

M5 Junction 10 Improvements Scheme

Environmental Statement Appendix 8.2 WFD Compliance Assessment TR010063 – APP 6.15

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6.15 Environmental Statement:

Appendix 8.2 WFD Compliance Assessment

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Document accessibility

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1. Introduction

1.1. Scheme Background

1.1.1. The M5 Junction 10 Improvements Scheme (The Scheme) is located 76 km to the south of Birmingham, 8 km to the south of Tewkesbury, 6.5 km to the north-west of Cheltenham, and 12 km to the north-east of Gloucester. It is the northernmost of four junctions serving the Gloucester and Cheltenham urban areas. The A4019 connects northern Cheltenham to the motorway at Junction 10. The Scheme proposes widening of the A4019 to improve traffic flow to and from Junction 10 while upgrading the motorway junction to an all-purpose, signalised roundabout will allow both northbound and southbound access. A link road will also run parallel to the M5 carriageway, connecting the A4019 through to the B4634 and the planned development area to the west of Cheltenham.

1.2. Purpose of the report

1.2.1. The Scheme is currently at the preliminary design stage (PCF Stage 3) with this Water Framework Directive (WFD) compliance assessment and the Environmental Statement (ES) developed in tandem.

1.2.2. The purpose of this WFD assessment is threefold:

- Understand the Zone of Influence (Zol) and baseline conditions.
- Understand which water bodies within the Zol have the potential to be impacted.
- Assess the potential impacts against the Scheme design including embedded mitigation to determine if the Scheme is compliant with WFD objectives.

1.3. Legislative Background

1.3.1. The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 aim to protect and enhance the quality of the water environment and inform the framework behind this WFD assessment. The WFD's principal aims are to protect and improve the water environment and promote the sustainable use of water. The headline environmental objectives of the WFD are:

- To prevent deterioration of the status of water bodies.
- To protect, enhance and restore all water bodies with the aim of achieving 'good status' by 2027 at the latest.
- To progressively reduce or phase out the release of individual pollutants or groups of pollutants and cease or phase out emissions, discharges and losses of priority hazardous substances.
- To prevent or limit the entry of pollutants to groundwater.
- To comply with the requirements of all WFD Protected Areas.

WFD compliance

1.3.2. There are two key objectives set out in the WFD legislation against which the impacts of proposed works on a water body need to be assessed to determine compliance with the overarching objectives of the WFD:

- Test A: The Scheme will not cause a deterioration in any element of water body classification.
- Test B: The Scheme will not prevent the WFD status objectives from being reached within the water body or other downstream water bodies.

- 1.3.3. The two obligations must be met to comply with the WFD. In addition, The Scheme should contribute to the delivery of the relevant WFD objectives. In this case, this will be based on what contribution the Scheme can make towards the water body reaching its objective GES/GEP through planned River Basin Management Plans (RBMP) Mitigation Measures. The delivery of this objective is central to the Environment Agency's implementation of the WFD, where it can be supported through its operational activities.

Surface water bodies

- 1.3.4. The WFD sets a default objective for all rivers, lakes, estuaries, groundwater, and coastal water bodies to achieve Good Status by 2027 at the latest. For natural surface water bodies, Good Status is a function of both Good Chemical Status (GCS) and Good Ecological Status (GES). The RBMPs outline the actions required to enable natural water bodies to achieve these objectives. Artificial and Heavily Modified Water Bodies (A/HMWBs) are considered unable to attain GES due to the modifications that are necessary to maintain their function for society or their 'human use' as they provide important socio-economic benefits. They are, however, required to achieve Good Ecological Potential (GEP), through the implementation of a series of Mitigation Measures. A/HMWBs still need to attain GCS which, along with GEP will collectively result in Good Status in these water bodies.
- 1.3.5. The overall ecological status of a water body is primarily based on consideration of its biological quality elements (phytoplankton, macrophytes, phytobenthos, benthic invertebrates and fish) and is determined by the lowest scoring of these elements. These biological elements are supported by the physico-chemical (water quality) and hydromorphological quality elements.
- 1.3.6. To achieve GCS, a water body must pass a separate chemical status assessment, relating to pass/fail checks on the concentrations of various identified priority/dangerous substances.

Groundwater bodies

- 1.3.7. For groundwater bodies, good status has a quantitative and a chemical element. Both are measured on a scale of Good or Poor, and a confidence rating is assigned to the status assessment of high or low. Together, these provide a single final classification of either Good or Poor status. There is also a trend objective set for groundwater bodies where environmentally significant and sustained rising trends in pollutant concentrations need to be identified along with a definition of the starting point (percentage of level or concentration) for trend reversal. Furthermore, there is requirement under the WFD that ensures the prevention of any input of priority substances and the limiting (or control) of the input of all other substances to groundwater to prevent the deterioration of status.

2. Methodology

2.1. Introduction

2.1.1. As the project is designated as a Nationally Significant Infrastructure Project (NSIP) it will go through a Development Consent Order (DCO) process. As a result, the WFD Assessment follows guidance produced by The Planning Inspectorate (PINS) in advice note 18 on WFD¹ which was developed specifically for projects that fall within this process. The guidance suggests that a WFD assessment be comprised of three key stages:

- Screening assessment.
- Scoping assessment.
- Impact assessment.

2.1.2. Further details of these stages can be found in the sections below. In addition to this guidance, the Environment Agency position statement 488_10²) has been used, where appropriate, to inform this assessment. This WFD compliance assessment includes all three stages outlined in both guidance documents.

2.1.3. This report is an updated version of that which was submitted for statutory consultation in 2019 as an appendix to the Preliminary Environmental Information Report (PEIR).

2.2. Stage 1 – WFD screening

2.2.1. An initial screening assessment determined the Zone of Influence (ZoI) of the Scheme and identified the potentially affected surface and groundwater bodies.

2.2.2. An assessment was made to determine if there were any activities associated with the Scheme that do not require further consideration; for example, activities which have been ongoing since before the current RBMP cycle and have thus formed part of the baseline.

2.2.3. Water bodies where there was a high confidence of no impact were screened out from detailed investigation at this stage: including those water bodies which were considered too far upstream or downstream to be impacted and those with no hydrological connectivity to the Scheme.

2.3. Stage 2 – WFD Scoping

2.3.1. For the WFD scoping stage, a desk study presented the baseline characteristics of each WFD water body using Catchment Data Explorer³ and the RBMP. This includes current classification status (2019, Cycle 2)⁴ for all elements, pressures affecting the water body, its sensitivity to change and identification of watercourses within each water body.

2.3.2. Field surveys were undertaken by an experienced fluvial geomorphologist and aquatic ecologist. Assessments were made to characterise (e.g. the form and processes) the receptors within the surface water bodies potentially affected by the Scheme, as identified in the screening assessment.

2.3.3. MoRPh surveys have, been completed on the River Chelt and The Leigh Brook by an accredited aquatic ecologist to inform the Biodiversity Net Gain (BNG) assessment (Appendix 7.18, application document TR010063 - APP 6.15) and have been used to support the characterisation of water bodies in this WFD assessment.

¹ The Planning Inspectorate, 2017. The Water Framework Directive. Advice Note Eighteen: The Water Framework Directive

² Environment Agency, 2016, Position Statement 488_10.

³ Environment Agency, 2021. Catchment Data Explorer [online] Available at: <https://environment.data.gov.uk/catchment-planning/> [Accessed 01 Aug. 2022]

⁴ At the time of reporting, only draft Cycle 3 data has been published with official Cycle 3 data due in September 2022. Therefore, to ensure consistency with previous versions of this report, the Cycle 2 data has been used rather than draft Cycle 3.

- 2.3.4. An assessment identified the mechanisms of impact from the Scheme to the surface water and groundwater receptors within the Zol based on the relevant water bodies as identified during the Stage 1 screening. The mechanisms of impact which have been considered are presented in Table 2-1 and Table 2-2 .
- 2.3.5. Scheme activities were scoped in and out based on the mechanisms of impact identified and the low-risk categories in the Environment Agency position statement 488_10.

Table 2-1 - Mechanisms of impact to surface water bodies

Mechanism of impact	Description	Element impacted				
		Biological	Physio chemical	Specific pollutants	Hydromorphological	Chemical
Direct loss or alterations to open channel	Any direct loss of watercourse or ditch. This could be from new culverts, culvert extensions, bridges reduced vegetation coverage or installation of hard bed or bank protection which will have a significant impact on the receptor.	✓			✓	
Habitat severance	Disconnection of habitats within the water body due to activities such as weirs, steep hydraulic gradients, or culverts.	✓				
Shading	Loss of light from the channel which is not associated with direct loss of habitat.	✓				
Changes in surface water runoff	Changes in the quantity and quality in the receiving watercourses due to any alterations to the impermeable area and drainage system.	✓	✓	✓	✓	✓
Changes in flood mechanisms within the surface water bodies	Changes in water quality in the receiving water courses due to increased runoff, and pollutants from routine runoff and spillages.	✓	✓	✓	✓	✓
Creation of new habitats	Any additional habitat creation as part of the Scheme. For example, enhancements of water courses or creation of new ditch length.	✓				

Table 2-2 - Mechanisms of impact to groundwater bodies

Mechanism of impact	Description	WFD element impacted	
		Quantitative	Chemical
Barriers to groundwater flow	Permanent below ground structures which forming a barrier to groundwater flow resulting in altered flow paths and changes to groundwater levels. Leading to a potential reduction in groundwater contributions to surface water bodies, GWDTEs or groundwater abstractions.	✓	
Groundwater control measures	Activities such as temporary dewatering and permanent groundwater control measures resulting in reduction in groundwater levels and therefore reduction in groundwater flow to dependent receptors such as surface water bodies, GWDTEs or groundwater abstractions.	✓	
Creating or altering pathways between the surface and the aquifer	Deep structures which extend below ground into the aquifer have the potential to introduce rapid vertical flow paths from surface to groundwater, potentially resulting in contamination of the groundwater body.		✓
Remobilising existing contaminants	Disturbing or re-mobilising existing poor quality groundwater by temporary dewatering, depressurisation or permanent groundwater control.		✓

2.4. Stage 3 – WFD impact assessment

- 2.4.1. Once the Scheme activities had been scoped in or out during Stage 2 Scoping, a WFD impact assessment (Stage 3) was undertaken to determine the potential impact against the water body elements and the Mitigation Measures (for HMWBs) associated with each water body.
- 2.4.2. A “Red, Amber, Yellow, Green, Blue” (RAYGB) coding system was used in a risk-based approach as outlined in Table 2-3. Definitions for the colour coding were assigned to indicate the level of risk of objective non-compliance within each water body, accounting for a) mitigation already “embedded” into the preliminary design (as summarised in section 5.2 of this document) and b) additional mitigation to be integrated into later phases of the design (as set out in section 6.2). The definitions are outlined in section 0.
- 2.4.3. The Highways England Water Risk Assessment Tool (HEWRAT) was used to understand the water quality impacts from the Scheme. The results of the HEWRAT assessments have been used to inform the potential impacts on the surface water bodies and watercourses for this WFD assessment.

Table 2-3 - Definitions of the colour coding system used to determine impacts

Type of impact	Impact of scheme element on WFD element	Impact on WFD element	Impact on WFD water body i.e. the combined impact on the water body as a result of all the impact on WFD elements	Examples	Outcome
Moderate Beneficial	Impacts when taken on their own have the potential to lead to significant improvement.	Impacts in combination with others have the potential to lead to the improvement in the class of a WFD element.	Impacts in combination with others have the potential to lead to the improvement in the WFD status of the water body.	Creation of significant areas of riparian habitats (for example, within a river diversion) which enhance the value of the water body. Removal of hard bank protection. Removal of barriers to fish species. Major improvement to groundwater quality or improved quality of GWDTE due to groundwater contributions.	Increase in status class for that water body
Minor / localised beneficial	Impacts when taken on their own have the potential to lead to a minor localised or temporary improvement.	Impacts in combination with others have the potential to lead to a minor localised improvement of the WFD element.	Impacts in combination with others have the potential to lead to a minor localised or temporary improvement that does not affect the overall WFD status of the water body.	Minor habitat creation measures such as creation of marginal berms up/downstream of a structure. Minor improvement to groundwater quality or improved quality of GWDTE due to groundwater contributions.	Localised improvement, no change in status of WFD water body.
Green (no impact)	No measurable change to any quality elements.	No measurable change to any quality elements.	No measurable change to any quality elements.	Clear span bridge which causes no significant light shading. Changes to flow with no likely impact in macroinvertebrate community/contamination in areas with highly tolerant invertebrate community (e.g. Average Score Per Taxon <4). Minor, temporary encroachment into the channel Improvement in the existing surface water quality through improvement to existing drainage systems. Minor, temporary changes to groundwater levels	No change
Yellow – Localised/temporary adverse impact	Impacts when taken on their own have the potential to lead to a minor localised or impact.	Impacts in combination with others have the potential to lead to a minor localised or temporary impact on the WFD elements. Consideration will be given to habitat creation measures.	Impacts in combination with others have the potential to lead to a minor localised or temporary impact on the WFD elements. Consideration will be given to habitat creation measures.	Loss of macrophytes/phytobenthos due to shading from a bridge or other structure. Temporary loss of invertebrates/macrophytes etc. during channel re-alignment Estimated loss in diversity of invertebrates for e.g. <100m of water body (due to habitat loss, changes to flow etc.). Localised loss of fish habitat/numbers of fish. Reduction in water quality with negligible knock on effects to biological elements Localised changes to groundwater levels or quality with no impact to GWDTE or protected water bodies.	No change in status of WFD water body when balanced against mitigation embedded in the scheme.
Amber – adverse widespread or prolonged impact	Impacts when taken on their own have the potential to lead to a widespread or prolonged impact. Consideration will be given to habitat creation measures.	Impacts in combination with others have the potential to have an adverse impact on the WFD element. Additional mitigation will be applied.	Impacts in combination with others have the potential to have an adverse impact on the WFD water body. The current WFD risk category will be taken into account when assessing these combined impacts. Consideration will be given to habitat creation measures.	Loss of macrophytes/phytobenthos for a significant length of water due to shading from a long (e.g. >200m) culvert or other similar structure. Likely significant drop in invertebrate diversity over e.g. >300m of water body (due to habitat loss /siltation or combination of various impacts etc.). Obstruction to upstream migration of fish to spawning grounds in a salmonid river therefore affecting fish in the whole of the WFD water body. Reduction in water quality with potential to cause knock on effects to biological elements. Adverse changes to GWDTE or baseflow contributions to protected surface water bodies.	Adverse impact but risk of status change needs to be considered with any additional mitigation and taking into account the level of confidence.
Red – adverse impact on an individual quality element and/or overall status of water body	Impacts when taken on their own have the potential to lead to a widespread or prolonged impact even with mitigation in place.	Impacts in combination with others have the potential to have an adverse impact on the WFD element and change its class. Consideration will be given to habitat creation measures.	Impacts in combination with others have the potential to have an adverse impact on the WFD water body and change its status. The current WFD risk category will be taken into account when assessing these combined impacts. Consideration will be given to habitat creation measures.	Loss or extensive change to a fishery Significant loss of hydromorphological diversity likely to impact the water body scale such as channelisation of a natural watercourse using hard engineering for a significant length. Creation of barriers which will inhibit migration and movement of fish within the system. Significant decline in water quality resulting in knock on effects to biological elements at the water body scale. Loss of or extensive change to GWDTE or baseflow contributions to protected surface water bodies. Any significant change in groundwater quality reducing WFD status.	Decrease in status of WFD water body when balanced against additional mitigation. Outcome is considered to be certain.

3. Stage 1 – WFD Screening

3.1. Scheme Location

3.1.1. The current Order limits of the Scheme extend approximately 2 km north and south of the proposed works on the M5 carriageway to Stoke Orchard and Old Gloucestershire Road respectively. The extension of the Order limits to this distance north and south is to incorporate any works that will be undertaken to update signs along the M5 Carriageway. There are expected to be no structural works any further north or south than the Villa Farm M5 Road Bridge or the existing River Chelt Crossing respectively.

3.1.2. Figure 3-1 illustrates the location of the Scheme and the Order limits.

Figure 3-1 - Scheme location

Figure provided in Appendix 8.2C at the end of this document.

3.2. Zone of Influence

Surface water

3.2.1. The Zone of Influence (Zol) has been determined throughout this assessment as part of the Screening and Scoping stages. The Zol consists of the WFD surface water catchments which have been screened and scoped into this assessment. Entire water body catchments which have the potential to be impacted have been outlined as the Zol to ensure that the impacts are assessed at the water body scale.

3.2.2. Baseline information, survey work, design details and professional judgement have been used to screen and scope out water bodies which are unlikely to be impacted. This includes those which are not hydrologically connected downstream or where impacts are unlikely to propagate upstream or downstream.

Groundwater

3.2.3. Due to the lateral extent of groundwater bodies in comparison to surface water bodies, a different approach has been utilised. The Zol for groundwater receptors has been limited to a 1 km radial buffer around the Scheme alignment. This study area has been adopted as a minimum for the groundwater assessments as, in line with DMRB LA113, the conceptual understanding indicates any impacts to groundwater flow will be dissipated within 1 km.

3.3. Water body screening

3.3.1. A screening assessment has been carried out to identify which water bodies have the potential to be impacted by the Scheme.

3.3.2. All water bodies which intersect the Order limit have been identified. Additionally, any surface water bodies which are hydrologically connected downstream have been identified up to the point where impacts are expected to have dissipated. Initially, this was limited to the River Chelt's confluence with the River Severn. However, following consultation with the Environment Agency, it was noted that due to hydrological connectivity between the Scheme and the Severn Estuary Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar and Site of Special Scientific Interest (SSSI), a wider area should be screened into the assessment to determine any potential for impact along a greater downstream hydrological connectivity.

3.3.3. Significant impacts from the Scheme are not expected to extend any further downstream than the Severn – conf R Avon to conf Upper Parting water body. Although within the Scheme there is the potential for a serious pollution incident to occur as a result of a spillage, the likelihood of such an incident occurring is low and acceptable under DMRB

LA 113 standards. With mitigation in place, to reduce the chance of a spillage causing a pollution incident, the likelihood of any impacts extending to the River Severn are unlikely and therefore not considered within this scope.

3.3.4. Where water bodies fall within the area of the Order limits where works will only be carried out on signage (as outlined in section 3.1) these water bodies will be screened out of further assessment as these works are expected to have no impact on the water environment.

3.3.5. These WFD water body catchments are presented in Appendix 8.2A and summarised below in Table 3-1 with a summary of the screening outcome. Figure 3-2 provides a map of the water bodies which were identified in this screening assessment.

Table 3-1 - Summary screening of WFD water bodies intersecting the Order limits

Water body Name	Water body ID	Water body type	Overall status (2019)	Screening (in/out)	Reason for Screening
Chelt – source to M5	GB109054032820	River	Moderate	In	
Chelt – M5 to conf. R. Severn	GB109054032810	River	Poor	In	
Leigh Bk – source to conf. R. Chelt	GB109054039770	River	Moderate	In	
Swilgate – source to conf. R. Avon	GB109054039780	River	Moderate	Out	Hydrological connectivity to signage works only
Hatherley Bk - source to conf R Severn	GB109054032801	River	Moderate	Out	Hydrological connectivity to signage works only
Severn – conf R Avon to conf Upper Parting	GB109054044404	River	Moderate	In	Included following consultation with Environment Agency
Severn Vale - Secondary Combined	GB40902G204900	Groundwater	Good	In	
Warwickshire Avon - Secondary Mudrocks	GB40902G990900	Groundwater	Good	In	

Figure 3-2 - WFD Water bodies considered as part of the screening assessment

Figure provided in Appendix 8.2C at the end of this document.

Screening summary

3.3.6. The Swilgate – source to conf. R. Avon and the Hatherley Bk - source to conf R Severn have been screened out of this assessment as they have hydrological connectivity to signage works only. The water bodies screened into the next stage of assessment are:

- Chelt – source to M5.

- Chelt – M5 to conf. R. Severn.
- Leigh Bk – source to conf. R. Chelt.
- Severn – conf R Avon to conf Upper Parting.
- Severn Vale - Secondary Combined.
- Warwickshire Avon - Secondary Mudrocks.

4. Stage 2 – WFD Scoping

4.1. Surface water baseline

WFD reportable reaches

- 4.1.1. The following four WFD surface water bodies (as identified in Table 3-1 and Figure 3-1) are included in this scoping:
- Chelt – source to M5.
 - Chelt – M5 to conf. R. Severn.
 - Leigh Bk – source to conf. R. Chelt.
 - Severn – conf R Avon to conf Upper Parting.
- 4.1.2. The Severn – conf R Avon to conf Upper Parting is the only surface water body which does not lie within the Chelt Hatherley and Normans Brook Operational Catchment. Instead, it lies within the Severn River and Trib Estuary Operational Catchment. All four surface water bodies lie within the Severn River Basin District (RBD) as outlined in the Severn RBMP.
- 4.1.3. The River Chelt is Main River and flows east to west through Cheltenham before flowing under the M5 carriageway approximately 0.9 km south of junction 10.
- 4.1.4. Although the Leigh Brook is not a Main River at its crossing point with the M5 (NGR SO907260), it is reportable under the WFD throughout its length between its source at Uckington, to its confluence with the River Chelt. Downstream of the A4019 (west of the M5 Carriageway) the watercourse is designated Main River.
- 4.1.5. The River Severn is Main River and WFD reportable through the Severn – conf R Avon to conf Upper Parting WFD water body catchment.
- 4.1.6. The current (2019, Cycle 2) status for the WFD river water bodies are provided in Table 4-1 along with objectives, designations, reasons for not achieving good (RNAG) status and linked protected areas.

Table 4-1 - Summary of WFD information for the four scoped surface water bodies

Water Body Name	Chelt – source to M5	Chelt – M5 to conf. R. Severn	Leigh Bk – source to conf. R. Chelt	Severn – conf R Avon to conf Upper Parting
Water Body ID	GB109054032820	GB109054032810	GB109054039770	GB109054044404
Hydromorphological Designation	Heavily modified	Not designated heavily modified or artificial	Not designated heavily modified or artificial	Heavily modified
Classification (2019 Cycle 2)	Moderate	Poor	Moderate	Moderate
Objectives	Good by 2027 (Disproportionate Burdens)	Good by 2027 (Disproportionate Burdens)	Moderate by 2015 (Unfavourable balance of costs and benefits)	Moderate by 2015 (Unfavourable balance of costs and benefits)
Ecological	Moderate	Poor	Moderate	Moderate
Supporting elements (surface water)	Moderate	-	-	Moderate
Mitigation Measures Assessment	Moderate	-	-	-
Biological quality elements	Good	Poor	Moderate	Bad
Macrophytes and Phytobenthos	Good	Poor	Moderate	-
Fish	High	-	-	-
Invertebrates	Good	Good	Good	Bad
Hydromorphological supporting elements	Supports Good	Supports Good	Supports Good	Supports Good
Physico-chemical quality elements	Good	Moderate	Moderate	Moderate
Acid Neutralising Capacity	High	High		High
Ammonia (Phys-Chem)	High	High	High	High
Biochemical Oxygen Demand (BOD)	High	Poor	-	High
Dissolved Oxygen	High	High	High	High
pH	High	High	High	High
Phosphate	Good	Poor	Poor	Moderate
Temperature	Good	High	High	High
Specific pollutants	-	High	-	High
Chemical	Fail	Fail	Fail	Fail
Priority substances	Does not require assessment	Good	Does not require assessment	Good
Other pollutants	Does not require assessment	Does not require assessment	Does not require assessment	Good
Priority hazardous substances	Does not require assessment	Good	Does not require assessment	Fail
RNAG (2019)	Physical modifications from Local and Central Government and Urban transport	Diffuse and Point source pollution from Agricultural land management, Water industry and Urban and transport	Diffuse and Point source pollution from Agricultural land management, Domestic general public and Urban and transport	Local and Central Government and Urban transport, Urban and transport, Navigation, Water Industry
Linked Protected Areas	Thames (Churn to Coln) NVZ S457 River Chelt NVZ S580 River Swilgate NVZ S582 Hatherley Bk - conf Norman's Bk to conf R Severn NVZ S579	River Chelt NVZ S580 Hatherley Bk - conf Norman's Bk to conf R Severn NVZ S580 River Chelt Urban Waste Water Treatment Directive (UKENRI46)	River Chelt NVZ S580 River Swilgate NVZ S582	River Chelt NVZ S580 River Swilgate NVZ S582 Hatherley Bk - conf Norman's Bk to conf R Severn NVZ S579 R Leadon - Glynch Bk to conf R Severn (W Channel) NVZ S578 River Chelt Urban Waste Water Treatment Directive (UKENRI46) River Avon (Warwickshire) Urban Waste Water Treatment Directive (UKENRI10)

Mitigation Measures

- 4.1.7. Under the WFD legislation, a Mitigation Measures assessment is required for all water bodies which are designated A/HMWB. The Chelt – source to M5 and the Severn – conf R Avon to conf Upper Parting are both designated as HMWB. Mitigation Measures are outlined by the Environment Agency in order to enable the water body to meet its objectives under the WFD.
- 4.1.8. Mitigation Measures for the River Chelt – source to M5 have been extracted from the Environment Agency water body summary sheets and presented in Table 4 2. A number of water body level measure actions have been stated and include channel improvement works, weir improvements, culverts and improvement to fish passage.
- 4.1.9. The extended water body summary sheet was not requested for Severn – conf R Avon to conf Upper Parting as it has been added into the assessment following consultation. However, a review of the 2nd cycle measures not linked to 2021 element outcomes v2⁵ has shown that no Mitigation Measures are in place for the catchment.
- 4.1.10. Where appropriate (i.e. for the River Chelt – source to M5), a Mitigation Measures assessment is undertaken as part of Test B within the Impact Assessment spreadsheets (Appendix 8.2A) and is summarised in section 5.3

Table 4-2 - Mitigation Measures for the River Chelt - source to M5 water body

Mitigation category	Flood protection and urbanisation designated uses
Working with physical form and function	Remove obsolete structure Re-engineer river Remove or soften hard bank Preserve or restore habitats In-channel morph diversity Bank rehabilitation Re-opening culverts Alter culvert channel bed Flood bunds Set-back embankments Floodplain connectivity
Re-engineer river	Fish passes Fish pass flow releases Reduce fish entrainment Enhance ecology Changes to locks etc
Remove or soften hard bank	Selective vegetation control Vegetation control Vegetation control timing Invasive species techniques Retain habitats Sediment management strategy Maintain channel bed/margins Woody debris Water level management
Preserve or restore habitats	Align and attenuate flooding

⁵ Environment Agency, 2020. WFD Cycle 2 mitigation measures assessment classification. Available at: WFD Cycle 2 mitigation measures assessment classification - data.gov.uk [Accessed 20 Aug. 2020]

In-channel morph diversity

Educate landowners

- 4.1.11. Although the Leigh Bk – source to conf. R. Chelt and Chelt – M5 to conf. R. Severn are not A/HMWB, some mitigation measures may still be in place. There were none highlighted for the Chelt – M5 to conf. R. Severn but the Leigh Bk – source to conf. R. Chelt highlights three measures downstream of Knightsbridge which have relevance to this Scheme:
- Improve habitat diversity through large woody debris.
 - Improve watercourse profile.
 - Increase habitat diversity.

Initial site walkover survey

- 4.1.12. A watercourse walkover was undertaken on the 23 and 24 July 2019 by an experienced fluvial geomorphologist and aquatic ecologist. The River Chelt was surveyed between the River Chelt Culvert and the Link Road Bridge locations (approximately 800 m of the channel). The Leigh Brook was surveyed along 500 m upstream of the Leigh Brook Culvert. MW3 was also surveyed downstream of the M5 for approximately 200 m. Spot checks were also completed on:
- The River Chelt approximately 650 m downstream of the River Chelt Bridge.
 - Drain 12 at the proposed crossing with the Link Road.
 - Drain 10 west of Withybridge Lane.
 - Drain 14 and 15 south of Old Gloucester Road.
- 4.1.13. A map of the watercourses included in this assessment can be found in Figure 4-1.
- 4.1.15. The site work comprised a walkover collecting georeferenced photographs and recording features that characterise the potentially affected watercourses, including planform, bed substrate and bank materials, modifications, flow types, habitat provisions and vegetation types (riparian and aquatic).
- 4.1.16. Access was available using public rights of way (PRoW) and to specified private land parcels within the Order limits. Several sites were not accessible due to land access not being granted or health and safety concerns. Following the watercourse walkover, detailed ecological surveys were undertaken on the River Chelt and Leigh Brook. Details of the survey screening approach, methods used, and survey locations can be found in the Aquatic Ecology Survey report (Appendix 7.12 - application document TR010063 - APP 6.15).
- 4.1.17. The detailed surveys comprised:
- Two electric fishing surveys on the River Chelt, centred on the proposed new Link Road River Chelt Bridge and the River Chelt Culvert.
 - Four macroinvertebrate surveys on the River Chelt upstream and downstream of the Scheme interactions (Link Road River Chelt Bridge and the River Chelt Culvert). One macroinvertebrate survey on the Leigh Brook downstream of the existing Leigh Brook Culvert.
 - Two macrophyte surveys on the River Chelt, at the proposed new Link Road River Chelt Bridge and the River Chelt Culvert and the River Chelt Culvert. One macrophyte survey on the Leigh Brook downstream of the Leigh Brook Culvert.
 - Two River Habitat Surveys (RHS) on the River Chelt, centred on the proposed new Link Road River Chelt Bridge and the River Chelt Culvert and the River Chelt Culvert. One RHS on the Leigh Brook downstream of the Leigh Brook Culvert.

- Two River Corridor Surveys (RCS) on the River Chelt, centred on the proposed new Link Road River Chelt Bridge and the River Chelt Culvert and the River Chelt culvert. One RHS on the Leigh Brook downstream of the Leigh Brook Culvert.
- 4.1.18. MoRPh Survey was completed on the Leigh Brook and River Chelt on the 12th May 2022 and the 7th July respectively. The surveys on the Leigh Brook were completed by an accredited Aquatic Ecologist and accredited Geomorphologist. The surveys on the River Chelt were completed by an accredited Aquatic Ecologist with support from a Geomorphologist. The MoRPh Survey was completed in line with BNG guidance with a MoRPh 5 assessment being undertaken at each of the crossing points: downstream of the M5 crossing of the Leigh Brook (Leigh Brook Culvert), at the link road River Chelt crossing and at the existing M5 River Chelt crossing.
- 4.1.19. A summary description for each WFD water body along with available relevant Environment Agency routine monitoring data and Scheme ecological survey data are below with photographs presented in Table 4-3 to Table 4-5.

Chelt – source to M5

- 4.1.20. This water body received a large amount of light due to minimal tree cover on the banks resulting in the establishment of both terrestrial herbs and scrub along with marginal macrophyte growth. Within the upstream surveyed reach (upstream of Withybridge), the river contained discrete areas of fine sediment deposition in deeper waters, as well as cobble outcrops in shallower areas. Gravel and pebble substrates were also evident within this reach and water was clear and free flowing. Large stands of stream water crowfoot were present indicating the channel flows relatively quickly all year round. Some isolated trees in the upstream reach provided a dappling effect adding diversity to the channel habitat. Within these more shaded areas small fish were observed. Although there is slightly more vegetation growth in this channel, it is still straightened and channelised in some sections. The weir causes discontinuity for fish movement and the concrete bed and banks have reduced biodiversity. There was significant lateral and vertical erosion visible within this reach with the Environment Agency confirming that the channel here, and upstream, is active and naturalising.
- 4.1.21. At the River Chelt Culvert, a large box culvert restricts high flows demonstrated by fine sediment depositions immediately upstream and within the structure. There was a slightly higher proportion of fine sediments and more extensive marginal macrophyte growth was evident at the base of the banks in this reach compared with the reach upstream of Withybridge Lane.

Background records

- 4.1.22. No ecological monitoring data less than 5 years old are available for the water body.

Aquatic macroinvertebrates

- 4.1.23. Three Environment Agency macroinvertebrate monitoring sites (Environment Agency Site ID 49705, 52020 and 52939), with survey data since 2010, are located within the water body. The closest of these to the Scheme is Environment Agency Site ID 49705, which is located approximately 0.5 km upstream of the Order limits (as the crow flies). The most recent surveys at this site were undertaken in May and October 2019 and biotic indices indicate that the macroinvertebrate community comprises a relatively species rich community (WHPT NTAXA 30 and 34) living in good water quality (WHPT 144.2 and 178.8). However, average scores per taxon of 4.81 and 5.26 indicate that the overall WHPT score may be driven by number of scoring species rather than the presence of extremely sensitive species⁶. Biotic indices are also indicative of a moderately sedimented

⁶ WHPT is the Whalley Hawkes Paisley Trigg metric which assesses the degree to which a community is sensitive to organic pollution. NTAXA is the number of scoring taxa that contribute to the overall total WHPT score. ASPT is the Average Score Per Taxon for the WHPT metric (i.e. the total WHPT divided by the NTAXA). Further information on WHPT can be found in: WFD-UKTAG (2014), River Assessment Method. Benthic Invertebrate Fauna. Invertebrates (General Scoping of surface water receptors is outlined in section 4.5 following the identification of Scheme activities. There are no other designated sites within the surface water study area. Degradation): Whalley, Hawkes, Paisley & Trigg metric in River Invertebrate Classification Tool (RICT) UKTAG Method Statement. ISBN: 978-1-906934-62-0.

to sedimented bed (PSI⁷ scores of 45.36 and 36.49) and a community moderately to highly sensitive to reductions in flow (LIFE⁸ index scores of 7.33 and 7.14).

- 4.1.24. Environment Agency Site ID 52020 is situated within 2 km of the Scheme and 4 km upstream of the existing M5 crossing and was most recently surveyed in April and September 2014. This site contains a slightly higher proportion of flow sensitive taxa (LIFE index scores of 7.8 and 7.77) than Environment Agency Site ID 49705, but has a community indicative of similar if not slightly lower water/habitat quality (WHPT NTAXA 21 and 25, WHPT total 138.3 and 159.6). It should be noted that since the data were collected in different years, they are not directly comparable.
- 4.1.25. Environment Agency Site ID 52939 is the furthest upstream site within the water body, approximately 6 km from the Order limits (as the crow flies). Most recent surveys at this site were undertaken in March and September 2014. These surveys returned similar WHPT and NTAXA scores as the other two sites within the water body (WHPT NTAXA 27 and 24, WHPT total 168.9 and 147.9) indicating relatively good water quality. This site has the highest PSI (71.74 and 73.33) and LIFE index (7.96 and 8.32) scores across the water body, indicating that the community here is more sensitive to low flows and only minimally sedimented.

Aquatic Macrophytes

- 4.1.26. One Environment Agency macrophyte monitoring site (Environment Agency Site ID 47049), which has been surveyed within the last ten years, is located within the water body. This site is located approximately 20 m from the Order limits and 0.5 km downstream of the existing M5 crossing. It was most recently surveyed in July 2014. This survey indicates that the plant community within the River Chelt typically comprises species associated with moderate to high nutrient levels and predominantly slow flow (River Macrophyte Nutrient Index (RMNI) 7.59 and River Macrophyte Hydraulic Index (RMHI) 7.14).

Fish

- 4.1.27. Four Environment Agency fish monitoring sites (Environment Agency Site ID 51183, 51184, 56463 and 10409) which have been surveyed within the last 10 years are located within the water body. The closest to the Scheme is Environment Agency Site ID 51183 which is located approximately 0.4 km from the Order Limits. Environment Agency Site ID 51184 is approximately 100 m further upstream and most recent survey for both sites was undertaken in September 2013. Only four species were caught during the surveys at this site, namely bullhead, three-spined stickleback, brown trout and European eel. Whilst limited species richness, the species present are considered to be important. European eel is a Critically Endangered species on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (2010), species of Principal Importance under section 41 of the Natural Environment and Rural Communities (NERC) Act 2006, and a UK Biodiversity Action Plan (BAP; 2007) priority fish species. Brown trout is a species of principal importance under section 41 of the NERC Act 2006 and a UK BAP (2007) priority fish species. Bullhead is a European Commission Habitats Directive Annex II non-priority species⁹. These species are also considered within Chapter 7 of the Environmental Statement: Biodiversity (application document TR010063 – APP 6.5).

⁷ PSI is the proportion of sediment sensitive invertebrates and is based on known ecological responses of different aquatic macroinvertebrate species or family groups to the accumulation of sediment on riverine substrata. Information on PSI can be found in: Extence, C.A., Chadd, R.P., England, J., Dunbar, M.J., Wood, P.J. and Taylor, E.D. (2013). The assessment of fine sediment accumulation in rivers using macro-invertebrate community response. *River Research and Applications*, 29, pp. 17-55.

⁸ LIFE is the lotic invertebrate index for flow evaluation. The metric was developed as a means of assessing flow as a stressor on aquatic macroinvertebrate communities. LIFE score categories identify the community as having a low, moderate or high sensitivity to flow reduction. With a lower score indicating a community made up of proportionally more taxa with a preference for low flows. Further information on LIFE scores can be found in: Extence, C.A., Balbi, D.M. and Chadd, R.P. (1999). River flow indexing using British benthic macroinvertebrates: A framework for setting hydroecological objectives. *Regulated Rivers: Research and Management* 15, pp. 543-574.

⁹ Animal and plant species of Community interest (i.e. endangered, vulnerable, rare or endemic in the European Community) whose conservation requires the designation of special areas of conservation. Note that the contents of this annex have been updated in April 2003 following the Treaty of Accession.

- 4.1.28. The same species were recorded at the two other Environment Agency fish monitoring sites within the water body.

Survey results

- 4.1.29. The RHS returned a habitat modification score of 2120 which indicates the reach is severely modified. Within the surveyed reach (centred on the proposed River Chelt Bridge) the downstream 100 m has been extensively lined with walls, the access road to the house crosses here and there is a weir at the upstream end of the walls. This modification is likely driving the habitat modification score. Upstream of this, the river has a more natural channel but appears to have been over-deepened. The banks are fenced more or less throughout and the vegetation is consequently dominated by trees, scrub and tall ruderals.
- 4.1.30. At the location of the River Chelt at new Link Road (WCID09_MRS_LR: SO 90882 24553 - SO 90839 24585) – one 50 m MoRPh survey was conducted on the River Chelt. The River Chelt at this location had a river condition of 'Moderate', where riparian land-use, lack of marginal and in-channel features (e.g., berms and large wood) and presence of the invasive non-native species Himalayan balsam (*Impatiens glandulifera*) constrained the condition of the watercourse. The entire length of the River Chelt within the Order limits at the new Link Road could not be surveyed. As such, river condition of 'Moderate' has been applied to the reaches of the River Chelt that could not be surveyed.
- 4.1.31. At the existing M5 Crossing (WCID10_MRS_J10_US – SO 90043 24791 – SO 90011 24823) - one 50 m MoRPh survey was conducted on the River Chelt. The River Chelt at this location had a river condition of 'Fairly Poor', constrained by approximately 40 m of the channel being culverted. The upstream 10 m of the River Chelt that was not culverted lacked in-channel and marginal features such as berms and riffles/pools.

Aquatic macroinvertebrates

- 4.1.32. 52 mixed level taxa were recorded across three sampling sites. Biological metrics are indicative of good habitat diversity and water quality, high sensitivity to reduced flows and slight to moderate channel sedimentation.

Aquatic macrophytes


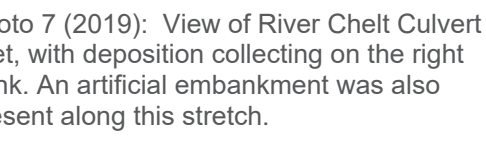
- 4.1.33. Within the surveyed reach (at the proposed River Chelt Bridge) 1% total cover of macrophytes was recorded in channel and 3% cover of filamentous algae. Species comprised branched bur-reed, water figwort, crescent-cup liverwort, umbrella liverwort and pink fruited thread-moss.

Fish

- 4.1.34. The reach had extensive glide and run habitat, with isolated areas of shallow riffle habitat. The most abundant species was bullhead, with three-spined stickleback and eel also recorded. River lamprey are listed on Annex III of the Bern convention, Annex II of the European Commission Habitats Directive and are protected under the Salmon and Freshwater Fisheries Act (1975). Furthermore, they are an Annex II species and a primary reason for the selection of the Severn Estuary SAC.

Table 4-3 - Water body photographs Chelt – source to M5



<p>Photo 1 (2022): Downstream view approximately 80m upstream from the Link Road River Chelt Bridge showing active bank erosion on the left bank.</p>	<p>Photo 2 (2022): View of right bank at site of the of the River Chelt Link Road Bridge. Bank erosion and in channel sediments shown with a large wood in channel.</p>
	
<p>Photo 3 (2019): View of site of for the Link Road River Chelt Bridge. An artificial embankment was present on both banks, alongside a straightened and over deepened channel. Some isolated trees provide shade.</p>	<p>Photo 4 (2019): View downstream from Link Road River Chelt Bridge. The flow was dynamic, with varying depth across the channel. Some deposits were vegetated with stream water crowfoot.</p>
	
<p>Photo 5 (2019): A weir marks the upstream extent of a 80 m long channelised section, approximately 200 m downstream from the Link Road River Chelt Bridge, outside of the Order limits.</p>	<p>Photo 6 (2019): The existing bridge on Withybridge Lane marks the downstream extent of the channelised section. Small fish (assumed to be stickleback or fry of a larger species) were observed within a shaded section of channel upstream of this bridge.</p>
	
<p>Photo 7 (2019): View of River Chelt Culvert inlet, with deposition collecting on the right bank. An artificial embankment was also present along this stretch.</p>	<p>Photo 8 (2019): View through the River Chelt Culvert showing fine sediment deposition. Trash and vegetation which were assumed to be flood deposits observed on the concrete walkway indicates flows have been much higher within this reach.</p>
	

Chelt – M5 to conf. R. Severn

- 4.1.35. The channel had similar characteristics as those seen upstream of the M5 crossing with agricultural land use on both banks for the majority of the water body length. This section of the channel was embanked in a similar manner to the channel upstream of the existing crossing and upstream of Withybridge Lane. The vegetation on both banks was denser than upstream, however there were sections of shade and sunlight. Higher flows shown in Photo 10 were a result of overnight rainfall following the first day of survey. Bed and bank material could not be clearly seen. Macrophyte species recorded during the site visit included *Ranunculus* species, and reed canary grass.

Background records

- 4.1.36. No ecological monitoring data less than 5 years old are available for the water body.

Aquatic macroinvertebrates

- 4.1.37. Two Environment Agency macroinvertebrate monitoring sites (Environment Agency Site ID 53408 and 161315), with survey data since 2010, are located within the water body. The closest of these to the existing M5 crossing is Environment Agency Site ID 53408, which is located approximately 1.5 km downstream of the existing crossing. The most recent surveys at this site were undertaken in March and September 2014 and biotic indices indicate that the macroinvertebrate community was composed of taxa relatively tolerant to organic pollution (WHPT ASPT 4.76 and 5.21), indicative of a moderately sedimented bed (PSI 45.83 and 58.49) and sensitive to reductions in flow (LIFE index 7.38 and 7.57).
- 4.1.38. The second Environment Agency macroinvertebrate monitoring site within the water body (Environment Agency Site ID 161315) recorded similar metric values indicating a similar habitat quality and community sensitivity (WHPT ASPT 5.2 and 4.9, PSI 59.62 and 48.39, LIFE index 7.5 and 7.13). This site is situated approximately 5km downstream of the Scheme and most recently surveyed in April and September 2014.

Aquatic Macrophytes

- 4.1.39. One Environment Agency macrophyte monitoring site (Environment Agency Site ID 47318), with survey data since 2010 is located within the water body. This site is located immediately upstream of the River Chelt confluence with the River Severn. It was most recently surveyed in July 2014. This survey indicates that the plant community within the River Chelt is typically comprises species associated with moderate to high nutrient levels and predominantly slow flow (RMNI 8.22 and RMHI 7.65).

Fish

- 4.1.40. Three Environment Agency fish monitoring sites (Environment Agency Site ID 54023, 51163 and 52484, with survey data since 2010 are located within the water body. The closest to the Scheme is Environment Agency Site ID 54023 which is located approximately 5 km downstream from the Order limits. Environment Agency Site ID 51163 is a further 450 m downstream and Environment Agency Site ID 52484 is located immediately upstream of the River Chelt confluence with the River Severn. There is a greater species richness recorded at these sites than the fish monitoring sites within the upstream Chelt – source to M5 water body. The most recent survey at Environment Agency Site 54023 was undertaken in July 2014, for Environment Agency Site ID 51163 it was September 2013 and Environment Agency Site ID 52484 was September 2015. Across these surveys 13 species were recorded, namely European eel, chub, dace, roach, barbel, bleak, gudgeon, stone loach, three-spined stickleback, minnow, flounder, perch and bullhead. Additionally, in 2014 during a previous survey, Atlantic salmon were also recorded at Site ID 52484. Atlantic salmon is a European Commission Habitats Directive Annex II and V species, a species of Principal Importance under section 41 of the NERC Act 2006 and a UK BAP (2007) priority fish species.

Survey results

- 4.1.41. The RHS returned a habitat modification score of 3605 which indicates the reach is severely modified. Within the surveyed reach (centred on the River Chelt Culvert) the habitat modification score was driven by bank and bed resectioning, embankments and the presence of the River Chelt Culvert.
- 4.1.42. Downstream of the River Chelt Culvert (WCID10_MRS_J10_DS) – one 50 m MoRPH survey was conducted, which has a river condition of ‘Fairly Poor’, constrained by the brick reinforcement on both banks of the River Chelt associated with the pedantised footbridge that crosses the River Chelt, the presence of a large outfall (assumed to be from sewage treatment works in the area) and its associated concrete channel bed reinforcement.

Aquatic macroinvertebrates

- 4.1.43. 31 taxa were recorded at one sampling sites. Biological metrics are indicative of moderate water quality, high sensitivity to reduced flows and moderate channel sedimentation.

Aquatic macrophytes

- 4.1.44. Within the surveyed reach (immediately upstream of the River Chelt Culvert) 3% total cover of macrophytes was recorded in channel and 3% cover of filamentous algae. Species comprised fool’s watercress, floating sweet-grass, amphibious bistort, reed canary grass, a water crowfoot species (of the subgenus Batrachium) and brooklime. Additional marginal species were great willowherb, common horsetail, creeping bent, soft rush and lady’s thumb.

Fish

- 4.1.45. The surveyed reach (immediately upstream of the River Chelt Culvert) provided extensive glide and run habitat, with isolated areas of shallow riffle habitat. The most abundant species recorded was minnow, with bullhead also recorded in high densities. Three-spined stickleback, stone loach and chub were also present.

Table 4-4 - Water body photographs Chelt – M5 to conf. R. Severn

	
<p>Photo 9 (2022): Upstream view of the River Chelt approximately 0.6 km downstream of the M5 crossing. Aquatic plants can be seen within the channel with thick vegetation growth on both banks.</p>	<p>Photo 10 (2019): Downstream view of the River Chelt with more vegetation growth on both banks. Continuous tree cover on the left bank provides shade.</p>

Leigh Bk – source to conf. R. Chelt

- 4.1.46. At the time of survey, the Leigh Brook was a straightened agricultural drainage ditch with no perceptible flow and water width of 0.5 m. Historical mapping show little change in sinuosity back to 1945 before the M5 was constructed suggesting modifications to the channel have been due to agricultural management.

- 4.1.47. The channel was overgrown with scrub and tall herbs causing large amounts of shade over the channel. Deposition of fines on the bed and lack of sunlight meant there was minimal vegetation growth on the river bed however, banks are fully vegetated.
- 4.1.48. The stretch was depositional as there were no signs of erosion but large volumes of fines cover the bed. Cobbles were also seen in this stretch which could suggest flows can become high enough for transportation of larger sediments however, there is potential that some erosion of fine sediments has occurred leaving some larger substrates exposed.

Background records

- 4.1.49. No ecological monitoring data less than 5 years old are available for the water body.

Aquatic macroinvertebrates

- 4.1.50. One Environment Agency macroinvertebrate monitoring site (Environment Agency Site ID 48480) with survey data since 2010 is located within the water body. This site is located over 5 km downstream of the Order Limit. Most recent surveys at this site were undertaken in March and September 2014. Biotic indices indicate that the macroinvertebrate community was composed of taxa tolerant to organic pollution (WHPT ASPT 4.7 and 4.24), indicative of a sedimented bed (PSI 32.43 and 36.17) and moderately sensitive to reductions in flow (LIFE index 6.74 and 7.05).

Aquatic Macrophytes

- 4.1.51. Three Environment Agency macrophyte monitoring sites (Environment Agency Site ID 158245, 158246 and 158247), with survey data since 2010 are located within the water body. The closest of these sites to the Scheme is Environment Agency Site ID 158245 which is located approximately 2 km downstream of the Order limits. This site was most recently surveyed in September 2011 and the survey indicates that the plant community within the Leigh Brook typically comprised species associated with moderate to high nutrient levels and predominantly slow flow (RMNI 7.36 and RMHI 7.01).

Fish

- 4.1.52. No Environment Agency fish monitoring sites with survey since 2010 are located within the water body.

Survey results

- 4.1.53. The RHS returned a habitat modification score of 2120 which indicates the channel in this location is severely modified. The section is very uniform, it is fenced and lined with trees and heavily shaded throughout, there is an access track bridge in mid-section, at the time of the survey water levels were low enough that there were dry reaches and water was ponded in some parts. Channel vegetation is limited to a few scattered stands of fool's-watercress and some bittersweet.
- 4.1.54. Downstream of the Leigh Brook Culvert – one 50 m MoRPh survey was conducted on the Leigh Brook (Survey Code: WCID02_MRS, SO 90731 26052 - SO 90699 26074). The Leigh Brook at this location had a river condition of 'Fairly Poor', where riparian land-use, the presence of the Leigh Brook Culvert and lack of marginal/in-channel features constrained condition. The remaining length of the Leigh Brook within the Order limits could not be surveyed due to access constraints. As such, a river condition of 'Fairly Poor' has been applied due to the similarities in habitat characteristics recorded in the MoRPh survey.

Aquatic macroinvertebrates

- 4.1.55. 19 taxa were recorded within the sampling site on the Leigh Brook (downstream of the Leigh Brook Culvert). Biological metrics are indicative of poor water quality, low sensitivity to reduced flows and heavy sedimentation.

Aquatic macrophytes

- 4.1.56. Within the surveyed reach downstream of the Leigh Brook Culvert) <1% total cover of macrophytes was recorded in channel and 0% cover of filamentous algae. The only macrophyte species recorded were fool’s watercress and great willowherb.

Fish

- 4.1.57. No fish survey was undertaken within the Scheme area (where access was available) since the habitat in this location was not suitable for fish.

Table 4-5 - Water body photographs Leigh Bk – source to conf. R. Chelt

	
<p>Photo 11 (2019): Small Drainage ditch with culvert under access track. Channel is overgrown with vegetation and historically straightened. No obvious valley in this location.</p>	<p>Photo 12 (2019): View of hedge lined drainage ditch along an arable field boundary with approximately 5m agricultural field buffer along the bank. Dense vegetation was present on both banks and isolated trees on the left provided 80% shade. No perceivable flow at the time of survey.</p>
	
<p>Photo 13 (2019): Leigh Brook Culvert could not be seen upstream of the Leigh Brook Culvert due to overgrown vegetation. No perceptible flow at this location at the time of survey.</p>	<p>Photo 14 (2019): The channel was heavily shaded by dense scrub and woodland downstream of the Leigh Brook Culvert. The earth banks were shallow sloping and sparsely vegetated, and no vegetation was recorded within the channel. The channel was almost dry with some pools of standing water. Cattel poaching was recorded. (Image taken by ecology team: September 2019).</p>

Severn – conf R Avon to conf Upper Parting

- 4.1.58. No field survey was undertaken for the River Severn as there are likely to be no physical impacts to the water body as a result of the Scheme. A review of online, freely available data has been undertaken to understand the characteristics. These have included:
- Google Earth Pro.
 - Historic mapping.
 - Environment Agency flood maps.
- 4.1.59. The River Chelt joins the Severn south of Apperley approximately 8 km upstream of the tidal influence at Gloucester. This section of the River Severn has no distinguishable valley sides and is surrounded by lowland agriculture.
- 4.1.60. The River is largely lined by a narrow stretch of mature vegetation with some places cleared for anthropogenic uses and some places having larger sections of woodland. The river seems to be embanked along long sections. The channel in this reach has an approximate width of 60 m and smooth flow can be seen.
- 4.1.61. The Severn Estuary Special Area of Conservation (SAC) and Special Protection Area (SPA) is approximately 40 km downstream from the Scheme. The site is designated for estuary habitat comprised of mudflats, sandflats, lagoons and salt marshes. Fish species which are qualifying features are sea lamprey, river lamprey and thwaite shad. Whilst a significant distance from the Scheme the River Severn is the longest river in the UK and a key strategic watercourse. The tributary systems of the Severn are an integral part of supporting the wider catchment, particularly in regards to fish spawning and rearing grounds. In addition to the species listed as qualifying features of the SAC designation the River Severn is known to be important for Atlantic salmon, brown trout, European eel, and many coarse fish species¹⁰.

Ordinary Watercourses

- 4.1.62. There are several ordinary watercourses within close proximity to the Scheme shown in Figure 4-1 and Table 4-6.
- 4.1.64. The watercourses have been classified as ‘drains’ or ‘main watercourses’ (MW) to ensure consistency with the ecological assessment as part of the Environmental Impa Assessment (EIA). As part of the WFD compliance assessment, all watercourse within these two categories will be referred to as ordinary watercourses. Table 4- shows some representative photographs of ordinary watercourses taken from across th Scheme.
- 4.1.65. Drainage ditches across the Scheme are surrounded by agricultural land and have been over deepened and straightened for agricultural purposes or highways drainage. There are fine sediments seen on the bed with no perceptible flow in the majority of watercourse seen. Vegetative debris has also been deposited along the stretch of channel with th majority overgrown with vegetation.
- 4.1.66. No recent Environment Agency monitoring data are available on these ordinary watercourses.

Table 4-6 - Ordinary watercourses within proximity to the Scheme

Chelt - source to M5 (GB109054032820)	Chelt - M5 to conf. R. Severn (GB109054032810)	Leigh Bk - source to conf. R. Chelt (GB109054039770)*
MW5	MW3	Drain 3
Drain 21	MW4	Drain 4
Uckington Moat	Drain 12	Drain 5
	Drain 13a	Drain 6
	Drain 14	Drain 7

¹⁰ Further information on the fish found within the River Severn can be found at: <https://www.unlockingthesevern.co.uk/our-river/fish-of-the-severn/> (accessed 13/8/2021).

	Drain 15	Drain 8
	Drain 16	Drain 9
	Drain 17	Drain 10
	Drain 19	Drain 11
	Drain 20	Drain 13

*Due to the progression through the PCF process and the development and subsequent removal of different highway options, the numbering of drains is not continuous. This is a result of some watercourses which were included at the options appraisal stage, not interacting with this option. Therefore, they are not included in this assessment (e.g. Drains 1 and 2 were considered for previous options which have not been selected as preferred and are not considered within this assessment). The numbering system has not been updated to ensure consistency with previous assessments.

Table 4-7 - Representative photographs ordinary watercourses

	
<p>Photo 15 (2019): Image of Drain 10 form public footpath over bridge. The channel was overgrown and over deepened. Himalayan Balsam was present. This watercourse flowed alongside the A409 and is straightened throughout.</p>	<p>Photo 16 (2019): Drain 12 upstream of Withybridge Lane. There was no flow within the channel and large woody features were present, blocking the channel.</p>
	
<p>Photo 17 (2019): MW3 downstream of the M5 which acted as agricultural drainage. The Channel was over deep and overgrown with vegetation. There was no perceivable flow at this location.</p>	<p>Photo 18 (2019): Drain 18 at its source alongside Hayden Lane. The channel was overgrown with vegetation and there was no perceptible flow. There were fine sediments on the bed and vegetation on both banks.</p>

Figure 4-1 - Watercourses within close proximity to the Scheme

Figure provided in Appendix 8.2C at the end of this document.

- 4.1.67. Scoping of surface water receptors is outlined in section 4.5 following the identification of Scheme activities.
- 4.1.68. There are no designated sites within the surface water study area. The Coombe Hill Canal is an SSSI which lies approximately 1.7 km overland to the west of the Scheme. The Site is down slope of the Scheme but is not within a downstream catchment as the A38 lies on an elevated ridge which forms a barrier to surface water flow pathways which are crossed by the Scheme. In times of high flows, the River Chelt is hydrologically connected to the Coombe Hill Canal due to overtopping of the banks approximately 7 km downstream of the M5. Water flows overland towards the canal. Due to the distance downstream, and conditions under which connectivity occurs (i.e. high flows and significant dilution), this site is not expected to experience any significant effects from the Scheme.

4.2. Groundwater Baseline

Geology and hydrogeology

- 4.2.1. Mapped geological conditions have been identified using online publicly available data from the British Geological Survey (BGS) Geology of Britain Viewer¹¹. This has been confirmed with data from site specific ground investigations.
- 4.2.2. 1:50,000 bedrock geology mapping indicates that the Zol is underlain predominantly by the Charmouth Mudstone Formation with a small area of the Rugby Limestone Member on its western edge. Superficial mapping indicates that the Zol is underlain by areas of Alluvium and Cheltenham Sand and Gravel (river terrace deposits). The mapped bedrock geology at a 1:50,000 scale is presented in Figure 4-2. Lithological descriptions of both superficial deposits and bedrock geology and a generalised geological sequence are provided in Table 4 8.
- 4.2.3. Site specific ground investigation was conducted in the Zol and is summarised in full in the M5 J10 Ground Investigation Report (GIR) (application document TR010063 - APP 6.15). Ground investigation data is broadly consistent with the mapped geology. It confirmed the presence of Charmouth Mudstone bedrock throughout the majority of the Zol. The Rugby Limestone member was not explicitly confirmed, however in the western most extremity of the Zol calcareous/limestone lithologies were identified in borehole logs. Site specific ground investigation data showed the lateral extent of superficial deposits to be slightly greater than the mapped extent. However due to the position of ground investigations the spatial extent of superficial deposits were not confirmed in eastern and western most extremities of the Scheme alignment. Borehole logs confirmed the presence of Alluvium on top of the Cheltenham Sands ranging from 0 – 2.7 m and 0 – 2.4 m thickness, respectively.
- 4.2.4. Lithological descriptions of both superficial and bedrock geology and a generalised geological sequence are provided in Table 4-8. Further detail particularly regarding made ground, soils and local geology can be found in Chapter 10 of the ES: Geology and Soils (application document TR010063 – APP 6.8).

Table 4-8 - Generalised geological sequence for the Scheme

Type	Period	Formation/ Sub-unit	Lithological Description ¹¹	Environment Agency Aquifer Designation ¹²
Superficial Geology	Quaternary	Cheltenham Sand and Gravel	Fine-medium grained of quartzose sand with seams of poorly sorted limestone gravel.	Secondary A

¹¹ BGS, 2021. Geology Of Britain Viewer | British Geological Survey (BGS). [online] Mapapps.bgs.ac.uk. Available at: <https://mapapps.bgs.ac.uk/geologyofbritain/home.html> [Accessed 25th Aug. 2022].

¹² Environment Agency, 2021. Environment Agency - Aquifers. [online] Apps.environment-agency.gov.uk. Available at: <http://apps.environment-agency.gov.uk/wiyby/117020.aspx> [Accessed 10 Nov. 2020]

Type	Period	Formation/ Sub-unit	Lithological Description ¹¹	Environment Agency Aquifer Designation ¹²
		Alluvium	Unconsolidated clay, sand and silt.	Secondary A
Bedrock Geology	Triassic	Charmouth Mudstone Formation	Dark grey laminated shales, blue/grey mudstones with local concretions and argillaceous limestone beds with some sandy layers at the base of the stratigraphy.	Secondary Undifferentiated
		Rugby Limestone Member	Grey argillaceous mudstones and limestones.	Secondary A

- 4.2.5. Groundwater level data is available from the site specific ground investigation. Monthly groundwater levels are available for the study area at 14 locations between August 2021 and February 2022 (Table 4-9). Nine were installed in the mudstone, three in the shallow superfcials and one paired install for both shallow superfcials and bedrock. These range between 0.11 and 5.98 mbgl, with an average of 1.59 mbgl. During the monitoring period groundwater levels fluctuated a minimum of 0.11 m, maximum of 5.58 m and average of 1.43 m. Locations of these monitoring locations can be found in Appendix 10.8 - Geology and soils chapter figures (application document TR010063 – APP 6.15).
- 4.2.6. Shallow groundwater in the superficial deposits is interpreted to flow broadly east to west, following topography and likely discharges to the River Chelt, again, as expected.

Figure 4-2 – Geology and groundwater bodies

Figure provided in Appendix 8.2C at the end of this document.

Table 4-9 - Groundwater level data within the Zol

Monitor ed formati on	A4019_BH001		A4019_BH002		A4019_BH010		LR_BH002		LR_BH007		LR_BH012		LR_BH018A		LR_BH024		LR_BH026		M5_BH014		M5_BH027		M5_BH032		WL_WS002		WL_WS004	
	mbgl	maod	mbgl	maod	mbgl	maod	mbgl	maod	mbgl	maod	mbgl	maod	mbgl	maod	mbgl	maod	mbgl	maod	mbgl	maod	mbgl	maod	mbgl	maod	mbgl	maod	mbgl	maod
Charmouth Mudstone			Cheltenham Sands and Gravels*/ Charmouth Mudstone**		Cheltenham Sands and Gravels & Upper Charmouth Mudstone		Charmouth Mudstone		Charmouth Mudstone		Charmouth Mudstone		Cheltenham Sands and Gravels & Charmouth Mudstone		Charmouth Mudstone		Charmouth Mudstone		Charmouth Mudstone		Charmouth Mudstone		Cheltenham Sands and Gravels & Charmouth Mudstone		Charmouth Mudstone		Cheltenham Sands and Gravels and Alluvium	
Units																												
Datum	-	26.2	-	26.85	-	33.9	-	27.00	-	26.95	-	26.95	-	27.91	-	27.5	-	26.4	-	23.91	-	26.85	-	23.3	-	25.35	-	24.7
13/08/2021	-	-	-	-	-	-	3.71	23	1.29	25.66	1.45	25.5	2.52	25.39	1.33	26.17	1.65	24.75	-	-	2.43	24.42	1.7	21.6	-	-	-	-
20/09/2021	1.1	25.1	1.34* / 1.45**	25.51* / 25.4**	1.67	32.23	3.16	23.84	1.3	25.65	1.6	25.35	2.48	25.43	1.62	25.88	1.41	24.99	1.3	22.61	2.23	24.62	1.6	21.7	-	-	-	-
05/10/2021	2.87	23.33	0.75* / 1.10**	26.1**/2 5.75**	1.43	32.47	3.48	23.52	0.11	26.84	1.68	25.27	2.12	25.79	1.51	25.99	1.28	25.12	1.72	22.19	2.29	24.56	1.31	21.99	-	-	-	-
19/10/2021	2.61	23.59	0.71* / 0.90**	26.14**/ 25.95**	3.62	30.28	2.91	24.09	0.91	26.04	0.4	26.55	2.43	25.48	0.9	26.6	1.15	25.25	1.55	22.36	2.4	24.45	1	22.3	-	-	-	-
22/11/2021	2.67	23.53	0.22* / 1.87**	26.63**/ 24.98**	1.42	32.48	1.94	25.06	0.92	26.03	1.35	25.6	2.12	25.79	1.32	26.18	1.04	25.36	1.41	22.5	2.27	24.58	0.8	22.5	-	-	-	-
13/12/2021	3.16	23.04	0.30* / 0.78**	26.55**/ 26.07**	1.3	32.6	1.24	25.76	0.96	25.99	2.88	24.07	2.24	25.67	1.51	25.99	0.91	25.49	1.25	22.66	2.05	24.8	0.45	22.85	0.49	24.86	0.87	23.83
24/01/2022	3	23.2	0.37* / 0.70**	26.48**/ 26.15**	1.22	32.68	1.86	25.14	0.89	26.06	1.31	25.64	2.3	25.61	1.32	26.18	0.96	25.44	1.28	22.63	2	24.85	0.7	22.6	0.72	24.63	0.98	23.72
14/02/2022	2.95	23.25	1.67* / 0.61**	25.18**/ 26.24**	1.25	32.65	1.44	25.56	0.82	26.13	5.98	20.97	1.83	26.08	1.33	26.17	0.75	25.65	1.2	22.71	1.86	24.99	0.35	22.95	0.39	24.96	0.56	24.14

WFD groundwater bodies

- 4.2.7. The following two WFD groundwater bodies (as identified in Table 3-1 and Figure 3-2) are included in this scoping assessment:
- Severn Vale - Secondary Combined (GB40902G204900).
 - Warwickshire Avon - Secondary Mudrocks (GB40902G990900).
- 4.2.8. The WFD groundwater bodies are situated within the Severn RBD and within the Severn England GW Management Catchment.
- 4.2.9. The current (2019, Cycle 2) status for the WFD groundwater bodies are presented in Table 4-10. The table also summarises the objectives, RNAG and linked protected areas set by the Environment Agency.
- 4.2.10. There are no mitigation measures in place within the water body summary sheets for the two groundwater bodies. There are no Groundwater Dependent Terrestrial Ecosystems (GWDTEs) within 1 km of the Scheme. The Coombe Hill Canal SSSI is a GWDTE located just to the west of the 1 km Zol. However, as it overlies the Triassic Branscombe Mudstone Formation, a different aquifer to that underlying the study area, it has not been assessed further in relation to groundwater effects.

Table 4-10 - Summary of WFD information for the two scoped groundwater bodies

Water Body Name	Severn Vale - Secondary Combined	Warwickshire Avon - Secondary Mudrocks
Water Body ID	GB40902G204900	GB40902G990900
Classification (2019 Cycle 2)	Good	Good
Objectives	Achieved at Good	Achieved at Good
Overall water body	Good	Good
Quantitative	Good	Good
Quantitative status element	Good	Good
Saline intrusion	Good	Good
Water Balance	Good	Good
GWDTEs test	Good	Good
Dependant surface water body status	Good	Good
Chemical	Good	Good
Chemical status element	Good	Good
Drinking water protected areas	Good	Good
General chemical test	Good	Good
GWDTEs test	Good	Good
Dependant surface water body status	Good	Good
Saline intrusion	Good	Good
RNAG (2019)	N/A – already at Good status	N/A – already at Good status
Linked Protected Areas*	Nitrates Directive: Cotswold Jurassic G83, Hereford, England G4, Newent G38 Drinking Water protected Area:	Nitrates Directive: Coventry G36 West Midlands G29 Warmington G82 Offenham G163 Cotswold Jurassic G83

Water Body Name	Severn Vale - Secondary Combined	Warwickshire Avon - Secondary Mudrocks
	Severn Vale - Secondary Combined	Balscote G164 Drinking Water protected Area: Warwickshire Avon - Secondary Mudrocks

*Linked Protected Areas may fall within the Water body but not specifically within the Zol for this Scheme

Groundwater designations, abstractions and discharges

- 4.2.11. There are no Source Protection Zones (SPZ) within 1 km of the Scheme.
- 4.2.12. There are no licensed groundwater abstractions within the Zol. However, there is a single groundwater discharge located approximately 250 m from the Scheme. Tewkesbury Borough Council supplied a review of private abstractions and discharges within 1 km of the Order limits which shows no private abstractions.

4.3. Permanent Scheme activities

- 4.3.1. The permanent Scheme activities have been outlined based on preliminary drawings as part of the current design (General arrangement plans: application document TR010063 – APP 2.9). The activities are detailed in the section below and summarised in Table 4-11. The mechanisms of impact have also been identified within the detailed impact assessment spreadsheets (Appendix 8.2A and Appendix 8.2B).
- 4.3.2. At this stage of the assessment, all permanent Scheme activities are scoped into the Impact assessment.
- **Link Road River Chelt Bridge:** A bridge will cross the River Chelt at NGR: SO 90759 24600 with a total bridge deck width of 20.8 m. The associated abutments will be set back from the river bank top at a minimum of 4 m. Existing active bank erosion, combined with potential high stream powers mean the need for bank protection is likely, along all or part of the river banks through the structure. The bank protection will ensure the river banks are stable and do not retreat, potentially encroaching on the adjacent access tracks and bridge abutments. At this stage, the details of the bank protection have not been determined. However, given the lack of sunlight from the above bridge deck, reducing vegetation growth, it has been assumed this would comprise hard bank protection (e.g. rip-rap or non-biodegradable geotextile) as a worst case scenario. This has also been applied across the length of the proposed abutments on both banks of the River Chelt. Green infrastructure would be used to tie in and transition from the grey bank protection to the natural (reprofiled) banks. At the detailed design stage, further assessment and consultation with the Environment Agency will determine the most pragmatic solution and confirm the need for bank protection, specify the materials and general arrangement which will endeavour to minimise and, where possible, exclude hard bank protection. Where this is not possible further measures to mitigate for this will be explored, such as naturalised toe frontages comprising wood etc.
 - **River Chelt Culvert:** The Scheme has been designed so that there are no changes to the existing culvert dimensions (NGR: SO 90021 24816). The only change will be the installation of a mammal ledge through the culvert. This culvert sits on the southern extent of the carriageway widening due to the installation of the southern slip roads. In the current design, the slip roads and associated verge embankments tie into the existing earthworks just north of the culvert. The Order Limit has been extended 100m upstream and downstream of this crossing with a width of 10m on either side of the bank top to allow for implementation of appropriate mitigation at the next stage of assessment.

- **Leigh Brook Culvert:** The Leigh Brook culvert will be extended from 53.525m to 69.875m to accommodate the installation of the two northern slip roads (NGR: SO 90758 26014).
- **Piffs Elm Culvert:** The culvert will be extended from 47.54m to 147.69m to accommodate the southern slip roads (NGR: SO 90383 25494).
- **Link Road flood culverts:** The link road currently crosses the River Chelt flood zone. To allow for flood flows to cross below the link road, two groups of culverts will be installed. One of these culverts will be implemented at the location of Drain 12 with dimensions 31.85m length. The ditch is likely to be realigned to run perpendicular to the link road.
- **Encroachment of drainage channels:** At several locations across the Scheme, drainage ditches may be relocated due to encroachment from road widening and embankment. Table 4-11 outlines ditches which are likely to be impacted. These ditches will be replaced with like for like habitats as a minimum. The details of these replacements have been highlighted as part of the Drainage Plans (Appendix 2.2 - application document TR010063 - APP 6..15) and Environmental Masterplans (application document TR010063 – APP 2.13) – see embedded mitigation in section 5.2.
- **Existing culvert extensions:** At several locations across the Scheme, there will be a loss of open ditch due to small scale culvert extensions. Table 4-11 outlines watercourses which are likely to be impacted.
- **Drainage:** A drainage strategy has been put into place to allow for management of volumes and quality of any surface runoff. The drainage strategy consists of six attenuation basins along the M5, A4019 and the link road. Details of the designs are summarised below. For further details refer to the Drainage Strategy Report (Appendix 2.1).
 - **M5 J10 and A4019:** Collection systems are to be a kerb and gully arrangement or combined drainage and kerbs as per the existing arrangement. Flows will be conveyed via pipes to new basins prior to discharge to watercourses via new ditches for at least 8m upstream of the outfalls, where feasible. Due to several private land parcels along the A4019 being retained, there is limited space to add additional open ditch features or swales. Flows are to be restricted to existing rates. Basins will include forebay areas to manage contaminants and contain spillages.
 - **Link Road:** The link road includes road side swales to collect runoff and convey it to new basins. Outgoing pipes from basins will discharge to new ditches at least 8m upstream of the outfalls. Flows are to be restricted to greenfield runoff rates. Ponds will include forebay areas to manage contaminants and contain spillages.
 - **Old Gloucestershire Road:** Changes to the B4634 Old Gloucester Road junction will result in a new drainage arrangement being required. The majority of runoff is proposed to be collected and attenuated within road side swales prior to discharge to ditches. Some other areas will be served by a kerb and gully arrangement with piped outfalls to ditches where swales are no feasible.
 - **S1 South:** There is no change in the existing mitigation for this catchment, discharge will flow through vegetated ditches prior to entering the River Chelt.
 - **M5 South of the River Chelt carriageway:** There is no change in the drainage layout of this catchment, therefore, no additional mitigation will be implemented. It has been included in the water quality assessment as part of the cumulative impact assessment on the river Chelt.
- **Flood compensation and A4019 culvert removal:** a flood storage area will be created to the south east of the M5 Junction 10 roundabout. The storage area will offset flood zones lost due to the elevated roundabout and associated embankments. The elevation of the A4019 will sever flood flows which currently flow from the River Chelt catchment northward over the A4019 to the Leigh Brook

catchment during the 100 year + climate change event and above. The twin culverts under the A4019 will be removed. These culverts currently carry flow from a small section (approximately 0.07km²) of the Leigh Brook catchment south of the A4019, to the main channel at the Leigh Brook culvert in the 100 year + climate change event and higher. As a result of the A4019 elevation and removal of the culverts, the peak flow in the Leigh Brook culvert will be reduced from 9.4m³/s to 3.2 m³/s in the 100 year + CC event.

- **Embankments:** Current designs show the M5 Junction 10 and link road to be strongly elevated, particularly at Piffs Elms Interchange and the River Chelt crossing. No significant cuttings were identified in the Scheme designs. Exact details on earthwork (embankment) type for raising the highway is not specified however a suite of options from shallow (non-reinforced) to steep (reinforced) embankment styles were identified. For the purpose of the WFD assessment the most intrusive embankment type was selected for assessment as part of a cautious approach. The most intrusive option includes a reinforced slope with a strip of foundation ~1 m in depth along the length of the embankment. Foundations are likely to comprise of impermeable substances and are continuous (i.e. sheet-like) in nature.
- **Piffs Elm Interchange Bridge (North and South):** Piling activities and designs throughout the Scheme have been identified and assessed as part of the WFD scoping. Piling will be concrete bore piling and will likely extend to 13 mbgl with ~1 m spacing between each bore. This piling is in the detailed design for the Link Road River Chelt Bridge, Piffs Elm Interchange Bridge North and Piffs Elm Interchange Bridge South. Details of these structures can be found in the Engineering Drawings and Sections (application document TR010063 – APP 2.10).

Table 4-11 - Summary of Scheme activities and mechanisms of impact

Scheme Activity	WFD water body	Receptor	Mechanism of impact pre-embedded mitigation
Link Road River Chelt Bridge	Chelt – source to M5	River Chelt	Direct loss or alteration to open channel Habitat severance Shading
	Severn Vale - Secondary Combined	Superficial Secondary A aquifer Bedrock Secondary (Undifferentiated) aquifer	Barriers to groundwater flow Groundwater control Creating or altering pathways between surface and aquifer Remobilising existing contamination
River Chelt Culvert	Chelt – source to M5	River Chelt	No direct impacts expected due to culvert being retained and dimensions unmodified.
	Chelt – M5 to conf. R. Severn		
Leigh Brook Culvert extension	Leigh Bk – source to conf. R. Chelt	Leigh Brook	Direct loss or alteration of open channel Habitat severance
Piffs Elm Culvert extension	Chelt – M5 to conf. R. Severn	Drain 22	Direct loss or alteration of open channel Habitat severance
Link road flood culverts	Chelt – M5 to conf. R. Severn	Drain 12	Direct loss or alteration of open channel

Scheme Activity	WFD water body	Receptor	Mechanism of impact pre-embedded mitigation
			Habitat severance
Encroachment of drainage channels	All surface water bodies	Drain 8 Drain 9 Drain 10 Drain 11 Drain 16	Direct loss or alteration of open channel
Existing culvert extensions	All surface water bodies	Drain 8 Drain 10 Drain 15	Direct loss or alteration of open channel Habitat severance
Drainage	All surface water bodies	River Chelt Leigh Brook MW3 Drain 8 Drain 15 Drain 21	Changes in surface water runoff
Flood storage	Leigh Bk – source to conf. R. Chelt	Leigh Brook Drain 22	Changes in flood mechanisms within the surface water bodies
	Severn Vale - Secondary Combined	Charmouth Mudstone bedrock and superficial deposits comprising Alluvium and Cheltenham Sands and Gravels	Barriers to groundwater flow Groundwater control Creating or altering pathways between surface and aquifer Remobilising existing contamination
Embankments	Severn Vale - Secondary Combined and Warwickshire Avon - Secondary Mudrocks	Secondary A and Secondary undifferentiated aquifer	Barriers to groundwater flow Groundwater control Creating or altering pathways between surface and aquifer Remobilising existing contamination
Piffs Elm Interchange North Bridge	Severn Vale - Secondary Combined	Secondary A and Secondary undifferentiated aquifer	Barriers to groundwater flow Groundwater control Creating or altering pathways between surface and aquifer Remobilising existing contamination
Piffs Elm Interchange South Bridge	Severn Vale - Secondary Combined	Secondary A and Secondary undifferentiated aquifer	Barriers to groundwater flow Groundwater control Creating or altering pathways between surface and aquifer Remobilising existing contamination

4.3.3. All Scheme activities are scoped into the next stage of the assessment where embedded mitigation will be outlined and an impact assessment completed.

4.4. Temporary Scheme activities

4.4.1. A list of temporary works which have the potential to impact the water environment are listed below.

- Construction of Link Road River Chelt Bridge will require a temporary bridge which will be constructed upstream of the new permanent structure. The construction and operation of the temporary bridge and the construction of the permanent bridge may cause temporary damage to riparian and channel features and habitats. The noise produced and potential in channel works associated with these activities could result in impacts to local fish species including Brown Trout, European Eel and River Lamprey.
- Construction associated with culvert replacements and extensions (for example the lengthening of the Leigh Brook and Piffs Elm Culverts) may result in a) localised damage to channel and riparian features and b) disruption of the natural hydraulic and sediment transport processes. For the Leigh Brook specifically, temporary over-pumping will be required.
- Realignment of minor watercourses to connect to new culverts or extended old culverts, for example the drain 14 and 15 along the B4634, presents a risk of damage to channel features, substrate and riparian zones.
- Realignment of ephemeral drainage ditches due to construction of Scheme components may result in temporary habitat loss, for example the construction of the Link Road-B4634 junction.
- The excavation of materials, and the subsequent deposition of soils, sediment, or other construction materials, for example through the creation of SuDS basins which are proposed at various locations including the combined basin and flood storage area.
- The spillage of fuels or other contaminating liquids from plant used in the construction process, for example, during the construction of the Link Road River Chelt Bridge.
- The mobilisation of contamination following the disturbance of contaminated ground or groundwater, for example through earth movement during the construction of the Link Road.
- Runoff from construction sites to surface water bodies, for example where construction works are immediately adjacent to a watercourse such as the Link Road construction immediately adjacent to the River Chelt.
- Disturbance of non-native invasive species - construction activities can result in the spread along surface water bodies and their riparian zone, for example through the construction of bridges and construction/modification of culverts.
- Risks to the groundwater environment are associated with the spillage of fuels or other contaminating liquids, introduction of rapid vertical flow paths from surface to groundwater and local changes to groundwater flow associated with piling activities.

4.5. Scoping outcomes

4.5.1. Water receptors have been scoped out based on the baseline information provided in sections 4.1 and 4.2 and, details of the Scheme activities outlined in sections 4.3.

4.5.2. Of the WFD water bodies the Severn – conf R Avon to conf Upper Parting is the only water body which is scoped out of further assessment. This is due to the Scheme activities having no direct impact to fish passage, with no new culverts or culvert extensions within the water body. No measurable effects on fish are anticipated as a result of works upstream on connected watercourses/water bodies with suitable fish habitat; since no permanent barriers to migration are being implemented. In addition, the design of the

drainage strategy, including mitigation, is expected to manage water quality such that impacts are not expected at this distance downstream (approximately 8 km).

- 4.5.3. Ordinary watercourses have been scoped out where they are not directly crossed by the Scheme alignment or hydrologically connected downstream from the Scheme alignment.
- 4.5.4. Due to the Scheme activities outlined above, both groundwater bodies are scoped into the next stage of the assessment.
- 4.5.5. The Scoping outcomes are presented in Table 4-12.

Table 4-12 - Surface water and groundwater scoping summary

Receptor	Scoped in/out	Reason for scoping out
Chelt - source to M5 (GB109054032820)	In	N/A
Chelt - M5 to conf. R. Severn (GB109054032810)	In	N/A
Leigh Bk - source to conf. R. Chelt (GB109054039770)	In	N/A
Severn – conf R Avon to conf Upper Parting	Out	The impacts from the Scheme activities are not expected to propagate this distance downstream. This includes impact from water quality and fish passage within connected water bodies: the installation of bank protection is unlikely to impact fish migration patterns or habitats. There are no other impacts which are likely to result in changes to fish migratory patterns or habitats.
Severn Vale - Secondary Combined	In	N/A
Warwickshire Avon - Secondary Mudrocks	In	N/A
MW3	In	N/A
MW4	Out	No hydrological connectivity to the Scheme alignment
MW5	Out	No hydrological connectivity to the Scheme alignment
Drain 3	Out	No hydrological connectivity to the Scheme alignment
Drain 4	Out	No hydrological connectivity to the Scheme alignment
Drain 5	Out	No hydrological connectivity to the Scheme alignment
Drain 6	In	N/A
Drain 7	Out	No hydrological connectivity to the Scheme alignment
Drain 8	In	N/A
Drain 9	In	N/A
Drain 10	In	N/A
Drain 11	In	N/A
Drain 12	In	N/A
Drain 13	Out	No hydrological connectivity to the Scheme alignment
Drain 13a	Out	No hydrological connectivity to the Scheme alignment

Receptor	Scoped in/out	Reason for scoping out
Drain 14	Out	Although within the Scheme alignment, no physical, alterations expected and no change in discharge.
Drain 15	In	N/A
Drain 16	In	N/A
Drain 17	Out	No hydrological connectivity to the Scheme alignment
Drain 19	Out	No hydrological connectivity to the Scheme alignment
Drain 20	In	N/A
Drain 21	In	N/A
Uckington Moat	Out	No hydrological connectivity to the Scheme alignment

5. Impact Assessment

5.1. Introduction

- 5.1.1. A detailed assessment of the impacts of the Scheme on the WFD water bodies has been completed and can be found in Appendix 8.2A and Appendix 8.2B (application document TR010063 - APP 6.15).
- 5.1.2. The assessments are based on the Scheme activities outlined in section 4.3 and embedded mitigation presented in section 5.2. They cover both Test A (no deterioration) and Test B (protecting future attainment of GES/GEP). They present the effect of Scheme components on WFD quality elements, on a temporary and permanent basis, using the colour coding described in section 2.4. Assessments are aggregated based on the WFD principle of “one out, all out” to eventually determine the effect of the Scheme at a water body scale.

5.2. Embedded mitigation

- 5.2.1. Embedded mitigation is defined as mitigation which has been captured as part of the current design. Mitigation for impacts to watercourses has been implemented to ensure compliance with the WFD (Test A and Test B) and to align with BNG requirements.
- 5.2.2. Embedded mitigation for permanent Scheme activities are outlined in Table 5-1 where the driving factors for implementation have been outlined. These mitigation measures have been captured as part of the Register of Environmental Actions and Commitments (REAC) (application document TR010063 – APP 7.4).
- 5.2.3. Additional mitigation is that which will be included in the next stage of design to mitigate any significant impacts. If the Scheme is not compliant with Test A and Test B, additional mitigation will be required to reach compliance. Additional mitigation is outlined in section 6.2.

Table 5-1 - Embedded mitigation

Mitigation	Description	Driving Factors	Receptors benefiting from mitigation
Link Road River Chelt Bridge	<p>The new structure has been designed to be a bridge with no in channel abutments. A bridge has been incorporated into the design to reduce impacts on habitats, fish passage and hydromorphology.</p> <p>In the sections 160 m upstream and 100m downstream of the River Chelt Link Road crossing and 100 m up stream of the M5 Culvert mitigation measures have been implemented to mitigate hydromorphological and ecological impacts on the River Chelt. These include:</p> <ul style="list-style-type: none"> Enhanced riparian and marginal aquatic planting to enhance biodiversity and allow for dappled lighting. Bank reprofiling or the creation of berms and two stage channels to enhance flood 	<p>Mitigation required to offset impacts to the Environment Agency’s Mitigation Measures as outlined in Table 4-2.</p> <p>These mitigation measures also support BNG requirements.</p>	River Chelt

Mitigation	Description	Driving Factors	Receptors benefiting from mitigation
	<p>plain connectivity (application document TR010063 – APP 2.13).</p> <ul style="list-style-type: none"> Installation of in channel morphological enhancements for example: riffle pool sequences and/or large wood/woody debris. <p>These opportunities align with the in channel morphological diversity, bank rehabilitation, set bank embankments, enhance ecology, and woody debris mitigation measures proposed as part of the River Chelt – Source to M5 Mitigation Measures and will help towards the attainment of GEP. Mitigation also includes further work at the detailed design stage to 'soften' any requirements for bank protection as outlined in section 4.3.2.</p>		
River Chelt Culvert	The Scheme design has been adjusted to ensure there are no alterations to the culvert dimensions or the channel.	Mitigation required to offset impacts to the Environment Agencies Mitigation Measures as outlined in Table 4-2.	River Chelt
Leigh Brook Culvert	<p>On the Leigh Brook, downstream of the Leigh Brook culvert, a section of approximately 200 m of channel will be enhanced through:</p> <ul style="list-style-type: none"> Bank reprofiling. Vegetation management. Installation of large wood. 	The mitigation here has been included to align with BNG requirements.	Leigh Brook
Like for like replacement of drainage ditches across the Scheme	As part of the Drainage Plans and Environment Plans (ES Appendix 2.1 and application document TR010063 – APP 2.13), ditches will be implemented along the base of all embankments. The ditches will replace any which have been lost due to encroachment with a like for like habitat as a minimum and sown with wet grassland mix. These measures will mitigate against changes to water body	Implemented to support WFD compliance. This is also a requirement of BNG to ensure no net loss of ditch habitat.	Drain 8 Drain 9 Drain 10 Drain 11 Drain 16 Drain 20

Mitigation	Description	Driving Factors	Receptors benefiting from mitigation
	hydromorphology and vegetation management.		
Vegetation management and Environment Plans (application document TR010063 – APP 2.13).	Environment Plans have been produced to ensure that permanent vegetation management is considered. These plans will mitigate against permanent vegetation loss upstream and downstream of any existing or new crossings. These plans will not impact the direct loss of habitat. These plans align with those considered for hydromorphological improvements.	Included as part of the WFD assessment to work towards the Environment Agency Mitigation Measures outlined in Table 4-2.	River Chelt Leigh Brook Piffs Elm Drain 8 Drain 9 Drain 10 Drain 11 Drain 12 Drain 14 Drain 15 Drain 16 Drain 20 Drain 21
Drainage strategy	The drainage strategy has followed the CIRIA guidance ¹³ and currently consists of six drainage ponds and swales along the Link Road. Flows from the drainage ponds will be restricted to greenfield runoff rates reducing any impact to the quantity of water within the receiving water courses. These mitigation measures have been included in accordance with the HEWRAT assessment. Results of the HEWRAT assessment are presented in the Water Chapter of the ES and the Surface Water Quality Assessment (application document TR010063 – APP 6.6 and TR010063 - APP 6.15 respectively). As part of the drainage strategy, where space allows, ditches have been given a sinuous planform to improve hydromorphological and biological diversity.	Requirement for WFD compliance to ensure no impact to water quality	River Chelt Leigh Brook Ditches feeding the Leigh Brook and River Chelt which include: Drain 15 Drain 8 Drain 10 Drain 11 Drain 21 MW3
Enhanced drainage ponds	Environmental Plans (application document TR010063 – APP 2.13) show that the drainage design includes six ponds which will be designed to allow for biological enhancements. This will include features such as submerged and marginal planting; variations in bed topography; shallow bank slopes to	Included to support the Environment Agency Mitigation Measures to enhance ecology as outlined in Table 4-2.	All WFD surface water catchments

¹³ CIRIA, 2010. Culvert design and operation guide (C689). London: CIRIA
 CIRIA, 2015. The SuDS Manual (C753). [online]. Available at:
https://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx [Accessed 29 April 2018]

Mitigation	Description	Driving Factors	Receptors benefiting from mitigation
	create drawdown zones; island features; and marginal shelves. Additional surrounding planting will also be included to help embed the pond into the landscape.		
Culvert design	Where new culverts or culvert extensions are proposed, design principles have been implemented to include: <ul style="list-style-type: none"> • Minimising the length, for instance by incorporating wingwalls into the design. • Minimising impact of the structure on natural flow and sediment process. • Where appropriate, mammal shelves will be implemented (application document TR010063 – APP 6.5). • Natural bed substrate will be retained, with the invert of the culverts will be set below natural bed level at both ends at 300mm depth. • Special consideration will be made to culvert extensions to ensure new materials tie in to existing and where the same materials can't be used, the design will work to ensure flow and sediment continuity is not impacted by change of material. 	Requirement for WFD compliance to ensure no impact to hydromorphology	Leigh Brook Piffs Elm Drain 12 Drain 13 Drain 16 Drain 19
Enhanced flood storage area	Environmental Plans (application document TR010063 – APP 2.13) show that the flood storage area between the M5 carriageway and the link road will be enhanced to gain environmental benefits. The area will include sections of permanent wetland which will include marginal planting, seeding of wetland grass and scattered scrub which will be allowed to naturalise over a monitoring period of two years prior to production of a management regime to suit the development conditions and habitats while functioning as a flood storage area.	Included to support the Environment Agency Mitigation Measures to enhance ecology as outlined in Table 4-2.	River Chelt catchment and floodplain connectivity

Mitigation	Description	Driving Factors	Receptors benefiting from mitigation
Groundwater mitigation measures for the Severn Vale and Warwickshire Mudrock	<p>Bore piles have >1 m distance between each pile instead of continuous sheet piling.</p> <p>A piling risk assessment will be completed at the detailed design stage to ensure the selected piling method will not introduce contamination pathways into the aquifer.</p> <p>The site-specific geology information and groundwater level data obtained from intrusive ground investigation for the Scheme has been taken into account in the design.</p>	Mitigation has been included to ensure WFD compliance in relation to impacts to groundwater bodies.	Both WFD groundwater bodies

Mitigation against temporary impacts

- 5.2.4. A 1st iteration Environmental Management Plan (EMP) (application document TR010063 – APP 7.3) has been completed at this preliminary design stage. This outlines all the mitigation required to mitigate all temporary impacts to a level which will not cause any significant impacts.
- 5.2.5. The EMP will be updated at the detailed design and construction stages (2nd iteration and 3rd iteration) and the mitigation measures outlined below will be secured as part of the 3rd iteration EMP.
- 5.2.6. Works will proceed following standard good practice working methods for environmental protection which will adhere to Guidance for Pollution Prevention (GPPs) and CIRIA C715 Environmental good practice. This includes;
- All debris arising from the construction and works will be effectively encapsulated and removed from site.
 - No pollutants will enter drainage, run-off to a watercourse or be allowed to infiltrate to a groundwater body.
 - The contractor will ensure that they have a robust Pollution Response Plan in place before works start.
 - Any pollution incident will be contained and cleaned up immediately and reported.
 - No storage of oils or chemicals will be allowed within 10 m of a watercourse.
- 5.2.7. To mitigate the potential for disturbance to migratory fish species using functionally linked habitat within the River Chelt, the following measures will be put in place. These will be secured via the 3rd iteration EMP followed by the Principal Contractor and overseen by a suitably qualified and experienced Ecological Clerk of Works (ECoW):
- All haul roads, lay down areas and compounds will be located at least 15 m from watercourses, except where access is required to specific locations for works to bridges/culverts for example.
 - Soft start procedures will be implemented, to gradually increase the sound/vibration intensity over a period of time. The aim is to deter fish species, namely brown trout, before the full volume/vibration intensity is reached so that noise exposure is reduced. Soft start up methods will be employed on plant being used for the in-channel works/works adjacent to watercourses identified as suitable for fish at the start of each working day to ensure sudden disturbance to fish and other wildlife is minimised as far as practically possible. Piling activities adjacent to

watercourses suitable for fish are limited to a relatively small geographical area at the proposed River Chelt Bridge.

- Start up and run down of plant will be undertaken at least 20 m from the watercourse where practicable. At this stage there is not expected to be a need to pump water from any temporary dammed area, further minimising noise from the works area. If in-channel works are to be required these will minimise noise as far as possible and ensure maintenance of flow within channel to facilitate ongoing fish movement/passage. Furthermore, appropriate screening of any pumping equipment during dewatering activities will be implemented (2 mm screens) to avoid any potential entrainment of fish during the works.
- It should also be stated that as mobile species (albeit confined to the watercourses), any fish subject to disturbance have the ability to temporarily move away from the source. This may temporarily and locally displace fish from feeding and shelter resources within the project site but is unlikely to cause any reduced fitness or individual mortality that could result in a long term or population level effect.
- Wherever possible, works will be timed outside the key ecologically sensitive periods for European eel and river lamprey. This is considered to be the migratory period for European eel (upstream migration February to July, downstream migration October to November) and the upstream migration and spawning period for river lamprey (winter and spring). By default, this will also avoid the spawning period for brown trout.
- No night-time (taken to be between 30 minutes prior to sunset until 30 minutes following sunrise) vibration work will occur during migratory periods. If night working is essential, minimal and directional lighting should be used.
- Ecologically sensitive design of structures such as culverts will be incorporated into the Scheme, to maintain connectivity, continuity of flow, and natural substrate establishment.

5.2.8. If in-channel working is required for installation of bank protection, the following mitigation will be implemented:

- If any dewatering is required as part of the works, the River Chelt will not be dewatered to its full extent, to ensure continuity of flow for fish passage.
- A fish removal/management plan will be implemented in consultation with the appropriate regulators (Environment Agency/Natural England).
- Any pumps/sumps used will be screened to prevent impingement of fish.
- During any river dewatering and/or in-channel working, an ecological watching brief and fish rescue plan will be developed and instigated in consultation with the Environment Agency/ Natural England.
- Prior to any in-channel works or de-watering, measures shall be implemented that act to displace fish from the working area. Measures may include the removal of channel features from the working area that provide cover such as large cobbles/boulders and large wood to reduce the overall attractiveness of the upstream reach for fish species. This is particularly relevant to benthic species such as bullhead and eel that frequently occupy voids between larger substrates. These substrates should be placed outside of the working area e.g., in the channel further upstream or downstream of the works and replaced following the reinstatement of flow.
- Consider the use of stop nets across the channel upstream of the works to prevent fish from becoming entrained in the working area.
- An ecological watching brief will need to be implemented to ensure fish do not become entrained in the working area as a result of dewatering.
- Any in-channel works will avoid key sensitive periods for fish species, as previously described.

5.3. Impact assessment summaries

Chelt – source to M5

- 5.3.1. This WFD compliance assessment concludes that the Scheme components affecting the Chelt – source to M5 will be compliant with the requirements of the WFD. This assumes the mitigation already ‘embedded’ in the preliminary design (as summarised in section 5.2) is implemented.
- 5.3.2. On this basis, the Scheme components affecting the Chelt – source to M5 are not considered to cause deterioration at the water body scale (thus passing Test A). The BNG assessment has been completed and demonstrates that, at the Link Road location, there will be an improvement in condition class from Moderate to Fairly Good for approximately 240 m of the River Chelt within the Order limits. There will be a reduction in condition class from Moderate to Fairly Poor for the approximate 20 m stretch directly impacted by the River Chelt Bridge and associated bank protection.
- 5.3.3. At the existing River Chelt Culvert location, mitigation measures will result in a 100 m stretch of the River Chelt increasing from a Fairly Poor to a Moderate Condition.
- 5.3.4. Although, at this stage, some Scheme activities have the potential to impact on the Mitigation Measures associated with this water body, with approximately 0.18% of the water body length negatively impacted against three Mitigation Measures:
- Remove or soften hard bank.
 - Preserve or restore habitats.
 - Enhance ecology.
- 5.3.5. The embedded mitigation in the form of ecological enhancements across 360 m will positively influence nine of the Mitigation Measures associated with the water body; working towards Test B. These mitigation Measures are:
- In-channel morph diversity.
 - Bank rehabilitation.
 - Flood bunds.
 - Set-back embankments.
 - Floodplain connectivity.
 - Selective vegetation control.
 - Vegetation control.
 - Woody debris.
 - Align and attenuate flooding.
- 5.3.6. It is expected that, with the additional mitigation proposed as part of this Scheme, it should not prevent future attainment of GEP; passing Test B.

Chelt – M5 to conf. R. Severn

- 5.3.7. This WFD compliance assessment concludes that the Scheme components affecting the Chelt – M5 to conf. R. Severn will be compliant with the requirements of the WFD. This assumes: a) the mitigation already ‘embedded’ in the preliminary design (as summarised in section 5.2) is implemented.
- 5.3.8. On this basis, the Scheme components affecting the Chelt – M5 to conf. R. Severn are not considered to cause deterioration at the water body scale (thus passing Test A) and will not prevent future attainment of GES (Test B).

Leigh Bk – source to conf. R. Chelt

- 5.3.9. This WFD compliance assessment concludes that the Scheme components affecting the Leigh Bk – source to conf. R. Chelt will be compliant with the requirements of the WFD. This assumes: a) the mitigation already ‘embedded’ in the preliminary design (as summarised in section 5.2) is implemented.
- 5.3.10. The BNG assessment has been completed and demonstrates that the mitigation measures implemented along the approximate 100 m stretch of the Leigh Brook, downstream of the Leigh Brook culvert will improve the condition from Fairly Poor to Moderate.
- 5.3.11. On this basis, the Scheme components affecting the Leigh Bk – source to conf. R. Chelt are not considered to cause deterioration at the water body scale (thus passing Test A) and will not prevent future attainment of GES (Test B).

Severn Vale - Secondary Combined

- 5.3.12. This WFD compliance assessment concludes that the Scheme components affecting the Severn Vale - Secondary Combined (GB40902G204900) will be compliant with the requirements of the WFD. This assumes the mitigation already ‘embedded’ in the preliminary design (as summarised in section 5.2) is implemented in full and thus limits the overall effect of the Scheme to negligible.

Warwickshire Avon - Secondary Mudrocks

- 5.3.13. This WFD compliance assessment concludes that the Scheme components affecting the Warwickshire Avon - Secondary Mudrocks (GB40902G990900) will be compliant with the requirements of the WFD. This assumes the mitigation already ‘embedded’ in the preliminary design (as summarised in section 5.2) is implemented in full and thus limits the overall effect of the Scheme to negligible.

5.4. Cumulative impact assessment

- 5.4.1. The detailed impact assessment spreadsheets outline that there would be no cumulative impacts from the combination of all Scheme activities on any of the surface water bodies. The HEWRAT assessment was completed to determine any cumulative impacts as a result of increased traffic, permeable area and alterations to the drainage system. The results demonstrated that changes in water quality are in line with EQS. Further details can be found in the Surface Water Quality assessment (application document TR010063 - APP 6.15).
- 5.4.2. The detailed impact assessment spreadsheets outline that there would be negligible cumulative impacts from the combination of all Scheme activities on each of the two groundwater bodies.

6. Mitigation

6.1.1. This section summarises measures proposed to mitigate the effects of the Scheme on the water environment. Three categories have been used to describe mitigation measures:

- **Embedded mitigation:** activities which have been captured as part of the preliminary design as outlined in section 5.2 and have informed the impact assessment.
- **Additional mitigation:** Additional mitigation is that which will be included in the next stage of design. If the Scheme is not compliant with Test A and Test B, additional mitigation will be outlined in this section.
- **Enhancements:** activities which are not required for the Scheme to be compliant with the WFD (Test A or Test B) but may be in line with Test C.

6.2. Additional mitigation

Operational mitigation

6.2.1. As the Scheme is compliant with the WFD for the water bodies scoped into the impact assessment, based on the design information available and embedded mitigation outlined in section 5.2, there is no additional mitigation required for the operational phase.

Temporary mitigation

6.2.2. An assessment of the temporary impact from the Scheme has been assessed with the information available and it was concluded that impacts are expected to be negligible following the implementation of the embedded mitigation in Section 5.2 which includes the implementation of best practice mitigation measures. These mitigation measures have been captured as part of the Register of Environmental actions and Commitments (REAC) and 1st iteration EMP which will be developed into the 2nd and 3rd iteration EMP as part of the detailed design and construction stages. This will ensure negligible impact from construction activities.

6.3. Enhancements

6.3.1. All enhancements that were proposed at PCF Stage 2 have been implemented as part of the design and have been considered within the embedded mitigation to help mitigate all impacts. This has included:

- Ecological enhancements to the flood storage area.
- Landscape plans which account for riparian planting requirements.
- Ecological enhancements to the drainage strategy in the form of swales, enhanced drainage basins and implementation of ditches rather than pipes where possible.

6.3.2. These activities further support the following Mitigation Measures outlined for the Chelt – source to M5 catchment:

- Preserve or restore habitats.
- Vegetation control.
- Enhance ecology.
- Floodplain connectivity.

7. Conclusions and recommendations

7.1. Conclusion

- 7.1.1. A WFD compliance assessment has been undertaken for the M5 Junction 10 Improvements Scheme and is based on the current design.
- 7.1.2. As per the PINS guidance, this WFD compliance assessment has been completed in three phases:
- Stage 1 (WFD Screening).
 - Stage 2 (WFD Scoping).
 - Stage 3 (WFD Impact Assessment).
- 7.1.3. Stage 1 (WFD Screening) identified WFD water bodies with the potential to be impacted.
- 7.1.4. Stage 2 (WFD Scoping) established a baseline for each of the WFD water bodies identified in Stage 1 (WFD Screening) and identified activities associated with the Scheme which may affect the water environment.
- 7.1.5. Stage 3 (WFD Impact Assessment) included a matrix-based approach to the WFD impact assessment which was then used to assess the effect of each individual Scheme activity on each of the individual WFD quality elements for a water body to be assessed.
- 7.1.6. The principal activities associated with of the Scheme affecting the water environment include: a new clear span bridge as part of the Link Road, culvert extensions including on the Leigh Brook and Piffs Elm culvert, realignment of drainage channels, drainage alterations and flood compensation.
- 7.1.7. A detailed WFD impact assessment has been undertaken for each of the following three WFD surface water bodies and two groundwater bodies scoped into the assessment:
- Chelt - source to M5 (GB109054032820).
 - Chelt - M5 to conf. R. Severn (GB109054032810).
 - Leigh Bk - source to conf. R. Chelt (GB109054039770).
 - Severn Vale - Secondary Combined.
 - Warwickshire Avon - Secondary Mudrocks.

River Chelt conclusions

- 7.1.8. This WFD compliance assessment has identified, the Scheme components affecting the two River Chelt Water bodies (Chelt - source to M5 and Chelt - M5 to conf. R. Severn) are not considered to cause deterioration at the water body scale (Test A) and will not prevent future attainment of GEP (Test B). The cumulative effects of the Scheme components is also considered to be negligible at the water body scale, and are not considered to have any adverse cumulative effects on downstream (or adjacent) WFD water bodies.
- 7.1.9. Although the Scheme is deemed to be compliant with the WFD objectives, additional assessments are required at the detailed design stage to include a scour assessment and consultation with the Environment Agency to determine the most pragmatic approach to bank protection under the Link Road River Chelt Bridge.
- 7.1.10. Therefore, assuming the best practice guidelines for design and construction, and identified specific mitigation measures are adhered to, this assessment concludes that the Scheme is likely to be WFD-compliant.

Leigh Brook conclusions

- 7.1.11. This WFD compliance assessment concludes that the Scheme components affecting the Leigh Bk – source to conf. R. Chelt are not considered to cause deterioration at the water

body scale (Test A) and will not prevent future attainment of GEP (Test B). The cumulative effects of the Scheme components is also considered to be negligible at the water body scale, and are not considered to have any adverse cumulative effects on downstream (or adjacent) WFD water bodies.

- 7.1.12. Therefore, assuming the best practice guidelines for design and construction, and identified specific mitigation measures are adhered to, this assessment concludes that the Scheme is likely to be WFD-compliant.

Severn Vale - Secondary Combined conclusions

- 7.1.13. This WFD compliance assessment concludes that the Scheme components affecting the Severn Vale - Secondary Combined (GB40902G204900) will be compliant with the requirements of the WFD. This assumes the mitigation already 'embedded' in the preliminary design (as summarised in section 5.2) is implemented in full and thus limits the overall effect of the Scheme to negligible.

Warwickshire Avon - Secondary Mudrocks conclusions

- 7.1.14. This WFD compliance assessment concludes that the Scheme components affecting the Warwickshire Avon - Secondary Mudrocks (GB40902G990900) will be compliant with the requirements of the WFD. This assumes the mitigation already 'embedded' in the preliminary design (as summarised in section 5.2) is implemented in full and thus limits the overall effect of the Scheme to negligible.

7.2. Recommendations

- 7.2.1. Consultation with the Environment Agency will be required to ensure construction and operational mitigation measures are appropriate as the Scheme progresses through detailed design. Continued consultation with the Environment Agency has been secured as part of the REAC.

Appendices



Appendix 8.2A. Surface water impact assessment

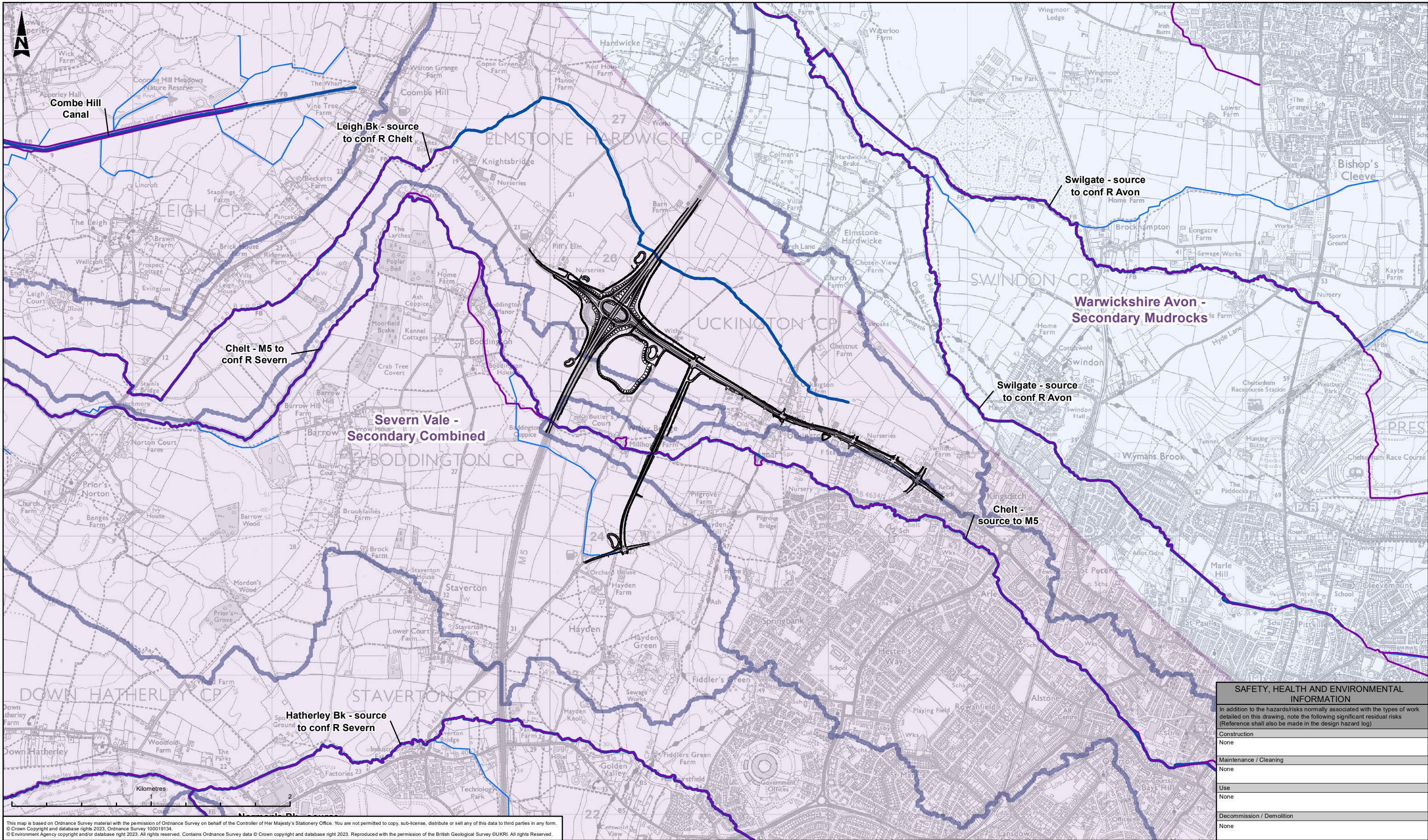
The Surface Water Impact assessment has been produced as a separate spreadsheet as Appendix 8.2A (application document TR010063 - APP 6.15) of this Road Drainage and the Water Environment chapter of the ES.

Appendix 8.2B. Groundwater impact assessment

The Groundwater Impact assessment has been produced as a separate spreadsheet as Appendix 8.2B (application document TR010063 - APP 6.15) of this Road Drainage and the Water Environment chapter of the ES.

Appendix 8.2C. WFD Figures

Figure reference	Document title	Sheet	Document number	Revision
3-1	Scheme Location	1 of 1	GCCM5J10-ATK-EWE-ZZ-GS-GI-000012	0
3-2	WFD Water bodies considered as part of the screening assessment	1 of 1	GCCM5J10-ATK-EWE-ZZ-GS-GI-000013	0
4-1	Watercourses within close proximity to the Scheme	1 of 1	GCCM5J10-ATK-EWE-ZZ-GS-GI-000014	0
4-2	Geology and groundwater bodies	1 of 1	GCCM5J10-ATK-EWE-ZZ-GS-GI-000015	0



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Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

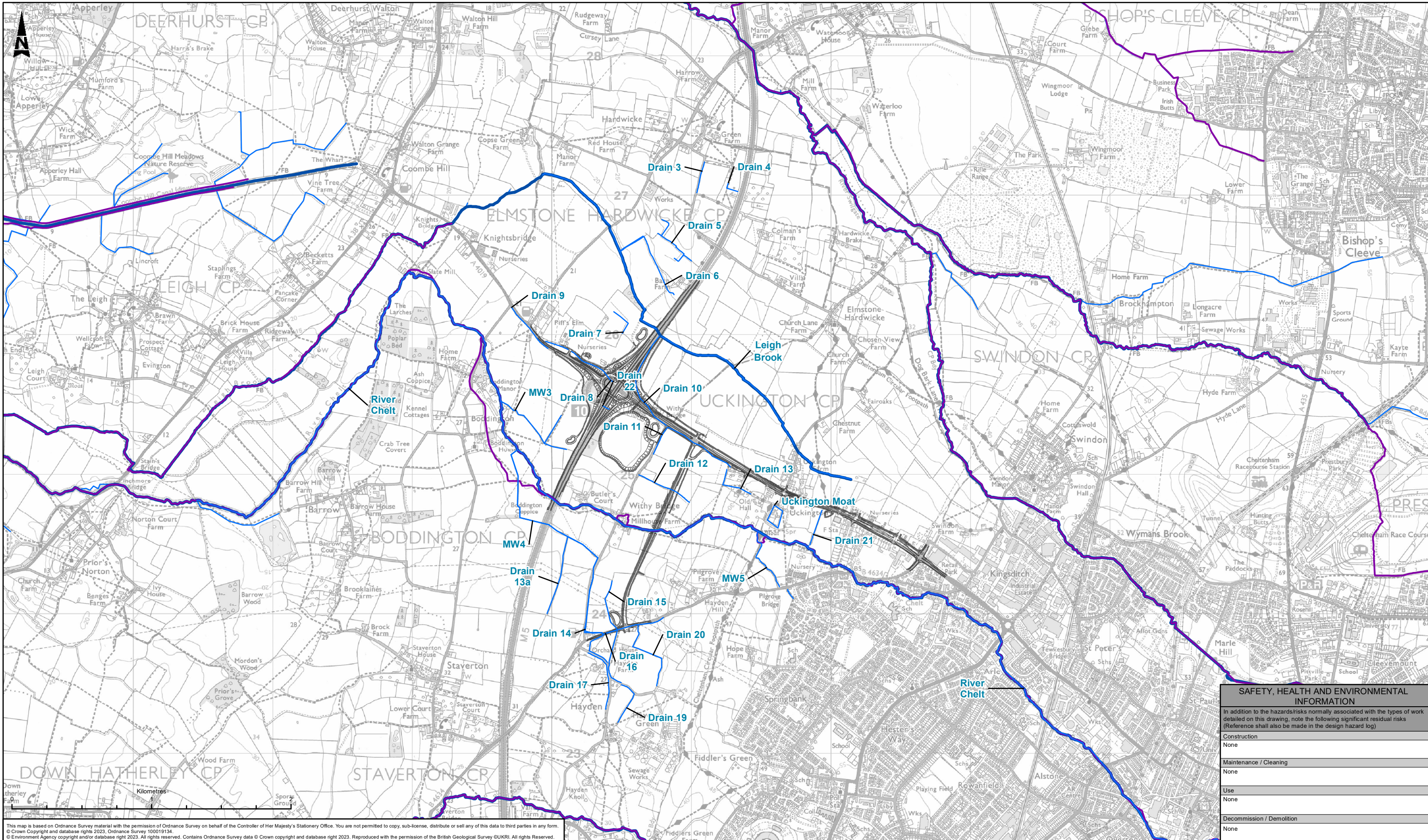
LEGEND	
	SCHEME ALIGNMENT
	SURFACE WATER BODY CATCHMENTS
	SEVERN VALE - SECONDARY COMBINED
	WARWICKSHIRE AVON - SECONDARY MUDROCKS
	STATUTORY MAIN RIVERS
	WFD WATERCOURSES
	ORDINARY WATERCOURSES

Description	Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
PUBLISHED	A1						01/05/23

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Project Title		M5 Junction 10 Improvements Scheme	
Drawing Title		FIGURE 3-2 WFD WATER BODIES CONSIDERED AS PART OF THE SCREENING ASSESSMENT	
Drawing Number		GCCM5J10 - ATK - EWE ZZ - GS - GI - 000013	
Original Size: A3	Scale: 1:25,000	Project Ref: 5214106	Sheet: 1 of 1 Rev: P02



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LEGEND	
	SCHEME ALIGNMENT
	STATUTORY MAIN RIVERS
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	ORDINARY WATERCOURSES

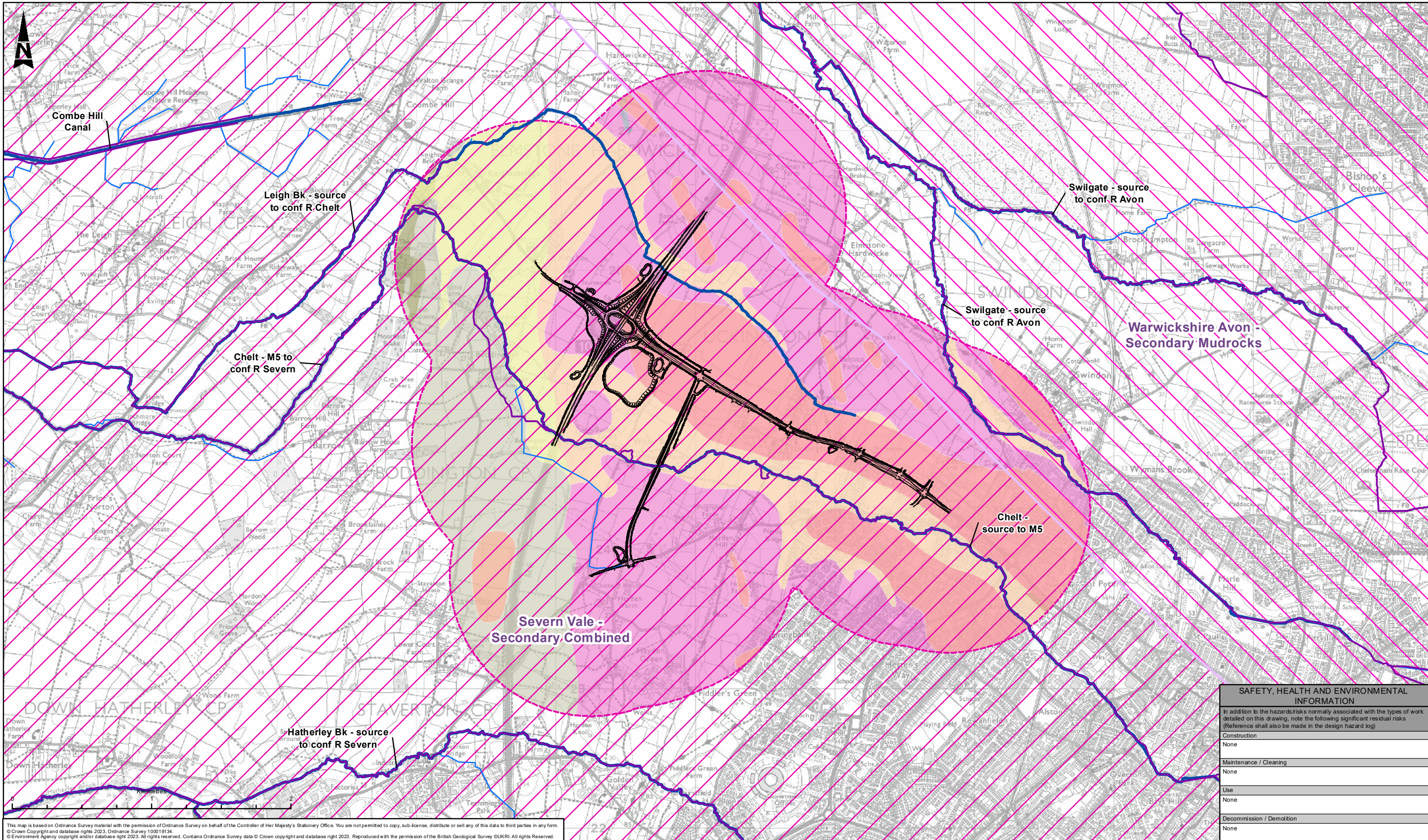
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Drawing Suitability: **PUBLISHED** Status: **A1**

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Project Title: M5 Junction 10 Improvements Scheme	
Drawing Title: FIGURE 4-1 WATERCOURSES WITHIN CLOSE PROXIMITY TO THE SCHEME	
Drawing Number: GCCM5J10 - ATK - EWE ZZ - GS - GI - 000014	
Original Size: A3	Scale: 1:25,000
Project Ref: 5214106	Sheet: 1 of 1
Rev: P02	



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Use	None
Decommission / Demolition	None

LEGEND — SCHEME ALIGNMENT 1KM STUDY AREA GROUNDWATER BODIES SEVERN VALE - SECONDARY COMBINED WARWICKSHIRE AVON - SECONDARY MUDROCKS STATUTORY MAIN RIVERS WFD WATERCOURSES ORDINARY WATERCOURSES SUPERFICIAL GEOLOGY ALLUVIUM - CLAY, SILT, SAND AND GRAVEL CHELTENHAM SAND AND GRAVEL - SAND AND GRAVEL BEDROCK GEOLOGY CHARMOUTH MUDSTONE FORMATION - LIMESTONE CHARMOUTH MUDSTONE FORMATION - MUDSTONE RUGBY LIMESTONE MEMBER - MUDSTONE AND LIMESTONE, INTERBEDDED SALT FORD SHALE MEMBER - MUDSTONE	<table border="1"> <thead> <tr> <th>Description</th> <th>Status</th> <th>Revision</th> <th>Drawn</th> <th>Checked</th> <th>Reviewed</th> <th>Authorised</th> <th>Issue Date</th> </tr> </thead> <tbody> <tr> <td>PUBLISHED</td> <td>A1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Description	Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date	PUBLISHED	A1							ATKINS Member of the SNC-Lavalin Group 5th Floor, Block 5 Shire Hall Bearland Gloucester GL1 2TH Tel: 08000 514 514 www.atkinsglobal.com Copyright © Atkins Limited (2023)	Project Title M5 Junction 10 Improvements Scheme Drawing Title FIGURE 4-2 GEOLOGY AND WFD GROUNDWATER BODIES Drawing Number Project: GCCM5J10 - ATK - EWE Originator: ZZ - GS - GI - 000015 Volume: 1 of 1										
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