A12 Chelmsford to A120 widening scheme

TR010060

9.68 Technical Note on Proposals for Main River Crossings

Rule 8(1)(k)

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A12 Chelmsford to A120 widening scheme

Development Consent Order 202[ ]

TECHNICAL NOTE ON PROPOSALS FOR MAIN RIVER CROSSINGS

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1 Introduction

1.1 Background

The proposed scheme

1.1.1 The A12 Chelmsford to A120 widening scheme (the proposed scheme) involves widening the existing A12 to three lanes throughout in each direction, where it is not already three lanes. This would mainly involve on-line widening of the carriageway, with off-line bypasses created between junctions 22 and 23 (Rivenhall End Bypass) and between junctions 24 and 25 (Kelvedon to Marks Tey). This would be accompanied by junction improvements (junctions 19 and 25), construction of new junctions catering for traffic movements both north and southbound (junctions 21, 22 and 24), and removal of existing junctions (junctions 20a, 20b and 23).

1.1.2 The proposed scheme includes eight watercourse crossings over Main Rivers. Of these, two crossings on the on-line sections of the proposed scheme will remain unchanged, another four crossings along the on-line sections will be extended to accommodate the widened carriageway, and two new crossings will be required on the off-line sections of the proposed scheme. In addition, two existing crossings on the proposed de-trunked section of the A12 will remain unchanged. Three of these structures are bridges and the remainder are culverts.

Concerns of the Environment Agency

1.1.3 The Environment Agency (EA) is a non-departmental public body, established in 1996 and sponsored by the United Kingdom government's Department for Environment, Food and Rural Affairs (Defra), with responsibilities relating to the protection and enhancement of the environment in England (and until 2013 also Wales). The EA is the principal flood risk management operating authority. It has permissive power (but not the legal obligation) to manage flood risk from designated Main Rivers and the sea. Other responsibilities of the EA include regulating major industry and waste, treatment of contaminated land, water quality and resources, fisheries, inland river, estuary and harbour navigations and conservation and ecology.

1.1.4 The ten watercourse crossings considered in this Technical Note are classed as Main Rivers, for which the EA has responsibilities. The EA has expressed concerns over the scheme proposals for extending existing structures and creating new culverts on the off-line section of the proposed scheme in several submissions to the Examining Authority in the Development Consent Order (DCO) examination of the proposed scheme. Their main concerns regarding proposed culverts relate to the potential impacts upon the habitats of the river sub-catchments. In particular, the EA has expressed concern that the proposed culverts would preclude natural fluvial processes in the watercourses, impede fish passage and migration, restrict the movement of riparian mammals such as otter and water vole, and introduce a level of artificial modification that the EA cannot accept.

1.1.5 The EA is concerned with the following aspects of the proposed design of the Main River crossings:

- Two new culverts for the new sections of highway, one 60 m long on Domsey Brook and one 46 m long on Rivenhall Brook. In each case, culverts associated with the existing A12 will remain in place.
- Extension of the existing crossings of the Domsey Brook and the Roman River. The EA states that the latter causes problems for ecology.
- Extension of the current bridge crossing of the River Brain, replicating the existing design, which the EA states adversely affects flows in summer with consequences for fish and eels.

1.1.6 The EA asserts that the Applicant has not demonstrated that these works will not introduce further barriers to species movement on these watercourses. Furthermore, the EA considers that the mitigation proposed (the placement of natural substrate in the culverts and mammal ledges for passage during high flows) are not sufficient. The EA would like to see the replacement of culverts with open span bridges to permit a more natural river form under the crossing.

1.1.7 The EA states that they are not prepared to consent to the disapplication of their permitting regime under the DCO and will require the Applicant to submit applications for FRAPs for the culverting. Furthermore, the EA states that they may consider it appropriate to refuse the FRAPs on the basis that the culverting is environmentally damaging. As part of their determinations for FRAPs, the EA will secure compliance with the Water Framework Directive.

1.1.8 The EA's latest position on their concerns is set out in their submission at deadline 5 [APP5-031] and their internal policies on culverts [APP5-030 and 032]. The Applicant has responded to these submissions at deadline 6 with the Statement of Common Ground [TR010060/EXAM/8.2] and Applicant's Comments on information received at Deadline 5 [TR010060/EXAM/9.61].

1.2 Study area

1.2.1 The two main catchments within the study area are the River Chelmer covering most of the study area and the River Colne to the north. The main tributaries of the Chelmer in the study area are from west to east: Boreham Brook, River Ter, and the River Blackwater (plus the Blackwater's tributaries: the River Brain, Rivenhall Brook and Domsey Brook). Roman River crosses the northern end of the proposed scheme west of junction 25 near Copford and is a tributary of the River Colne. The locations of these features are illustrated on Figure 14.1 Sheets 1-11 Key Water Environment Features in the Environment Statement [APP-239].

1.2.2 The River Chelmer lies to the south of the proposed scheme, flowing approximately west to east from the south of Chelmsford and discharging to the sea north of Maldon. The river is artificially straightened throughout its reach, with a semi-sinusoidal planform and a trapezoidal cross section.

1.2.3 Boreham Brook crosses the A12 east of junction 19 and flows around to the south of Boreham, joining the River Chelmer on the west side of Church Road and approximately 2.5km downstream of its crossing under the A12 (see

Appendix A Figure 1 Sheet 1). Boreham Brook exhibits very low natural geomorphological form within the channel's character.

1.2.4 The River Ter passes under the A12 to the west of Hatfield Peveril and flows approximately south and south east, joining the River Chelmer on the west side of Wick Mere (Appendix A Figure 1 Sheet 1). The channel along the River Ter exhibits a comparatively varied geomorphological character between reaches upstream and downstream of the existing A12 River Ter crossing. Upstream, the River Ter exhibits an artificially straight planform. Downstream, the River Ter exhibits variation in cross-section, river processes (i.e., bank erosion and deposition) and depositional features. All of which, provide opportunity for habitat. Modifications, further to the artificial straightening include a spillway off-taking flows beneath the existing A12, the River Ter crossing and an Environment Agency gauging weir downstream of the River Ter crossing. The proposed scheme would not alter the existing River Ter crossing and impacts on the River Ter, as a result of the proposed scheme, are not anticipated.

1.2.5 The River Blackwater crosses the A12 just north of Kelvedon and flows approximately south west towards Witham and then approximately south and south east to join the River Chelmer east of Maldon, picking up the tributaries of Rivenhall Brook and the River Brain (Appendix A Figure 1 Sheets 2 to 4). The River Blackwater has a varied geomorphological character with differing planform, width, depth and substrate, supporting varied habitat throughout its catchment. There are modifications through the catchment including channel crossings (bridges), and various points where the channel has either been widened or constricted.

1.2.6 The River Brain flows through Witham and joins the Blackwater about 400m downstream of its crossing under the A12 (Appendix A Figure 1 Sheet 2). The geomorphological character of the River Brain is varied; with an artificially restored reach, exhibiting near natural conditions, between the B1389 and B1018 (approximately 450m upstream of the existing A12). This reach is fed by an historically dredged secondary channel.

1.2.7 Rivenhall Brook flows in a south easterly direction, passing under the A12 east of Rivenhall End and joining the Blackwater River about 800m downstream (Appendix A Figure 1 Sheet 3). Rivenhall Brook exhibits an artificially straightened planform and a trapezoidal cross section.

1.2.8 Domsey Brook rises south-west of Marks Tey and joins the River Blackwater near Kelvedon (Appendix A Figure 1 Sheet 4). It is artificially straightened throughout its reach, with a semi-sinusoidal planform and a trapezoidal cross section, modified in a number of places, predominantly via bridging and culverting on the A12 and Inworth Road. These limit the natural connectivity of the river both longitudinally (i.e., locally impacting flow dynamics and sediment transportation) and laterally, with its natural floodplain, preventing flood flows from being conveyed downstream. It is culverted at its confluence with the River Blackwater and the bridge at Inworth Road and there is bankside reinforcement throughout.

1.2.9 Roman River cross the A12 just west of junction 25 (Appendix A Figure 1 Sheet 5). The channel along Roman River differs between the reaches upstream of

the existing A12 and railway line and those immediately downstream. Upstream, the channel is gently sinuous, lined by narrow band of deciduous trees. Downstream of the A12, Roman River has an artificially straight planform, realigned to make way for the existing A12. Here the channel had a modified and uniform cross-section lacking in depositional features, whilst bank undercutting was evident. Bed substrate material ranged from fine to coarse gravels and vegetative debris.

1.2.10 Roman River and River Ter exhibit similar channel form and pressures, modifying channel form and flow. Their channels are constrained at the A12 crossings and/or culverts as a result.

1.2.11 It is clear from the brief summary above that the Main Rivers in the study area are modified. All of which, barring the River Ter and Rivenhall Brook, have been designated as heavily modified, as per Water Environment (Water Framework Directive) Regulations. Channel straightening and other works in what is an intensely cultivated agricultural area as well as bank strengthening works and numerous crossings reflect such modifications. The River Blackwater has the most extensive areas of natural morphology, which would benefit wildlife, but is itself heavily modified in sections too.

1.3 Purpose of the report

1.3.1 The purpose of this report is to summarise the Applicant's approach to designing the watercourse crossings, including the assessment of environmental impacts with particular regard to riverine mammals and fish. It also sets out to demonstrate that proposed scheme accords with the requirements of the NNNPS and other relevant policy statements.

1.4 Report structure

1.4.1 This technical note is structured as follows:

- Section 2: an overview of the legislation and policy framework regarding the disapplication of statutory consents (in this case Flood Risk Activity Permits - FRAP - granted by the EA) and the ability of the EA to withhold environmental permits to authorise culverts, the legal and policy framework for the environmental impact assessment of options, and the EA’s internal policy on the provision of culverts.
- Section 3: a summary of relevant literature in relation to riparian mammals and culverts.
- Section 4: a description of the proposed works for each watercourse, the mitigation proposals and ecological effects, scope for alternative structures, the environmental implications and a statement on the feasibility of providing the alternative solution.
- Section 5: conclusions.

2 Legislation and policy framework

2.1 Planning Act 2008

2.1.1 Under Section 150 of the Planning Act 2008 an order granting development consent may include a provision disapplying the requirement to obtain a statutory consent or authorisation. However, for certain consents, that provision may only be included if the body who is responsible for granting that consent has given consent for the disapplication. Usually, where such consent is given, a mechanism will be included in the DCO which provides an alternative, streamlined mechanism for consent to be obtained. This recognises the fact that a number of issues may have been resolved and agreed during the DCO examination process.

2.1.2 Article 3(4)(a) of the dDCO has, to date, included the disapplication of regulation 12 of the Environmental Permitting (England and Wales) Regulations 2016 in relation to the requirement for environmental permits for the carrying on of a flood risk activity or a water discharge activity ("Environmental Permits"), and protective provisions in favour of the Environment Agency in Part 7 of Schedule 11.

2.1.3 The Environment Agency has not yet agreed to this disapplication and therefore in the Deadline 6 draft Development Consent Order the Applicant has deleted Article 3(4)(a) and Part 7 of Schedule 11. It follows that the Applicant will have to apply for the Environmental Permits under the Environmental Permitting (England and Wales) Regulations 2016 in the normal way.

2.1.4 Section 4.5 below considers the extent to which the Environment Agency would retain the discretion to refuse to grant environmental permits for the scheme on the basis of the use of culverts if the development consent order is granted.

2.2 Environmental Impact Assessment Regulations

2.2.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations) Schedule 4 Information for inclusion in environmental statements item 2 states that an Environmental Statement must include "*A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects*." This places the onus of deciding which alternatives to study on the developer, not on an environmental regulator or other third party or at the insistence of that party, and that only alternatives which are reasonable need be considered.

2.2.2 Under the EIA Regulations Schedule 4, item 8, measures are required to avoid, prevent, reduce, or offset any identified significant adverse effects of the development on the environment.

2.2.3 Schemes are designed to take into account various factors, including embodied carbon usage, technical complexity, buildability, health and safety for

construction operatives, whole life cost, and environmental issues. The Environmental Statement presents the assessment of the preferred options for the Main River crossings on biodiversity and the water environment.

2.2.4 Consideration of reasonable alternatives is provided in the Environmental Statement Chapter 3 Assessment of Alternatives [APP-070], but this does not include an assessment of bridges versus culverts. The Environmental Statement Chapter 9 Biodiversity [APP-076], Chapter 14 Road Drainage and Water Environment [APP-081], and Appendix 14.5 Flood Risk Assessment [APP-162 to APP-173] present the results of the impacts of the proposed scheme on biodiversity and the water environment.

2.2.5 The environmental impact assessment did not identify significant adverse effects of the proposed crossings on the watercourses and associated habitats and species. These points are illustrated for each Main River crossing in Chapter 4. Furthermore there is no duty on the developer to consider alternatives where the design does not have adverse environmental effects. This is discussed further in Section 4.5.11 on case law Sainsburys v First Secretary of State.

2.3 National Networks National Policy Statement ("NNNPS")

2.3.1 Paragraph 4.48 of NNNPS makes it clear that, where activities authorised by the DCO are governed by Environmental Permitting (England and Wales) Regulations 2016, environmental permits will need to be obtained before those activities can be carried out.

2.3.2 Paragraphs 4.50 and 4.51 state:

"4.50 In deciding an application, the Examining Authority and the Secretary of State should focus on whether the development itself is an acceptable use of the land, and on the impacts of that use, rather than the control of processes, emissions or discharges themselves. They should assess the potential impacts of processes, emissions or discharges to inform decision making, but should work on the assumption that in terms of the control and enforcement, the relevant pollution control regime will be properly applied and enforced. Decisions under the Planning Act should complement but not duplicate those taken under the relevant pollution control regime.

4.51 These considerations apply in an analogous way to other environmental regulatory regimes, including those on land drainage and flood defence and biodiversity."

2.3.3 Paragraphs 4.53 states that "*the Examining Authority may wish to seek the views of the regulator on the scope of the permit or consent and any management plans (such as any produced for noise) that would be included in an Environmental Permit application*".

2.3.4 The test which the Secretary of State must consider is set out in paragraphs 4.55 and 4.56 of NNNPS:

"4.55 The Secretary of State should be satisfied that development consent can be granted taking full account of environmental impacts. This will require close cooperation with the Environment Agency and/or the pollution control authority, and other relevant bodies, such as the MMO, Natural England, Drainage Boards, and water and sewerage undertakers, to ensure that in the case of potentially polluting developments:

- *the relevant pollution control authority is satisfied that potential releases can be adequately regulated under the pollution control framework; and*
- *the effects of existing sources of pollution in and around the project are not such that the cumulative effects of pollution when the proposed development is added would make that development unacceptable, particularly in relation to statutory environmental quality limits.*

4.56 The Secretary of State should not refuse consent on the basis of regulated impacts unless there is good reason to believe that any relevant necessary operational pollution control permits or licences or other consents will not subsequently be granted."

2.3.5 It is important to understand the context for this assessment and the circumstances in which the Secretary of State may refuse consent. The assessment must only take into account decisions which may lawfully be taken by the Environment Agency. As stated below (in paragraph 4.5 of this Note) if the Secretary of State does decide to grant a DCO which includes culverts, it would not then be open to the Environment Agency, to refuse to grant the Environmental Permits on the basis that open span bridges should have been used instead of culverts. This should be clearly borne in mind when the Secretary of State comes to apply these paragraphs of NNNPS.

2.3.6 It is also clear from paragraph 5.227 that the Secretary of State should consider mitigation provided as part of the scheme and how these can be secured by requirement:

"If the Environment Agency continues to have concerns and objects to the grant of development consent on the grounds of impacts on water quality/resources, the Secretary of State can grant consent, but will need to be satisfied before deciding whether or not to do so that all reasonable steps have been taken by the applicant and the Environment Agency to try to resolve the concerns, and that the Environment Agency is satisfied with the outcome.

2.3.7 Under the heading "Decision making",

5.98 Where flood risk is a factor in determining an application for development consent, the Secretary of State should be satisfied that, where relevant:

- *the application is supported by an appropriate FRA;*
- *the Sequential Test (see the National Planning Policy Framework) has been applied as part of site selection and, if required, the Exception Test (see the National Planning Policy Framework).*

5.99 When determining an application the Secretary of State should be satisfied that flood risk will not be increased elsewhere and only consider development appropriate in areas at risk of flooding where (informed by a flood risk

assessment, following the Sequential Test and, if required, the Exception Test), it can be demonstrated that:

- *within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and*
- *development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and priority is given to the use of sustainable drainage systems.*

5.100 For construction work which has drainage implications, approval for the project's drainage system will form part of any development consent issued by the Secretary of State. The Secretary of State will therefore need to be satisfied that the proposed drainage system complies with any National Standards published by Ministers under Paragraph 5(1) of Schedule 3 to the Flood and Water Management Act 2010.93 In addition, the development consent order, or any associated planning obligations, will need to make provision for the adoption and maintenance of any Sustainable Drainage Systems (SuDS), including any necessary access rights to property. The Secretary of State, should be satisfied that the most appropriate body is being given the responsibility for maintaining any SuDS, taking into account the nature and security of the infrastructure on the proposed site. The responsible body could include, for example, the applicant, the landowner, the relevant local authority, or another body such as the Internal Drainage Board.

5.101 If the Environment Agency continues to have concerns and objects to the grant of development consent on the grounds of flood risk, the Secretary of State can grant consent, but would need to be satisfied before deciding whether or not to do so that all reasonable steps have been taken by the applicant and the Environment Agency to try and resolve the concerns.

5.102 The Secretary of State should expect that reasonable steps have been taken to avoid, limit and reduce the risk of flooding to the proposed infrastructure and others. However, the nature of linear infrastructure means that there will be cases where:

- *upgrades are made to existing infrastructure in an area at risk of flooding;*
- *infrastructure in a flood risk area is being replaced;*
- *infrastructure is being provided to serve a flood risk area; and*
- *infrastructure is being provided connecting two points that are not in flood risk areas, but where the most viable route between the two passes through such an area.*

5.103 The design of linear infrastructure and the use of embankments in particular, may mean that linear infrastructure can reduce the risk of flooding for the surrounding area. In such cases the Secretary of State should take account of any positive benefit to placing linear infrastructure in a flood-risk area.

5.104 Where linear infrastructure has been proposed in a flood risk area, the Secretary of State should expect reasonable mitigation measures to have been

made, to ensure that the infrastructure remains functional in the event of predicted flooding."

2.3.8 Paragraph 4.26 provides general guidance on the assessment of alternatives.

"4.26 *Applicants should comply with all legal requirements and any policy requirements set out in this NPS on the assessment of alternatives. In particular:*

- *The EIA Directive requires projects with significant environmental effects to include an outline of the main alternatives studied by the applicant and an indication of the main reasons for the applicant's choice, taking into account the environmental effects.*
- *There may also be other specific legal requirements for the considerations of alternatives, for example, under the habitats and Water Framework Directives.*
- *There may also be policy requirements in this NPS, for example the flood risk sequential test and the assessment of alternatives for developments in National Parks, the Broads and Areas of Outstanding Natural Beauty."*

2.4 Water Environment (Water Framework Directive) Regulations

2.4.1 Under the Water Environment (Water Framework Directive) Regulations (England and Wales) 2017, there is a requirement for a developer to assess all activities proposed as a part of a development or scheme within or adjacent to any waterbody within England and Wales. This includes surface water and groundwater.

2.4.2 The Regulations stipulate that all water bodies should meet Good Ecological Status (GES) (or Good Ecological Potential (GEP) if an artificial or heavily modified water body) by a set timeframe. Overall ecological status (or potential) is made up of a number of biological, hydromorphological and chemical quality characteristics called elements. The overall status is determined by the lowest element status.

2.4.3 Any activity which has the potential to have an impact on ecology will need consideration in terms of whether it could cause deterioration in the ecological status or potential of a water body. It is, therefore, necessary to consider the possible changes associated with the proposed options for any proposed scheme.

2.4.4 Consideration of the generic environmental objectives set out below is used for the assessment of any activity to determine its compliance in relation to the Regulations:

- No changes affecting high status sites;
- No changes that will cause failure to meet surface water Good Ecological Status or Potential or result in a deterioration of surface water Ecological Status or Potential;

- No changes which will permanently prevent or compromise the Environmental Objectives being met in other water bodies; and
- No changes that will cause failure to meet good groundwater status or result in a deterioration groundwater status.

2.5 Environment Agency's Policy on Culverts

2.5.1 At Deadline 5 the Environment Agency provided the Applicant with their internal policy on culverting watercourses (Environment Agency Document Ref: 169_19, published in April 2019) and its supporting guidance (Environment Agency Document 170_19, published in June 2019). The policy states that it should be used by the Environment Agency to provide advice to highways authorities and developers amongst other parties.

2.5.2 The key statement in the policy is that the Environment Agency is "opposed to the culverting of any watercourse because of the adverse ecological, flood risk, geomorphological, human safety and aesthetic impacts."

2.5.3 The policy goes on to state that:

- Environmental permitting applicants will be expected to demonstrate why culverting is both necessary and the only reasonable and practicable alternative. Section 4.5 below explains why this policy should be given no weight in the Secretary of State's assessment of whether or not to make the development consent order and sets out the correct legal tests;
- Applicants should provide appropriate assessments to demonstrate that culverting will not increase flood risk elsewhere;
- Will not result in an unacceptable impact on channel stability and the habitats(s) and species present
- Applicants should demonstrate that mitigation and compensation measures will be put in place to reduce or nullify any impacts to the Environment Agency's satisfaction;
- When designing the culvert the Applicant should take into account the predicted impacts of climate change, natural channel geomorphology and future development planned in the catchment.

2.5.4 The Applicant has previously responded to a number of these points through previous examination responses which are summarised in Table 2.1.

Table 2.1 : Summary of the Applicant's Responses on Culverts

Element	Response
Necessity and alternatives	Of the eight Main River crossings on the new A12 alignment and two crossings on the de-trunked sections of the A12, there would be no changes to the structures on the Boreham Brook and River Ter and so there would be no change to the permeability to otters or fish. Ashman's Bridge (River Blackwater) would be extended, however the Applicant

Element	Response
	understands from previous representations (Environment Agency's response to ExQ2 [REP4-074]) that the Environment Agency is generally supportive of the proposed extension of this bridge. The environmental assessment has been undertaken in accordance with the National Networks National Policy Statement (see NNNPS Accordance Tables [APP-251]) and in line with the mitigation hierarchy as presented in DMRB LA 104, whereby the Applicant has sought to avoid impacts where possible. As detailed in Environmental Statement Chapter 3: Assessment of Alternatives [APP-070], the refinement of Option 2 for the proposed scheme provided environmental benefits including reducing potential development within the floodplain. By using the existing crossing of the River Blackwater (Ashman's Bridge), potential effects from severance of the river from construction of a new structure were avoided. Paragraph 5.51 of the draft NNNPS states that if significant harm to biodiversity cannot be avoided, mitigation needs to be considered, and where significant harm cannot be avoided or mitigated, it should be compensated for. The Applicant considers that its designs for the Main River crossings including mitigation result in no significant adverse effects, so that further mitigation in the form of open span bridges is not required under the draft policy. Section 4.5 below explains why the Applicant is not required to assess alternatives to culverts.
Flood risk	As stated in the Flood Risk Assessment [APP-162] all new culverts have been designed in accordance with the Design Manual for Roads and Bridges. The proposed scheme therefore ensures that the culverting proposals would not increase flood risk up to at least the 1% Annual Exceedance Probability event plus an allowance for climate change.
Mitigation	Mitigation for biodiversity impacts of the culverting proposals include: • Provision of mammal ledges • Incorporation of gravels to improve sediment substrate of the river bed and overall channel heterogeneity (commitments RDWE 39 and RDWE 42 in the Register of Environmental Actions and Commitments (REAC) [REP4-023]).

Element	Response
	• Where practicable, in-channel works would be avoided for Main Rivers during freshwater fish spawning and migration periods (October to May inclusive) (commitment BI4 of the REAC [REP4-023]). • Where sections of watercourses are to be isolated as part of construction work, fluming would be used to protect any fish species present, preventing direct mortality of fish migrating from downstream (commitment BI42 in the REAC [REP4-023]). • Improved planting along the floodplain and local measures to improve water quality such as planting (RDWE 39, RDWE 40, and RDWE 42 in the REAC [REP4-023]) riparian vegetation and trees to be added at the entrance and exit of crossing structures (Rivenhall; Domsey Underbridge; Domsey East). Culverts have been designed in accordance with CIRIA best practice: (Culvert, Screen and Outfall Manual, C786).
Climate change	See flood risk above.

2.5.5 The Environment Agency's internal guidance document (170_19) lists a number of potentially determinantal effects of culverting watercourses. These are listed in Table 2.2 below.

Table 2.2 : Mitigation of potentially detrimental effects of culverting

Potential Effect	Proposed Mitigation
Increase flood risk	See Table 2.1
Adverse effects morphology, fisheries and wildlife	See Table 2.1
Adverse effects on protected species	See Table 2.1
Barrier to fish passage	See Table 2.1

Potential Effect	Proposed Mitigation
Geomorphology, changes to channel stability	See Table 2.1. The proposed scheme also sets out that measures such as energy dissipation, incorporation of open channel features (pool-riffle sequences) and realignment of watercourse sections (where appropriate) will alleviate potential risks to in-channel morphological instability
Provision of drainage connections	The proposed scheme sets out the highways surface water drainage proposals in ES Appendix 14.6 Surface Water Drainage Strategy [APP-174 to 179] demonstrating that it is not impacted by the culverting proposals.
Increased maintenance costs	The potential for increased maintenance costs would be borne by National Highways as the operator of the new culvert assets.
Health and safety hazards for workers and children	Annex P of the Flood Risk Assessment [APP-162] includes the result of the culvert screening assessment, which identifies where a culvert screen may be required in accordance with CIRIA C786. The risk to children and workers would be addressed during detailed design via a standard Hazard Elimination and Risk Reduction process.
Reduced groundwater recharge	The construction of culverts has the potential to reduce groundwater discharge to surface watercourses in areas where groundwater baseflow is supporting surface water flows. The magnitude of potential impact would be proportional to the length of the culvert compared to the length of affected watercourse receiving groundwater baseflow. The proposed culverts represent a very small proportion of the affected watercourses. Consequently, the magnitude of potential impact would be expected to be small to negligible and no mitigation measures are considered necessary.
Monitoring water quality and sources of pollution	The draft surface water quality monitoring plan that will form part of the 2nd Iteration Environmental Management Plan includes for downstream monitoring pre-construction, during construction and post construction of all sites of identified interest including downstream of culverts.

Potential Effect	Proposed Mitigation
	For any new culvert there will be a relative lack of light penetration and potential for reduced air circulation but the effects of this on water quality are unknown and limited to the length of any new culvert. Consideration of prevention of ponding and the transfer of rubbish / litter into the culvert are part of the culvert design process.
Reduced resilience for communities and wildlife	This would be addressed though the mitigation measures outlined above.

3 Literature review

3.1.1 This section provides a summary of literature referred to by the Applicant within representations made during the Examination.

3.1.2 CIRIA guidance (Benn *et al.* 2019) provides recommendations for minimum culvert sizes, including culverts for mammal passage, comprising

- 600 mm diameter/height for culvert lengths <20m, and
- 900mm diameter for height for length >20m.

3.1.3 Table 3.1 below provides a comparison of the size of the new culverts for the proposed scheme against the CIRIA recommendations, showing that the two new culverts on the off-line section of the A12 have been designed in accordance with this guidance.

Table 3.1 : Mitigation of potentially detrimental effects of culverting

Proposed culvert	Length	Width	Height	Minimum height to be compliant with CIRIA guidance	Compliant with CIRIA guidance?
Rivenhall Brook	46m	4.5m	3.1m	900mm (0.9m)	✓
Domsey Brook East	60m	2.7m	2.7m	900mm (0.9m)	✓

3.1.4 Regarding the length of culverts, the Applicant recognises that empirical data to support or refute the idea that culverts are an effective mitigation measure for mammal passage (notably otter and water vole) are not available and acknowledges the study presented by Wilkinson and Chadwick (2012), referenced by the Environment Agency. However, the study is limited by the lack of dimensions in order to draw conclusions about which lengths of culverts are or are not effective. The Water Vole Mitigation Handbook (Dean *et.al.,* 2016) suggests that culverts up to 35m long are known to be effective for water vole. However, while this information is useful, it does not mean by omission that culverts of a different (longer) length are ineffective.

3.1.5 A publication from The Otter Consultancy (Blackbridge, 2017) reports evidence of otter using a 116m long culvert without mammal ledges. This is significantly longer than the longest proposed culvert for the proposed scheme (Domsey Brook west at 70.1m), suggesting that the length of culverts being proposed would not pose a barrier to the movement of otter.

3.1.6 A publication by Philcox and Grogan (Patterns of otter *Lutra lutra* road mortality in Britain, 1999) concludes no significant difference in the number of casualties located within 100m of a watercourse when comparing culverts, bridges or locations within a road crossing and states the optimal approach to road crossing design is to maintain continuous, where possible, natural bank above the level of high flows, by using either wide-span bridges, over-sized culverts or artificial ledges. While there is no explicit definition available for what size of culvert constitutes an 'over-sized' culvert, the dimensions of existing culverts and new culverts designed for the proposed scheme exceed the minimum recommended size (in most cases considerably so) as per Table 12.2 of the CIRIA Culvert, Screen and Outfall Manual (2019) and so in comparison with the guidance are 'over-sized'.

3.1.7 In summary, based on the literature currently available, the Applicant does not consider the proposed crossings would reduce permeability or introduce any new barriers to riparian mammals (notably otter and water vole). In addition, in some locations (i.e., where retrofitting of mammal ledges to existing structures otter fencing are proposed) there would be an improvement on baseline conditions. Therefore, the proposed crossings would not give rise to any significant adverse effects on the passage of riparian mammals.

4 Review of the proposed crossings

4.1 Overview

4.1.1 There are eight watercourse crossings along the proposed scheme and two watercourse crossings on the existing A12 on what will become the de-trunked sections. No changes are proposed to two of the structures along the existing A12, namely Boreham Brook culvert and the River Ter Bridge, and the two structures on the de-trunked section, namely Rivenhall Brook culvert and Domsey Brook culvert (east crossing). It is proposed to widen the existing River Brain Bridge, Ashman's Bridge over the River Blackwater, and Roman River culvert along the on-line section. New structures are proposed for the Rivenhall Brook culvert and Domsey Brook (east crossing), while the existing Domsey Brook (west crossing) will be extended, all on the off-line sections of the proposed scheme. The locations of these structures and key features are illustrated on Figure 1 Sheets 1 to 5 in Appendix A and Table 3.1 summarises the proposed works.

Table 4.1 Summary of proposed works to watercourse crossings

Structure	On- / off-line	Proposed Dimensions
Boreham Brook culvert	On-line	No change
River Ter Bridge	On-line	No change
River Brain Bridge	On-line	Width extended 7m to the east and 5m to the west. No change in span length at 28.7m.
Rivenhall Brook culvert (existing)	On-line of de-trunked section of A12	No change
Rivenhall Brook culvert (new)	Off-line	46m long, 4.5m wide and internal height clearance of 3.1m
River Blackwater (Ashman's Bridge)	On-line	Asymmetrical widening 10.1m to the south
Domsey Brook (west crossing)	Off-line as the section diverges from existing	Widen the existing arch structure by 34.6m to 70.1m in total
Domsey Brook (east crossing)	Off-line section	New box culvert 2.7m x 2.7.m, and 60m long
Domsey Brook (east crossing)	On-line of de-trunked section of A12	No change to existing 2 No. 1m diameter culverts
Roman River Bridge	On-line section	Extend the existing box culvert 4.8m wide by 2.1m high along a 12m length

4.2 Watercourse crossings on the on-line section

Boreham Brook culvert

4.2.1 Boreham Brook is a tributary of the River Chelmer which is culverted under the A12. This crossing is shown on Sheet 2 of the General Arrangement Plans and is illustrated in Appendix A Figure 1 Sheet 1. The proposed scheme would include slip road widening at this location, which would be achieved by widening the northbound and southbound highway embankment but would not require altering or extending the existing A12 Boreham Brook culvert which would remain unchanged.

4.2.2 Evidence of otters was recorded north and south of the Boreham Brook culvert (as shown on Sheet 1 of Figure 2 within Appendix 9.10 Riparian Mammal Survey Report [APP-134]), suggesting this structure is currently permeable to otters and does not cause severance. There were no records of water vole within the immediate surroundings of this structure (as shown on Sheet 1 of Figure 3 within Appendix 9.10 [APP-132]), however water vole were recorded south of junction 19 (including using a culvert outside the Order Limits to cross beneath the existing A12).

4.2.3 Three species of freshwater fish were recorded within Boreham Brook (downstream) (Table 6.6 of Appendix 9:1 Aquatic Ecology Survey Report [APP-125]) including European eel which are protected under the European Eel Council Regulation ((EC) No. 1100/2007)) and under the Water Framework Directive (2000/60/EEC). They are listed under the UK BAP and Section 41 of the NERC as a priority species and are also listed as Critically Endangered under the IUCN Red List. As there were no fish monitoring points within the upstream section of the Boreham Brook (including monitoring data from the Environment Agency) it is not possible to infer the permeability of the existing structure to fish.

4.2.4 However, it is noted that the Boreham Brook culvert is not identified as a ‘high priority’ or ‘super-critical’ obstruction as per the Environment Agency’s fish and eel migration barriers database (Environment Agency, 2016), suggesting that this structure is not currently considered a significant barrier to fish passage. This data set covers eels, salmonids, coarse fish and Water Framework Directive (WFD) fish rank and was last updated in September 2020.

4.2.5 As there would be no change to the existing culvert, no changes to the ecological baseline conditions are predicted, and no mitigation measures are proposed. In accordance with Table 3.13 of DMRB LA108 ‘no change’ on County level receptors (otters, water vole and fish) would result in neutral (not significant) effects. Consequently, therefore no potential for significant effects on riparian mammals and fish at the Boreham Brook culvert are predicted.

4.2.6 The assessment of effects of the proposed scheme on the water environment of the Boreham Brook is reported in Table 14.15 of Chapter 14 of the Environmental Statement [APP-081], which reports a slight adverse effect upon surface water quality which would not be environmentally significant.

4.2.7 The Boreham Brook culvert passes beneath both the A12 mainline as well as the Northbound and Southbound Junction 19 sliproads. These features would

present a significant challenge for any proposed upgrade works to this structure. The replacement of the current culvert with a larger, more open structure would necessitate multiple long duration total closures of the eastern half of Junction 19 and A12 mainline over a number of months which would give rise to significant impacts to the communities of Boreham and Chelmsford due to the required diversions as well as causing significant disruption to the wider strategic road network. This section of the existing A12 contains statutory undertaker equipment in both verges which would need to be temporarily moved during these works which would add, significantly, to both the cost, programme and complexity.

4.2.8 The replacement of the existing Boreham Brook culvert with a larger, more open structure would have a number of environmental effects during construction. These include the removal of soil above the culvert to create the larger structure, which would need to be disposed of within the scheme or removed off site. The earthworks would result in the loss of vegetation and associated biodiversity, which would be mitigated through landscaping. As indicated above, there would be disruption to local communities due to closures. Following construction, a more natural channel with associated landscaping would improve the current culverted section of the brook.

4.2.9 Given the lack of significant impact on the baseline conditions caused by the proposed scheme and the high complexity, cost and disruption any upgrade proposal would require, these works are considered to be disproportionate and unjustified.

River Ter Bridge

4.2.10 The River Ter is a tributary of the River Chelmer. The existing River Ter Underbridge carries the A12 two lane dual carriageway and Junction 20A off-slip over the River Ter. The bridge was commissioned in circa 1965 and comprises a three-span precast prestressed concrete superstructure. The structure comprises a centre river span of 14.858m, two side spans of 10.299m each and provides approximately 8m of headroom to the mean river level.

4.2.11 The existing structure would be retained by the proposed scheme, with the carriageway widened from two to three lanes in each direction, which would be achieved without modifications to the bridge substructure. The additional lane in each direction would be provided by altering the width of the running lanes and verges. This bridge is shown on sheet 5 of the General Arrangement Plans [AS-010] and sheet 3 of the Structures Engineering Drawings and Sections – Part 2 [APP-032].

4.2.12 Evidence of otters was recorded north and south of the River Ter Bridge (as shown on Sheet 1 of Figure 2 within Appendix 9.10 Riparian Mammal Survey Report [APP-134]), suggesting this structure is currently permeable to otters and is therefore not a barrier to movement. While the Applicant did not record any evidence of water vole in close proximity to this structure during baseline surveys (Appendix 9.10 [APP-132]), it is recognised that water vole populations could increase in the future. The current structure is considered to be of suitable size to be permeable to water vole, and as no works are proposed for this

structure, it would therefore continue to support movement of riparian mammals across the proposed scheme.

4.2.13 Twelve species of freshwater fish were recorded within the River Ter (downstream) including European eel and brown trout (Table 6.6 of Appendix 9:1 [APP-125]). Brown trout are protected under the Salmon and Freshwater Fisheries Act (1975) and the WFD (2000/60/EEC). They are also listed under the UK BAP and Section 41 of the NERC as a priority species. As there were no fish monitoring points within the upstream section of the River Ter (including monitoring data from the Environment Agency) it is not possible to infer the permeability of the existing structure to fish. However, it is noted that the River Ter Bridge is not identified as a 'high priority' or 'super-critical' obstruction as per the Environment Agency's fish and eel migration barriers database (Environment Agency, 2016), suggesting that this structure is not currently considered a significant barrier to fish passage. This data set covers eels, salmonids, coarse fish and Water Framework Directive (WFD) fish rank and was last updated in September 2020.

4.2.14 As this structure would not be widened, there would be no change in the impacts on ecological receptors and no mitigation measures are proposed. In accordance with Table 3.13 of DMRB LA108 'no change' on County level receptors (otters, water vole and fish) would result in neutral (not significant) effects. As a consequence there is no potential for significant effects on riparian mammals and fish at the River Ter Bridge.

4.2.15 The river channel beneath the bridge is already heavily modified which links to the weir system that is located 10m upstream. There are limited works that could be implemented by the proposed scheme that would not impact the functionality of the weir, as such these are not considered to be feasibly deliverable. It is noted that the weir already includes a baffled fish-pass to maintain connectivity within the channel.

4.2.16 Given the current favourable baseline conditions and lack of impact being caused by the proposed scheme it is considered that the Applicant's proposals to provide no additional mitigation or enhancement at this river crossing is appropriate.

River Brain Bridge

4.2.17 The existing Brain Bridge carries the A12 over the River Brain and two unclassified roads serving the Whetmead Nature Reserve and a public right of way (PRoW) south of Witham (see Appendix A Figure 1 sheet 2). The bridge was commissioned in 1963 and comprises a single span deck formed of precast prestressed concrete beams within *in situ* concrete infill. The structure comprises a single clear span of approximately 12.8m between bearings and the total width of the structure varies between 28.573m and 28.628m and provides approximately 3.5m headroom to the average river level below.

4.2.18 The existing structure would be widened by approximately 7m to the east and 5m to the west to accommodate three running lanes in each direction, a central reserve, and associated hard strips and verges. The vertical retaining walls would be maintained preserving the box-like form under the bridge span while

the existing wingwalls will be taken down and the abutments widened to support the new bridge decks. The location of this bridge is shown on sheet 8 of the General Arrangement Plans [AS-011] and the plan forms and cross sections are shown on sheet 11 of the Structures Engineering Drawings and Sections [APP-032].

4.2.19 Evidence of otters was recorded east and west of Brain Bridge (as shown on sheet 2 of Figure 2 within Appendix 9.10 Riparian Mammal Survey Report [APP-134]), suggesting this structure is currently permeable to otters and is therefore not a barrier to movement. A water vole burrow was recorded immediately east of Brain Bridge (as shown on sheet 2 of Figure 3 within Appendix 9.10 [APP-132]), however this was assessed as disused and therefore would not be impacted during construction of the proposed scheme. As per commitment BI11 of the REAC [REP4-023] pre-construction surveys would be undertaken for species including otter and water vole to update the baseline prior to construction. While there were no records during surveys undertaken by the Applicant of water vole west of Brain Bridge, historic water vole records obtained from Essex Wildlife Trust Records Centre (as presented in Table 6.3 of Appendix 9.10) indicate the presence of water vole west of Brain Bridge, confirming that this structure does not pose a barrier to movement of water vole underneath the existing A12.

4.2.20 Ten species of freshwater fish were recorded within the River Brain (downstream), including European eel (Table 6.6 of Appendix 9:1 [APP-125]). Monitoring data from the Environment Agency (Table 6.3 [APP-125]) recorded nine out of these ten species of freshwater fish upstream of the River Brain (including European eel, the exception being three-spined stickleback), indicating that the existing Brain Bridge is not a barrier to fish passage.

4.2.21 In addition, it is noted that the Brain Bridge is not identified as a ‘high priority’ or ‘super-critical’ obstruction as per the Environment Agency’s fish and eel migration barriers database (Environment Agency, 2016), suggesting that the Brain Bridge is not currently considered a significant barrier to fish passage. This data set covers eels, salmonids, coarse fish and Water Framework Directive (WFD) fish rank and was last updated in September 2020.

4.2.22 The proposed widening of the structure would not reduce its permeability to riparian mammals – its large span and height would continue to support movement of otter and water vole. As per Section 3 of this report, there is evidence of otter using culverts more than 100m long (The Otter Consultancy, 2017), which is considerably longer than the proposed length of the extended structure of 40.628m (based on the longest measurement stated in the paragraphs above). It is also proposed to create water vole habitat within an ecological mitigation area immediately south of the River Brain (as shown on sheet 8 of Part 2 of the Environmental Masterplan [APP-087]).

4.2.23 As per commitment RDWE42 of the REAC at Deadline 6 [TR010060/APP/6.5], enhancements of the existing Brain Bridge include the introduction of natural substrates along the riverbed to support natural flow regulation and improve overall channel heterogeneity, therefore ensuring there is no barrier to migration of fish and eels. In addition, no changes in flow velocity are anticipated as a

result of the proposed widening of this structure and there would therefore be no new barriers to fish passage.

4.2.24 The Applicant has considered provision of baffles within the Brain Bridge. The function of baffles is to increase water depth by holding water back in the structure and providing sufficient depth for fish during lower flows, facilitating passage. They may also provide pseudo fish resting refuges during higher flows. However, while resting pools can be considered, the implementation of baffles and resting pools would potentially result in increased flow velocity at this location, which could be problematic in terms of creating additional barriers to fish passage. As part of the detailed design for the scheme the Applicant would investigate potential opportunities for improvements to this crossing, such as the creation of rock rolls.

4.2.25 Considering the evidence of passage of otters through much longer and narrower culverts, and the mitigation being proposed with respect to fish, the proposed widening of the structure by 12m is not considered to reduce its permeability to riparian mammals or fish. In accordance with Table 3.13 of DMRB LA108 in order to have a significant effect (i.e., moderate or above) on a County level receptor (otters, water vole and fish) the proposal would have to result in a major adverse level of impact. Table 3.11 of LA 108 defines a major adverse impact as permanent or irreversible damage which affects the integrity or key characteristics of the resource. As, in the Applicant's view, permeability of the water course would be maintained, there would therefore be no potential for significant effects on riparian mammals and fish at the River Brain Bridge.

4.2.26 The main concerns raised by the Environment Agency in respect to this structure relate to the existing, three-tiered concrete invert slab that forms the river channel below the structure as well as supporting the PRoW and unclassified Road. This slab also plays a structural role in providing scour protection to the abutment foundations ensuring the long term stability of the structure. It is therefore, not considered feasible to remove the concrete invert apron due to the potential damage to the existing structure combined with the increased health and safety risks of working in confined spaces and adjacent to and/or within water. The existing structure has been in place for over 60 years and enhancement is disproportionate given the impacts. The three-tiered concrete invert slab will be considered further in detailed design and options to increase the depth of the main channel will be investigated. Options to remove the upper and lower track and provide a single track will also be considered, however, the Applicant notes that this needs to be balanced with the need to maintain the integrity of the structure whilst ensuring no detriment on flood impact. The Applicant will continue to consult with the Environment Agency as this develops.

4.2.27 No alternative forms of crossing are considered to be feasible in this location. To replace this structure with a larger one that would allow a more natural channel form would require extensive earthworks and construction near and within the watercourse with potential short term impacts on ecology and the water environment. It would also cause considerable disruption to road users during demolition and construction, increased health and safety risks to operatives, and increase embodied carbon. Overall, the replacement of the

current structure with a larger open span structure provides disproportionately low benefits when compared to the increased capital whole life costs.

Rivenhall Bridge

4.2.28 The existing Rivenhall Bridge is a small bridge style culvert which comprises of a 4.2m simple support concrete deck span upon 2.0m high abutments with a total length of 28m. This structure would remain unchanged on the de-trunked section of the A12 to the north of Witham and Rivenhall End. The responsibility for maintaining this structure would be passed to Essex County Council. This structure is located on Figure 1 sheet 3 in Appendix A.

4.2.29 Evidence of otters was recorded east and west of Rivenhall Brook existing culvert (as shown on sheet 3 of Figure 2 within Appendix 9.10 Riparian Mammal Survey Report [APP-134]), suggesting this structure is currently permeable to otters. While the Applicant did not record any evidence of water vole in close proximity to this structure during baseline surveys (Appendix 9.10 [APP-132]), it is recognised that water vole populations could increase in the future. The current structure is considered to be of suitable size to be permeable to water vole. The proposed de-trunking of the existing A12 in this location would result in a predicted reduction in traffic from 82,000 to 8,000 vehicles per day, and a reduction in the speed limit on the de-trunked sections of the A12 to 40mph from the current 70mph, would provide an improvement on the baseline condition, as it would mean otters are more likely to be able to safely cross the road in the eventuality that they attempt to cross the carriageway rather than use the culvert.

4.2.30 No fish data are available for the Rivenhall Brook. However European eel and brown trout have been reported from the Blackwater downstream of the confluence with the Rivenhall. As such, these species could be expected to be present within the brook.

4.2.31 It is noted that the Rivenhall culvert is not identified as a ‘high priority’ or ‘super-critical’ obstruction as per the Environment Agency’s fish and eel migration barriers database (Environment Agency, 2016), suggesting that this structure is not currently considered a significant barrier to fish passage. This data set covers eels, salmonids, coarse fish and Water Framework Directive (WFD) fish rank and was last updated in September 2020.

4.2.32 As there would be no change to the existing culvert, no changes to the ecological baseline conditions are predicted at this location and no mitigation measures are proposed. In accordance with Table 3.13 of DMRB LA108 ‘no change’ on County level receptors (otters, water vole and fish) would result in neutral (not significant) effects. There is therefore no potential for significant effects on riparian mammals and fish at the existing Rivenhall culvert.

4.2.33 The existing bridge structure is highly constrained vertically with the A12 mainline pavement construction sited directly on top of the structure. Whilst it would be feasible to replace this bridge with a wider span structure to maintain a more natural riverbed, this would necessitate an increase in the structural depth of the structure to support the increased loading. This would encroach upon the vertical clearance above the watercourse, creating a darker, more

enclosed space compared to the current structure. The works themselves would require the open excavation of the existing A12 mainline over a two to three month period causing significant impact on the community of Rivenhall End and directly impacting businesses, such as the Shell garage, located 100m to the south of the structure. Both verges contain a large number of statutory undertakers' equipment which would need to be diverted to allow for any proposed upgrade works, significantly increasing their cost and complexity.

4.2.34 Given the lack of impact the proposed scheme is having at this river crossing, combined with the relative cost, complexity and reduced benefits of an upgraded structure, the Applicant considers the current proposals to be appropriate.

River Blackwater (Ashman's Bridge)

4.2.35 The River Blackwater is crossed by Ashman's Bridge, a three span deck formed of precast pretensioned prestressed concrete beams with *in situ* concrete infill. commissioned in 1965 (see Appendix A Figure 1 sheet 3). The central river span is approximately 12.2m wide and provides approximately 5.5m of headroom to the mean river level. The abutments and intermediate piers are supported on piled foundations.

4.2.36 The structure would be upgraded to accommodate three running lanes in each direction, a central reserve, and associated hard strips and verges. The structure would be widened asymmetrically by approximately 10.1m to the south to accommodate the increased cross-section. The location of the bridge is shown on sheet 12 of the General Arrangement Plans [AS-012] and the plan and cross sections are shown on sheet 18 of the Structures Engineering Drawings and Sections [APP-032].

4.2.37 The existing PRoW and Ashman's Farm Footbridge would be relocated approximately 75m to the south. The relocated footbridge would incorporate accessibility ramps on both sides.

4.2.38 Evidence of otters was recorded north and south of Ashman's Bridge (as shown on sheet 3 of Figure 2 within Appendix 9.10 Riparian Mammal Survey Report [APP-134]), suggesting this structure is currently permeable to otters and is therefore not a barrier to movement. While the Applicant did not record any evidence of water vole in close proximity to this structure during baseline surveys (Appendix 9.10 [APP-132]), it is recognised that water vole populations could increase in the future. Due to its large span and height, the current structure is considered to be of suitable size to be permeable to water vole, and this would be maintained once the structure is extended.

4.2.39 Ten species of freshwater fish were recorded within the River Blackwater (downstream) including brown trout (Table 6.6 of Appendix 9:1 [APP-125]). Monitoring data from the Environment Agency (Table 6.3 [APP-125]) recorded all ten of these species of freshwater fish upstream of the River Blackwater, indicating that the existing crossing is not a barrier to fish passage.

4.2.40 In addition, it is noted that Ashman's Bridge is not identified as a 'high priority' or 'super-critical' obstruction as per the Environment Agency's fish and eel migration barriers database (Environment Agency, 2016), suggesting that this

structure is not currently considered a significant barrier to fish passage. This data set covers eels, salmonids, coarse fish and Water Framework Directive (WFD) fish rank and was last updated in September 2020.

4.2.41 The proposed extension of the structure would not reduce its permeability to riparian mammals and fish as its large span and height would continue to support movement of these species. As per Section 3 of this report, there is evidence of otter using culverts more than 100m long (The Otter Consultancy, 2017), which is considerably longer than the proposed length of the extended structure of 39.35m. As stated by the Environment Agency in paragraph 1.5.10 of their Written Representation [REP2-054], 'replicating the existing structure will not create a barrier to fish or mammals. Therefore, we have no objection to the proposed structure'. Due to the fact there is therefore no potential for impacts (i.e. there would be 'no change' as defined by Table 3.11 of LA 108) to County level receptors (otters, water vole and fish), the significance of effect would be neutral (not significant) for riparian mammals and fish at Ashman's Bridge.

4.2.42 The Applicant considered options to remove the need to widen this structure and thus remove any impact on the watercourse below. However, the horizontal curvature of the highway's alignment requires a significant widening of the central reserve and southern verge to ensure minimum safe stopping sight distances are achieved. The design of the widened sections aims to mirror the existing structural form to ensure there is no deterioration to the condition of the river environment. Scour protection is required to the pier foundations in line with the existing structure, however, a natural river bed can be maintained.

4.2.43 Ashman's Bridge already provides a more open structure underneath which allows for the passage of riparian mammals and fish. To replace this with a larger structure for environmental reasons is not justified, a position accepted by the Environment Agency.

4.2.44 Given the current favourable baseline conditions and lack of impact being caused by the proposed scheme it is considered that the Applicant's proposals to provide no additional mitigation or enhancement at this river crossing is appropriate.

Domsey Brook (east crossing) existing crossing

4.2.45 Domsey Brook rises to the north of the A12 near Marks Tey and is crossed twice by the existing A12 before joining the River Blackwater approximately 1.7km downstream from the east crossing.

4.2.46 The Domsey Brook east crossing on the existing A12 comprises two 45m long, 1m diameter culverts. These will remain in place on what will become the de-trunked section of the A12. There are no proposals to modify these culverts.

4.2.47 There were no records of otter or water vole within this section of the Domsey Brook. It is therefore not possible to infer permeability of the existing structure to riparian mammals. However, the proposed detrunking of the existing A12 in this location would result in a reduction in traffic from 82,000 to 8,000 vehicles per day, and a reduction in the speed limit on the de-trunked sections of the A12 to 50mph compared to the current 70mph would mean otters are more likely to be

able to safely cross the road in the eventuality that they attempt to cross the carriageway instead of moving under the bridge.

4.2.48 Six species of freshwater fish were recorded within the Domsey Brook (downstream) including European eel (Table 6.6 of Appendix 9:1 [APP-125]). As there were no fish monitoring points within the upstream section of Domsey Brook (including monitoring data from the Environment Agency) it is not possible to infer the permeability of the existing structure to fish.

4.2.49 However, it is noted that the Domsey Brook (east crossing) is not identified as a 'high priority' or 'super-critical' obstruction as per the Environment Agency's fish and eel migration barriers database (Environment Agency, 2016), suggesting that this structure is not currently considered a significant barrier to fish passage. This data set covers eels, salmonids, coarse fish and Water Framework Directive (WFD) fish rank and was last updated in September 2020.

4.2.50 Given that there are no proposed changes to this structure, no changes to the ecological baseline conditions are predicted and no mitigation measures are proposed. In accordance with Table 3.13 of DMRB LA108 'no change' on County level receptors (otters, water vole and fish) would result in neutral (not significant) effects. Consequently, no potential significant effects are predicted for riparian mammals and fish at the Domsey Brook (east) existing culvert.

4.2.51 It would be feasible to replace the existing culvert structure with a wider span bridge from an engineering perspective. This could take the form of a precast concrete portal frame bridge which would allow for the retention of a more natural river bed. However, as with a number of the existing river crossings on the A12, the vertical clearance is restricted by the relatively low profile of the existing A12 highways alignment in relation to the water course underneath. As such any structural widening is expected to have a negligible benefit on the natural light permitted through the structure as the increased structural depth will encroach on the available headroom.

4.2.52 Any proposed upgrade works would give rise to significant additional cost and programme impacts as well as adverse effects due to need to undertake open excavation across the existing A12 carriageway. This would include significant disruption to local communities including Kelvedon and Feering due to required diversion routes for local traffic.

4.2.53 The replacement of the existing Domsey Brook twin culverts with a new more open structure would result in the need to remove and dispose of materials and spoil, loss of existing planting on both sides of the carriageway, and potential impacts on water quality and aquatic ecology. These effects would be mitigated through the CEMP and landscaping schemes. During operation the improvement in the crossing would have limited relief on light levels through the structure given the variations in elevations of the highway and river channel, although a wider structure might improve permeability for riparian mammals and fish.

4.2.54 The proposed scheme does not include any alterations to the existing A12 infrastructure in the location of the existing Domsey Brook crossing, nor has it been shown to be creating any new significant effects to the river environment that need to be mitigated or avoided through the implementation of a new river

structure. For these reasons, though possible, these works are not considered to be justifiable compared to the proposed, 'do nothing' option.

Roman River

4.2.55 Roman River is a tributary of the Colne River, which it joins about 15km downstream. The existing culvert carries the A12 over the Roman River and comprises a 40m long box culvert type structure. The preferred solution for the culvert extension is a precast box culvert which offers high durability and closely matches the existing culvert opening reducing changes to existing conditions. This option has the benefits of low maintenance requirements and simple construction form leading to added safety benefits.

4.2.56 The proposed scheme would involve widening the southbound highway embankment and extending the existing 4.8m wide by 2.1m high culvert by approximately 12m. A section of the Roman River south of the A12 would be realigned and designed to match the existing channel capacity. This culvert is shown on sheet 19 of the General Arrangement plans part 5 [AS-013] and sheet 30 of the Structures Engineering Drawings and Sections [APP-032].

4.2.57 Evidence of otters was recorded south of the Roman River crossing only (as shown on sheet 5 of Figure 2 within Appendix 9.10 Riparian Mammal Survey Report [APP-134]), suggesting the existing structure may not be permeable to otters. There were no records of water vole within the immediate surroundings of this structure (as shown on sheet 3 of Figure 3 within Appendix 9.10 [APP-132]), and therefore it is not possible to infer whether the Roman River culvert is permeable to this species.

4.2.58 Mitigation would comprise the installation of mammal ledges (as per commitment BI32 in the REAC [REP4-023]) within the extended section of the culvert as well as ledges retrofitted to each side of the existing structure. This would improve permeability to otters (and other mammals) at times of high water flow, compared with the baseline scenario. It is considered that the increase in the length of the structure would be offset by the provision of mammal ledges and that overall, there would not be a significant decrease in the permeability of the structure to otters and water vole.

4.2.59 Three species of freshwater fish were recorded within the Roman River (downstream) including brown trout (Table 6.6 of Appendix 9:1 [APP-125]). As there were no fish monitoring points within the upstream section of the Roman River (including monitoring data from the Environment Agency) it is not possible to infer the permeability of the existing structure to fish. As per commitment RDWE42 of the REAC at Deadline 6 [TR010060/APP/6.5], enhancements of the existing structure include the introduction of sediment substrate along the riverbed to act as natural flow regulation and provide overall channel heterogeneity. This would reduce impacts associated with the proposed lengthening of this structure, therefore maintaining fish passage.

4.2.60 In addition, it is noted that the Roman River structure is not identified as a 'high priority' or 'super-critical' obstruction as per the Environment Agency's fish and eel migration barriers database (Environment Agency, 2016), suggesting that this structure is not currently considered a significant barrier to fish passage.

This data set covers eels, salmonids, coarse fish and Water Framework Directive (WFD) fish rank and was last updated in September 2020.

4.2.61 The baseline data described above indicate that water vole are not currently present on this section of the Roman River, and otter and fish are known to be present downstream but not confirmed upstream of the crossing on the Roman River. While the existing structure may cause some loss of connectivity for aquatic ecology, the provision of mammal ledges and substrate within the structure would reduce any further impacts associated with the proposed extension of the existing structure on riparian mammals and fish. Consequently, with mitigation, in accordance with Table 3.13 of DMRB LA108, it is assessed there would be 'no change' on County level receptors (otters, water vole and fish) which would result in neutral (not significant) effects.

4.2.62 Much like in the case of Boreham Brook above, the biggest constraint in replacing the existing Roman River culvert with a wider more open structure is its location under the existing A12 mainline carriageway and southbound Junction 25 off-slip. This could only be achieved through open excavation of the A12 mainline which would necessitate significant numbers of full and partial closures of the carriageway over a number of months. This would have significant impacts on the community of Marks Tey and Copford due to the required diversions as well as causing significant disruption to the wider strategic road network. It is important to note that there is little vertical clearance between the existing culvert structure and finished road level of the A12 mainline in this location. As such, whilst a wider portal frame bridge structure could be installed in place of the current culvert, which would allow for a more natural channel, very little increase in vertical clearance (<1m) would be achieved. This would negate one of the core aims of replacing this structure, increasing the natural light. It should be noted that this section of the A12 mainline carriageway is currently being fully replaced as part of the concrete roads programme. As such any intervention in this location would result in a significant degree of abortive works and waste of taxpayers' money.

4.2.63 The replacement of the existing Roman Bridge with a new more open structure would result in the need to remove and dispose of materials and spoil, loss of existing planting on both sides of the carriageway, and potential impacts on water quality and aquatic ecology. These effects would be mitigated through the CEMP and landscaping schemes. During operation the improvement in the crossing would have limited relief on light levels through the structure given the variations in elevations of the highway and river channel, although a wider structure might improve permeability for riparian mammals and fish.

4.2.64 Whilst an alternative to the proposed extension to the existing box-culvert is feasible for this river crossing, the relative benefits need to be weighed up against the increased cost, technical risk and programme impacts. The Applicant maintains that the proposed extension of the existing box culvert does not give rise to any additional significant effects at this river crossing. When combined with the limited benefits of the alternative the increased costs and scheme risks are not considered to be justifiable.

4.3 Watercourse crossings on the off-line section

Rivenhall Brook

4.3.1 The Rivenhall Brook is a tributary of the River Blackwater, which it joins about 850m downstream. It is proposed to culvert the brook in a new structure located approximately 90m south-east of the existing A12 crossing of the same brook. This structure is shown on sheet 11 of the General Arrangement Plans Part 4 [AS-012] and sheet 15 of the Structures Engineering Drawings and Sections [APP-032].

4.3.2 Baseline surveys indicate that the existing Rivenhall Brook culvert which has a height of 2.0m and a span of 4.2m, does not pose a barrier to otters. The proposed new culvert would have a comparable span of 4.5m however the internal height clearance would be greater at 3.1m. Whilst the proposed culvert is longer than the existing culvert, (46m compared to 28m) as per Section 3 of this report, there is evidence of otters using culverts more than 100m long (The Otter Consultancy, 2017). The size of the proposed culvert also exceeds the dimensions specified in CIRIA guidance for culverts for mammals (diameter). It is therefore considered that the proposed culvert would be permeable to otters. While the Applicant did not record any evidence of water vole in close proximity to this structure during baseline surveys (Appendix 9.10 [APP-132]), it is recognised that water vole populations could increase in the future. The proposed new structure is considered to be of suitable size to be permeable to water vole.

4.3.3 It should also be noted that the existing culvert on the Rivenhall Brook lacks mammal ledges, whereas mammal ledges would be installed on both sides of the proposed new culvert (as per commitment BI32 in the REAC [REP4-023]). This would provide a safe means for mammals (specifically otter) to cross under the proposed A12. Otter fencing would also be provided either side of the proposed new culvert to mitigate mortality of otters by directing otters to the culvert entrances and dissuading them from entering the carriageway.

4.3.4 No fish data are available for the Rivenhall Brook. However European eel and brown trout have been reported from the Blackwater downstream of the confluence with the Rivenhall. As such, these species could be expected to be present within the brook. The invert of the proposed new culvert would be buried beneath the natural bed of the watercourse to allow the continuation of sediment conveyance and reduce the impact on local flow dynamics (as committed to in RDWE 39 [REP4-023]). This would replicate the natural stream bed material within the structure to aid permeability to fish and eels.

4.3.5 It is considered that the above mitigation measures would offset any impacts associated with proposed new structure. Consequently, with mitigation, in accordance with Table 3.13 of DMRB LA108, it is assessed there would be ‘no change’ on County level receptors (otters, water vole and fish) which would result in neutral (not significant) effects on riparian mammals and fish at the Rivenhall Brook crossing.

4.3.6 The option of a 10m precast portal bridge structure was reviewed as part of a structural review process and would be feasible to construct from an

engineering perspective. This would allow for the retention of a more natural bank along the watercourse. However, it would result in a slight reduction in headroom compared to the proposed box culvert due to the constraints of the vertical alignment of the proposed highway. As a result, there would not be much to differentiate between the two options in terms of natural light ingress.

4.3.7 Both options offer the same opportunities in terms of precast elements and off-line construction, however, there are significant disbenefits of the portal bridge options when compared to the box culvert in terms of cost, embodied carbon and programme. The most critical of these are the construction durations and wider programme implications. These have been assessed at 15 weeks for the box culvert and 24 weeks for the portal bridge. The crossing of the Rivenhall Brook is on the critical path for the overall scheme as it allows for the establishment of the temporary haulage routes between the proposed borrow-pits and the new junction 22 and mainline embankment earthworks. A 9 week increase in the completion of this crossing would therefore have direct impact on the open for traffic date and associated indirect costs. The effects of this delay could be mitigated through the extended use of on-road haulage, or through the introduction of a temporary crossing of the Rivenhall Brook, however, these would be costly to implement and would have their own environmental considerations.

4.3.8 The potential environmental effects during construction would be similar for both options. During operation, while the more open design would allow a more natural river form, it would have limited relief on light levels as explained above.

4.3.9 Whilst an alternative to the proposed box culvert is feasible for this river crossing, the relative benefits need to be weighed against the increased cost, technical risk and programme impacts. In the case of Rivenhall Brook, the proximity of the existing culvert structure (Rivenhall Bridge), approximately 90m to the north of the proposed structure, also needs to be considered as this would limit the impact of these benefits over the wider river catchment. The Applicant maintains that the proposed box culvert does not give rise to any additional significant effects at this river crossing. When combined with the limited benefits of the alternative the increased costs and scheme risks are not considered to be justifiable.

Domsey Brook (west crossing)

4.3.10 The existing Domsey Brook underbridge carries the A12 over Domsey Brook and was commissioned in 1965. The structure comprises a single span of 7.0m. The structure consists of a cast *in situ* reinforced concrete parabolic arch with a 5.5m rise and a shrinkage key at the crown. The arch springing is monolithic with the reinforced concrete invert slab which forms a spread footing. Beyond the extents of the structure on both sides, Domsey Brook has mass concrete revetments and dwarf walls. The total width of the structure is 38.1 m between the tops of headwalls.

4.3.11 This structure would be extended asymmetrically by approximately 34.6m plus a 9.2m long wing wall to the south-east to accommodate the new carriageway with three running lanes in each direction, a central reserve, and associated hard strips and verges. A section of the watercourse immediately upstream of

the crossing would be realigned to make way for the proposed highway widening works and allow the watercourse to tie-in with the proposed extension to the crossing. This bridge is shown on sheet 14 of the General Arrangement Plans Part 4 [AS-012] and sheet 23 of the Structures Engineering Drawings and Sections [APP-032].

4.3.12 Evidence of otters was recorded east and west of the Domsey Brook west crossing (as shown on sheet 4 of Figure 2 within Appendix 9.10 Riparian Mammal Survey Report [APP-134]), suggesting this structure is currently permeable to otters and is therefore not a barrier to movement.

4.3.13 While the Applicant did not record any evidence of water vole in close proximity to this structure during baseline surveys (Appendix 9.10 [APP-132]), it is recognised that water vole populations could increase in the future. The current structure is considered to be of suitable size to be permeable to water vole.

4.3.14 The extended structure would be approximately 72.7m long whereas there is evidence of otters using culverts more than 100m long (The Otter Consultancy, 2017). In addition, as mitigation for the proposed extension of this structure, mammal ledges would be fitted to each side of the structure, including the existing section, thereby improving the permeability to otters at times of high water flow. It is considered that the increase in length would be offset by the provision of the mammal ledges in this location and that overall, there would not be a significant decrease in the permeability of the structure to otters or water vole. In addition, otter fencing would be provided to dissuade otters from entering the carriageway and to direct them to the culvert entrances. This would reduce the risk of mortality to otters should they attempt to cross the carriageway and would be an improvement on baseline conditions where there is currently no otter fencing.

4.3.15 Six species of freshwater fish were recorded within the Domsey Brook (downstream) including European eel (Table 6.6 of Appendix 9:1 [APP-125]). As there were no fish monitoring points within the upstream section of Domsey Brook (including monitoring data from the Environment Agency) it is not possible to infer the permeability of the existing structure to fish. However, the structure is considered to be of suitable size to facilitate the passage of fish.

4.3.16 As per commitment RDWE42 of the REAC at Deadline 6 [TR010060/APP/6.5], sediment would be introduced along the Domsey Brook realignment to create self-cleaning channels. This would replicate pool-riffle sequences, creating additional aquatic habitat and promote habitat diversity, which would contribute towards the regulation of flow velocities, thereby reducing the likelihood of any adverse effects on fish in this location.

4.3.17 It is considered that the provision of mammal ledges would offset any impacts associated with the proposed extension of the existing structure and the use of otter fencing would be an improvement on baseline conditions. The proposed extension to the structure is not considered to reduce permeability to fish, although under low flow conditions, water depth and vegetation growth immediately upstream of the Domsey (west) culvert may reduce the passability of the structure to fish. Increased water depth at higher flow conditions will increase the ability of fish to move freely through this structure. In accordance

with Table 3.13 of DMRB LA108 in order to have a significant effect (i.e., moderate or above) on a County level receptor (otters, water vole and fish) the proposal would have to result in a major adverse level of impact. Table 3.11 of LA 108 defines a major adverse impact as permanent or irreversible damage which affects the integrity or key characteristics of the resource. As, in the Applicant's view, permeability of the water course would be maintained, there would therefore be no potential for significant effects on riparian mammals and fish at the Domsey Brook (west) crossing.

4.3.18 The existing Domsey Brook west crossing consists of single span cast *in situ* reinforced concrete arch structure with a relatively complex geometry compared to an equivalent box culvert. This limits the viable structural options available for widening this structure. A 'do-nothing' option was explored and ruled out because the footprint of the existing structure is not sufficient to accommodate a widened A12 even if departures were applied. The full replacement of the structure was also discounted due to significant cost, programme and disruption impacts of having to excavate across the A12 on a section of on-line highways widening. Whilst a box culvert would be significantly cheaper to provide in the widened section, this was ruled out due to structural compatibility with the existing cross-section. Therefore, a precast arched structure has been proposed which closely mirrors the shape of the existing culvert both structurally and aesthetically whilst offering the benefits of relatively quick and simple installation. Both the existing and proposed cross-sections are generous in their proportions with a span of 7.0m and a vertical clearance of 5.5m as such the opacity of the structure is not considered to be an issue in this location. Under this option an artificial stone mattress river bed has been proposed as opposed to maintaining a natural bed in the widened section. This is driven by the requirement to provide piled foundations and appropriate scour protection for the structure to remove the risk of differential settlement and ensure long term stability respectively. These features encroach significantly into the available space in the base of the structure meaning a natural channel of sufficient cross-section cannot be maintained.

4.3.19 Given the relatively low assessed impact on the river catchment of the proposed structural improvement works and the complexity of the existing structural form no alternative is considered to be feasible for this main river crossing.

Domsey Brook (east crossing)

4.3.20 A new Domsey Brook east crossing is required on the off-line section of the proposed A12. The precast concrete box culvert would be located approximately 100m from the existing A12. The culvert would have inner dimensions of 2.7m height and 2.7m width. The overall length of the culvert will be 60m and it will be square to the A12, with 3.5m long wing walls at both ends as the A12 would be on embankment. The Domsey Brook would be realigned through the new culvert. The location of this culvert is shown on sheet 17 of the General Arrangement Plans Part 5 [AS-013] and the plan and cross section are shown on sheet 26 of the Structures Engineering Drawings and Sections [APP-032].

4.3.21 There were no records of otter or water vole within this section of the Domsey Brook. Six species of freshwater fish were recorded within the Domsey Brook (downstream) including European eel (Table 6.6 of Appendix 9:1 [APP-125]). As there were no fish monitoring points within the upstream section of Domsey Brook (including monitoring data from the Environment Agency) it is not possible to infer the permeability of the existing structure to fish.

4.3.22 As mitigation for the proposed structure, mammal ledges would be fitted to each side of the structure, thereby improving the permeability to otters at times of high water flow. The provision of mammal ledges in this location would aim to maintain permeability for riparian mammals, particularly otters - a species that has been recorded using longer culverts (The Otter Consultancy, 2017). The size of the proposed culvert also exceeds the dimensions specified in CIRIA guidance for culverts for mammals (0.9m diameter). The proposed height and span of the Domsey Brook (east) culvert is therefore considered to be permeable to riparian mammals. Otter fencing would be provided to dissuade otters from entering the carriageway and to direct them to the culvert entrances. This would reduce the risk of mortality to otters should they attempt to cross the carriageway.

4.3.23 The invert of the proposed new culvert would be buried beneath the natural bed of the watercourse to allow the continuation of sediment conveyance and reduce the impact on local flow dynamics (as committed to in RDWE 39 [REP4-023]). This would replicate the natural stream bed material within the structure to aid permeability to fish and eels.

4.3.24 It is considered that the above mitigation measures would offset any impacts associated with the proposed new culvert. Consequently, with mitigation, in accordance with Table 3.13 of DMRB LA108, it is assessed there would be ‘no change’ on County level receptors (otters, water vole and fish) which would result in neutral (not significant) effects on riparian mammals and fish at the proposed Domsey Brook (east) crossing.

4.3.25 Similarly to Rivenhall Brook, consideration of a 12m wide precast portal frame bridge structure was given during the structures optioneering process. Whilst it is determined to be a feasible option from an engineering perspective, the alternative form would have greater impacts on scheme cost, embodied carbon and programme. Initial geotechnical assessment of foundation requirements for the alternative portal frame solution confirmed that this would only be feasible with the inclusion of a permanent sheet pile wall either side of the watercourse over the entire length of the structure to achieve the required design bearing resistance. By comparison the proposed box culvert would only require a 300mm bed of structural stone (6N). Other additional complexities include the requirement for increased temporary works including piling platforms and larger crane platforms to install the heavier structural elements compared to an equivalent box culvert.

4.3.26 Whilst an alternative to the proposed box culvert is feasible for this river crossing, the relative benefits, again, need to be weighed up against the increased cost (at least a doubling), technical risk and programme impacts. In the case of Domsey Brook, the proximity of the existing culvert structure (Domsey Brook East – existing), approximately 100m to the north of the

proposed alignment, also needs to be considered as this would limit the impact of any benefits upon the wider river catchment. The Applicant maintains that the proposed box culvert does not give rise to any additional significant effects at this river crossing. When considered in combination with the limited benefits, the increased costs and associated impacts are not considered to be justifiable.

4.4 Cumulative effects of watercourse crossings

4.4.1 The proposed scheme spans three operational river catchments:

- River Chelmer catchment (Boreham Brook and River Ter)
- River Blackwater catchment (River Brain, Rivenhall Brook, River Blackwater and the Domsey Brook)
- River Colne catchment (Roman River).

4.4.2 The proposed scheme would have three crossings over tributaries to the Chelmer River, the Boreham Brook, the River Ter and the River Blackwater. No works are proposed to the Boreham Brook and Ter Bridge, so there would be no change in ecological conditions as a result of the scheme.

4.4.3 The Applicant has assessed that the widening of Brain Bridge over the River Brain, a tributary of the River Blackwater, would maintain permeability of the water course and consequently there would be no potential for significant effects on riparian mammals and fish at this location.

4.4.4 As stated by the Environment Agency in paragraph 1.5.10 of their Written Representation [REP2-054], 'replicating the existing structure will not create a barrier to fish or mammals. Therefore, we have no objection to the proposed structure'. This supports the Applicant's view that there would be no significant effects on riparian mammals and fish as a consequence of widening Ashman's Bridge.

4.4.5 The Rivenhall Brook and Domsey Brook are also tributaries of the River Blackwater. Although construction of the proposed scheme would lead to two additional crossing points (Rivenhall Brook culvert and Domsey Brook (east)), it is considered that overall there would be no significant effects. The proposed scheme would lead to routing of traffic onto structures which have reduced risks for otters due to the presence of mammal ledges, ensuring they are useable even in a peak flow scenario, and with the presence of otter fencing to guide otters through the culvert and deter them from crossing the carriageway. The proposed scheme would also lead to a reduction in traffic and vehicle speeds on the existing culverts, resulting in less risk to otters in the eventuality they attempt to cross the carriageway at these locations.

4.4.6 Lastly, the proposed scheme would require widening of the Domsey west culvert which as detailed within Section 4.3 is assessed as still being permeable to riparian mammals and fish.

4.4.7 The Roman River culvert is the only structure located within the River Colne catchment. As stated above, the provision of mammal ledges and substrate within the structure would reduce any impacts associated with the proposed

extension of the existing structure on riparian mammals and fish. Consequently, no significant effects are predicted.

4.4.8 All crossings create a degree of artificial form to the channel planform and cross section. However, geomorphological assessment of each channel shows that all of the channels described are semi-sinusoidal, artificially modified and exhibit artificial cross section and a paucity of in-channel features.

4.4.9 In terms of compliance with WFD Regulations, the compliance assessment ascertained that compliance could be achieved without degradation to the wider catchments of each relevant watercourse.

4.5 Consideration of Alternatives

The Requirement to Assess Alternatives

4.5.1 The Environment Agency has sought an assessment of the alternative options from the Applicant, considered to justify the inclusion of culverts within the scheme. The Applicant does not consider that there is a justification for such a comparative exercise in either law or policy.

4.5.2 As a matter of law, a decision maker can choose to have regard to a potential alternative to a scheme where the scheme is identified as having conspicuously harmful effects and where the scheme seeks to overcome such harm by reference to countervailing public interest benefits: Trusthouse Forte v Secretary of State for the Environment (1987) 53 P & CR 293 at 299-300.

4.5.3 In R (Mount Cook Land Limited) v Westminster City Council [2017] PTSR 116 at [30] the court explains that, in the absence of conflict with planning policy and/or other planning harm, the relative advantages of alternative uses on the application site or of the same use on alternative sites are normally irrelevant. In those "exceptional circumstances" where alternatives might be relevant, vague or inchoate schemes, or which have no real possibility of coming about, are either irrelevant, or where relevant, should be given little or no weight.

4.5.4 Paragraph 4.26 of the NNNPS provides general guidance on the assessment of alternatives.

> "4.26 *Applicants should comply with all legal requirements and any policy requirements set out in this NPS on the assessment of alternatives. In particular:*
>
> *The EIA Directive requires projects with significant environmental effects to include an outline of the main alternatives studied by the applicant and an indication of the main reasons for the applicant's choice, taking into account the environmental effects.*
>
> *There may also be other specific legal requirements for the considerations of alternatives, for example, under the habitats and Water Framework Directives.*
>
> *There may also be policy requirements in this NPS, for example the flood risk sequential test and the assessment of alternatives for*

developments in National Parks, the Broads and Areas of Outstanding Natural Beauty."

4.5.5 Paragraph 4.26 is aligned with the approach in caselaw, since it refers to the EIA Directive requiring projects "with significant environmental effects" to include an outline of the main alternatives studied.

4.5.6 The Applicant has assessed the likely significant effects of culverting in Chapter 14 of the Environmental Statement: Road Drainage and the Water Environment [APP-081 [paragraph ref 14.11.39 and Table 14.16; and paragraph ref 14.13.1 to 14.13.17]]. This concludes that it will not give rise to any significant residual effects [paragraph ref 14.13.18; Table 14.19].

4.5.7 In addition no significant adverse effects were identified for the Main River crossings, no likely significant effects have been identified under the Habitats Directives as explained in the Habitats Regulations Assessment No Significant Effects Report [APP-201] or the Water Environment Regulations (WFD Regulations) Compliance Assessment [APP-159], and project design and mitigation for the Main River crossings do not significantly affect flood risk as explained in the Flood Risk Assessment [APP-162].

4.5.8 The Applicant has not been provided with any assessment by the Environment Agency which demonstrates that the proposed culverts would be likely to have significant residual effects.

4.5.9 Since the Applicant's assessment does not identify any "conspicuously harmful effects" arising from the proposed culverts, no duty arises as a matter of law for the Secretary of State to consider alternative proposals to them.

4.5.10 The only other means by which the Secretary of State could be required to consider alternatives would be if this was required by adopted policy. The Applicant is not aware of any such policy requirement in the NNNPS, the NPPF or the relevant adopted development plans. It is notable that the EA has not identified any adopted policy requirement to consider alternatives to the proposed culverts.

4.5.11 It was established in Sainsburys v First Secretary of State [2007] EWCA Civ 1083 that where a development is determined on its own merits to be acceptable in policy terms, there is no duty upon the decision maker to consider whether a yet more acceptable alternative can be identified.

4.5.12 The Applicant submits that the since the culverts do not give rise to any likely significant impacts they are acceptable in policy terms and do not have to be justified further.

4.5.13 As such, the Applicant considers that there is no legal or policy requirement for the Secretary of State to consider alternatives to the culverts proposed. The EA's position is thus not founded in law or policy and is unjustified.

4.5.14 Even if exceptional circumstances do arise (which is not accepted) the EA has not identified the design of any alternative water crossing which it says should have been assessed. Applying the approach in Mount Cook, the EA's "vague or inchoate" assertions regarding alternative schemes should in any event be given little if any weight.

4.5.15 The Applicant has had regular meetings with the EA over a significant period of time to discuss this and other issues. Despite requests, the EA has failed to provide:

a) The evidence which the EA relies upon to establish that the proposed culverts give rise to conspicuously harmful effects, if any;

b) The basis on which the EA contends that there is a legal duty upon the Secretary of State to consider alternatives to the proposed culverts, if indeed it does so contend;

c) The basis on which the EA contends that there is a policy-based duty upon the Secretary of State to consider alternatives to the proposed culverts, if indeed it does so contend (this includes identifying precisely the adopted policy documents relied upon where this duty is stated);

d) The design of the water crossings which the EA considers should have been assessed in sufficient detail to enable the Applicant to assess the likely significant impacts (positive and negative) of such alternative proposals.

4.5.16 The Applicant is keen to have clarity from the EA in relation to these matters as quickly as possible and to reach further agreement if this can be achieved.

The Weight to be Placed on the Environment Agency's Internal Policies

4.5.17 In its most recent submissions, the Environment Agency has stressed the statement in their internal policy note which states that environmental permitting applicants will be expected to demonstrate why culverting is both necessary and the only reasonable and practicable alternative and has adopted this approach in its objection to the scheme.

4.5.18 Paragraphs [5.5.1 to 5.5.16] above set out the correct legal and policy tests to be applied by the Secretary of State in making a decision in relation to the scheme. Paragraphs 4.50 and 4.51 of the NNNPS state:

"4.50 In deciding an application, the Examining Authority and the Secretary of State should focus on whether the development itself is an acceptable use of the land, and on the impacts of that use, rather than the control of processes, emissions or discharges themselves. They should assess the potential impacts of processes, emissions or discharges to inform decision making, but should work on the assumption that in terms of the control and enforcement, the relevant pollution control regime will be properly applied and enforced. Decisions under the Planning Act should complement but not duplicate those taken under the relevant pollution control regime.

4.51 These considerations apply in an analogous way to other environmental regulatory regimes, including those on land drainage and flood defence and biodiversity."

4.5.19 The Applicant is not aware of any adopted Government Policy which requires the assessment of alternatives to the culverts proposed in the absence of

conspicuous effects. It is therefore necessary to consider the Environment Agency's policies and to consider what weight should be attached to them.

4.5.20 The Environment Agency's policy notes are internal policies only. Where the Environment Agency is a developer in its own right, in the construction of flood defences, it is free to adopt these policies for their own projects. However, these policies are not adopted by Government and they do not reflect the approach in the NNNPS. They require assessment of alternatives in every case i.e. even if a culvert would not cause harm at all. Accordingly they are not reflective of legal authorities. The Applicant is not aware that these policies have been the subject of consultation with either the public or government.

4.5.21 The internal policies are at odds with the policies against which the current project falls to be assessed and weight of legal authority. As such, the Applicant's view is that these policies should have no weight in the infrastructure planning process

The Environment Agency's Discretion with regard to Environmental Permits

4.5.22 In the event that the Secretary of State makes the DCO in its current form (i.e. including culverts in the design of the authorised development) that would include the culverts to which the Environment Agency has objected.

4.5.23 It would not then be open to the Environment Agency, in considering whether or not to grant the Environmental Permits, to act inconsistently with the Secretary of State's independent factual judgment on the issue and to refuse to grant the Environmental Permits on the basis that open span bridges should have been used instead of culverts. Those arguments would have been fully heard and rejected, and the Environment Agency would not retain the right to maintain and act upon its original opinion. The principle of that development would have been established by the grant of development consent.

4.5.24 This position is clear from case law, in particular the precedent set by the Court of Appeal in case of (R. v Warwickshire CC Ex p. Powergen Plc (1998) 75 P. & C.R. 89) ("Powergen").

4.5.25 In Powergen outline planning permission was refused by the local planning authority on grounds that the local highway authority considered the proposed access to be detrimental to highway safety. On appeal the Inspector concluded that the proposals for access to the site were adequate, and granted outline planning permission subject to the highway works being carried out. The local highway authority then refused to enter into the legal agreement under Section 278 of the Highways Act 1980 which was required to allow the highway works to be carried out for the same reasons that it had objected to the original planning application.

4.5.26 The applicant then applied for judicial review of this refusal. The key part of Forbes J's judgment quoted in the Court of Appeal was at page 92 as follows:

> *"In my opinion, where the benefit to the public of the proposed highway works, in respect of which an agreement with the Highway Authority is sought under section 278 of the 1980 Act, has been fully*

considered and determined in the planning process, because the highway works in question form a detailed and related aspect of the application for development of land in respect of which planning consent has been properly obtained through that planning process, then the Highway Authority's discretion whether to enter into the section 278 agreement will necessarily be somewhat limited. In such a case, the matters remaining to be considered by the Highway Authority in the proper exercise of its discretion under section 278, are likely to be relatively minor in nature. I agree with Mr Hicks that the proper exercise of that discretion by the Highway Authority will not embrace a further and separate reconsideration of the benefit to the public of the highway works in question by reference to the same reasons as those which had already been considered and determined in the planning process. If such a reconsideration by the Highway Authority were to be a proper exercise of its discretion under section 278, then that would largely frustrate the scheme of the legislation of which section 278 is conceded to be part."

4.5.27 Forbes J then went on to consider whether the local highway authority's decision was "Wednesbury unreasonable" (i.e. irrational). In a passage also quoted by the Court of Appeal he found as follows:

"...the Inspector's conclusions should be treated as both reasonable and final. The present proceedings are not the place to reconsider the merits of the foregoing dispute. Since the development proposals as a whole were found to be in the public interest, so too were the detailed highway works which formed a necessary and related part of those proposals. In those circumstances... no reasonable Highway Authority would, on the sole basis of the arguments as to road safety which had been fully considered and determined in the planning process, refuse to enter into any necessary Section 278 Agreement on the grounds that to do so was not a benefit to the public, thereby preventing the development from proceeding. I have therefore come to the conclusion that the decision of the County Council in this case to refuse to enter into the Section 278 agreement in question is both perverse and unreasonable in the Wednesbury sense."

4.5.28 In giving the leading judgment of the Court of Appeal, Simon Brown L.J. stated:

"I have reached the clear conclusion that the judge below came to the right answer: that following a successful appeal by the developer the relevant highway authority has no option but to co-operate in implementing the planning permission by entering into a section 278 agreement... I see it rather as raising this simple question: is it reasonable for a highway authority, whose road safety objections have been fully heard and rejected on appeal, then, quite inconsistently with the Inspector's independent factual judgment on the issue, nevertheless to maintain its own original view? To my mind there can be but one answer to that question: a categoric "no"...

...the Inspector's conclusion on that issue, because of its independence and because of the process by which it is arrived at,

necessarily becomes the only properly tenable view on the issue of road safety and thus is determinative of the public benefit."

4.5.29 Applying the reasoning to the A12 case, if the Secretary of State has considered the Environment Agency's objection regarding a failure to assess alternatives and rejected it, such a rejection would only be likely to arise where the Secretary of State has accepted that the scheme will not give rise to significant adverse effects, those effects cannot be described as conspicuous and thus no legal duty to assess alternatives arises. The DCO would thus be granted on the basis of that reasoning.

4.5.30 It will not then be open to the Environment Agency to refuse to grant a permit on the basis that there has been no assessment of alternatives to culverting. Applying the Powergen case, it is necessary to ask: "is it reasonable for the Environment Agency, whose objections to culverting have been fully heard and rejected by the Secretary of State after Examination, then, quite inconsistently with the Secretary of State's independent factual judgment on the issue, nevertheless, to maintain its original view?".

4.5.31 It is the Applicant's case that it is highly likely that a Court would conclude that such an approach was Wednesbury unreasonable (i.e. irrational) and unlawful. The Powergen case establishes that once the issue regarding alternatives to culverting is determined by the Secretary of State in the DCO process it would not be lawful for the EA to seek to go behind that decision in the permitting process. The Secretary of State's conclusion as to the acceptability of culverts would be the "only properly tenable view" on the issue and determinative of the public benefit.

5 Conclusions

5.1 Engineering Feasibility

5.1.1 Of the eight Main River crossings along the proposed scheme:

- there are no proposals to modify the existing Boreham Brook culvert and the River Ter Bridge,
- modifications are proposed to widen the existing River Brain Bridge, Ashman's Bridge over the River Blackwater, Domsey Brook (west crossing), and Roman River bridge.
- new culverts are proposed on the Rivenhall Brook and Domsey Brook (east crossing).

In addition, two existing structures on the on-line section of the A12 will remain on the de-trunked section of the highway, Rivenhall Brook culvert and Domsey Brook (east crossing).

5.1.2 Where the existing structures require no or some modifications, the implications for programme, embodied carbon, whole life costs and construction-related environmental impacts are all minimised by the proposed scheme (Boreham Brook culvert, River Ter Bridge, River Brain Bridge, and Ashman's Bridge). The structural integrity and buildability are important considerations where considering options to unusual structures such as Domsey Brook (west crossing). On the smaller structures such as Roman River Bridge and Rivenhall Brook existing, bridge options would not provide material gains in terms of bridge clearance due to the constraints imposed by the existing A12 highways alignment.

5.1.3 For the two new crossings at Domsey Brook (east crossing) and Rivenhall Brook, wide span bridge structures would be possible to construct, however, the ecological benefits to the wider river catchments would be limited due to the relative proximity of the existing culvert structures that are not being affected by the proposed scheme. For this reason, the additional capital and operational costs combined with the increase in programme, embodied carbon, technical complexity and construction disruption are not considered to justify the implementation of bridge structures over the proposed box-culvert solutions.

5.2 Environmental Impacts

5.2.1 The Applicant has taken reasonable steps to obtain data on riparian mammal and fish in the study area. Notwithstanding the Applicant has committed to undertaking post-construction monitoring of the structures with proposed mammal ledges to determine whether the ledges are enabling safe passage of wildlife (including otters) under the A12 (as per commitment BI49 in the REAC [REP4-023]). These data would also be used to inform the design of river crossings for future National Highways projects.

5.2.2 Based on the data available, and with consideration to what can be inferred from desktop and baseline data for the proposed scheme it is possible to draw conclusions with respect to the likely effects on each main watercourse.

5.2.3 It should also be noted that, as stated in Section 4, the size of the proposed new culverts on the Rivenhall Brook and Domsey Brook (east) exceed the dimensions specified in CIRIA guidance on culvert sizes for mammals.

5.2.4 The assessment of effects has been undertaken in accordance with DMRB LA 108. As per Table 9.22 of Chapter 9: Biodiversity, water vole, otter and fish are all County level receptors. It is not considered that any of the proposals for main river crossings would lead to a level of impact of sufficient size (i.e., major adverse) that would lead to a significant (i.e., moderate or above) effect. Effects on otters, water vole and fish are therefore considered not significant with respect to the proposals for main river crossings, although cumulatively the benefits to otters from provision of mammal ledges and fencing is considered to provide a slight beneficial (not significant) effect (paragraph 9.11.331 to 9.11.336 of Chapter 9: Biodiversity [APP-076]). Scheme wide, construction effects for water vole are considered to be moderate beneficial due to the proposed area of new habitat creation within ecological mitigation areas (see paragraph 9.10.78 of Chapter 9: Biodiversity [APP-076]).

5.3 Legal and Policy Position

5.3.1 As a matter of law there is no legal or policy requirement for the Applicant to assess alternative options. In the absence of conflict with planning policy and/or other planning harm, the relative advantages of alternative uses on the application site or of the same use on alternative sites are normally irrelevant (R (Mount Cook Land Limited) v Westminster City Council [2017] PTSR 116).

5.3.2 A decision maker can choose to have regard to alternatives where a scheme has been identified as having conspicuously harmful effects and where the scheme seeks to overcome such harm by reference to countervailing public interest benefits: Trusthouse Forte v Secretary of State for the Environment (1987) 53 P & CR 293 at 299-300. That is not the case in respect of this scheme.

5.3.3 The Applicant has undertaken a full assessment of the likely significant effects of culverting and has not identified significant adverse effects. The Environment Agency has not provided any countervailing assessment.

5.3.4 The Applicant has not identified any policy requirements to consider alternatives. Where a development is determined on its own merits to be acceptable in policy terms, there is no duty upon the decision maker to consider whether a yet more acceptable alternative can be identified Sainsburys v First Secretary of State [2007] EWCA Civ 1083).

5.3.5 The Environment Agency has suggested that reliance should be placed on its own internal policies which state that environmental permitting applicants will be expected to demonstrate why culverting is both necessary and the only reasonable and practicable alternative.

5.3.6 The Applicant does not consider that these policies should be given any weight in the infrastructure planning process. They are internal policies which do not appear to have not been consulted upon. They are not adopted by the government and do not reflect the approach in the NNNPS or in case law, and are therefore at odds with the policies against which the A12 project falls to be assessed,

5.3.7 In considering whether or not to grant environmental permits for the scheme the Environment Agency may not act inconsistently with the Secretary of State's independent factual judgment on the issue of the acceptability of culverts (R. v Warwickshire CC Ex p. Powergen Plc (1998) 75 P. & C.R. 89). The Secretary of State's conclusion as to the acceptability of culverts would be the "only properly tenable view" on the issue and determinative of the public benefit.

5.4 Concluding Statements

5.4.1 The Applicant has developed proposals for the Main River crossings which do not lead to significant adverse effects on ecology and the water environment and therefore accord with the NNNPS. There is therefore no need for alternatives to be assessed and no duty upon the decision maker to consider whether a yet more acceptable alternative can be identified.

5.4.2 Nevertheless, the review of the engineering designs contained in this note demonstrates that either the replacement of existing bridges is not required for environmental reasons or that the option of providing a bridge instead of a culvert would not lead to significantly better environmental outcomes given in particular the low lying nature of the terrain, but also the opportunities to provide mammal ledges and natural substrate in the culverts to benefit movement of riparian mammals and fish. Replacing the proposed Main River crossings with open span bridges would be disproportionate in terms of whole life cost, embodied carbon, and adverse construction impacts compared with any environmental gains manifest during the operational phase.

Appendix A Figures

FIGURE 1

Boreham Brook

Hydrological connectivity: **Within the River Chelmer catchment.** The Boreham Brook is a tributary of the River Chelmer. The confluence with the River Chelmer is approximately 2.5km downstream of the A12/Great Eastern Main Line (GEML) railway culvert.

Ecological baseline: Evidence of otters were recorded north and south of the Boreham Brook culvert in surveys undertaken by the Applicant, suggesting this structure is currently permeable to otters.

Scope of proposed work: **No works** are required to any of the existing crossings of the Boreham Brook (nor are any new crossings proposed). Therefore, there is **no change to the baseline with respect to fragmentation at this location.**

Permeability to wildlife: As there would be no works to crossings on the Boreham Brook there would be no change to the permeability of the structure to wildlife, including mammals and fish.

River Ter

Hydrological connectivity: **Within the River Chelmer catchment.** The River Ter is a tributary of the River Chelmer, which is crossed by the existing A12 via the River Ter Bridge

Ecological baseline: Evidence of otters were recorded north and south of the River Ter bridge in surveys undertaken by the Applicant, suggesting this structure is currently permeable to otters.

Scope of proposed work: The proposed scheme would involve upgrading the highway to three lanes per carriageway, however this widening would be achieved with **no change to the existing bridge structure or highway embankment.**

Permeability to wildlife: As there would be no change to the River Ter bridge there would be no change to the permeability of the structure to wildlife, including mammals and fish.

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Legend

- Order Limits
- Proposed Scheme
- Main River
- Ecological Mitigation Area with water vole enhancements

Otter Survey Results

- Footprint
- Spraint

Operational Catchment

- Blackwater
- Chelmer

A12 River Crossing

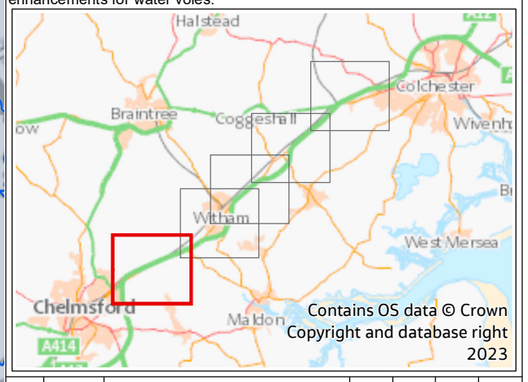
- No works proposed to existing crossing

Water Vole Survey Results

- Burrow
- Latrine

Summary of effects on main rivers within the River Chelmer catchment

As there would be no change to structures on the Boreham Brook or River Ter there would be no effect change to the permeability of these water courses to wildlife, including otters, water voles, fish and eels. New habitats to be created with the ecological mitigation areas south of J19 would provide enhancements for water voles.



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P01	09/06/23	For review and comment	JC	AJ	CF	KT

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: PROPOSALS FOR CULVERTS
SHEET 1 OF 5

Drawing Status: S2 - SUITABLE FOR INFORMATION

Scale @ A3	1:20000	DO NOT SCALE
Jacobs No.	B36601D1	Rev P01
Client No.	HE551497	

Drawing Number: HE551497-JAC-EGN-5+SCHME-SK-LE-0001(1)

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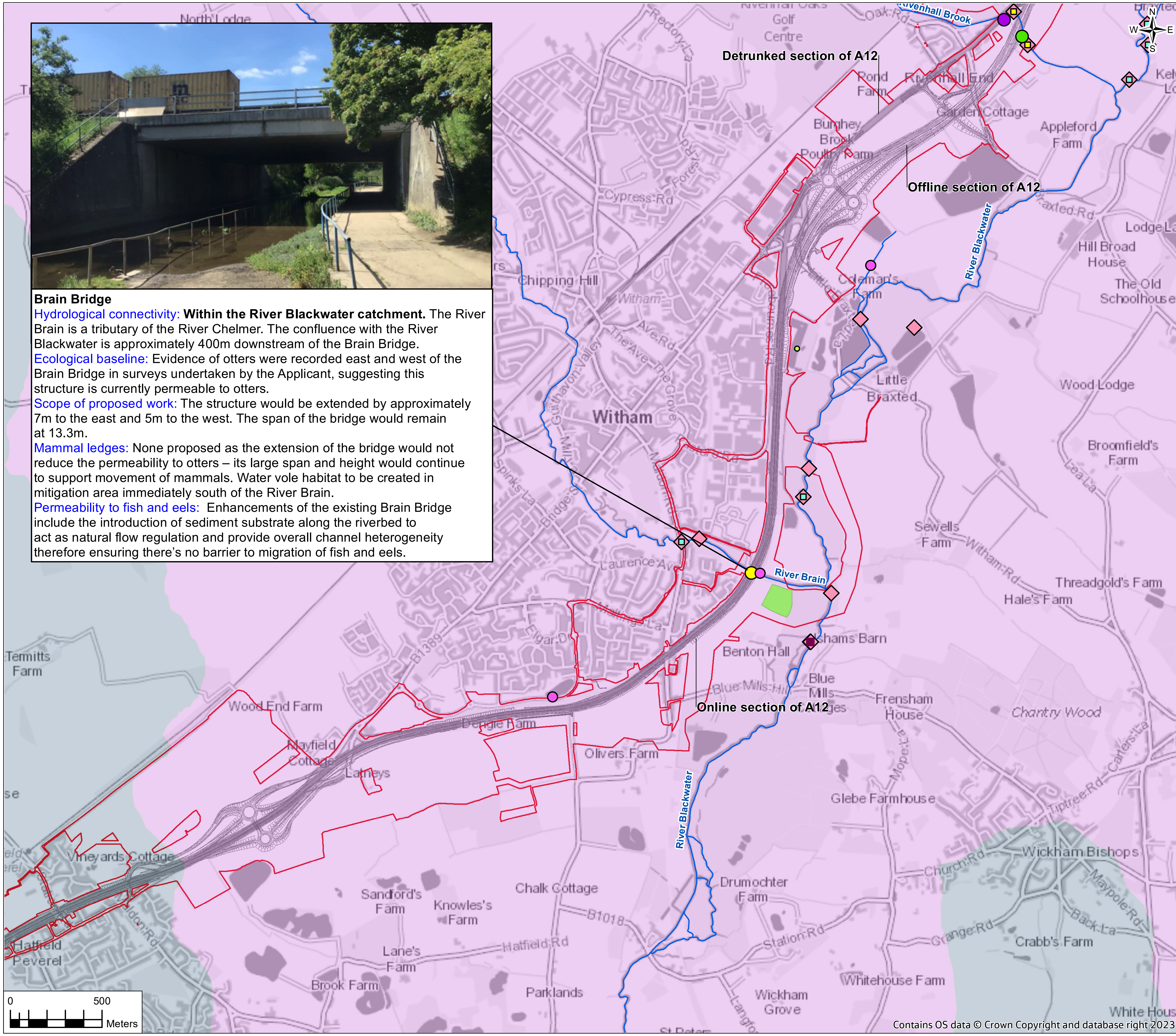
FIGURE 1



Brain Bridge

Hydrological connectivity: **Within the River Blackwater catchment.** The River Brain is a tributary of the River Chelmer. The confluence with the River Blackwater is approximately 400m downstream of the Brain Bridge.

Ecological baseline: Evidence of otters were recorded east and west of the Brain Bridge in surveys undertaken by the Applicant, suggesting this structure is currently permeable to otters.

Scope of proposed work: The structure would be extended by approximately 7m to the east and 5m to the west. The span of the bridge would remain at 13.3m.

Mammal ledges: None proposed as the extension of the bridge would not reduce the permeability to otters – its large span and height would continue to support movement of mammals. Water vole habitat to be created in mitigation area immediately south of the River Brain.

Permeability to fish and eels: Enhancements of the existing Brain Bridge include the introduction of sediment substrate along the riverbed to act as natural flow regulation and provide overall channel heterogeneity therefore ensuring there's no barrier to migration of fish and eels.

Legend

- Order Limits
- Proposed Scheme
- Main River
- Ecological Mitigation Area with water vole enhancements

Otter Survey Results

- Spraint
- Spraint - Potential couch
- Spraint - Confirmed couch
- Sighting

Operational Catchment

- Blackwater
- Chelmer

A12 River Crossing

- Extension of existing crossing
- Proposed new main river crossing
- No works proposed – detrunked section of existing A12

Water Vole Survey Results

- Burrow
- Latrine

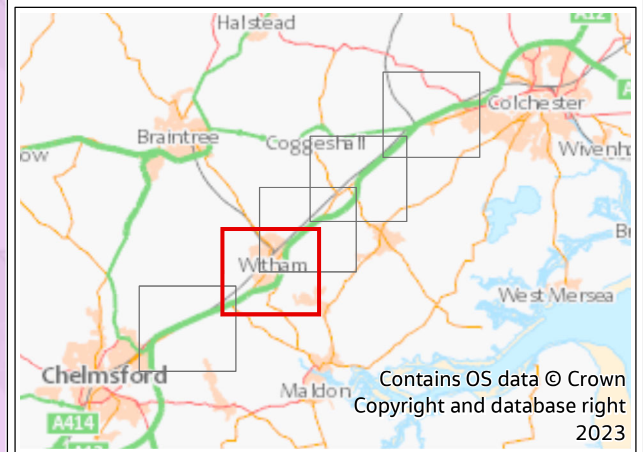
Summary of effects on main rivers within the River Blackwater catchment

River Brain – Widening of the Brain Bridge would not affect permeability to otters and migration of fish and eels would be maintained through introduction of sediment substrate – no effects.

Rivenhall Brook – Improvements provided ad the span and height of the proposed culvert would be marginally increased and mammal ledges and otter fencing would be provided. Permeability to fish and eels maintained by burying the invert to allow continuation of sediment conveyance.

River Blackwater – As agreed with the EA replicating the existing structure will not create a barrier to fish or mammals.

Domsey Brook – Increase in length of culvert at west crossing offset through provision of mammal ledges. Sediment augmentation would create additional aquatic habitat and promote habitat diversity. Provision of a 2.7m x 2.7m culvert compared to 2No. 1m diameter pipes would greatly improve the permeability of the east crossing to mammals and fish.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
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Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: PROPOSALS FOR CULVERTS
SHEET 2 OF 5

Drawing Status: S2 - SUITABLE FOR INFORMATION

Scale @ A3	1:20000	DO NOT SCALE
Jacobs No.	B36601D1	Rev P01
Client No.	HE551497	

Drawing Number: HE551497-JAC-EGN-5+SCHME-SK-LE-0002

FIGURE 1

River Blackwater

Hydrological connectivity: Within the River Blackwater catchment. The River Blackwater is a tributary of the River Chelmer. The confluence with the River Chelmer is approximately 12km downstream of the A12 crossing (Ashman's Bridge).

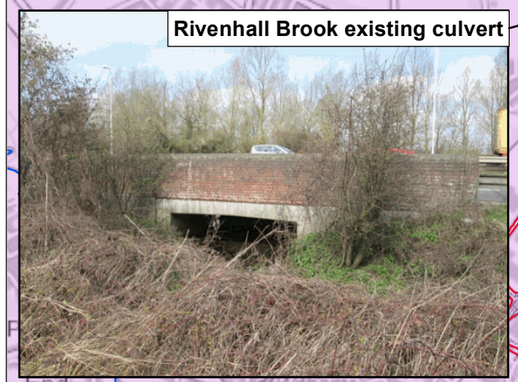
Ecological baseline: Evidence of otters were recorded north and south of Ashman's Bridge in surveys undertaken by the Applicant, suggesting this structure is currently permeable to otters.

Scope of proposed work: The structure would be asymmetrically extended by approximately 10.1m to the south.

Mammal ledges: None proposed

Permeability to fish and mammals: Paragraph 1.5.10 of the Environment Agency's Written Representation [REP2-054], states 'replicating the existing structure will not create a barrier to fish or mammals. Therefore, we have no objection to the proposed structure'.

Rivenhall Brook existing culvert



Rivenhall Brook proposed culvert

Online section of A12

Offline section of A12

Detrunked section of A12

Rivenhall Brook

Hydrological connectivity:Within the River Blackwater catchment. The Rivenhall Brook is a tributary of the River Blackwater and flows south-east towards the River Blackwater approximately 850m south-east of the A12 crossing.

Ecological baseline: Evidence of otters were recorded east and west of the Rivenhall Brook culvert in surveys undertaken by the Applicant, suggesting this structure is currently permeable to otters.

Rivenhall Brook existing culvert

Hydrological connectivity: Span of 4.2m and an internal height clearance of 2.0m. Length of culvert is 28m.

Changes in traffic flow as a result of the scheme: detrunking of the existing A12 would result in a reduction in traffic from 82,00 to 7,000 vehicles per day, and a reduction in the speed limit on the detrunked sections of the A12 would be 40mph compared to the current 70mph. In combination this would reduce the risk of mortality to otters should they attempt to cross the carriageway.

Rivenhall Brook proposed culvert

Scope of proposed work: New offline crossing of the Rivenhall Brook adjacent to the current A12 through a 46m long culvert structure with a span of 4.5m and an internal height clearance of 3.1m

Mammal ledges: To be fitted to each side of the structure including the existing section, thereby improving the permeability to otters at times of high water flow.

Permeability to fish and eels: The invert would be buried beneath the natural bed of the watercourse to allow the continuation of sediment conveyance and reduce the impact on local flow dynamics (as committed to in RDWE39 in the REAC [REP4-023]). This would maintain permeability to fish and eels

How is the proposed solution improved compared to the baseline:

- New structure has an increased span and internal height compared to existing culvert
- Mammal ledges provide safe means to cross under proposed A12 compared to existing A12
- Otter fencing provided to prevent mortality of otters on proposed A12 compared to existing A12 where none currently exists
- Speed and volume of traffic, and therefore risk of mortality reduced at existing crossing

0 500 Meters

Legend

- Order Limits
- Proposed Scheme
- Main River

Otter Survey Results

- Otter sightings
- Otter sightings - Confirmed holt
- Spraint
- Spraint - Potential couch
- Spraint - Confirmed couch
- Spraint - Confirmed couch - Otter sightings

Operational Catchment

- Blackwater
- Colne Essex

A12 River Crossing

- Extension of existing crossing
- Proposed new main river crossing
- No works proposed – detrunked section of existing A12

Water Vole Survey Results

- Burrow
- Latrine

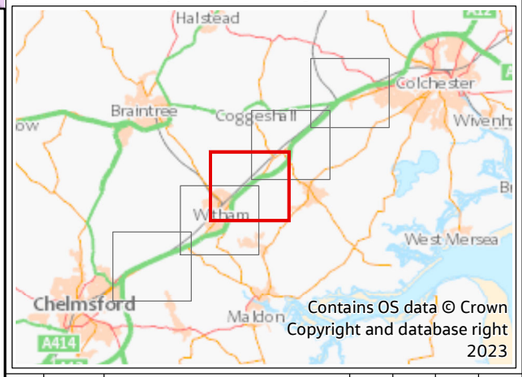
Summary of effects on main rivers within the River Blackwater catchment

River Brain – Widening of the Brain Bridge would not affect permeability to otters and migration of fish and eels would be maintained through introduction of sediment substrate – no effects.

Rivenhall Brook – Improvements provided ad the span and height of the proposed culvert would be marginally increased and mammal ledges and otter fencing would be provided. Permeability to fish and eels maintained by burying the invert to allow continuation of sediment conveyance.

River Blackwater – As agreed with the EA replicating the existing structure will not create a barrier to fish or mammals.

Domsey Brook – Increase in length of culvert at west crossing offset through provision of mammal ledges. Sediment augmentation would create additional aquatic habitat and promote habitat diversity. Provision of a 2.7m x 2.7m culvert compared to 2No. 1m diameter pipes would greatly improve the permeability of the east crossing to mammals and fish.



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Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: PROPOSALS FOR CULVERTS
SHEET 3 OF 5

Drawing Status: S2 - SUITABLE FOR INFORMATION

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Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-EGN-5+SCHME-SK-LE-0003

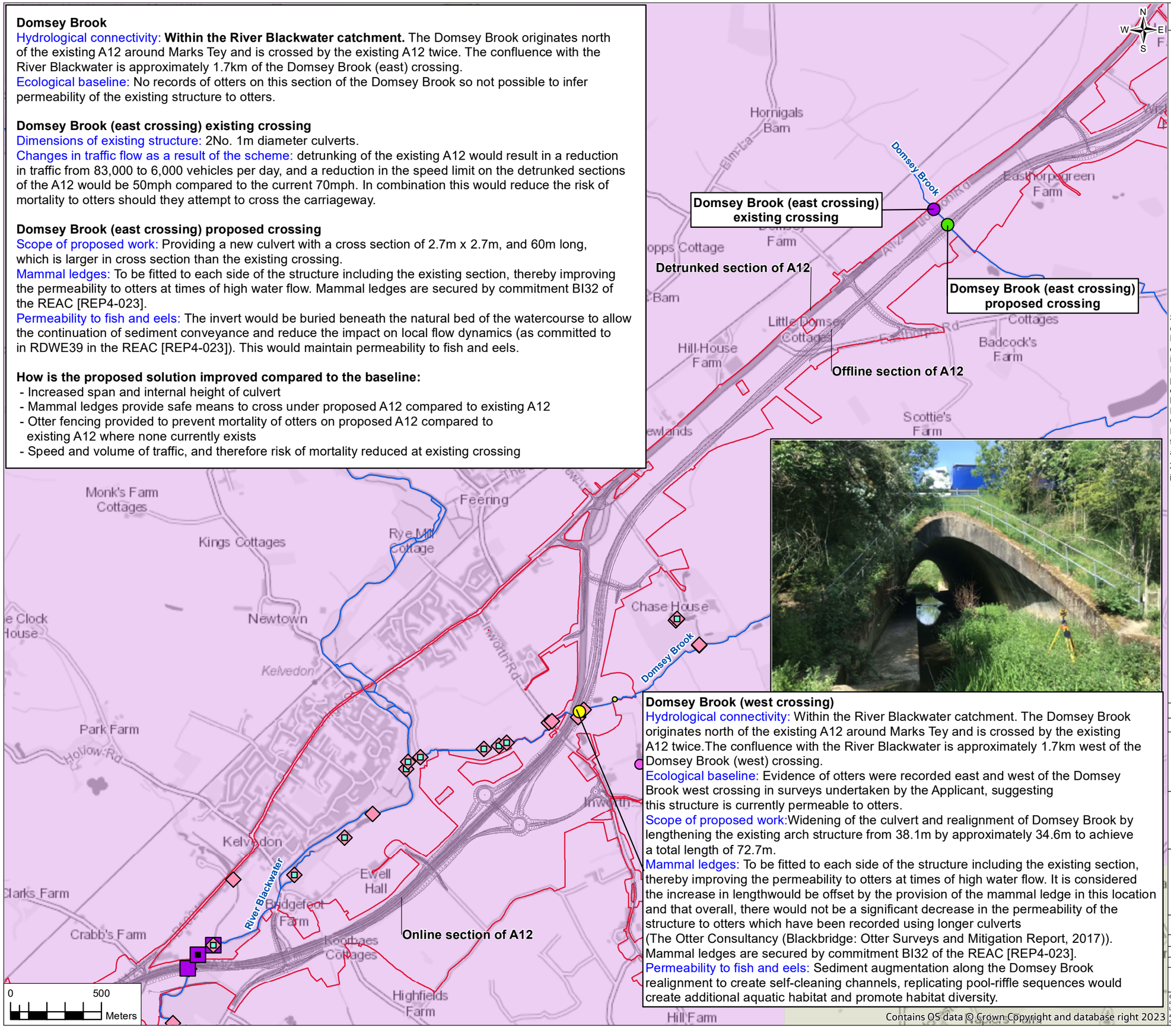
FIGURE 1

Domsey Brook
Hydrological connectivity: **Within the River Blackwater catchment.** The Domsey Brook originates north of the existing A12 around Marks Tey and is crossed by the existing A12 twice. The confluence with the River Blackwater is approximately 1.7km of the Domsey Brook (east) crossing.
Ecological baseline: No records of otters on this section of the Domsey Brook so not possible to infer permeability of the existing structure to otters.

Domsey Brook (east crossing) existing crossing
Dimensions of existing structure: 2No. 1m diameter culverts.
Changes in traffic flow as a result of the scheme: detrunking of the existing A12 would result in a reduction in traffic from 83,000 to 6,000 vehicles per day, and a reduction in the speed limit on the detrunked sections of the A12 would be 50mph compared to the current 70mph. In combination this would reduce the risk of mortality to otters should they attempt to cross the carriageway.

Domsey Brook (east crossing) proposed crossing
Scope of proposed work: Providing a new culvert with a cross section of 2.7m x 2.7m, and 60m long, which is larger in cross section than the existing crossing.
Mammal ledges: To be fitted to each side of the structure including the existing section, thereby improving the permeability to otters at times of high water flow. Mammal ledges are secured by commitment BI32 of the REAC [REP4-023].
Permeability to fish and eels: The invert would be buried beneath the natural bed of the watercourse to allow the continuation of sediment conveyance and reduce the impact on local flow dynamics (as committed to in RDWE39 in the REAC [REP4-023]). This would maintain permeability to fish and eels.

How is the proposed solution improved compared to the baseline:
- Increased span and internal height of culvert
- Mammal ledges provide safe means to cross under proposed A12 compared to existing A12
- Otter fencing provided to prevent mortality of otters on proposed A12 compared to existing A12 where none currently exists
- Speed and volume of traffic, and therefore risk of mortality reduced at existing crossing



Domsey Brook (west crossing)
Hydrological connectivity: Within the River Blackwater catchment. The Domsey Brook originates north of the existing A12 around Marks Tey and is crossed by the existing A12 twice.The confluence with the River Blackwater is approximately 1.7km west of the Domsey Brook (west) crossing.
Ecological baseline: Evidence of otters were recorded east and west of the Domsey Brook west crossing in surveys undertaken by the Applicant, suggesting this structure is currently permeable to otters.
Scope of proposed work:Widening of the culvert and realignment of Domsey Brook by lengthening the existing arch structure from 38.1m by approximately 34.6m to achieve a total length of 72.7m.
Mammal ledges: To be fitted to each side of the structure including the existing section, thereby improving the permeability to otters at times of high water flow. It is considered the increase in lengthwould be offset by the provision of the mammal ledge in this location and that overall, there would not be a significant decrease in the permeability of the structure to otters which have been recorded using longer culverts (The Otter Consultancy (Blackbridge: Otter Surveys and Mitigation Report, 2017)). Mammal ledges are secured by commitment BI32 of the REAC [REP4-023].
Permeability to fish and eels: Sediment augmentation along the Domsey Brook realignment to create self-cleaning channels, replicating pool-riffle sequences would create additional aquatic habitat and promote habitat diversity.

Legend
- Order Limits
- Proposed Scheme
- Main River

Otter Survey Results
- Otter sightings
- Otter sightings - Confirmed holt
- Spraint
- Spraint - Confirmed couch
- Spraint - Confirmed couch - Otter sightings

A12 River Crossing
- Extension of existing crossing
- Proposed new main river crossing
- No works proposed – detrunked section of existing A12

Water Vole Survey Results
- Burrow
- Latrine

Operational Catchment
- Blackwater
- Colne Essex

Summary of effects on main rivers within the River Blackwater catchment
River Brain – Widening of the Brain Bridge would not affect permeability to otters and migration of fish and eels would be maintained through introduction of sediment substrate – no effects.
Rivenhall Brook – Improvements provided ad the span and height of the proposed culvert would be marginally increased and mammal ledges and otter fencing would be provided. Permeability to fish and eels maintained by burying the invert to allow continuation of sediment conveyance.
River Blackwater – As agreed with the EA replicating the existing structure will not create a barrier to fish or mammals.
Domsey Brook – Increase in length of culvert at west crossing offset through provision of mammal ledges. Sediment augmentation would create additional aquatic habitat and promote habitat diversity. Provision of a 2.7m x 2.7m culvert compared to 2No. 1m diameter pipes would greatly improve the permeability of the east crossing to mammals and fish.

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A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: PROPOSALS FOR CULVERTS
SHEET 4 OF 5

Drawing Status: S2 - SUITABLE FOR INFORMATION

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Client No.	HE551497	

Drawing Number: HE551497-JAC-EGN-5+SCHME-SK-LE-0004

Roman River

Hydrological connectivity: **Within the River Colne catchment.** The Roman River originates north of the A1 and its confluence with the River Colne is approximately 15km downstream of the Roman River crossing.

Ecological baseline: Evidence of otters was recorded south the Roman River crossing only, suggesting the existing structure may not be permeable to otters.

Scope of proposed work: Extending the existing watercourse culvert (retaining existing cross-sectional dimensions of width 4.8m x height 2.1m) by approximately 12m.

Mammal ledges: To be fitted to each side of the structure including the existing section, thereby improving the permeability to otters at times of high water flow, and reducing the likelihood of fragmentation as a result of this structure which would be an improvement compared to the baseline scenario. It is considered the increase in length would be offset by the provision of the mammal ledges in this location and that overall, there wouldn't be a significant decrease in the permeability of the structure to otters. Mammal ledges are secured by commitment BI32 of the REAC [REP4-023].

Permeability to fish and eels: Enhancements of the existing structure include the introduction of sediment substrate along the riverbed to act as natural flow regulation and provide overall channel heterogeneity therefore ensuring there's no barrier to migration of fish and eels

Roman River

Online section of A12

Detrunked section of A12

Offline section of A12

0 500 Meters

FIGURE 1

Legend

- Order Limits
- Proposed Scheme
- Main River

Otter Survey Results

- Spraint
- Spraint - Confirmed couch

Operational Catchment

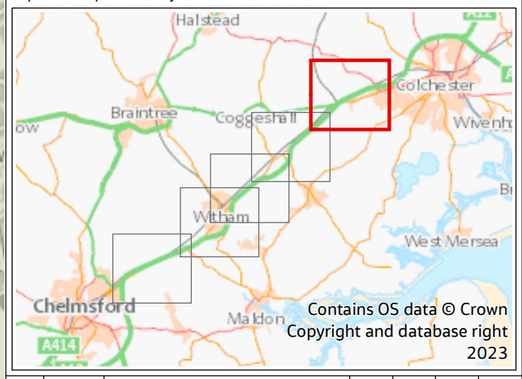
- Blackwater
- Colne Essex

A12 River Crossing

- Extension of existing crossing
- Proposed new main river crossing
- No works proposed – detrunked section of existing A12

Summary of effects on main rivers within the River Colne catchment

Only one structure, the culvert on the Roman River is affected by the proposed scheme. Effects of widening the structure would be offset by provision of mammal ledges and introduction of sediment substrate to improve the permeability to mammals and fish.



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Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: PROPOSALS FOR CULVERTS
SHEET 5 OF 5

Drawing Status: S2 - SUITABLE FOR INFORMATION

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Jacobs No.	B36601D1	Rev P01
Client No.	HE551497	

Drawing Number: HE551497-JAC-EGN-5+SCHME-SK-LE-0005

Appendix B References

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