 – report of water pollution incident at the landfill site (labelled P3 on **Figure 14.1** [**TR010027/APP/6.2**]), but no further details are available.

Ecology

14.6.25 Chapter 9 Biodiversity indicates that otter are confirmed to be present on Hollywell Brook and the River Blythe. It is considered that otter would likely use all watercourses crossed by the Scheme at least on an occasional basis. There is no evidence of water vole in the study area.

14.6.26 Fish surveys were undertaken as part of the High Speed 2 (HS2) project in 2013 and found that Hollywell Brook and Shadow Brook are of poor habitat quality for fish, and no notable fish species were recorded. This situation is unlikely to have changed over the intervening period, especially given the characteristics of the relevant watercourses, which are considered likely only to support common and widespread species (see Chapter 9 Biodiversity for further detail).

14.6.27 Chapter 8: Biodiversity indicates that aquatic invertebrate surveys have been undertaken as part of the HS2 project in 2013 (HS2, 2013), examining Hollywell Brook and Shadow Brook, which fall within the study area. These surveys recorded the following:

a. Shadow Brook: A high invertebrate diversity comprising mostly common species with the exception of locally common leech and caddisfly. Based on the biological and environmental data collected, Shadow Brook was of moderate overall quality; and

b. Hollywell Brook: A moderate invertebrate diversity of common and widespread species. Based on the biological and environmental data collected, Hollywell Brook was of moderate overall quality.

14.6.28 It was determined that the overall quality of these water bodies is unlikely to have changed over the intervening period.

14.6.29 Numerous ponds within 500m of the Scheme have been identified as containing, or are assumed to contain, GCN as described above. These are ponds 6, 7, 11, 12, 13, 19 and 36 (see **Figure 14.1** [**TR010027/APP/6.2**]). None of these ponds fall within the proposed Order limits.

14.6.30 Details of aquatic ecology for the River Blythe are provided in Appendix 14.1 [**TR010027/APP/6.3**] using data from the EA's Water Quality Archive website [Ref 14-43]. No additional data is available from online sources for the remaining watercourses.

Sites of ecological importance

14.6.31 Using DEFRA's online MAGIC map [REF 14-40] the following designated sites of ecological importance were identified within the vicinity of the Scheme:

a. Bickenhill Meadows SSSI, which is split into two sites (First Castle Meadow unit (NW) and Shadowbrook Meadows unit (SE)) covering a combined area of 7.7ha (see **Figure 14.1** [**TR010027/APP/6.2**]), featuring natural lowland grasslands. It has a status of 'Unfavourable – Recovering'. This area features habitats that may be groundwater dependent. The tributary of Shadow Brook flows through the middle of the SE SSSI unit and the tributary of Low Brook flows through the middle of the NW SSSI unit;

b. Shadowbrook Meadows Local Nature Reserve, which incorporates the Bickenhill Meadows SSSI to the north of Shadowbrook Lane. The site is 4.4ha in area and consists of four fields incorporating both wet and dry meadows and a wet alder woodland with pollarded willows around its margin;

c. River Blythe SSSI, for lowland river on clay with diverse morphological features and plant communities. It has a status of 'Unfavourable – Recovering'; and

d. Coleshill and Bannerly Pools SSSI, which incorporates three pools and an intervening bog area covering 37.6ha. This is the only valley mire system in Warwickshire. It has a status of 'Unfavourable – Recovering'. These pools are not considered by the Road Drainage and Water Environment impact assessment due to their distance from any physical works and lack of hydrological connectivity to upstream waterbodies that intersect the Scheme.

14.6.32 Full details regarding the Bickenhill Meadows SSSI are provided in Appendix 14.2 [**TR010027/APP/6.3**], including site descriptions, the designation details and Management Principles.

14.6.33 Full details regarding the River Blythe SSSI are provided in Appendix 14.1 [**TR010027/APP/6.3**], including site descriptions, the designation details and Management Principles.

Flood risk

14.6.34 An FRA is provided in Appendix 14.4, which assesses the present risk of flooding from all sources including fluvial, surface water, groundwater, artificial sources and sewer and water supply infrastructure. Please refer to the FRA (Appendix 14.4) [**TR010027/APP/6.3**] and **Figure 14.2** [**TR010027/APP/6.2**] for a full description of the flood risk baseline, which is also summarised below.

Tidal flooding

14.6.35 The consideration of tidal flooding from sources including the sea and estuaries was scoped out of the assessment, due to the distance from the Scheme to the coastline.

Fluvial flooding

River Blythe

14.6.36 The River Blythe is a Main River, and land immediately surrounding the river is classified as Flood Zone 2 and 3. Flood Zone 2 comprises of land having between a 1 in 100 (1.0% Annual Exceedance Probability (AEP)) and 1 in 1,000 (0.1% AEP) annual probability of river flooding. Flood Zone 3 comprises of land having a 1 in 100 (1.0% AEP) or greater annual probability of river flooding. As such, the River Blythe is considered at a medium and high risk of flooding.

Hollywell Brook

14.6.37 Hollywell Brook is a Main River, and the land surrounding Hollywell Brook is located within Flood Zone 2 and 3 (a medium and high risk of fluvial flooding, respectively).

14.6.38 As the Scheme would cross localised areas of indicative Flood Zone 3 associated with Hollywell Brook, hydraulic modelling was undertaken of flood levels. This found that the channel does not exceed capacity in the 1 in 100 year event plus 50% allowance for climate change, and also that the capacity of the channel is sufficient to retain flow associated with a 1 in 100 year event plus 50% allowance for climate change event. As such, the land surrounding the channel is not located in Flood Zone 3 (as suggested on the EA's Flood Map for Planning).

Shadow Brook and tributary of Shadow Brook

14.6.39 Upstream (west) of the M42 motorway, the land adjacent to Shadow Brook is classed as Flood Zone 1. Flood Zone 1 comprises land assessed as having a less than 1 in 1000 year, or 0.1% AEP of fluvial or tidal flooding in any given year. East of the M42 motorway, the adjacent land is classified as Flood Zone 3 (at high risk of fluvial flooding).

14.6.40 The tributary originates west of the M42 motorway by Shadow Brook Lane, before flowing north east where the stream is culverted. Land directly adjacent to the tributary and the wider area is located entirely within Flood Zone 1 (at low risk of fluvial flooding).

Low Brook

14.6.41 The extent of Low Brook within close proximity to the Scheme is mainly located within Flood Zone 1 (at low risk of fluvial flooding).

Small watercourse beneath A45 Coventry Road to Pendigo Lake

14.6.42 A small unnamed ordinary watercourse flows north from the A45 Coventry Road (A45) by the western arm of M42 Junction 6. This watercourse is culverted beneath the A45, and originates from Wyckhams Close. The watercourse continues in an open channel until it is culverted beneath highway infrastructure. It is assumed the watercourse discharges into Pendigo Lake via a culvert.

14.6.43 Land directly adjacent to the tributary and the wider area is located entirely within Flood Zone 1 (i.e. at low risk of fluvial flooding).

Flood Defences

14.6.44 There are no EA raised flood defences located in proximity to the Scheme.

Surface water flood risk

14.6.45 The majority of the Scheme is located on undeveloped (greenfield) land currently used for agricultural purposes. There are also small areas of the Scheme located on areas of existing highway infrastructure.

14.6.46 The EA's online Risk of Flooding maps [REF 14-44] indicate that the majority of the Scheme is classed as 'very low' risk of flooding from surface water. Very low chance of surface water flooding is defined by a less than 1 in 1000 (<0.1% AEP) annual probability of flooding in any given year.

14.6.47 Areas at low (considered to have a chance of flooding between a 1% AEP and 0.1% AEP in any year), medium (considered to have a chance of flooding between a 33.3% AEP and 1% AEP) and high risk (considered to have a chance of flooding greater than 33.3% AEP) of flooding are also located in proximity to the Scheme. These are predicted to be associated with topographical low spots throughout the area, causing surface water to pond or are reflective of the location of local watercourses and drainage ditches.

14.6.48 Based on the information above the risk of flooding from overland flow is considered to be low.

Flooding from artificial waterbodies

14.6.49 Artificial flood sources include raised channels, such as canals, or storage features such as ponds and reservoirs.

14.6.50 Pendigo Lake, located approximately 300m west of the crossing point of the Scheme with Hollywell Brook, is classified as a reservoir on the EA online Long-term Risk of Flooding map [REF 14-44]. This indicates that the Scheme would not be located in an area at residual risk of flooding from a reservoir as a result of structural failure or breach. Furthermore, the SMBC SFRA [REF 14-35] states that investigation into the history of the reservoir did not uncover any records of breach or overtopping.

14.6.51 The Grand Union Canal is owned and managed by the Canals and Rivers Trust (CRT) who undertake regular inspections and maintenance, if required. Given the local topography and its distance from the Scheme, no flood risk from this source is predicted.

14.6.52 There are a number of ponds within the study area. However, the risk of flooding from these ponds is expected to be very localised.

14.6.53 Based on this information, the current risk of flooding from artificial sources is considered to be low.

Flooding from groundwater

14.6.54 The SMBC SFRA [REF 14-35] states there are no known problems with flooding from groundwater within the borough of Solihull.

14.6.55 The 'Areas Susceptible to Groundwater Flooding' maps [REF 14-45] provided by the EA to inform the SMBC pFRA [REF 14-46] have been used to identify areas where geological and hydrogeological conditions show that groundwater might emerge. This information is shown as a proportion of 1km grid squares where there is potential for groundwater emergence. The data does not show where flooding is likely to occur, but instead is used at a strategic level to indicate areas for further investigation.

14.6.56 The dataset indicates that land to the north of A45 and M42 Junction 6 is located in an area with >= 50% <75% risk of groundwater emergence whilst the Scheme to the south of A45 and M42 Junction 6 is located in an area with <25% risk of groundwater emergence.

14.6.57 Considering the susceptibility data and the lack of flooding shown in historic flood records, the Scheme is classified as being at low flood risk from groundwater sources.

Flooding from drains and sewers

14.6.58 Sewer and surface water flooding are often interconnected; insufficient drainage capacity in the sewer network can result in extensive surface water flooding and, by the same rationale, large volumes of surface water can overload the public sewers, causing the sewer network to back up, surcharge and ultimately flood.

14.6.59 The existing greenfield catchments drain to various named and unnamed watercourses, including Shadow Brook, located towards the southern section of the dual carriageway. There is no record of sub-surface land drainage within the existing fields.

14.6.60 The existing slip roads on the approach to and leaving M42 Junction 6 are kerbed with gullies and are the main method for draining the carriageway. The M42 motorway carriageway within the Order Limits is mainly un-kerbed, and filter drains are provided to drain the carriageway.

14.6.61 The existing drainage on the local road network including Solihull Road, Catherine-de-Barnes Lane, Bickenhill Lane and also Clock Interchange consists of mainly kerbs and gullies, with some combined kerb drainage.

14.6.62 Catherine-de-Barnes Lane is kerbed and drained by gullies in sections within the Order Limits. It has been assumed that the gullies outfall into carrier pipe networks, which in turn discharge to existing named or unnamed watercourses.

14.6.63 Solihull Road is kerbed and drained by gullies in sections within the Order Limits. It has been assumed that the gullies outfall either over the edge, or into a carrier pipe network. Runoff flows from Solihull Road and the M42 motorway are then discharged to an existing watercourse on the eastern side of the M42 motorway.

14.6.64 The Clock Interchange and Bickenhill Lane are kerbed and drained by gullies or combined kerb units into a carrier pipe network. Runoff flows from Clock Interchange and Bickenhill Lane are then discharged to existing watercourses to the north and south of Clock Interchange.

14.6.65 The SMBC SFRA [REF 14-35] indicates the Scheme crosses the four digit postcode area (B92 0) where four properties have been affected by flooding from drains or sewers, according to the Severn Trent Water DG5 register. As the Scheme would not cross settlement areas (mainly greenfield land), there is expected to be no risk of flooding. Based on this information, the risk of flooding from drainage and sewer infrastructure is considered low.

14.7 Potential impacts

14.7.1 The process of scoping identified that the introduction and/or modification of road infrastructure associated with the Scheme would potentially result in different types and durations of impact on water resources, during both the construction and operational phases.

Construction phase

14.7.2 Temporary construction impacts that would last for all or part of the construction phase are likely to include the following:

a. reduction in water quality, both surface and groundwater, due to deposition or spillage of soils, sediments, oils, fuels, or other construction chemicals, or through mobilisation of contamination following disturbance of contaminated ground or groundwater, or through uncontrolled site run-off;

b. alteration in fluvial, overland and groundwater flow paths, and potential increase in flood risk, as a result of storing construction materials in the floodplain;

c. increased risk of blockage of drains as a result of increased material (sands, gravels etc.) transported in runoff from the Scheme; and

d. increased discharge to local watercourses due to a temporary increase in impermeable area during construction.

14.7.3 Construction activities such as earth works, excavations, site preparation, levelling and grading operations result in the disturbance of soils. Exposed soil is more vulnerable to erosion during rainfall events due to loosening and removal of vegetation to bind it, compaction and increased runoff rates. Surface runoff from such areas can contain excessive quantities of fine sediment, which may eventually be transported to watercourses where it can result in adverse impacts on water quality, flora and fauna. Construction works within, along the banks and across watercourses can also be a direct source of fine sediment mobilisation.

14.7.4 Contamination of surface waters, groundwater and soil could result from leakage and spills of fuels, oils, chemicals and concrete during construction affecting watercourses indirectly via site runoff or directly where works are close to and within a water body. Contamination may reduce water quality and impact aquatic fauna and flora.

14.7.5 Any construction works on the floodplain have the potential to increase the rate and volume of runoff and increase the risk of blockages in watercourses that could lead to flow being impeded, and a potential rise in flood risk.

Operation phase

14.7.6 Operational impacts of the Scheme are likely to include the following:

a. impacts on the surface or groundwater quality from highway run-off (including the use of de-icants) or as a result of accidental spillages;

b. changes in the natural form of the landscape, which may have a subsequent effect on surface water and groundwater drainage patterns, including adverse effects on local ecologically sensitive sites;

c. increased risk of fluvial flooding to the Scheme and surrounding area due to loss of floodplain storage;

d. increase in flood risk (fluvial, surface water, sewer and drainage infrastructure) due to an increase in surface water runoff from the Scheme, and increased risk of fluvial flooding over the lifetime of the Scheme from climate change effects (increased peak river flows);

e. impacts on hydraulic processes and sediment dynamics in watercourses and their floodplains; and

f. loss of or changes to the morphology of water bodies that could have both temporary and long term impacts on the hydromorphological conditions of the water bodies.

14.8 Design, mitigation and enhancement measures

14.8.1 The Scheme has been designed, as far as possible, to avoid and minimise impacts and effects on the water environment through the process of design-development (see Chapter 4 Scheme history and alternatives), and by embedding measures into the design of the Scheme.

14.8.2 A number of standard and embedded measures have been identified, which would be implemented by the contractor to reduce the impacts and effects that construction of the Scheme would have on water resource receptors.

Embedded mitigation

Drainage

14.8.3 As part of the Scheme design, a number of tanks, reed beds and swales have been incorporated into the overall water management strategy. These have been designed to mimic natural drainage as far as practicable and to provide a number of other benefits to ecological habitat creation (see Chapter 9 Biodiversity).

14.8.4 As part of the Scheme design, a drainage strategy (Appendix 14.5 [**TR010027/AP/6.3**]) (incorporating the use of SuDS) will be implemented as part of the Scheme to manage surface water runoff and accidental spillages that may drain to watercourses. SuDs are the preferred solution they provide a number of functions, including, a way to minimise the risk and impact of flooding in addition to potentially providing a degree of treatment for pollutants.

14.8.5 Attenuation has been incorporated to control any increase in the rate of flow towards the impacted watercourses resulting from increased impermeable road areas. Without attenuation increased flows may result in bank erosion, increased sediment loading, greater flooding and increased pollution to the impacted watercourses. The specific treatment approach adopted for each road catchment has been designed to reflect the extent of flow attenuation and pollutant treatment required, as well as to reflect stakeholder concerns.

14.8.6 Flow attenuation and water quality treatment measures are included variously in the form of filter drains, reed bed areas, proprietary storage tank systems, vortex grit separators and swales. The treatment train specifications for each road catchment are summarised in **Table 14.4** and described in more detail within the Drainage Strategy Report (Appendix 14.5 [**TR010227/APP/6.3**]).

Table 14.4 Treatment train for drainage networks

Network	Receiving waterbody	Road Section being drained	Treatment train
1A	Ditch at Four Winds	Realigned Catherine-de-Barnes Lane (Local Road)	Filter Drain – Storage Tank – Grassed Ditch
1B	Shadow Brook	New Mainline Link Road and western roundabout of Junction 5A (Trunk Road)	Filter Drain – Storage Tank – Reed Bed – Grassed Swale
2A	Ditch at Clock Interchange	Realigned Catherine-de-Barnes Lane (Local Road)	Filter Drain – Storage Tank – Grassed Swale
2B	Existing Drainage Network	New Mainline Link Road (Trunk Road)	Filter Drain – Storage Tank – Grassed Swale
3	Tributary of Shadow Brook	Shadowbrook Lane (Local Road)	Grassed Ditch
4	Tributary of Low Brook	Realigned Catherine-de-Barnes Lane and Clock Lane (Local Road)	Oversized Pipes
5	Hollywell Brook	Freeflow link from A45 eastbound to M42 northbound at Junction 6 (northern section) (Trunk Road)	Filter Drain
6	Ditch to Pendigo Lake	Freeflow link from A45 eastbound to M42 northbound at Junction 6 (southern section) (Trunk Road)	Vortex Grit Separator – Ditch
7	Drainage network number 7 is not used.		
8	Ditch to tributary of the Blythe	M42, eastern roundabout of Junction 5A and Solihull Road overbridge (Trunk Road)	Filter Drain – Storage Tank –Reed Bed – Grassed Swale – Ditch
10	Existing Drainage Network	Network includes realignment of Eastway roundabout and roads connecting to it (Local Road)	Ditch

Network	Receiving waterbody	Road Section being drained	Treatment train
11	Hollywell Brook	Freeflow link from M42 southbound to the A45 eastbound at Junction 6 (southern section) (Trunk Road)	Filter Drain – Reed Bed – Grassed Swale
12	Hollywell Brook	Freeflow link from M42 southbound to the A45 eastbound at Junction 6 (northern section) (Trunk Road)	Filter Drain – Grassed Swale
13	Ditch at Bickenhill Lane roundabout	Bickenhill Lane northbound (Local Road)	Vortex Grit Separator – Ditch
14	Existing Drainage Network	Bickenhill Lane southbound and Clock Interchange (Local Road)	Vortex Grit Separator – Ditch
15	Hollywell Brook	Short section of M42 northbound (Trunk Road)	Filter Drain

14.8.7 The Drainage Strategy (Appendix 14.5 [**TR010227/APP/6.3**]) has been designed in accordance with HD33/16 [REF 14-26], ensuring no surcharge for a 1 in 1 year return period and no flooding in a 1 in 5 year return period. The network has been designed including a 20% increase in rainfall intensity to consider the effects of climate change. Peak discharge rates are to be controlled and SuDS that discharge to a watercourse would accommodate the 1 in 100 year return period +40%. For culverts that convey permanent watercourses beneath roads the flow rate has been assessed for return periods up to 100 years.

14.8.8 The number of new surface water outfalls has been minimised where possible and the drainage strategy makes use of numerous existing outfalls from the M42 and surrounding network, in order to prevent construction of unnecessary structures along the river bank. For the new outfalls, pre-fabricated concrete headwalls would be used where possible to avoid the need for pouring wet concrete close to the watercourse as this represents a spillage risk.

14.8.9 The attenuation reed beds have been located out of Flood Zones 2 and 3, with the exception of the northernmost tip of the reed bed discharging to Hollywell Brook to the northeast of M42 Junction 6 (network 11 in **Table 14.4)**. However, the majority of this reed bed is located in Flood Zone 1 and it has embanked edges thereby reducing the risk of receiving flood waters from Hollywell Brook.

14.8.10 Pre-earthworks drainage would be installed to convey land runoff/intercepted existing land drainage. This would take the form of filter drains or ditches and would be particularly important at the top of cuttings and toe of embankments. Both approaches would provide a degree of treatment for pollutants, although land runoff would be unlikely to have a high pollutant load when compared to road runoff and does not require further treatment.

14.8.11 Ditches are simpler to construct and maintain, fit in with the existing drainage philosophy and have higher capacities than typical filter drains but require more land so are not viable at constrained locations. They also tend to collect litter, although litter picking would be included in the requisite maintenance schedules for the Scheme. Filter drains use stone resources which typically need to be cleaned or replaced every ten to 15 years, as is standard practice for highway maintenance.

14.8.12 In general, the pre-earthworks ditches tie in to the existing road outfalls that are being utilised by the Scheme or to those new outfalls that are included for drainage of the new link road. This reduces the number of new outfalls required on the surrounding watercourses. The exception is one additional outfall to Shadow Brook, immediately downstream of the M42 at SP19241 80928.

Bickenhill Meadows SSSI Pumping Solution

14.8.13 Due to the proximity of the new link road to Bickenhill Meadows SSSI, and the potential for this new cutting to affect the hydrology of the site, an investigation into the hydrological regime and functioning of each unit of the Bickenhill Meadows SSSI was undertaken during the development of the impact assessment. This included collection of new primary data through the Ground Investigation and a bespoke water table monitoring programme. This enabled the development of conceptual models which describe the hydrological functioning of each SSSI unit which are fully described in Appendix 14.2 (Bickenhill Meadows SSSI: Hydrological Investigation Technical Note [**TR010027/APP/6.3**]).

14.8.14 There is potential for a significant adverse environmental effect on the hydrology of the Shadowbrook Meadows SE unit of the wider Bickenhill Meadows SSSI, by means of loss to the surface water catchment (see Appendix 14.2 [**TR010027/APP/6.3**]).

14.8.15 The impact assessment is presented in Chapter 9 Biodiversity, due to the receptor being the sensitive grasslands within the SSSI, with further details given in Appendix 14.2 (Bickenhill Meadows SSSI: Hydrological Investigation Technical Note [**TR010027/APP/6.3**]).

14.8.16 A pumped mitigation solution has been developed to mitigate for the loss of surface water catchment at Shadowbrook Meadows SE 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 SSSI. 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 reed bed/ditch feature in the vicinity of Shadowbrook Meadows SE unit. 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 SSSI. The above design principle has been developed in consultation with and agreed in principle with Natural England.

14.8.17 Highways England will continue to refine the mitigation solution using: data obtained from the ongoing dipwell monitoring; and information gathered from further analysis of the local topography and existing water sources. These refinements will seek to identify a sustainable drainage mechanism to mitigate the effects of the Scheme on Bickenhill Meadows SSSI. Highways England will seek to agree any refinements to the mitigation approach with Natural England prior to commencement of the Scheme.

Culverts

14.8.18 The Scheme design would include five culverts. Three of these are existing culverts that require extension as part of the proposed works, and are located at SP 19893 83638 (Hollywell Brook), SP 19419 83041 (small stream beneath the A45), and SP 18782 83261 (drainage ditch at Bickenhill Lane). The remaining two new culverts are for field drainage only, and are located at SP 18994 80822 and SP 18393 81975.

14.8.19 Extension of any replacement of culverts have been designed in such a way as to minimise the potential adverse hydromorphological, water quality and biological impacts of the structure, while being large enough to convey flood flows (as described in the FRA (Appendix 14.4 [**TR0100027/APP/6.3**]).

14.8.20 It is proposed that the base of each culvert would be sunken below the current bed level and backfilled with a suitable grade substrate to ensure a naturalised bed is provided through the extended culvert structure. With the exception of Hollywell Brook there is limited evidence along these small watercourses of any functional flows and processes. However, the provision of a naturalised bed would help to maintain channel/process continuum. Culverts have been sized appropriately to carry the watercourse without constriction or narrowing, and would be no smaller than the size of existing culverts to ensure that they do not accumulate sediment upstream due to afflux caused by too narrow a culvert.

Ditch realignment

14.8.21 Realignment or regrading of minor drainage ditches would also be required at the following locations:

a. realignment and regrading of a minor ditch off Catherine-de-Barnes Lane, to the southwest of the proposed Barber's Coppice roundabout (SP 18361 81081);

b. regrading of minor ditch off Catherine-de-Barnes Lane, to the northwest of the proposed Barber's Coppice roundabout (SP 18348 81187);

c. diversion and realignment of a minor ditch to the southeast of Bickenhill roundabout (SP 18771 83175); and

d. realignment of a minor ditch adjacent to the M42, immediately north of Hollywell Brook (SP 19917 83685).

14.8.22 The minor drainage ditches are not considered functioning watercourses as they are largely dry with a low biodiversity value. However, the realignment would ensure conveyance of flow was unimpeded and would be sensitive to the aquatic ecology.

Standard Mitigation

14.8.23 The Outline Environmental Management Plan (OEMP) [**TR010027/APP/6.11**] details the measures that would be undertaken during construction of the Scheme to mitigate temporary effects on the water environment.

14.8.24 These measures broadly focus on:

a. managing the risk of pollution to surface waters and the groundwater environment;

b. measures to control the storage, handling and disposal of substances and during construction. Measures relating to the control of small or more significant spillages are included in the Outline Water Management Plan (OWMP);

c. the management of activities within floodplains (i.e. kept to a minimum) with temporary land take required for construction to be located out of the floodplain as far as reasonably practicable or allowances made for floodplain control measures and contingency actions; and

d. managing the risk from groundwater flooding through appropriate working practices (during earth cutting activities) and with adequate plans and equipment in place for de-watering to ensure safe dry working environments.

14.9 Assessment of significant effects

Value (importance of receptors)

14.9.1 The prediction of impacts and the assessment of effects has taken account of the embedded and standard mitigation measures and the additional measures identified within Section 14.8.

14.9.2 Based on the baseline data, and assessed against **Table 14.1**, the local water resources receptors within the study area have been attributed the following importance:

a. River Blythe: Very High Importance for water quality on the basis of its scale and regional importance, being a SSSI and a WFD reportable watercourse (despite current Poor Ecological Status). In terms of morphology the importance of the River Blythe is considered to be High. This is based on diverse morphological features that closely conform to natural but with some deviation due to direct and indirect catchment pressures, which are also reflected in the SSSI being at 'Unfavourable – Recovering' status.

b. Hollywell Brook, Shadow Brook and tributary, and the tributary of Low Brook: High Importance for water quality on the basis of discharging directly into the River Blythe SSSI and/or being tributaries of WFD reporting reaches. The tributary of Shadow Brook and the tributary of Low Brook also flow through the Bickenhill Meadows SSSI units. In terms of morphology, Hollywell Brook is of Medium Importance as it retains some natural features. Shadow Brook, Low Brook and their tributaries are Low Importance. This is due to the clear signs of past modification, including culverting, straightening, artificial cross sections in places and deficiency of bedforms.

c. all other watercourses: Low Importance for water quality and morphology, with the majority of these being agricultural ditches and drains without nature conservation designations and minimal social and economic use. They have a small relative size, are heavily modified or artificial, and lack morphological features and functional flows.

d. Pendigo Lake and ponds online to Hollywell Brook: Medium Importance due to their connectivity to Hollywell Brook, with Pendigo Lake also being a popular site with anglers and visitors to the NEC;

e. ponds identified as having GCN (ponds 6, 7, 11, 12, 13, 19 and 36): High Importance on the basis of containing species protected by law.

f. all other ponds: Low Importance as they are not designated and have minimal social and economic use.

g. groundwater: Medium Importance as the WFD groundwater body has a classification of Good, supports local non-potable and some PWS, but is not a principal aquifer.

Floodplain Sensitivity for Impact Assessment

14.9.3 The floodplain adjacent to Hollywell Brook at the point that it crosses the M42 through a culvert is predominantly rural downstream and until its confluence with the Blythe, and there are no immediate surrounding buildings. Upstream of the culvert the NEC car parks are adjacent to the watercourse, but with the watercourse itself in a steep cutting. The FRA (Appendix 14.4) indicates that the Hollywell Brook channel does not overtop in the 1% AEP (1 in 100 year event) plus 50% allowance for climate change. Therefore, the sensitivity of the Hollywell Brook floodplain for impact assessment purposes is considered Low.

14.9.4 The source of Shadow Brook, which would be crossed by the new link road is within Flood Zone 1 and is located within agricultural land. To the east of the existing M42 crossing of Shadow Brook there is Flood Zone 3 in the immediate vicinity of the channel, but the surrounding agricultural land is within Flood Zone 1 and there are no buildings in the vicinity until the crossing of Shadowbrook Lane approximately 900m downstream. As such, the sensitivity of the floodplain for impact assessment is considered Low.

14.9.5 The tributary of Shadow Brook within the Order Limits is within the Bickenhill Meadows SSSI SE unit. There are two buildings within 200m of the stream, one each side of the SSSI. However, given the small size of the stream, the topography which rises away from the stream, and that the area is wholly within Flood Zone 1, the sensitivity of the floodplain of the tributary is considered Low.

14.9.6 The tributary of Low Brook within the Scheme area is within the Bickenhill Meadows SSSI NW unit. There are no buildings in the vicinity of the stream, with agricultural land downstream of the SSSI. The area is also within Flood Zone 1 and so the sensitivity of the floodplain here is considered Low.

14.9.7 The criteria described in **Table 14.1** do not provide examples of sensitivity for other forms of flood risk and so the sensitivity is based on the existing baseline risk as described in the FRA (Appendix 14.4 [**TR010027/APP/6.3**]). For the purpose of this impact assessment the sensitivity of non-fluvial forms of flood risk is as follows:

a. Surface Water – Mainly Low Sensitivity, with localised areas of Medium and High Sensitivity associated with watercourses;

b. Flooding from Artificial Sources (Reservoirs) – Low Sensitivity;

c. Flooding from Artificial Sources (Other Artificial Water Bodies) – Low Sensitivity;

d. Flooding from groundwater – Low Sensitivity; and

e. Flooding from Sewers and Water Supply Infrastructure – Low Sensitivity.

Magnitude of impacts and significance of effect

Construction

Surface water quality

14.9.8 Where construction works are undertaken in close proximity to waterbodies, close to existing land drains providing a pathway to surface watercourses, groundwater or ponds, or on steeper terrain angled towards a waterbody, there is the potential for adverse effects on water quality due to deposition or spillage of soils, sediments, oils, fuels, or other construction chemicals spilt on site. There may also be indirect water quality effects to downstream receptors, including the River Blythe and Low Brook.

14.9.9 Construction of road outfalls for the Scheme would require some works close to and potentially within the receiving watercourses. There would be the potential for conveyance of spills and fine sediment during any works to these outfalls to result in direct impacts to the receiving watercourses. New outfalls are proposed to Shadow Brook and a ditch close to the Clock Interchange. Works may also be undertaken to existing outfalls at Hollywell Brook, a tributary of Shadow Brook, a tributary of Low Brook, and at several small drainage ditches. There may also be indirect effects to downstream receptors including the River Blythe (also a SSSI), Low Brook and waterbodies that are online to Hollywell Brook (including Pendigo Lake) through hydrological connectivity with the upstream receptors.

14.9.10 The drainage designs include extension of three existing culverts which convey Hollywell Brook, a small stream beneath the A45, and a drainage ditch at Bickenhill Lane beneath the road network. Two new culverts would be constructed for field drainage, as described in Section 14.8. The construction works for this culverting has the potential to cause reduction in water quality through sediment disturbance from site clearance and works to the culvert, mobilisation of any existing ground contamination, and the risk of chemical spillages from plant, equipment and materials. Morphological impacts would also be likely, and are considered under operational impacts.

14.9.11 During construction all works would be carried out in accordance with the mitigation measures set out in the OEMP [**TR010027/APP/6.11**] and which includes an OWMP, any discharges to surface water of ‘unclean runoff’ would require a Water Activity Permit from the EA. The conditions attached to any such consent, and to limits on oils, suspended solids and other pollutants, would be adhered to. Further details on relevant consents are given in Section 14.2.

14.9.12 With the implementation of standard mitigation measures as defined within the OEMP [**TR010027/APP/6.11**] and the OWMP, would help avoid or reduce any potential adverse effects on surface water quality impacts during construction. Therefore, taking this into account alongside the risk presented by the nature of the works and its duration (as described in Chapter 3 The Project), it is considered that the construction works would have a negligible magnitude of impact upon the water quality of the very high importance River Blythe, the high importance Hollywell Brook, Shadow Brook, and their respective tributaries, and the low importance drainage ditches. This gives a neutral effect (not significant) for each of these watercourses.

14.9.13 Culverting of watercourses would give a temporary, minor adverse magnitude of impact during construction due to the need to work within watercourses. For the high importance Hollywell Brook this could give a slight to moderate adverse effect. However, given that this would be an extension of an existing culvert and would only be temporary the effect is considered to be slight adverse effect (not significant). The remaining culverts impact low importance waterbodies and so would give a temporary slight adverse effect (not significant) for these receptors.

14.9.14 The preferred main compound area is proposed to be located to the southeast of the Clock Interchange, with access from Catherine-de-Barnes Lane. Access to this compound would be via Catherine-de-Barnes Lane with two exits; one onto the northbound carriageway of Catherine-de-Barnes Lane, to the south of Clock Interchange and the other at the maintenance access track off St Peter's Lane. As such, there would be potential for conveyance of spills and fine sediment towards the downstream receptors including the nearby drainage ditches around the Clock Interchange and their connected downstream receptors which are Pendigo Lake, Hollywell Brook and ultimately the River Blythe.

14.9.15 Satellite compounds situated in the vicinity of surface waterbodies also have the potential to cause pollution. The following list outlines the nearest receptors to each satellite compound (please refer to Chapter 3 The Project for plans of these locations):

a. Catherine-de-Barnes North Bridge Satellite Compound – ditches at Clock Interchange;

b. Satellite compound for Airport way Link – ditches at Clock Interchange;

c. Catherine-de-Barnes South Bridge Satellite Compound – tributary of Shadow Brook;

d. Accommodation bridge Satellite Compound – Shadow Brook / tributary of Shadow Brook;

e. Junction 5A West Satellite Compound – Shadow Brook;

f. A45 NMU Bridge (central, north and south compounds) – ditch beneath A45 (to Pendigo Lane) and ditches at Clock Interchange;

g. NEC bridge Satellite Compound – Hollywell Brook;

h. M42 junction 6 North East Quadrant Satellite Compound – Hollywell Brook; and

i. Hollywell Brook satellite compound - Hollywell Brook.

14.9.16 Implementation of standard mitigation measures defined within the OEMP [**TR010027/APP/6.11**] and the OWMP would avoid, or reduce, the potential for adverse surface water quality impacts from the compound areas. Taking this into account alongside the risk presented by the nature of the works and its duration, the magnitude of impact is assessed as negligible, thereby giving a neutral effect (not significant).

Potential risk of flooding from fluvial sources during construction

14.9.17 The construction phase of the Scheme would involve works in areas close to and within the floodplains of the Hollywell Brook, Shadow Brook, and tributaries of Shadow Brook and Low Brook. Should a fluvial flood event occur during construction this could be a significant risk to construction workers in the vicinity of watercourse crossings and on the floodplain, with the greatest risk occurring around the Hollywell Brook, although hydraulic modelling suggests no out of bank events up to the 1% AEP event plus 50% allowance for climate change.

14.9.18 The baseline risk could be exacerbated during construction works by the temporary increase in the rate and volume of surface water runoff from an increase in impermeable areas such as compacted soils, any on-going in channel works that may constrict or alter the flow within it, and the presence of stockpiled materials and equipment temporarily stored on the floodplain. Sediment, construction materials and equipment may also be washed downstream where it may block the channel and lead to or increase the risk of flooding.

14.9.19 However, with the implementation of standard construction methods and mitigation as described in the OEMP and OWMP this risk can be effectively managed (for example by monitoring weather forecasts and EA flood warnings, by undertaking works close to watercourses during periods of dry weather, by ensuring an adequate temporary drainage system was in place and maintained throughout the construction phase, and avoiding stockpiling material on floodplains). As such, the magnitude of flooding from these sources during construction, on site and further downstream, is considered to be negligible resulting in a neutral effect (not significant).

Potential risk of flooding from surface water sources during construction

14.9.20 The Scheme site would in general be at a low risk from surface water flooding, although in some areas associated with watercourses there are areas of medium and high risk. However, during the works existing surface flow paths may be disrupted and altered due to site clearance, earthworks, and excavation work. The exposure and compaction of bare earth and the construction of new embankments and impermeable surfaces may increase the rates and volume of runoff and increase the risk from surface water flooding. However, with the implementation of standard construction methods and mitigation measures, this

risk can be effectively managed (for example by monitoring weather forecasts and EA flood warnings, by undertaking works in and close to watercourses during periods of dry weather, and by ensuring an adequate temporary drainage system was in place and maintained throughout the construction phase, including any temporary damming of all or part of the channel, over-pumping or fluming of flow). As such, the magnitude of flooding from these sources during construction is considered to be negligible resulting in a neutral effect (not significant).

Potential risk of flooding from artificial sources during construction

14.9.21 The proposed works to the M42 north of Junction 6 lie immediately downstream of Pendigo Lake, which is classified as a reservoir on the EA online Long-term Risk of Flooding map [REF 14-44]. Flooding from reservoirs is extremely difficult to predict as it may happen with little or no warning, and evacuation would need to be undertaken immediately. However, the risk of flooding from reservoirs is considered unlikely due to their highly regulated nature and strict maintenance controls. Furthermore, the EA online long-term Risk of Flooding map indicates that the Scheme would not be located in an area at residual risk of flooding from a structural failure or breach.

14.9.22 The Grand Union Canal is located to the southwest of the Scheme and is regularly inspected by the CRT, who also undertakes maintenance along this canal. Given the topography and distance from the Scheme, no flood impact is predicted from the canal.

14.9.23 There are several ponds in the study area, but flooding from these ponds would be localised and would not pose a significant flood risk to the Scheme.

14.9.24 Based on this information, the current risk of flooding from artificial sources is considered to be negligible, resulting in a neutral effect (not significant).

Potential risk of flooding from groundwater sources during construction

14.9.25 The ‘Areas Susceptible to Groundwater Flooding’ maps [REF 14-45] provided by the EA indicated that land to the north of A45 and M42 Junction 6 is located in an area with >= 50% <75% risk of groundwater emergence whilst the Scheme to the south of A45 and M42 Junction 6 is located in an area with <25% risk of groundwater emergence. The Ground Investigation indicates that groundwater levels are variable across the Scheme, with recorded depths ranging from 0.75-11.67m. Higher groundwater levels in the area are associated with scattered patches of superficial glaciofluvial deposits (sands, gravels and clays) throughout the area.

14.9.26 Given the range of groundwater levels observed, cutting excavations are likely to liberate groundwater in some areas in the form of seepages from any higher permeability zones of superficial deposits that are intercepted. Open excavations in some locations may also be more prone to becoming inundated by groundwater.

14.9.27 The risk to construction workers from groundwater flooding would be managed accordingly through appropriate working practices and with adequate plans and equipment in place for de-watering to ensure safe dry working environments and safe working in confined spaces (such as the provision of escape routes and banksman to monitor works). It is proposed that these measures would be included in a comprehensive groundwater mitigation strategy, which would be considered at the detailed design stage to mitigate the risk of groundwater flooding during both the construction phase and post-construction. With the implementation of these measures, a negligible magnitude of impact is predicted resulting in a neutral effect (not significant).

Potential risk of flooding from drainage infrastructure during construction

14.9.28 The Scheme is at low risk of flooding from sewers and other water supply infrastructure. However, during the construction works a number of water distribution assets would be locally diverted or protected as follows:

a. existing potable water supply on Solihull Road Overbridge to be diverted across new structure;

b. existing potable water supply on Catherine-de-Barnes Lane to be diverted to suit realigned Catherine-de-Barnes Lane;

c. existing potable water supply on Shadowbrook Lane to be diverted to suit realigned the Shadowbrook Lane;

d. existing potable water supply to be diverted across Catherine-de-Barnes Lane North Overbridge;

e. existing potable water supply in the footway cycleway of the A45 Westbound corridor to be diverted or protected to suit the introduction of the free flow link to the A45 Westbound; and

f. existing potable water supply in the central reservation of the A45 Corridor to the west of the West Coast Main Line to be protected or diverted to suit the installation of the central pier of the proposed A45 pedestrian overbridge.

14.9.29 It is assumed that the appointed Contractor would liaise closely with the applicable utility provider regarding the diversion and protection of these assets (as outlined in Chapter 3 The project). As such, the magnitude of flooding from these sources during construction is considered to be negligible resulting in a neutral effect (not significant).

Operation

Surface water quality: Routine Road Runoff

14.9.30 The HAWRAT assessment is presented in Appendix 14.3 [**TR010027/APP/6.3**]. The following presents a summary of the results for existing outfalls, existing and new outfalls with the Scheme but without mitigation, and then with mitigation. Routine road runoff assessment of existing outfalls.

14.9.31 Firstly, the existing outfalls were assessed for routine road runoff using HAWRAT Method A. This did not include outfalls from the new link road as there are no existing outfalls at his location. For this assessment, run-off at the point of discharge prior to any dilution from receiving waters would be expected to have concentrations over the toxicity thresholds for both soluble metals and sediment-bound pollutants ('Fail'). Due to this result, a Step 2 Tier 1 assessment has been undertaken in order to consider dilution in the watercourse from the existing drainage network.

14.9.32 The majority of the networks pass the assessment of acute dissolved metal impact and chronic sediment-bound pollutant impact, with the exception of networks 8 and 11 (Appendix 14.3, **Table 3** [**TR010027/APP/6.3**]). These two networks carry a significant proportion of the M42 drainage, where annual average daily traffic flows exceed 100,000 vehicles/day.

14.9.33 Network 8 outfalls to a small drainage ditch with little dilution or dispersal potential for pollutants, and in order for this outfall to pass the assessment a treatment of 57% for dissolved metals would be required, and 88% for chronic sediment-bound pollutants.

14.9.34 The existing Network 11 discharges to Hollywell Brook, and although there is greater dispersal and dilution potential for pollutants, indicative pollution levels are also predicted to exceed the thresholds for dissolved metal and sediment-bound pollutants, requiring 38% and 73% treatment, respectively.

14.9.35 When looking at the predicted copper and zinc concentrations, there is only one breach of the EQS as outlined in the DMRB and the WFD. For watercourses with a water hardness >250mg/l $CaCO_3$ the EQS' are 28µg/l for dissolved copper and 7.8µg/l for dissolved zinc. These EQS values give an indication of the expected annual average concentrations. Only dissolved zinc concentration at network 8 fails the EQS standards with 8.33µg/l. While in general the long term averages may be within EQS, HAWRAT also assesses short term (acute impacts) for soluble pollutants, which can significantly affect the ecology of receiving waters. The acute soluble results are based on Runoff Specific Thresholds (RSTs) that are designed to protect organisms from short-term exposure (six hours and 24 hours) to significant pollution. Therefore, while in general copper and zinc are within the long-term EQS, the HAWRAT failures for copper represent unacceptable acute impacts.

14.9.36 Existing networks 5, 11, 12 and 15 discharge to Hollywell Brook within 100m of each other and so have been assessed for cumulative impacts for metals and sediments. This shows that there is currently a failure for acute copper impacts and sediment impacts to Hollywell Brook. Networks 13 and 14 discharge within 100m of each other to ditches which flow to Pendigo Lake. A cumulative assessment of these outfalls shows an existing failure for sediment-bound pollutants.

14.9.37 Given the failures of HAWRAT for the existing drainage network, the Scheme presents the opportunity to lessen the extent of pollution from these outfalls. This is discussed further below in relation to the proposed drainage arrangements.

Routine road runoff assessment of proposed outfalls

14.9.38 The assessment of the pollutant risk from routine road runoff for the proposed drainage strategy is shown in Appendix 14.3 **Table 4** [**TR010027/APP/6.3**]. In the absence of any mitigation (as explained in section 14.3), outfalls 1A, 1B, 2A, 2B, 6, 8, 11, 13 and 14 all fail the assessment. Existing outfalls 8 and 11 now require 63% (+6% from existing) and 41% (+3% from existing) treatment for dissolved pollutants, and 91% (+3% from existing) and 75% (+2% from existing) removal for sediment-bound pollutants, respectively. This would be largely a consequence of the increased impermeable areas draining to the existing outfalls.

14.9.39 Both of the outfalls draining the new mainline link road (networks 1B and 2B) fail the assessment, and require 29% and 34% treatment for dissolved metals and 80% and 87% removal of sediment-bound pollutants, respectively.

14.9.40 Both of the outfalls draining the realigned Catherine-de-Barnes Lane fail the assessment for sediment-bound pollutants, with network 1A requiring 44% settlement of sediments, and 2A requiring 52% treatment of sediments.

14.9.41 Networks 6, 13 and 14 fail the assessment for sediment-bound pollutant only, and require 36%, 15% and 9% treatment respectively to achieve the levels required by DMRB HD45/09, in comparison to no treatment under existing conditions.

14.9.42 As in the existing drainage situation, only one breach of EQS is recorded, which is again at network 8, where annual average soluble zinc is 10.23µg/l (compared to the EQS of 7.8µg/l). The remaining failures for dissolved metals are associated with acute (short term exposure) impacts rather than longer term average concentrations.

14.9.43 The assessment of cumulative outfalls indicates that all three sets of neighbouring outfalls (i.e. to Hollywell Brook, ditches south of Bickenhill Lane roundabout and ditches north of Bickenhill roundabout) fail the assessments. The percentage treatment required has also increased from those that are present in the existing scenario due to the larger impermeable areas being drained.

Routine road runoff assessment of proposed outfalls with proposed mitigation

14.9.44 The proposed mitigation for the drainage networks is summarised in **Table 14.4**. The proposed mitigation has been approved by both the EA and Birmingham Airport. Approval from the latter was required to ensure that the proposals did not cause significantly increased bird presence in the vicinity of the airport which could lead to bird strikes by aircraft. The initial assessment was repeated for failing outfalls with incorporation of these proposed mitigation measures, using the treatment efficiencies outlined in DMRB HD33/16 [REF 14-26] and HA103/06 [REF 14-25] and as listed within Appendix 14.3 [**TR010027/APP/6.3**].

14.9.45 Results of the assessment of routine road runoff including initial mitigation proposals are shown in Appendix 14.3, **Table 6** [**TR010027/APP/6.3**]. All networks now pass the assessment for acute and long-term dissolved metal impacts, as well as for chronic sediment-bound pollutant impacts.

14.9.46 With the implementation of the proposed mitigation measures, the two assessments of cumulative networks now both pass the HAWRAT. For the cumulative network 5, 11, 12 and 15, the embedded mitigation incorporated in the assessment consisted of filter drains for all networks; a wetland and grassed swale for network 11; and a vegetated ditch upstream of Hollywell Brook for network 15. The cumulative assessment of network 13 and 14 has included a vortex grit separator for each outfall prior to discharge to a vegetated ditch. The cumulative assessment of network 2A and 2B includes filter drains, a sediment tank and grassland swale.

14.9.47 Based on the above assessment of the impact of routine road runoff, a negligible magnitude is predicted for all surface watercourses with the exception of the M42 outfalls to Hollywell Brook and the ditch to Shadow Brook. For these latter two watercourses a moderate beneficial magnitude of impact is predicted because they are already failing the routine road runoff assessment under the existing drainage arrangements, but would both pass for dissolved metals and sediment-bound pollutants following implementation of the Scheme. The remaining watercourses are negligible as they are currently passing the assessment, and this would remain the case once the Scheme was operational. Overall, this would give a moderate beneficial effect (significant) for Hollywell Brook, a slight beneficial effect (not significant) to the ditch to Shadow Brook, and a neutral effect (not significant) for all other surface watercourses from routine road runoff.

Routine road runoff assessment – impacts on groundwater

14.9.48 Networks 1A, 2A, 2B, 6, 8, 10, 13 and 14 discharge to small drainage ditches that have predicted Q95 flows below 0.001 m^3/s, meaning that they can also be considered for groundwater assessment as soakaways. DMRB HD45/09 Method C is used to assess risk of pollution impacts from routine runoff on groundwater. The risk assessment procedure is based on examination of the 'Source-Pathway-Receptor' protocol. The principle applied is that all elements of the source-pathway-receptor linkage must have to be present to create a pollutant linkage. The presence of the pollutant itself does not pose a risk to groundwater if there is no identifiable pathway. The assessment takes into account traffic density, rainfall volume and intensity, soakaway geometry, depth of the unsaturated zone, flow type (for example fissure flow, intergranular flow), effective grain size and lithology. Full details of the assessment are given in Appendix 14.3 [**TR010027/APP/6.3**].

14.9.49 Results of the Method C assessment for networks 1A, 2A, 2B, 6, 8, 10, 13 and 14 are shown in Appendix 14.3 Tables 7 to 13 [**TR010027/APP/6.3**]. All of the sites are assessed as presenting a medium risk to groundwater, except network 14 which has a score that falls marginally within the high risk category, due to being located within mapped alluvium, which has greater porosity and permeability than other surrounding geology. As all sites are medium to high risk, mitigating measures should be considered to protect groundwater. As described above, treatment measures have been identified for these networks in **Table 14.4**, and HD33/16 [REF 14-26] indicates that the use of swales and constructed surface wetlands are compatible with soakaways as well as watercourses. Therefore, the mitigation measures identified are considered essential for protection of groundwater resources as well as surface watercourses.

14.9.50 Based on the above assessment of the impact of routine road runoff, a negligible magnitude of impact is predicted for groundwater waterbodies with the application of mitigation as has been described within the Drainage Strategy (Appendix 14.5 [**TR010027/APP/6.3**]). This would give a neutral effect (not significant) for all groundwater from routine road runoff.

Surface water quality: accidental spillages

14.9.51 Method D in DMRB HD45/09 [REF 14-32] provides a method that gives an indication of an accidental spillage resulting in a serious pollution incident on a receiving water body, and guides the need for spillage containment measures. Watercourses should be protected so that the risk of a serious pollution incident has an annual probability of less than 1% (equivalent to a return period of 1 in 100 years), unless they are considered to be sensitive (for example covered by a SSSI designation) in which case a more stringent annual probability of 0.5% is applied (1 in 200 years). Where the risk is greater than the allowable standard, spillage containment measures can be built into the drainage designs to reduce the risk.

14.9.52 For the Scheme, the probability that a spillage would cause a pollution incident has been calculated for each drainage network and for the cumulative outfalls identified in the preceding analysis. Data used in the calculations is presented in Appendix 14.3 Table 2 [**TR010027/APP/6.3**]. This includes road lengths draining to each outfall, and modelled traffic data for the 2038 design year.

14.9.53 The results are shown in Appendix 14.3 Table 14 [**TR010027/APP/6.3**] for each network in the absence of mitigation. Results show that the annual probability of a spillage incident meets the acceptable standard of 1% AEP (1 in 100 years) in all cases (or the more stringent probability of 0.5% AEP for network 3 upstream of Bickenhill Meadows SSSI). The cumulative assessments of networks 5, 11, 12 and 15 to Hollywell Brook, networks 13 and 14 to ditches north of the Bickenhill Lane roundabout and networks 2A and 2B to ditches south of the Bickenhill Lane roundabout, all pass the assessment.

14.9.54 The networks posing the most risk to the receiving water environment (despite passing) are the cumulative outfalls to Hollywell Brook, where the risk of spillage would be one event in 181 years. The DMRB HD45/09 [REF 14-32] indicates that the spillage risks calculated in Appendix 14.3 Table 14 [**TR010027/APP/6.3**] would be further reduced by 40% where filter drains are used, by 40% where swales are used, by 50% for wetlands, by 30% for vegetated ditches and by 50% for oil separators.

14.9.55 Based on this HAWRAT Method D analysis, the risk of an accidental spillage resulting in a pollution incident (with inclusion of embedded mitigation) is considered acceptable for all outfalls based on the proposed drainage strategy.

14.9.56 With regards to existing outfalls, following the implementation of embedded mitigation measures such as, filter drains, reed beds and oil separators, it is considered that there would be minor beneficial magnitude of impact on surface water quality for all receiving waterbodies from accidental spillages as a result of the Scheme. This is due to the Scheme implementing treatment measures for spillages where none are currently in place, thus being able to better capture and treat runoff prior to entering the water environment.

14.9.57 For Hollywell Brook and the tributaries of Shadow Brook and Low Brook (as high importance receptors) this would be slight beneficial effect (not significant). For the remaining ditches that currently have road outfalls (as low importance receptors) this would be a neutral effect (not significant).

14.9.58 For the watercourses receiving new drainage outfalls, namely Shadow Brook and ditches at Clock Interchange and Four Winds, as there is no existing spillage risk to be improved, by implementing the embedded mitigation the magnitude of impact is predicted to be negligible, thereby giving a neutral effect (not significant).

Surface water quality: surface de-icing

14.9.59 During cold periods, which typically occur between October and April each year when temperatures are around 4°C or less, de-icing salts would likely be applied (when required) to the Scheme road network to maintain a safe driving surface and to help clear away any snow fall. The application of de-icant salts tends to be intermittent and can be very variable between years depending on how many cold days there are and how long a cold period lasts. During this time, highway runoff (that may also include snow melt) may contain sodium chloride (NaCl) and lesser amounts of clay, cyanide, sediment, and a number of metals. De-icing salts can also be corrosive to metals and may potentially increase the mobilisation of heavy metals in sediments (such as in highway treatment ponds). Similarly, NaCl can potentially trigger the release into solution of accumulated nutrients and heavy metals absorbed to suspended solids.

14.9.60 Generally, it is considered that because de-icing salts are used only infrequently and in the colder months, over short periods and with frequent higher flows in between in which to dilute and disperse 'salty' water, and when flora tends to have died back and fauna less active and dormant, as such, significant long term adverse effects are not likely to occur. SuDS systems may also provide some dilution of salt, although they are not generally considered to reduce salinity and there is a risk that the 'salty' water can re-mobilise metals deposited in the sediments.

14.9.61 While de-icing salts have often been linked to detrimental impacts to aquatic ecosystems, and macroinvertebrates in particular [REF 14-47], there are also numerous scientific reports indicating that road salts do not induce significant acute negative responses on macroinvertebrate communities, but that responses are variable at the species level, where different tolerances are observed [REF 14-48;14-49]. These latter studies considered short term/pulsed exposures of road salt on macroinvertebrate communities where there were short residence times for the de-icant. It was considered that salt could accumulate and have more detrimental impacts in more restricted-flow systems leading to potential chronic effects on fauna.

14.9.62 The M42 is currently treated using a pre wet mixture of rock salt (70%) and brine (30%). The de-icing regime is purely weather dependent, with decisions made regarding when to grit the road based on three weather updates per day. As a broad indication of spreading rates, the Highways Winter Maintenance: A Practical Guide [REF 14-50] suggests 10 to 20 g/m^2 of salt in a precautionary salting, increasing to 20-40 g/m^2 prior to snowfall or rain followed by freezing. Given that there are numerous existing outfalls to the watercourses in the study area, and notably Hollywell Brook and Shadow Brook, it is expected that the aquatic communities of these watercourses may already be adapted to seasonal exposure to de-icant salts.

14.9.63 For the existing highway outfalls that have little change in catchment surface area under the Scheme (i.e. Networks 3, 4, and 6) there is likely to be a negligible magnitude of impact to water quality from surface de-icing in comparison to the existing situation, resulting in a neutral effect (not significant). This would be the case for the tributary of Shadow Brook, the tributary of Low Brook and the small ditch under the A45 towards Pendigo Lake. It is anticipated that effects from de-icing salts would be greatest where receiving waterbodies are small and have limited dilution, such as is the case with the smaller drainage ditches, especially where they receive new highway discharges.

14.9.64 The Q95 flows for these watercourses (estimated from Lowflows software analysis) are in the region of 0.001m^3/s. In places these streams are overgrown, thereby reducing dispersal efficiency. For these watercourses there is considered to be minor adverse magnitude of impact on the receiving watercourses when road salts are washed off the carriageway. This minor magnitude of impact would result in a slight to moderate effect for the high importance Shadow Brook, according to **Table 14.3**. However, given the temporary, intermittent nature of the

impact this is considered to be a slight adverse effect (not significant). For the low importance drainage ditches the minor adverse magnitude of impact would give a neutral effect (not significant). For the larger Hollywell Brook which has a greater Q95 flow of 0.007 m^3/s, there is greater dilution and dispersal capacity. As such, the magnitude of impact is expected to be negligible from de-icing, thereby giving a neutral effect (not significant).

River morphology: Culverts

14.9.65 The Scheme design includes five culverts. Three of these are existing culverts that require extension, and are located at SP 19893 83638, SP 19419 83041, and SP 18782 83261 and these convey Hollywell Brook, a small stream beneath the A45, and a drainage ditch at Bickenhill Lane, respectively, beneath the road network. The remaining two new culverts are for field drainage only, and are located at SP 18994 80822 and SP 18393 81975. The culvert extensions would unavoidably cause direct loss of riparian, bank and bed habitats, and cause indirect losses through shading effects. Shading is likely to reduce light intensity, photosynthesis, metabolic activity and biochemical cycling within the watercourse, thereby impacting on the aquatic ecosystem. The structures may also hamper movement of mammals and are likely to interrupt continuity of the natural hydraulic and sediment regimes and this is assessed in Chapter 8 Biodiversity.

14.9.66 Detailed design for the culverts aims to minimise changes in river alignment and length as much as is feasible. Furthermore, once constructed the channel bed would be naturalised to encourage ecological continuum. Despite these approaches to softening the impacts of the culverts, a minor adverse magnitude of impact to river morphology is expected from the extended culverting of Hollywell Brook (medium importance in terms of morphology), the unnamed stream (beneath the A45) and the minor drainage ditch (both of which are low importance in terms of morphology). The magnitude of impact is considered minor as the watercourses are already culverted and the proposed extensions would not cause a significant worsening in comparison to the existing scenario. For Hollywell Brook this results in a slight adverse effect (not significant) according to **Table 14.3**. For the low importance watercourses (i.e. the unnamed ditches) the culvert extensions give a negligible adverse effect (not significant). The two new culverts to field drains would be expected to have a moderate adverse magnitude impact on the drainage ditches as they would introduce new culverting where there currently is none. For these low importance receptors (in terms of morphology) a slight adverse effect (not significant) is predicted.

River morphology: Outfalls

14.9.67 The final position and orientation of each of the proposed outfalls (see **Table 14.4**) would be micro-sited during final designs and agreed with the EA or SMBC (as LLFA) as part of the application process for Environmental Permits for works to Main Rivers or Ordinary Watercourse Consent (to all other watercourses). The permanent features are unavoidable point impacts, but the cumulative length of bank impacted would be insignificant at the scales of the water bodies. It is not

intended to recess outfalls from the channel banks, because this can risk creation of 'dead zones' with sedimentation and vegetation blockage risks, and because drainage systems would be designed with treatment trains upslope of the outfalls, and only treated water would be discharged to the water bodies. The receiving water bodies are not laterally dynamic channels, so there would be low risk of structures or habitats being exposed and degraded by natural channel movement relative to rigid structures. For outfalls to Shadow Brook and Hollywell Brook, which are Main River downstream of the M42, Environmental Permits may only be required where they are greater than 300mm diameter. Due to the limited size of each outfall, and with good design, a negligible magnitude of impact is predicted, resulting in a neutral effect (not significant) for all outfalls (as listed in **Table 14.4**).

River morphology: loss of Shadow Brook headwater area

14.9.68 Approximately 20m of Shadow Brook at its headwater channel to the east of the M42 at SP 18903 81015 would be lost due to construction of the new link road (i.e. approximately 0.5 % of total channel length). A site visit to the source area confirmed that the watercourse at this point is a dry, overgrown agricultural ditch, which is of limited value in terms of flow regime, sediment transport, biodiversity and other socio-economic and recreational attributes. The watercourse retains its ditch course character until downstream of the M42 where it becomes a more functional watercourse and is a designated Main River. Given there would only be a small loss of what is effectively a dry ditch at the source of Shadow Brook, the magnitude of impact is considered minor adverse. Furthermore, pre-earthworks drainage ditches would collect water from the west of the new link road, which would be cut-off by the road, and return it to Shadow Brook just upstream of the M42 and would thereby maintain the flow regime downstream. As the morphology of Shadow Brook is a low sensitivity receptor for morphology, a neutral effect (not significant) is predicted.

Diversion of minor ditch courses

14.9.69 Realignment and regrading of minor drainage ditches would be undertaken at SP 18361 81081, SP 18348 81187, SP 18771 83175 and SP 19917 83685 as described in Section 14.8. These are artificial, ephemeral, vegetated drainage ditches with minimal socio-economic or biodiversity value, and are not considered functional watercourses for the majority of the year. The diversions would mean unavoidable loss of the existing sections of channel including riparian, bank and bed habitats. However, the realigned channels would aim to improve conveyance of flow and be sensitive to the aquatic ecology. Overall, the diversion and regrading of ditches would result in a moderate adverse magnitude of impact to these low importance receptors, resulting in a slight adverse effect (not significant).

Groundwater flow

14.9.70 While there would be potential for groundwater flows to be intercepted during construction of cuttings and excavations for the Scheme (for example for the new link road) as discussed above, once the Scheme was operational and the ground reprofiled, it is considered there would be negligible magnitude of impacts to groundwater flow. Results from the Ground Investigation indicate that the majority of the new link road alignment is located over, and surrounded by, shallow Mercia Mudstone which has low permeability. Groundwater flows would be of more significance in areas where there are thick superficial glaciofluvial deposits, which are more permeable and support groundwater movement. There appear to be isolated deposits of this nature across the study area, but these are not contiguous. In addition, where superficial deposits are located along the road alignment these are generally less than 2m in thickness. The new link road cutting reaches depths of up to 10m, and would mainly intercept the less permeable Mercia Mudstone, with little resultant impact on groundwater flow. As such, impacts to groundwater flow are assessed as negligible in magnitude during operation, resulting in a neutral effect (not significant).

Loss of surface water catchment to tributary of Shadow Brook: Impacts on flow regime

14.9.71 The new mainline link road would cut-off approximately 21% of the surface water catchment to the tributary of Shadow Brook, as measured at the point where it flows out of the Bickenhill Meadows SSSI SE unit, which is believed to be a groundwater dependent terrestrial habitat. This is an ephemeral watercourse, and is thought to have a limited role in maintaining the wet conditions in the SSSI that are required to provide a suitable habitat for the sensitive grassland species contained within by recharging the groundwater held within the superficial sand and gravels and supporting maintenance of an elevated water table. The channel enables drainage of the surrounding grasslands when they are oversaturated following heavy rainfall. However, the stream is not known to provide out of bank flows and so does not frequently inundate the surrounding grasslands with floodwater. This is discussed in further detail in relation to the conceptual model describing the hydrology of the SSSI unit in Appendix 14.2 (Bickenhill Meadows SSSI: Hydrological Investigation Technical Note [**TR010027/APP/6.3**]).

14.9.72 A pumped mitigation solution has been developed to mitigate for the loss of surface water catchment at Shadowbrook Meadows SE 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 SSSI. 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 reed bed/ditch feature in the vicinity of Shadowbrook Meadows SE unit. 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 SSSI. The above design

principle has been developed in consultation with and agreed in principle with Natural England.

14.9.73 This would ensure that surface water lost to the cutting would be returned to the SSSI catchment. Any water that did not infiltrate into the SSSI from the ditch would be conveyed to the northwest of the site and the confluence with the tributary of Shadow Brook which runs through the centre of the SSSI. All surface water that is cut-off upstream of the Scheme would therefore be returned to the catchment surrounding the tributary of Shadow Brook.

14.9.74 With the inclusion of a pumped mitigation solution, there would be a negligible magnitude of impact on the flow regime of the tributary of Shadow Brook as it flows out of Bickenhill Meadows SSSI, resulting in a neutral effect (not significant).

Reconfiguration of WGAA: impacts to surface watercourses

14.9.75 In the event the sports facilities are reconfigured and the clubhouse is affected, foul sewage would continue to be pumped to a Severn Trent Water network. As such, there would be no increase in risk to receptors off site that receive foul water discharges from the WGAA clubhouse. Therefore, no impact is predicted from foul water discharges.

14.9.76 The ongoing management of the sports pitches is anticipated to require use of a range of grass management, nutrient and chemical products to maintain a suitable high quality playing environment. However, the types of products to be used, when, how frequently, in what doses, and their fate through the sub-soil and sports pitch drainage system, it is not anticipated to be wholly different the current management routine of the existing WGAA.

14.9.77 As such, noting that there are currently three active pitches at the site draining to the surrounding watercourses and it is reasonable to assume that a similar management routine would be implemented to the three reconfigured sporting pitches, no worsening of the existing situation is anticipated. Thus, the impact on water quality from sports pitch management is therefore negligible for all options

14.9.78 Final designs for the WGAA reconfiguration are not yet available, but for the purposes of the assessment it is assumed that the proposed car parks and access road would have restricted surface water runoff rates from the increased area of hardstanding. They are also assumed to include treatment for total suspended solids, metals and hydrocarbons that collect on the car park and may be transferred to nearby ditches through runoff. The selection of appropriate attenuation (for example permeable pavement) would be made through consultation with CIRIA document C753 *The SuDS Manual* [REF 14-24] and following this a negligible magnitude of impact on water quality of the surrounding watercourses is anticipated. Overall, based on the available information, it is concluded that there would be a negligible magnitude of impact on surface water quality from reconfiguration of the WGAA under all options, resulting in neutral effects (not significant) on the ditches and tributaries of Low Brook.

14.9.79 The worst case option of the five current proposals (for this assessment) is considered to be Option 5 due to the construction of a car park to the north of the site, immediately adjacent to a drainage ditch which is believed to have connectivity to the tributary of Low Brook which flows through Bickenhill Meadows SSSI. There is potential for water quality impacts on this ditch during construction, although this would be mitigated through the standard mitigation measures set out in the OWMP within the OEMP [**TR010027/APP/6.11**]. Operational runoff would have appropriate attenuation. Therefore, despite this being the worst case option for the purpose of this assessment, it would still be considered to have a neutral effect (not significant) on the ditch and downstream tributary of Low Brook.

Ponds: impacts on morphology and surface water quality

14.9.80 Three ponds of low importance are located within the Order Limits and are to be lost during construction. These are ponds 8, 39 and 43 as described in Chapter 8: Biodiversity. These are of low importance as they have minimal value in terms of biodiversity (i.e. do not contain GCN or other protected species), and are of limited social and economic value. Given that there would be creation of equivalent habitat through construction of three larger wetlands as part of the Drainage Strategy for the Scheme, it is considered that a slight effect (not significant) is the most appropriate finding for these three ponds.

14.9.81 There would be no direct physical impacts to other ponds or lakes in the study area, including the online Pendigo Lake at the NEC or other smaller ponds such as those that are online with Hollywell Brook downstream of the M42. Any potential indirect water quality or sediment impacts to these online waterbodies would be prevented by implementation of the Drainage Strategy for the Scheme. Therefore, there would only be negligible magnitude impacts at most to the remaining ponds in terms of morphology and water quality, leading to a neutral effect (not significant) on these ponds.

Flood Risk Effects

Potential increased risk of fluvial flooding

14.9.82 A hydraulic model and capacity assessment was undertaken for Hollywell Brook to establish Flood Zone extents and the capacity of the watercourse channel. The results of the modelling indicated the channel does not over top its banks in the 1% AEP event or 1% AEP plus 50% allowance for climate change event. It is therefore considered that land adjacent to Hollywell Brook to the north of M42 Junction 6 is located in Flood Zone 1 rather than Flood Zone 3, as indicated on the EA's online indicative Flood Map for Planning. As a result the risk of flooding from Hollywell Brook is considered to be low and compensatory storage in this area would not be required for the Scheme.

14.9.83 A culvert sizing exercise was undertaken within the FRA to ensure that the proposed culvert extensions to Hollywell Brook, and two minor ditches are of adequate size to ensure conveyance of flow without increasing flood risk. The culvert sizing has been incorporated into the Scheme design. The culverting of the minor ephemeral field drains are not considered a flood risk as they do not carry functional flows.

14.9.84 Overall, a negligible magnitude of impact is predicted on fluvial flood risk, resulting in a neutral effect (not significant) on all watercourses crossed by the Scheme.

Potential increased risk of surface water flooding

14.9.85 The site is generally at Low risk from surface water flooding, although there are some areas of medium and high risks associated with watercourses.

14.9.86 The Scheme alignment is predominantly on undeveloped (greenfield) land currently used for agricultural purposes. Given that the new link road would increase the impermeable area along the entirety of its length, there would be the potential for the surface water flood risk, both to the highway alignment and surrounding area to increase.

14.9.87 Data gathered as part of the Ground Investigation [REF 14-51] has indicated that infiltration to ground would be unsuitable for drainage of the Scheme and instead surface water runoff would be discharged to local watercourses through 15 outfalls (see **Table 14.4**). Various attenuation measures have been incorporated into the Scheme which include storage tanks and wetlands. Peak runoff would be attenuated up to the 1% AEP (1 in 100 year) rainfall event plus 40% climate change in accordance with the NPPF and EA guidance. Attenuation storage is also designed to accommodate the 1 in 100 year return period with 40% allowance for climate change.

14.9.88 With the implementation of the Drainage Strategy (Appendix 14.5) there should be no increase in surface water flood risk from the Scheme. Overall, a negligible magnitude of impact is predicted, resulting in a neutral effect (not significant).

Potential increased risk of flooding from groundwater

14.9.89 The majority of the Site is considered to be at low risk of groundwater flooding as it is located in an area having < 25% risk of groundwater emergence on the EA's Areas Susceptible to Groundwater Flooding [REF 14-45]. The flows from the Scheme are to be discharged to surrounding surface watercourses. Thus, the impact on groundwater flooding mechanisms due to the Scheme are considered to be low in the operational phase. Overall, a negligible magnitude of impact is predicted resulting in a neutral effect (not significant).

Potential increased risk of flooding from artificial sources/drainage infrastructure

14.9.90 The site is at Low risk of flooding from artificial sources, sewers and other water supply infrastructure. As the proposed drainage strategy is to discharge directly into watercourses at an attenuated rate via a dedicated highway drainage network (i.e. no runoff would be discharged to nearby sewers during operation of the Scheme) there should be no impact to the flood risk from existing sewers and drainage infrastructure (i.e. a neutral effect (not significant)).

WFD assessment

14.9.91 In December 2000, the European WFD (2000/60/EEC) [REF 14-1] came into force. Its objectives include to protect, enhance and restore all bodies of surface and groundwater with the aim of achieving good surface water status and good groundwater status by 2015.

14.9.92 In England, the EA is the competent authority for implementing the WFD, although many objectives will be delivered in partnership with other relevant public bodies and private organisations (for example local planning authorities, water companies, Rivers Trusts, large private landowners and developers). As part of its regulatory role and statutory consultee on planning applications and environmental permitting (under the Environmental Permitting Regulations (England and Wales) 2010 (as amended), the EA must consider whether proposals for new developments have the potential to:

a. cause a deterioration of a waterbody from its current status or potential; and/or

b. prevent future attainment of good status or potential where not already achieved.

14.9.93 In determining whether or not a development is compliant or not compliant with the WFD objectives for a water body, the EA must consider the conservation objectives of any Protected Areas (i.e. SSSIs) and adjacent WFD water bodies, where relevant.

14.9.94 A pWFD assessment is provided in Appendix 14.1 [**TR010027/APP/6.3**]. This considers the potential for deterioration and failure to improve in the WFD waterbodies in the study area. The potentially impacted waterbodies are the three designated reaches of the River Blythe (Blythe from source to Cuttle Brook, Blythe from Temple Balsall to Patrick Bridge and Blythe from Patrick Bridge to the River Tame), Hatchford-Kingshurst Brook (as the tributary of Low Brook sits within this designation) and the Tame Anker Mease – Secondary Combined WFD groundwater body.

14.9.95 The pWFD assessment concludes for all watercourses that that there is not predicted to be any deterioration or prevention of improvement to the WFD status, provided that good practice mitigation measures are implemented as outlined in the OEMP [**TR010027/APP/6.11**] during construction and that the outlined mitigation measures for operation, such as attenuation of runoff from road outfalls, are implemented as described in this chapter.

14.10 Monitoring

14.10.1 No significant adverse effects have been recorded by the assessment of Road Drainage and the Water Environment. Therefore, no further monitoring of these effects is proposed.

14.10.2 A programme of water quality monitoring will be undertaken prior to, during, and post-construction to ensure that no detrimental effect on the water environment occurs, and to allow any pollution incidents to be identified and remedied. This is standard practice for construction works of this type, and further details are outlined in the OEMP and OWMP [**TR0100027/APP/6.11**].

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