River Avon Tidal Flood Risk Management Strategy

Activity 9C: Pre-scoping Report

September 2017

Quality information

Prepared by	Checked by	Approved by
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Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	26/01/17	Draft	NT	N.Titley	Technical Director
2	10/04/17	Final draft	NT	N.Titley	Technical Director
3	31/07/17	Final	DD	D.Dales	Technical Reviewer
4	21/09/17	Final	N Smith	N Smith	Regional Director

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Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

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1. Introduction

1.1 Background

Bristol City Council (BCC) has commissioned AECOM to prepare the River Avon Tidal Flood Risk Management Strategy (TFRMS). A tidal flood risk management strategy for Bristol is vitally important for the city, not just because of the threat to lives and property but also because of the risk of long-term reputational damage on the city's attractiveness and economic performance. Climate change predictions have the potential to constrain the scale and form of development in central Bristol today.

This project will deliver a Tidal Flood Risk Management Strategy (TFRMS) (the 'Strategy') for the area of Bristol at risk of flooding from the River Avon, including the city centre (between Cumberland Basin and Netham).

The flood risk in the study area is dominated by tidal events and this is the focus of the study. The development of the Strategy will be underpinned by an appraisal of management options of 'strategy alternatives' to address present and future tidal flood risk. The Strategy will recommend the preferred programme of adaptive measures identifying when measures are needed and how they will be funded.

1.2 This Report

Environmental assessment has formed one of several work streams informing the development of this TFRMS in order to ensure that environmental constraints and opportunities are integrated throughout the project. The environmental reports that have been produced include:

- Baseline mapping (Task 9A); and
- Options appraisal, including long-listing and short-listing considerations (Task 9B).

This Report follows on from the 9B Environmental Options Appraisal Report and Addendum which provided a high level environmental appraisal of 39 long list strategic options and the Preferred Option over the duration of the Strategy appraisal period (2015-2115). The Preferred Option is appraised in the 9B Addendum.

The purpose of this Report is to develop a Pre-Scoping report (Task 9C) which provides a framework for the future Environmental Impact Assessment (EIA) process and precedes a formal request to the determining authority, BCC, for an opinion on whether the project is deemed 'EIA Development' or the expected scope of the EIA (a 'Scoping Report').

2. The Need for EIA

Directive 2014/52/EU sets out the circumstances in which EIA is required for major projects. The Directive is transposed into English law through Statutory Instruments, with the most relevant to the Strategy being No. 571 The Town and Country Planning (Environmental Impact Assessment Regulations 2017 (The EIA Regulations))..

The EIA Regulations divides development into two classes: Schedule 1 projects where EIA is always required and Schedule 2 projects requiring EIA only if the particular project in question meets certain thresholds and is judged likely to give rise to significant environmental effects.

The project does not fall within any of the descriptions of development listed in Schedule 1. However, the project does fall under the category of "infrastructure projects" listed in Schedule 2:

- Part 10 (h) – "Inland-waterway construction not included in Schedule 1, canalisation and flood-relief works"

As the project is listed in Schedule 2, it is first necessary to consider whether the project meets or exceeds the thresholds in relation to the specific development type, which are as follows:

- The area of the works exceeds 1 hectare.

The likely works area, including the land required during construction has been estimated to cover approximately 5 hectares (ha). This estimate assumes a 5 km frontage and allows for a 'practical worst case' working area of up to 5 m behind the scheme alignment and 5 m in front. It is therefore necessary to consider the likelihood of significant environmental effects in order to determine the need for EIA.

The Marine Works Environmental Impact Assessment Regulations 2015 (as amended in 2017) are not considered to apply to the project, as the purpose of the Strategy is specifically for in-land water way flood-relief works; however it may be prudent to seek the formal opinion of BCC's Planning Department on this matter.

It is considered that a formal request for an EIA Screening Opinion under Part 2 of the EIA Regulations (on whether the Council deems the Project 'EIA Development') is not required, given the scale of the project and the sensitive receiving environment. Screening is not mandatory and, unless written confirmation would be helpful, it is recommended that BCC proceeds on the assumption it is EIA Development.

It is recommenced that an EIA Scoping Report, representing the next stage in the EIA process, is produced following this 9C Report to inform consultation with the planning authority and other relevant statutory bodies. This too is not a mandatory requirement but it is strongly recommended by AECOM and good industry guidance to achieve the objectives outlined in Section 2.1 below.

2.1 Scoping an EIA

The specific objectives of an EIA Scoping Report are:

- To identify the potential for significant environmental effects associated with the project;
- To facilitate early engagement with stakeholders in a formal setting, and providing an opportunity for statutory regulators such as Environment Agency (EA), Natural England (NE), Historic England (HE), etc to raise any concerns or comments early in the process and to formally comment on the proposals;
- To provide an opportunity to communicate the proposals and planned approach to the project, and invite stakeholders (statutory and non-statutory) to provide comments to BCC (as the regulator) on the project;
- To define and seek agreement on the methods to be used to assess the environmental effects of the project;
- To set out the proposed structure of the Environmental Statement (ES), which is the resultant report outlining the findings of the EIA process; and
- To support the request for a formal Scoping Opinion from BCC as the determining authority, which will be published on the Council's Planning website and will take into account comments received from statutory and non-statutory organisations and members of the public.

2.2 Structure of the Scoping Report

It is proposed that the Scoping Report will include the following chapters:

Chapters	Description
Introduction	Introduces the project and provides a brief description of the Strategy.
Application site and surroundings	Describes the application site and surroundings to assist the readers understanding of the sensitivity of the receiving environment.
Project Description and Programme of Works	Provides a brief description of the project and a schedule of the expected programme of works.
Approach to EIA	Describes the EIA process and proposed approach to EIA to be taken by the technical specialists.
Key/Non Key Issues	Identifies the likely 'Key' and 'Non-Key' issues. Key issues are those topics which have the potential to result in significant environmental effects. Non-key issues are those topics which are unlikely to result in significant environmental effects, and as such are proposed to be scoped out of the ES and not considered any further.
Cumulative Effects	Other existing/approved developments in the vicinity of the project, which will be considered in the ES to determine whether significant effects are likely as a consequence of the project when considered together with these other schemes.
Structure of the Environmental Statement	The chapters which are proposed to be included in the Environmental Statement will be listed in this chapter of the Scoping Report.

3. Programme of Works

There is 5 week statutory period for BCC under The Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (and amendments) to collate comments from stakeholders and respond in the form of a Scoping Opinion. The Draft 2017 Regulations suggest the 5 week period will be retained.

4. Stakeholder Consultation

The following statutory bodies should be consulted with by BCC at Scoping Stage:

- BCC;
- South Gloucestershire Council;
- North Somerset Council
- Environment Agency;
- Natural England;
- Historic England;
- Network Rail;
- Highways England; and
- Bristol Water;
- Western Power Distribution; and
- Wessex Water.

In addition, consultation with the following non-statutory bodies is also suggested:

- Marine Management Organisation (MMO);
- The Bristol Port Company;
- Inland Waterway Association (Bristol Avon Navigation) – Avon and Wiltshire Branch;
- Bristol Harbour Authority;
- Royal Society for the Protection of Birds (RSPB);
- Avon Wildlife Trust;
- Bristol Avon Rivers Trust;
- Bristol Civic Society; and
- Avon Gorge Wildlife Project (& National Trust)

5. The Proposed Scheme

5.1 Overview

The preferred option contains the following measures:

- Epoch 1 (2015-2030) – Low Defences;
- Epoch 2 (2030-2065) – Low Defences; and
- Epoch 3 (2065-2115) – High Defences.

To deliver the preferred option, approximately 5 km of new raised defences will be required across the study area, the locations of which are present in Figure 5-1. Within central Bristol, new raised defences will be required in core areas, comprising: Cumberland Road, Commercial Road, Clarence Road, Cattle Market Road, Totterdown, and St. Phillips. Defences in these locations should prevent local flooding to the properties and assets situated behind. In addition, new defences at additional core areas including Entrance Lock, Netham, Bathurst Dam, and Cumberland Road underpass will also be required. These defences will prevent water from flowing into the floating harbour and flooding properties in central Bristol once the harbour capacity is exceeded. Part of the new defences at Entrance Lock and Netham will be the installation of new tidal stop gates and operating infrastructure. For more details of the preferred option and detriment mitigation measures see the Outline Design Report.

In addition to the above measures numerical modelling has found that implementation of the Strategy's main defences would lead to an increased risk of flooding (detriment) in three areas: Totterdown, Netham, Bower Ashton and Bedminster, and therefore detriment mitigation works have been included in The Strategy to resolve the issue. Proposals in these areas are at an early stage of development, and include:

- Bower Ashton - Raising of the existing bank.
- Totterdown - This involves raising of private defences which have recently been constructed.
- Bedminster - Detriment Mitigation in the form of Property Level Protection is proposed to be installed into approximately seven properties. It is not considered that this measure would require WFD assessment.
- Netham - This involves raising the existing sheet piled defence to prevent overtopping to a height of 10.4 m. This may need a WFD assessment for the River Avon and potentially the Bristol Floating Harbour. As well as:

  • Flap the Brislington Brook outfall;

  • Culvert the open section of Brislington Brook or raise defences around it;

  - Provide overpumping when Brislington Brook cannot discharge under gravity; and
  - Property Level Protection measures will be installed to a small number of properties.
- Netham - Upstream storage somewhere to capture fluvial water.

Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Constraints\Figure 11 - Epoch 3 - v1.mxd

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Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

Allignment Name
- BATHURST DAM
- CATTLE MARKET ROAD
- CLARENCE ROAD
- COMMERCIAL ROAD
- CUMBERLAND ROAD
- CUMBERLAND ROAD EAST
- ENTRANCE LOCK
- NETHAM
- TOTTERDOWN

AECOM Internal Project No:

60478613

Drawing Title:

Preferred Option Alignment

Scale at A3: 1:15,000

Drawing No:			Rev:
FIGURE 5.1			V2
Drawn:	**Chk'd:**	**App'd:**	**Date:**
GM	SM	NT	24/01/17

6. Proposed EIA Scope

6.1 Key Issues and Non-key Issues

Table 6-1 presents the socio-environmental aspects currently considered as 'key' and 'non-key' issues, based on the currently available information. The non-key issues are not expected to lead to significant environmental effects and therefore are currently proposed to be scoped out of the EIA process; further justification for this will be provided in the EIA Scoping Report.

It should be noted that an aspect scored as 'negligible' in the 9B Addendum can still be identified as a 'key issue'; the former took into account likely mitigation, whereas topics in this 9C Report are identified as key and non-key issues based on whether the aspect warrants a detailed assessment to demonstrate there are no likely significant effects.

Table 6-1: Key and Non-key Issues

Environmental Topic	Construction	Operation
Terrestrial Ecology		
Estuarine Ecology		
Landscape		
Archaeology and Heritage		
Estuarine Archaeology		
Air Quality		
Noise Quality		
Water Resources and Flood Risk		
Sediment/Geomorphology		
Land Quality and Land use		
Traffic and Transport		
Marine Navigation		
Socio-economics		
Cumulative Effects		

Key

	Non-key Issue
	Negative Key Issue
	Positive Key Issue

6.2 Discussion by Environmental Topic

The table below presents a justification of each environmental topic in terms of whether it is considered a 'key' or 'non-key' Issue.

Table 6-2 Description of key and non-key issues

Environmental Aspect	Construction	Operation
Terrestrial Ecology	It is proposed that Terrestrial Ecology is scoped in as a **key issue** due to the potential for negative impacts on transient European protected species which utilise the river corridor. It is intended that a Phase 1 Habitat Survey will be carried out at scoping stage to confirm the potential for any European protected species, with the findings reported in the ES (as either a technical chapter or appendix). The Phase 1 Habitat Survey will also note the location of any invasive species which are likely to be present throughout the river corridor. An Invasive Species Management Plan will be produced in order to prevent the spread of these species, as well as recommend measures to ensure their safe disposal, in accordance with the Wildlife and Countryside Act, 1981 (as amended).	During the operational phase there may be impacts associated with habitat fragmentation, for example some species such as bats may be prevented from hunting/foraging and dispersing due to the physical presence of the defences, therefore this aspect is considered a **key issue** that should be considered further in the EIA process.
Estuarine Ecology	During construction of the project, piling and other construction works have the potential to cause direct effects on riparian habitat, in-channel fish habitats as well as intertidal mud habitat. There is potential to affect fish generally through mobilisation of sediment and also as a result of noise and vibration. There is also the potential for some intertidal habitat loss at front line locations, although the amount of habitat loss expected has not yet been calculated. As such, this topic has been identified as a **key issue** during the construction phase.	During the operation phase there may be potential negative impacts on transient species such as fish and eels due to the presence of physical barriers, such as the Brislington Brook flap, and therefore this aspect has been scoped in as a **key issue**. There is also potential for habitat fragmentation caused by the physical presence of the defences, for example some species such as otter may be prevented from hunting/foraging and dispersing at certain locations. At Bower Ashton there is the potential for a negative impact on estuarine geomorphology as a result of the Strategy constructing a new flood defence and causing coastal squeeze. At this location there is an undeveloped area of grassland behind the proposed embankment; although this is not an entirely naturalised area due to the presence of the channelised River Avon and water infrastructure (e.g. culverted watercourses), theoretically, without the embankment the river banks could erode over time, allowing the intertidal mudflat in this location to retreat

		inland and thus be preserved in extent notwithstanding sea level rise. The Severn Estuary Shoreline Management Plan (SMP) Review (2010) provides an assessment of the risks associated with coastal processes and presents a policy framework to reduce these risks to people and the developed, historic and natural environment in a sustainable manner. The SMP policy for the area (policy unit BRIS5) is Hold the Line (HTL) which is "to provide some level of coastal defence, keeping the position of the defence approximately where it is at the moment". In terms of coastal squeeze, it is considered the Strategy is in conformity with the Severn Estuary SMP, despite the construction of the earth embankment at Bower Ashton. The adopted SMP and its policies have been accepted by key consultees (Bristol City Council, Environment Agency and Natural England). Despite the SMP stating that HTL for this policy unit is the best environmental option, it is acknowledged that this does not mean that there are no environmental effects at all and therefore any habitat loss as a result of coastal squeeze will be mitigated/compensated before this embankment is constructed. The Bower Ashton embankment's alignment would also be setback at a level above high tide. This means it would not directly encroach into the intertidal zone at the time of construction in the first epoch, and the landward transgression of intertidal habitats, assuming the gradient of the river bank permits transgression, would not be impeded until sometime later on in the Strategy. It is anticipated that the intertidal habitats would be monitored at regular intervals following the implementation of the scheme to verify the conclusions of the Environmental Statement (or identify the need for additional mitigation). The method and frequency of this monitoring will be determined at EIA stage. In total, the direct footprint loss for estuarine habitats associated with the Strategy is estimated to be 2218 m2. This is based on 2218 m length of defences and a maximum 1 m encroachment out from current defences. This estimate includes the Netham detriment works and at this stage there is uncertainty as to whether these works will lead to encroachment in order to raise defence heights; should the footprint not be increased at Netham the maximum estuarine land take will reduce to an estimated 1268m2 (0.127 ha). Such losses would require compensation in order to maintain

		habitat balances. It would be the responsibility of BCC to ensure compensatory habitat has been provided, and agreed with the Environment Agency and Natural England, prior to any losses occurring. Whilst recognising the need to potentially compensate as a result of the Strategy, suitable sites for habitat creation should be identified at a later stage of scheme development once the total area of habitat loss, both direct loss via encroachment and indirect losses by altering tidal water levels and impedance of habitat "rollback" has been predicted using hydraulic modelling, habitat characterisation and geomorphological appraisal. The further work for scheme implementation should include identifying the type of habitat that could be lost as a result of coastal squeeze. At this early stage of design we have assumed a worst case scenario that encroachment will be in the intertidal zone. A targeted, Phase 1 Habitat Survey should be completed at EIA stage to characterise habitats and confirm the type and quality of habitat which has the potential to be impacted directly and indirectly. Alongside ecological work, a geomorphological appraisal would be necessary to confirm whether the estuary's form and adjacent hinterland would permit the rollback of intertidal habitats under rising sea levels i.e. steep river bank gradients may limit the likelihood of rollback. It would be prudent to ascertain when the habitat losses are likely to occur. A separate modelling exercise is recommended for scheme implementation during the EIA phase in order to estimate the projected coastal squeeze under the future baseline and with development scenarios. It is not considered possible or appropriate to estimate the potential habitat losses at this stage of the project because more detailed baseline information and design is required than is currently available at the time of writing. It is acknowledged that the River Avon intertidal mud in the Strategy area is outside any European site, but could be used by larval lamprey (ammocoetes) associated with the Severn Estuary SAC, or by non-breeding birds associated with the Severn Estuary SPA (at least occasionally in small numbers). However, given the small amount of intertidal mudflat in this area, it is unlikely that creating the embankment at

		Bower Ashton will radically affect the ability of the Bristol Avon to support ammocoetes. The Preliminary HRA Report provides further information on this issue.
Landscape	As parts of the alignment are located within a visually sensitive area (particularly Entrance Lock) the proposed scheme may have a negative effect on the landscape character of the area. During construction works, any impacts are likely to be associated with the views of construction sites and construction equipment such as piling rigs. On this basis Landscape is identified as a **key issue** during the construction phase.	Once operational the defences are likely to affect key views to and from the river. As a conservative approach this has been scoped in as a **key issue**, however design options to mitigate this effect should be explored, such as installing glass planes to maintain key views or incorporating green infrastructure (trees and shrubs) into the design. This has the potential to actually improve the public realm, which may indeed result in a positive impact in some areas. A landscape and visual impact assessment should be carried out as part of the EIA to establish the impact at each location.
Archaeology and Heritage	The construction of the proposed scheme has the potential to impact a number of designated heritage assets (particularly at Entrance Lock) that lie within close proximity to the alignment of the proposed scheme. In some cases, piling works have the potential to affect these assets from a physical perspective but mainly from a setting perspective. Due to the historic nature of the study area there is also the potential for archaeological remains. Consequently, there is considered to be potential for impacts which may result in significant environmental effects in respect of heritage and archaeology. This topic is therefore proposed to be scoped in as a **key issue** during the construction phase.	During the operational phase, it is possible that there will be a negative impact for some archaeology and heritage assets as the defences may have a negative impact on the setting of these assets. Archaeology and Heritage has therefore been scoped in as a **key issue** as a worst case scenario for this aspect. A heritage assessment is recommended as part of the EIA to establish the impact on archaeological and heritage assets at each location. During the lifetime of the Strategy there is the potential for some positive impacts on Archaeology and Heritage, as these assets will be protected from flooding as a result of the project.
Estuarine Archaeology	No Estuarine Archaeology is expected to be affected as a result of the construction of the defences as the project will not be affecting the estuarine area, therefore Estuarine Archaeology is proposed as a **non-key issue** that should not require consideration in the ES.	No Estuarine Archaeology is expected to be affected as a result of the construction of the defences as the project will not be affecting the estuarine area, therefore Estuarine Archaeology is proposed as a **non-key issue**.
Air Quality	There is potential for the construction of the proposed scheme to generate atmospheric pollution and dust as a result of the construction operations and construction-related traffic. However, it is anticipated that any impacts will be mitigated through the production of a Construction Environmental Management Plan (CEMP) and will thus constitute a	Once operational, the defences will have no impact on air quality and therefore it is recommended air quality can be scoped out of the EIA as a **non-key issue**.

	negligible impact. No noticeable impacts upon air quality are anticipated once the scheme is completed and operational. It is therefore proposed that Air Quality is identified as a **non-key issue**, however this will be reviewed at scoping stage once more information is available concerning traffic flows.	
Noise	Piling and excavation operations during the construction of the defences are likely to lead to noise and vibration impacts. However, due to the urban nature of the receiving environment this will not be dissimilar to baseline noise conditions. The availability of different piling techniques allows potential adverse noise and vibration impacts to be mitigated where necessary through design and control measures. The impacts of any water-borne noise and vibration upon aquatic species will be assessed separately as part of the estuarine ecology chapter. On this basis noise impacts on humans is planned to be scoped out of the EIA as a **non-key issue** and does not warrant a technical chapter in the ES.	The potential for noise and vibration impacts during the operation of the proposed scheme will be limited to periods of maintenance and are likely to be of short duration. On this basis, any noise and vibration impacts are expected to be minor and therefore it is proposed that Noise is identified as a **non-key issue**.
Water Resources and Flood Risk	Construction activity such as piling may lead to impacts on water quality as a result of sedimentation. A Water Frame Directive (WFD) assessment will be carried out to determine the level of significance of the impact. It is not expected that construction impacts would affect the overall potential of the waterbody or affect the next cycle of the River Basin Management Plan (RBMP), and therefore this topic is proposed to be scoped out as a **non-key issue**.	Once operational, the defences will have a major beneficial effect on flood risk in the region. A Flood Risk Assessment is not deemed necessary as there will be a hydraulic modelling report which will be appended to the ES (or submitted as a separate document) as part of the planning application. It is not expected that the presence of the defences would affect the overall potential of the waterbody or affect the next cycle of the River Basin Management Plan (RBMP), and therefore this topic is proposed to be scoped out as a non-key issue, however this conclusion will be reviewed when more detailed design information is available at Scoping Phase.
Sediment/ geomorphology	The construction of front line defences could potentially result in a small loss of intertidal habitat. At this point, there has been no detailed design of defences and therefore it is not possible to quantify what (if any) loss of mudflat would result from defence construction. Due to the nature of the scheme it is not considered that any major impacts will arise in respect of sediment/geomorphology, and therefore the overall potential of the waterbody, and the next cycle of the RBMP are unlikely to be affected. This topic is therefore proposed to be scoped out as a **non-key issue,** however this will be reconsidered at scoping stage when the amount of	Any changes to geomorphology during the lifetime of the Strategy are considered to be part of the baseline i.e. caused by sea level rise. It is acknowledged that there is the potential for a small amount of habitat loss at one or two locations as a result of coastal squeeze, for example at Bower Ashton. However it is considered that this is unlikely to affect the overall potential of the waterbody, and the next cycle of the RBMP and therefore sediment/geomorphology is scoped out of the EIA as a **non-key issue**. This conclusion will be revisited during the EIA process.

	land take (if any) has been calculated. Any impacts associated with piling in the construction phase will be mitigated through standard good industry practice measures contained within a CEMP.	
Land Quality and Land use	This topic is proposed to be scoped into the EIA due to the potential for contaminated land at locations where the defences are proposed. Any intrusive groundwork in these locations has the potential to mobilise contaminants from historical uses. Considering the close proximity of the River Avon, which is a sensitive receptor, it is suggested that this is scoped in as a **key issue**. Ground Investigation works and contaminated land sampling will be undertaken to establish 'high risk' areas. If any contamination land is discovered, this will be remediated and therefore may result in a positive key issue.	The defences in the operational phase will have no impact on Land Quality and Land Use, and therefore it is proposed this aspect should be scoped out of the EIA as a **non-key issue**. There may be a positive impact on Land Use over the lifetime of the Strategy, as more land will be protected from flooding which means more land will be potentially be available for development.
Traffic and Transport	There will be elevated traffic on strategic highway assets during the construction phase, caused by HGV's transporting materials to and from the construction site. In addition, a Network Rail bridge may have to be closed during construction of the Cattle Market Road alignment. As such, it is proposed to be scoped into the EIA as a **key issue**.	The defences in the operational phase are not expected to have any impact on traffic and transport, and therefore it is suggested this aspect can be scoped out of the EIA as a **non-key issue**.
Marine navigation	During the construction phase, it is not considered that any major impacts will arise in respect of marine navigation, as there will be no structures in-river affecting marine navigation. As such it is proposed as **a non-key issue**. There may be temporary vessels in the river to assist construction; however it is considered this can be adequately dealt with measures contained within a CEMP.	The defences in the operational phase should have no impact on marine navigation, and therefore it is expected that this aspect can be scoped out of the EIA as a **non-key issue**.
Socio-economics	Any negative impacts in relation to socio-economics are anticipated to relate to temporary access restrictions / severance during construction and potentially short-term noise impacts when piling and excavation work is being undertaken. However, impacts are anticipated to be minor due to the absence of residential receptors in the vicinity of the proposed scheme, and it is therefore proposed to scope the assessment of socio-economics out of the EIA as a **non-key issue**.	Once the defences are operational it is anticipated that there will be socio-economic benefits due to the protection of over 1150 residential and 700 commercial properties from tidal flooding; this is therefore considered as a positive **key issue.** BCC may want to consider including an assessment on Socio-economics to demonstrate the positive effects in order to provide a balanced assessment of the effects of the project; however it is not required unless BCC suggests otherwise in the Scoping Opinion.

Sustainability	The opportunities to acquire equipment from sustainable sources and minimise waste are expected to be limited, although a series of commitments for the Contractor(s) could be considered and included in the planning application. The impacts associated with construction are likely to be limited to greenhouse gas emissions from the construction activities (HGV and operation of plant). As the defences will be 'future proofed' the defences will only need to be piled once, reducing the amount of greenhouse gases produced during the construction phase. As such it is proposed that Sustainability is scoped out as a **non-key issue**.	There will be no obvious greenhouse gas emissions during operation. The project, by its very nature, will inherently provide protection against climate change predictions. BCC may want to consider including an assessment on Sustainability to demonstrate the positive effects in order to provide a balanced assessment of the effects of the project; however it is not required unless BCC suggests otherwise in the Scoping Opinion.
Cumulative Effects	Cumulative effects during construction phase will be considered in the EIA.	Cumulative effects during operational phase will be considered in the EIA. This will include in-combination effects and cumulative effects. The Strategy has the potential to combine with other planned or on-going activities in the vicinity to result in cumulative effects, such as The Severn Estuary Shoreline Management, The Severn Estuary Strategy, Bristol City Council Local Plan, and Bristol Central Area Plan. Generally the TFRMS is considered to align with and support these other plans and strategies.

7. Habitats Regulations Assessment (HRA)

The UK is bound by the terms of the Habitats Directive (92/43/EEC). Under Article 6(3) of the Habitats Directive, an appropriate assessment is required where a plan or project is likely to have a significant effect upon a European Site, either individually or in combination with other projects. The Directive is implemented in the UK by the Conservation of Habitats and Species Regulations 2010 (as amended) (the "Habitats Regulations").

A preliminary HRA report (see Appendix B) has been carried out which presents an analysis of the Likely Significant Effects of the Strategy on the European sites for which a risk of effect is present: the Severn Estuary SAC and Severn Estuary Ramsar site, with specific reference to their migratory fish qualifying interests. The preliminary report concluded that the Strategy would result in "no likely significant effects" on any European Sites, either alone or in combination with other projects and plans, providing a number of precautionary measures are followed such as: using low noise and vibration piling techniques and carrying out works outside of the sensitive season for fish migration.

This conclusion will be reviewed in the HRA, which would be dealt with under the EIA process with the first step being screening, once the precautionary measures have been further developed and incorporated into the project, in order to confirm the conclusion of no likely significant effects.

8. Water Framework Directive (WFD)

The Water Framework Directive 2000/60/EC provides an established framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. The Directive was transposed into UK legislation through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (Statutory Instrument 2003 No. 3242) for England and Wales.

An Outline Preliminary WFD Assessment has been carried out (see Appendix C) which has confirmed the need for a WFD assessment on the basis that the defences in some locations will be constructed in currently undefended areas. This may have a negative impact on the ecological potential of the waterbody (Bristol Avon). The reason for this is that constructing defences in currently undefended areas will likely involve a reduction of aquatic habitat area; there is also the potential for the hydromorphology of the waterbody to be negatively affected. The aim of the WFD assessment will be to evaluate the total combined length and percentage of the water body affected to assess the overall significance of the impact. Whilst an individual scheme may have an insignificant impact on WFD quality elements within a reach, the combined effect of several small-scale schemes may cause deterioration to the ecological potential of the waterbody.

The extent of habitat affected as well as the scale of impact is not able to be accurately estimated at present, as until a design freeze for the scheme is produced containing further detail of alignments and construction it is not possible to measure this effect. In addition, this assessment will require the support of hydraulic modelling to establish the impacts of the scheme on low and high tide levels within the study area against the current situation. This will then be used to ascertain the scale of potential impacts to habitats and areas of loss and will inform the requirements for compensatory habitat area. This should also be evaluated in the wider context of likely impacts due to sea level rise. Suitable mitigation and/or compensation may be required within the water body to satisfy WFD compliance and this should be discussed and planned in close consultation with Natural England, the Environment Agency and other key stakeholders.

9. Marine Management Organisation (MMO) Licence

Any activity which involves construction, alteration or improvement to inshore marine areas is likely to require a marine licence from MMO. This has been confirmed through early consultation with the MMO in the earlier phases of the Strategy. A marine licence is likely to be required for the proposed frontline alignments: Netham, Bathurst Dam, Commercial Road, Clarence Road and Cattle Market Road, due to the potential impact on the River Avon as a result of construction activity.

If it is determined that the project is likely to have a significant environment effect, the EIA process must be completed before a licence from the MMO can be granted. The MMO is required to have a

formal period of public consultation before determining a marine licence application. This will include a 42-day period during which members of the public may make representations. If planning consent is granted by BCC for the planning application (supported by the ES), a decision on whether to grant a marine licence can then be taken. If planning consent is refused, the application may not be granted.

10. Project EIA Risks

The following details the EIA risks which can currently be foreseen:

- There are a number of ecological surveys that are likely to be required, which will be identified by the Phase I Extended Habitat Survey. These surveys are often seasonally constrained. A table is provided in Appendix A which shows the optimal windows when these surveys can be carried out.
- Archaeological, geo-physical or trial-trenching may be required, depending on the likely presence and significance of any buried archaeology based on a secondary data review, which would have time and cost implications;
- Ground Investigation works and contaminated land sampling may be required which would have time and cost implications.

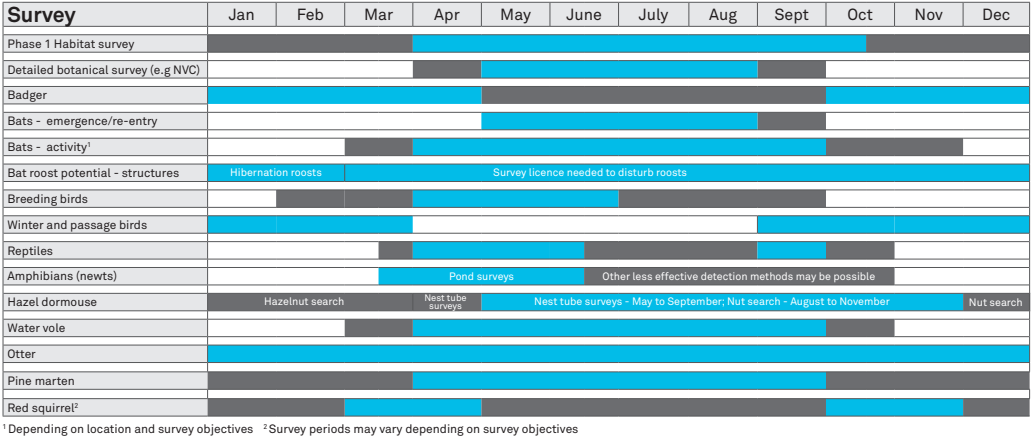
11. Next Steps

It is considered that the next steps for the EIA process should include:

1. The Applicant (BCC) needs to consider whether a formal enquiry should be made to the Planning Department of BCC regarding whether the Council agrees that the project does not fall under the Marine EIA Regulations;
2. It is not considered necessary to submit a formal request to confirm whether BCC considers the project to be EIA Development, however the Applicant has the option of doing so and may wish to formalise this step;
3. Preparation of a formal EIA Scoping Report, in line with the latest (2017) EIA Regulations (on the basis the project does not fall under the Marine EIA Regulations) which will provide statutory and non-statutory consultees with an opportunity to comment on the project, and scope of the EIA. This is not mandatory but is strongly endorsed by AECOM;
4. Steps to consult with non-statutory and statutory consultees early in the process should be taken (see section 4). As a minimum, it is proposed that one meeting should be held with the planning team, Natural England, Historic England and the Environment Agency.
5. The Applicant and design team should aim to incorporate environmental mitigation as early as possible into the next stages of the design evolution, and identify opportunities for enhancement. A number of potential enhancement opportunities have been identified in the HRA screening and SEA for the Strategy; these should be further explored with a requirement for schemes to deliver appropriate additional benefits (in addition to required mitigation and compensation). Key areas of opportunity lie with public realm and landscape enhancement, where potential measures such as green infrastructure resilience corridor initiatives should be further assessed during scheme development to provide betterment. In addition biodiversity enhancement is possible through removal of invasive species, re-planting of native species, regrading and riverbank restoration, for example.

Appendix A Ecology Survey Schedule

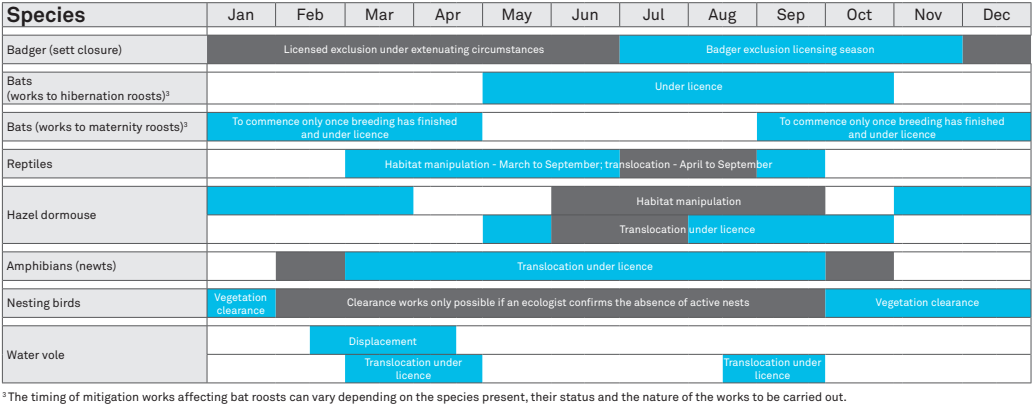
Survey Timing



[1] Depending on location and survey objectives [2] Survey periods may vary depending on survey objectives

Optimal Sub optimal Outside typical survey season	Timings are indicative. They may be affected by site conditions, habitat type and average weather conditions, which will vary from year to year and across regions. Seasonal constraints to surveys should also be considered for other species groups, such as: white-clawed crayfish and other aquatic invertebrates, specific bird species and terrestrial invertebrates. Please contact AECOM ecologists for more information on ecological timings or other species surveys.

Mitigation Timing



[3] The timing of mitigation works affecting bat roosts can vary depending on the species present, their status and the nature of the works to be carried out.

Optimal Sub optimal - mitigation work may be less effective or not possible Mitigation often not effective or possible	Timings are indicative. They may be affected by site conditions, habitat type and average weather conditions, which will vary from year to year and across regions. Seasonal constraints to mitigation should also be considered for: white-clawed crayfish translocation, otter habitat/dwelling compensation, habitat creation and enhancement. Please contact AECOM ecologists for more information on mitigation timings.

Appendix B Preliminary HRA

River Avon Tidal Flood Risk Management Strategy Report to Inform a Habitat Regulations Assessment

No Likely Significant Effects Report

Bristol City Council

September 2017

Quality information

Prepared by	Checked by	Approved by
NT Technical Director	JD Principal Flood and Coastal Specialist	NS Regional Director

Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	10/01/17	Draft for client review	JR	James Riley	Associate Director
2	17/03/17	Updated following client and Environment Agency comments	JR	James Riley	Associate Director
3	31/07/17	Final	JR	David Dales	Technical Reviewer
4	21/09/17	Final	NS	Nikki Smith	Regional Director

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Limitations

AECOM Infrastructure & Environment UK Limited ("AECOM") has prepared this Report for the sole use of Bristol City Council ("Client") in accordance with the Agreement under which our services were performed **River Avon Tidal Flood Risk Management Strategy RESP1007626 (23/10/15) and Response to Tender Submission Clarifications (03/11/15) (the "Agreement")**. The report takes into account the particular instructions and requirements of the Client in accordance with the provisions of the Agreement. It is not intended for and cannot be relied upon by any third party. No liability is accepted by AECOM and no responsibility is undertaken to any third party.

Information obtained by AECOM has not been independently verified by AECOM, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by AECOM in providing its services are outlined in this Report. The work described in this Report was undertaken in June 2017 and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

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1. Introduction

1.1 Background

In 2016 AECOM devised the Bristol City Tidal Flood Risk Management Strategy (TFRMS) on behalf of Bristol City Council. Effective strategic tidal flood risk management is essential for the city of Bristol, not just because of the threat to lives and property but also because of the risk of long-term reputational damage on the city's attractiveness and economic prosperity. This project will deliver a Tidal Flood Risk Management Strategy (TFRMS) (the 'Strategy') for the area of Bristol at risk of flooding from the River Avon, including the city centre (between Cumberland Basin and Netham), Shirehampton and Avonmouth.

The preferred programme of adaptive measures covers a 100 year appraisal period (2015-2115) has been carried out and split into three time epochs:

- Epoch 1: 2015 to 2030 (short term);
- Epoch 2: 2030 to 2065 (medium term); and
- Epoch 3: 2065 to 2115 (long term).

By developing management options in accordance with these time epochs it will allow for an adaptive approach to management to be developed that keeps pace with climate change and potential sea level rise.

Six intervention measures were considered in the short list appraisal. These included:

- Do Minimum;
- Local scale property level protection & temporary / demountable defences;
- High Defences;
- Low Defences;
- Narrow Tidal Barrier; and
- Wide Tidal Barrier.

Following the production of the first draft of this HRA, it was identified that detriment mitigation (i.e. measures to avoid increased flood risk in some parts of the Strategy area due to new defences in other parts) would be required. In the Netham area (DM5) this included:

- Installing a flap on the Brislington Brook outfall;
- Culverting the open section of the Brislington Brook; and
- Providing over-pumping when the Brislington Brook cannot discharge under gravity.

In addition, at Bower Ashton the proposals involve the raising of the existing bank to a height of 10.3 m. This bank will be approximately 480 m long, with an average height increase of 1.4 m, and a maximum height increase of 2.4 m.

1.2 Commission

Bristol City Council has commissioned AECOM to undertake a Tidal Flood Risk Management Strategy along the tidal River Avon. The Strategy is primarily required to mitigate the significant risk of flooding to residential areas which lie behind the waterfront industry.

The study is intended to gain the necessary data and evidence required to build a robust business case for the Strategy, which encompasses a 5km frontage from the Cumberland Road to the Netham Road overbridge. The outputs of the study will include an outline design for the preferred option, and will allow Bristol City Council to develop and submit a strategic Outline Business Case to the Environment Agency to apply for grant aid funding for the Strategy.

Although not specifically required in the scope of the commission, the deliverables of the study will contribute in the future towards planning applications for any flood risk mitigation schemes emanating from the Strategy.

1.3 This Report

Regulation 61(1) of the Conservation of Habitats and Species Regulations 2010 (as amended) states that '*A competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which—*

(a) is likely to have a significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects), and

(b) is not directly connected with or necessary to the management of that site,

must make an appropriate assessment of the implications for that site in view of that site's conservation objectives'.

Regulation 61(5) states that '*In the light of the conclusions of the assessment, and subject to regulation 62 (considerations of overriding public interest), the competent authority may agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the European site or the European offshore marine site (as the case may be)'.*

The study is only intended to provide sufficient information and analysis to support the development of the outline business case for the Strategy. However, since the Strategy constitutes a plan, it is considered prudent to consider that it falls within the remit of the aforementioned Regulations.

AECOM was appointed by the Council to provide the authority with an independent technical report to inform the Council in its discharge of duties under the Conservation of Habitats & Species Regulations (2010, as amended), specifically as they relate to protection of internationally important wildlife sites.

In accordance with Regulation 61(3) this report should be provided to Natural England for their comment and their comments taken into account in producing a final version of this report.

European Union (EU) Directive 92/43/EEC1 on the conservation of habitats and of wild flora and fauna (known as the 'Habitats Directive') protects habitats and species of European nature conservation importance. Together with Directive 2009/147/EC2 on the conservation of wild birds (the 'Birds Directive'), the Habitats Directive establishes a network of internationally important sites designated for their ecological status. Special Areas of Conservation (SACs) and Sites of Community Importance (SCIs) are designated under the Habitats Directive and promote the protection of flora, fauna and habitats. Special Protection Areas (SPAs) are designated under the Birds Directive in order to protect rare, vulnerable and migratory birds. These sites combine to create a Europe-wide 'Natura 2000' network of designated sites, which are hereafter referred to as 'European Sites'.

The Conservation of Habitats and Species Regulations 2010 (as amended)[3] (the 'Habitats Regulations') incorporate all SPAs into the definition of 'European Sites' and, consequently, the protections afforded to European Sites under the Habitats Directive apply to SPAs designated under the Birds Directive.

In addition to sites designated under European nature conservation legislation, UK Government policy states that internationally important wetlands designated under the Ramsar Convention 1971 (Ramsar sites) are afforded the same protection as SPAs and SACs for the purpose of considering development proposals that may affect them. Paragraph 118 of the National Planning Policy Framework makes it clear that potential Special Protection Areas and proposed Ramsar sites should be treated as if they were already designated.

Since the Strategy only provides sufficient information to support the development of a strategic outline business case, the HRA report must be similarly high-level and cannot examine potential impacts to the definitive extent that will need to be undertaken for the planning application. As such, the HRA focuses on identifying any risks posed by the Strategy to European sites and, where such risks exist, sets out the protocols or mitigation measures that would need to be incorporated into the full project as it is developed for a planning application.

[1] Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora. Adopted 21 May 1992.
[2] Council Directive 2009/147/EEC on the Conservation of wild birds. Adopted 30 November 2009.
[3] The Conservation of Habitats and Species (Amendment) Regulations (SI No. 1927 of 2012). HMSO, 2012.

1.4 Preferred option

The Options Identification and Environmental Appraisal presented a high-level environmental appraisal of 39 strategic options as part of the long list options phase. The 39 options were then reduced to seven options during shortlisting, before a preferred option was selected (Option D). The options considered a range of flood risk intervention measures including: a Do Minimum approach, property level protection / temporary defences, low defences, high defences, and a tidal barrier. The preferred strategic option that was selected encompasses the construction of low defences during Epochs 1 and 2, and then raising these defences in Epoch 3. The exact time within Epoch 3 when the defences are upgraded is flexible and the upgrade will involve crest raising of the low defences rather than starting the construction of new high defences from first principles.

To deliver the preferred option (Option D1), approximately 5 km of new raised defences will be required across the study area. Within central Bristol, new raised defences will be required in core areas, comprising: Cumberland Road, Commercial Road, Clarence Road, Cattle Market Road, Totterdown, and St. Phillips. Defences in these locations should prevent local flooding to the properties and assets situated behind. In addition, new defences at additional core areas including Entrance Lock, Netham, Bathurst Dam, and Cumberland Road underpass will also be required.

An overview of the preferred option is present in the Activity 9B: Options Identification and Environmental Appraisal Addendum.

2. Methodology

There is essentially a four stage process for Habitats Regulations Assessment (HRA):

- **Screening (Stage 1)** – The process of identifying the potential likely significant effects of a project upon a European site, either alone or in-combination with other plans and projects, within the context of the sites conservation objectives. That is the purpose of this report;

- **Appropriate Assessment (Stage 2)** – Considering the effects on the integrity of the European site, either alone or in-combination with other plans and projects, with regard to the site's structure, function and conservation objectives. Where there are adverse effects on the integrity of the European site, an assessment of the efficacy of mitigation measures is carried. If those mitigation options cannot avoid adverse effects then development consent can only be given if Stages 3 and 4 are then followed;

- **Assessment of Alternative Solutions (Stage 3)** – Examining alternative solutions that would avoid or have a lesser adverse effect on the European site; and

- **Imperative Reasons of Overriding Public Interest (IROPI) (Stage 4)** – This is the assessment where no alternative solution exists and where adverse effects remain. The process is to assess whether the development is necessary for IROPI and, if so, the potential compensatory measures needed to maintain the overall coherence of the site or integrity of the European site network. This is not considered to be a standard part of the process and would only be carried out in exceptional circumstances.

All four stages of the process are referred to as the HRA, to clearly distinguish the whole process from the stages within it. This report addresses Stages 1 and 2.

2.1 Likely Significant Effects

Stage 1 is essentially a risk assessment, typically utilising existing data, records and specialist knowledge. The process involves identifying the likely impacts of a project upon a European Site, either alone or in combination with other plans and projects, and considers whether the impacts are likely to be significant. The purpose of the test is to decide whether an Appropriate Assessment is required.

In the determination of Likely Significant Effect, guidance is provided in English Nature's (now Natural England's) Habitats Regulations Guidance Note 3[4] (HRGN3), 'The Determination of Likely Significant Effect under the Habitats Regulations'. This involves a preliminary consideration of whether a qualifying feature is likely to be directly or indirectly affected (in which case there is a presumption that a significant effect is likely). In such a case, a fuller consideration should then be applied, using further analysis and information, to confirm and justify the presence or absence of 'Likely Significant Effect'. Appropriate Assessment (Stage 2) is needed in cases where a Likely Significant Effect is identified. A Likely Significant Effect is, in this context, any effect that may be reasonably predicted as a consequence of a plan or project that may affect the conservation objectives of the features for which the site was designated, but excluding trivial or inconsequential effects.

2.2 Other Plans and Projects

The Conservation of Habitats and Species Regulations (2010, as amended) make it clear that the determination of likely significant effects must not be made in isolation but 'in combination', taking into account the cumulative effects of the specific development for which planning permission is being sought alongside those of other plans or projects. In this case, the projects of particular relevance due to their proximity or potential for similar impacts on the same European sites are:

- The Shoreline Management Plan (SMP2) for the Severn Estuary, which sets coastal defence policy for a wide area including the European sites described in Section 3[5].

There are no additional known cumulative schemes ongoing within the River Avon. An updated check will be made during the EIA Scoping stage to support the HRA of the planning application.

[4] English Nature. Habitats regulations guidance note: The Determination of Likely Significant Effect under The Conservation (Natural Habitats & c) Regulations 1994. HRGN 3. November 1999.
[5] https://www.severnestuarycoastalgroup.org.uk/shoreline-management-plan/

3. European Sites, Interest Features and Conservation Objectives

This document discusses the following European sites as being relevant to the analysis:

- Avon Gorge Woodlands Special Area of Conservation (SAC), located 1.1km downstream of the western boundary of the study area; and
- Severn Estuary Special Protection Area (SPA), located 8.2km downstream of the western boundary of the Strategy frontage;
- Severn Estuary Ramsar site – co-located with the SPA; and
- Severn Estuary SAC - co-located with the SPA and Ramsar site.

3.1 Avon Gorge Woodlands SAC

The SAC is designated for the lime (*Tilio cordata*) woodland which transitions to species rich scrub and calcareous grasslands. The limestone grassland and cliff ledges support a diversity of uncommon species including *Sorbus bristoliensis* and *Sorbus wilmottiana*. The forests are mixed woodland on base-rich soils normally associated with rocky slopes. The SAC is also designated for the semi-natural grassland habitats and scrubland on calcareous substrates.

The conservation objectives for the SAC are as follows:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- *The extent and distribution of qualifying natural habitats*
- *The structure and function (including typical species) of qualifying natural habitats, and*
- *The supporting processes on which qualifying natural habitats rely*

There is no mechanism for the Strategy (which is situated upstream of the SAC) to affect any interest features of the SAC, as the qualifying features are purely terrestrial.

3.2 Severn Estuary SPA

The SPA qualifies as a SPA for its wintering bird species:

- Wintering populations of Bewick's swan (*Cygnus columbianus bewickii*), common shelduck (*Tadorna tadorna*), dunlin (*Calidris alpina alpina*), pintail (*Anas acuta*), redshank (*Tringa totanus*) and curlew (*Numenius arquata*).

The SPA also qualifies for supporting populations of Ringed Plover (*Charadrius hiaticula*) as well as supporting 93,986 individual waterfowl.

The conservation objectives for the SPA are as follows:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- *The extent and distribution of the habitats of the qualifying features*
- *The structure and function of the habitats of the qualifying features*
- *The supporting processes on which the habitats of the qualifying features rely*
- *The population of each of the qualifying features, and,*
- *The distribution of the qualifying features within the site.*

There is no mechanism for the Strategy to affect the wintering bird populations given the distance between the SPA and the Strategy, as the SPA lies outside of the zone of influence.

3.3 Severn Estuary SAC

The SAC is designated for its estuaries, subtidal sandbanks, intertidal mudflats and sandflats, refs and Atlantic salt meadows (*Glauco-Piccinellietalia maritimae*). The SAC is also designated for populations of anadromous fish including sea lamprey (*Petromyzon marinus*), River lamprey (*Lampetra fluviatilis*) and twaite shad (*Alosa fallax).*

The conservation objectives for the SAC are as follows:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- *The extent and distribution of qualifying natural habitats and habitats of qualifying species*
- *The structure and function (including typical species) of qualifying natural habitats*
- *The structure and function of the habitats of qualifying species*
- *The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely*
- *The populations of qualifying species, and,*
- *The distribution of qualifying species within the site.*

Although the SAC designation only comes up the River Avon as far as the M5 bridge, there is a potential disturbance mechanism where migratory fish for which the SAC is designated travel further up the River Avon, as disturbing (or injuring) these species when outside the SAC could still affect the ability of the SAC to achieve its conservation objectives. This is therefore discussed in the subsequent section of this report.

3.4 Severn Estuary Ramsar site

The Severn Estuary qualifies as a Ramsar as illustrated in Table 1.

Table 1. Ramsar

Ramsar Criterion	Description of Criterion	Severn Estuary
1	A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.	Due to immense tidal range (second-largest in world), this affects both the physical environment and biological communities. Qualifying features include: • H1110 Sandbanks which are slightly covered by sea water all the time • H1130 Estuaries • H1140 Mudflats and sandflats not covered by seawater at low tide • H1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
3	A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.	Due to unusual estuarine communities, reduced diversity and high productivity.

4	A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.	This site is important for the run of migratory fish between sea and river via estuary. Species include Salmon *Salmo salar*, sea trout *S. trutta*, sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, allis shad *Alosa alosa*, twaite shad *A. fallax*, and eel *Anguilla anguilla*. It is also of particular importance for migratory birds during spring and autumn.
5	A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.	**Species with peak counts in winter:** 70919 waterfowl (5 year peak mean 1998/99-2002/2003)
6	A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.	**Qualifying Species/populations (as identified at designation):** Species with peak counts in winter: Tundra swan (*Cygnus columbianus bewickii*), greater white-fronted goose (*Anser albifrons albifrons*), common shelduck (*Tadorna tadorna*), gadwall (*Anas strepera strepera*), dunlin (*Calidris alpina alpina*) and common redshank (*Tringa totanus totanus*)
8	A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.	The fish of the whole estuarine and river system is one of the most diverse in Britain, with over 110 species recorded. Salmon *Salmo salar*, sea trout *S. trutta*, sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, allis shad *Alosa alosa*, twaite shad *A. fallax*, and eel *Anguilla anguilla* use the Severn Estuary as a key migration route to their spawning grounds in the many tributaries that flow into the estuary. The site is important as a feeding and nursery ground for many fish species particularly allis shad *Alosa alosa* and twaite shad *A. fallax* which feed on mysid shrimps in the salt wedge.

There is no mechanism for the Strategy to affect the bird assemblages of the Ramsar site as it lies outside of the zone of influence given the distance from the study area. There is a potential disturbance mechanism to migratory fish associated with the Ramsar site, as already discussed for the SAC.

3.5 The Bristol Channel Approaches cSAC

The Bristol Channel Approaches cSAC has been recognised as an area with predicted persistent high densities of harbour porpoise (*Phocoena phocoena*). The entire site has been identified as an important area for porpoises during the winter season.

There is no mechanism for the Strategy to affect harbour porpoise. Although harbour porpoise visit shallow bays, estuaries, and tidal channels less than 200m in depth, and have been known to swim up rivers (including some anecdotal evidence for their occasional presence in the River Avon) the study area lies over 100km from the cSAC. Guidance from the Joint Nature Conservation Committee (JNCC) is that a likely significant effect on an SAC designated for marine mammals is unlikely to arise from works that are located more than 50km from the

SAC[6]. As a general precaution however, any 'in river' impact piling works should cease if there is evidence of dolphin or porpoise being present at the time of piling.

[6] Email correspondence from JNCC to AECOM dated 27/09/16

4. Likely Significant Effects

This chapter presents an analysis of the Likely Significant Effects of the Strategy on the only European sites for which a risk of effect is present: the Severn Estuary SAC and Severn Estuary Ramsar site, with specific reference to their migratory fish qualifying interests.

4.1 Severn Estuary SAC and Ramsar site

The application site is upstream of the Severn Estuary SAC and Ramsar site and as a consequence this section of the river is used as a migratory route for the SAC and Ramsar fish species as part of their life cycles. Any adverse impacts to fish populations in the River Avon would cause an adverse effect on the SAC and Ramsar downstream.

4.1.1 Noise

Migratory fish species for which the Severn Estuary SAC is designated, including sea lamprey and river lamprey could be impacted by noise and vibration resulting from the proposed Strategy where it involves cofferdams or other in-river piling. Likewise migratory fish species, for which the Ramsar site is designated, including Atlantic salmon, twaite shad, allis shad, eel and sea trout, will also be sensitive to underwater noise. Crest raising of the defences may involve the use of cofferdams or other forms of sheet piling. Depending on substrate, sheet piling can be pushed or pressed down to the rock, which is virtually silent, or vibrated down to the rock (which does generate some underwater noise). However, they may also need (at least to start and finish a pile) to be hammered or driven down to the rock and this can generate substantial underwater noise. Noise has been experimentally demonstrated to cause behavioural responses in fish. If noise of sufficient decibels propagated across the cross-section of a watercourse it can also provide an acoustic barrier to movement. If the sound pressure level is sufficiently great underwater noise can also cause injury or death.

The lower Bristol Avon is difficult to survey for fish using the Environment Agency standard techniques, due to the width, depth and flow. Consequently the lower Bristol River Avon has been subject to fisheries surveys using hydroacoustic equipment by the Environment Agency and partners in order to provide fish abundance data for a 20km stretch of the River between Bristol and Bath[7]. The highest abundance of fish was recorded immediately downstream of Bath where roach, bream and perch were recorded. The mean fish density in the most prolific stretch of the Avon was found to compare favourably with other large rivers such as the Severn.

Data supplied by the Environment Agency suggests that there is good evidence of the migratory species for which the River Severn is designated utilising the River Avon. The data suggests that there is evidence of salmon utilising the River Chew, upstream of Bristol (caught during fish surveys), for spawning and sea trout have also been recorded within the River Somerset Frome (anecdotal evidence from anglers). The River Chew merges with the River Avon and thus there is reason to believe that salmon may be utilising the stretch of the River Avon in which the Strategy will be implemented. Data from the Environment Agency also states that eels are routinely caught in fish surveys across the Bristol catchment. There is also the possibility of sea and river lamprey as well as twaite and allis shad being present in low numbers, as they are present in the estuary and the River Avon is passable up to Netham Weir.

The most up-to-date noise thresholds for fish come from the Acoustic Society of America (ASA) guidelines by Popper et al (2014)[8] accredited by the American National Standards Institute (ANSI). These guidelines are based on a review of the latest literature but still reflect the considerable uncertainty that exists in the impact of sound on fish. For example, very few species have been studied in order to determine quantifiable criteria but the Popper thresholds do consider the sensitivity of different fish based on their anatomy. For example, the most sensitive fish are those that have a swim bladder that is also used in hearing such as the Clupidae (herring) species.

There is very little data available for lamprey of any species with respect to hearing, and no audiograms are understood to exist that would provide an indication as to their sensitivity to noise, or indeed a confirmation as to whether they are able to detect sound at all (Popper, 2005)[9]. In common with cephalopods, lamprey have statolith organs, and so it is thought that they may also have a sensitivity to low frequency sound (Lenhardt and

[7] Environment Agency (2014) Bristol Avon Fish Monitoring, Environmental Monitoring , Wessex
[8] Popper et al., 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI.
[9] Popper A N (2005) A review of hearing by Sturgeon and Lamprey. Submitted to the U.S. Army Corps of Engineers, Portland District, August 12, 2005, Available at: http://www.nwpapp

Sismour, 1995)[10], or particle velocity rather than sound pressure as species of 'hearing generalist' fish. Due to the general apparent lack of sensitivity to sound of lamprey, and the lack of both detailed information on lamprey hearing or appropriate criteria to assess them by (with respect to particle velocity), they have not been considered further.

4.1.2 Intertidal habitat loss

For the most part the frontage to be defended already has existing flood defences, with built-up areas behind them which would prevent any landward retreat of intertidal habitats even without this Strategy. Any loss of intertidal habitat along most of the frontage would not therefore be the result of this Strategy.

Improving the standard of flood defences could, depending on how they are constructed, potentially result of further loss of intertidal habitat due to (for example) increased defence footprint. At this point, there has been no detailed design of defences and therefore it is not possible to quantify what (if any) loss of mudflat would result from defence construction.

Detriment mitigation devised since the original draft of this HRA was produced includes a new embankment proposed at Bower Ashton. At this location there is an undeveloped area of grassland behind the proposed embankment; theoretically, without the embankment the river banks could erode over time, allowing the intertidal mudflat in this location to retreat inland and thus be preserved in extent notwithstanding sea level rise.

At Bower Ashton there is the potential for a negative impact on estuarine geomorphology as a result of the Strategy constructing a new flood defence and causing coastal squeeze. At this location there is an undeveloped area of grassland behind the proposed embankment; although this is not an entirely naturalised area due to the presence of the channelised River Avon and water infrastructure (e.g. culverted watercourses), theoretically, without the embankment the river banks could erode over time, allowing the intertidal mudflat in this location to retreat inland and thus be preserved in extent notwithstanding sea level rise.

The Severn Estuary Shoreline Management Plan (SMP) Review (2010) provides an assessment of the risks associated with coastal processes and presents a policy framework to reduce these risks to people and the developed, historic and natural environment in a sustainable manner. The SMP policy for the area (policy unit BRIS5) is Hold the Line (HTL) which is "to provide some level of coastal defence, keeping the position of the defence approximately where it is at the moment". In terms of coastal squeeze, it is considered the Strategy is in conformity with the Severn Estuary SMP, despite the construction of the earth embankment at Bower Ashton. The adopted SMP and its policies have been accepted by key consultees (Bristol City Council, Environment Agency and Natural England). Despite the SMP stating that HTL for this policy unit is the best environmental option, it is acknowledged that this does not mean that there are no environmental effects at all and therefore any habitat loss as a result of coastal squeeze will be mitigated/compensated before this embankment is constructed.

The Bower Ashton embankment's alignment would also be setback at a level above high tide. This means it would not directly encroach into the intertidal zone at the time of construction in the first epoch, and the landward transgression of intertidal habitats, assuming the gradient of the river bank permits transgression, would not be impeded until sometime later on in the Strategy. It is anticipated that the intertidal habitats would be monitored at regular intervals following the implementation of the Strategy to verify the conclusions of the Environmental Statement (or identify the need for additional mitigation). The method and frequency of this monitoring will be determined at EIA stage.

In total, the direct footprint loss for estuarine habitats associated with the Strategy is estimated to be 2218 m^2. This is based on 2218 m length of defences and a maximum 1 m encroachment out from current defences. This estimate includes the Netham detriment works and at this stage there is uncertainty as to whether these works will lead to encroachment in order to raise defence heights; should the footprint not be increased at Netham the maximum estuarine land take will reduce to an estimated 1268m^2 (0.127 ha).

It is acknowledged that the River Avon intertidal mud in the Strategy area is outside any European site, but could be used by larval lamprey (ammocoetes) associated with the Severn Estuary SAC, or by non-breeding birds associated with the Severn Estuary SPA (at least occasionally in small numbers).

[10] Lenhardt M L, Sismour E (1995) Hearing in the sea lamprey (Petromyzon marinus) and the long nose gar (Lepisosteus spatula). The Association for Research in Otolaryngology, Abstract: 259.

Ammocoetes are blind, wormlike animals that burrow into silt. With respect to juvenile ammocoete nursery areas, optimal habitat can be defined by[11]:

- Several square metres of stable, consolidated fine sediment;
- Presence of shade;
- Relatively shallow water depth, generally <50cm;
- Low water velocity;
- Presence of organic detritus; and
- Delivery of well oxygenated water.

A continuous stream of water passes in through the mouth and out through the gills while the ammocoete remains static in the mud. After approximately three years, the ammocoete will metamorphose and migrate to the sea. Unlike salmon smolts, the timing of juvenile migration in lamprey is protracted and poorly documented. However, lamprey macrophthalmia and ammocoetes are not strong swimmers, attaining maximum individual speeds of less than 1 m s^{-1}, and sustained speeds of less than 0.5 m s^{-1}. As such, their migration is generally believed to be primarily passive[12], with the ammocoetes distributed throughout the water column[13] and most downstream movement due to washout during spates.[14].

Since ammocoetes have a preference for fairly shallow water, but do require the continuous presence of some water in order to filter feed and not die of hypoxia, the shallow water at the lower edge of the intertidal zone may constitute valuable habitat. Such habitat will gradually disappear as sea levels rise and water depths increase, without any ability for the habitat to migrate inland and thus preserve the shallow edges. However, given the small amount of intertidal mudflat in this area, it is unlikely that creating the embankment at Bower Ashton will radically affect the ability of the Bristol Avon to support ammocoetes.

During the winter period the Somerset Levels & Moors may be subject to freezing conditions which can mean that birds move out to coastal areas such as the extensive mudflats and associated high-tide roosts of the Severn Estuary SPA/Ramsar site. While passage and wintering birds associated with this SPA/Ramsar site may sometimes then use the mudflats in the tidal River Avon around Bristol, the amount of intertidal mudflat available (generally a maximum 20m wide strip and often much less) inherently limits the value of these mudflats compared to those within the Severn Estuary SPA/Ramsar site itself and only a small proportion of the total SPA/Ramsar population is likely to utilise these mudflats at any time.

However, measures will be devised and presented as part of the detail to support a planning application to ensure no net loss of intertidal habitat.

4.1.3 Habitat fragmentation and blockage of fish passage

Following the production of the first draft of this HRA, it was identified that detriment mitigation (i.e. measures to avoid increased flood risk in some parts of the Strategy area due to new defences in other parts) would be required. In the Netham area (DM5) this included:

- Installing a flap on the Brislington Brook outfall;
- Culverting the open section of the Brislington Brook; and
- Providing over-pumping when the Brislington Brook cannot discharge under gravity.

It is important to note that proposals in these areas are at an early stage of development, and further investigations and design development on a local level will be required to confirm and refine proposals. Nonetheless, depending on their design, all of these features could provide a blockage to eel passage. Given that the SAC is partly designated for its eel populations, and these are known to travel up and down the Bristol Avon, such a blockage would constitute a likely significant effect without the requirement that adequate fish (specifically eel) passage is designed into these features.

[11] Scottish Natural Heritage Commissioned Report No. 027 (ROAME No. F01AC608)
[12] Physiology and Ecology of Fish Migration. Edited by Katsumi Tsukamoto CRC Press 2013 Pages 105–131 Print ISBN: 978-1-4665-9513-2
[13] Moser, M.L., Jackson, A.D., Lucas, M.C. et al. Rev Fish Biol Fisheries (2015) 25: 103. doi:10.1007/s11160-014-9372-8
[14] https://ifm.org.uk/wp-content/uploads/2016/01/River-lamprey-Summary-2008.pdf

5. Mitigation measures to avoid a likely significant effect

5.1 Noise

Wherever piling works will take place beyond or close to the existing flood defence there is the potential for associated noise and vibration to affect fish generally and in particular the ability of migratory fish such as salmon to utilise the river. Detailed construction methods for the proposed Strategy are not known at this stage but where technically feasible, the project will utilise low noise and vibration piling techniques such as pressing or vibro-piling rather than impact/percussive piling.

Where impact piling is required, adverse impacts have been predicted for migrating fish during the migration season, and so a number of additional mitigation measures will need to be adopted to minimise the impacts on migrating salmon (and other SAC fish species) as follows:

- The lowest power levels of impact piling equipment that can undertake the task will be selected;
- No percussive piling will be permitted at dusk and dawn and no piling of any kind will occur between the hours of 6pm and 8am;
- The piling programme will be carefully scheduled to minimise impact piling during the most sensitive time periods;
- Piling will be permitted on the ebb tide only during migration upstream and during the flood tide only for migration downstream;
- Scheduling impact piling to restrict percussive piling to a maximum of *N* hours per day/ per week during the sensitive season (*N* to be determined on the basis of local site conditions, particularly water depth at piling position and confirmed details of the piling equipment to be used).
- Where necessary, low tide working (where percussive piling is only permitted at low tide ± *X* hours (*X* to be determined based on tidal cycles and local site conditions) can also be adopted during the migration season (though this can be very time restrictive in the winter months).

Furthermore, it is recommended that such works should take place outside of the sensitive season for migration. For Atlantic salmon and sea trout this is generally April to June, although the Atlantic salmon migration period for the Bristol Avon can be later in the season (July to October). European eel start migrating upstream into the catchment from mid-February, with juvenile eels migrating when water temperatures are between 13 and 14°C. If it is not possible to avoid conducting works during the sensitive season, underwater noise modelling and measurement can be used to determine the precise nature of any noise barrier created during piling and if necessary enable mitigation to be devised.

As a general precaution however, any ‘in river’ impact piling works should cease if there is evidence of dolphin or porpoise being present at the time of piling.

As planning application(s) are developed, the mitigation measures listed above will need to be developed further, with particular regard to the noise generated by the actual construction methods. These further developed measures will need to be included in an HRA to accompany the planning application. They will then need to be conditioned as part of any planning permission.

5.2 No Net Loss of Intertidal Habitat

As detailed defence design takes place, every opportunity should be taken to minimise net loss of intertidal mudflat to reduce the losses identified in this analysis.

In total, the direct footprint loss for estuarine habitats associated with the Strategy is estimated to be 2218 m^2. This is based on 2218 m length of defences and a maximum 1 m encroachment out from current defences. This estimate includes the Netham detriment works and at this stage there is uncertainty as to whether these works will lead to encroachment in order to raise defence heights; should the footprint not be increased at Netham the maximum estuarine land take will reduce to an estimated 1268m^2 (0.127 ha). Such losses would require compensation in order to maintain habitat balances. It would be the responsibility of BCC to ensure compensatory habitat has been provided, and agreed with the Environment Agency and Natural England, prior to any losses occurring. Whilst recognising the need to potentially compensate as a result of the Strategy, suitable

sites for habitat creation should be identified at a later stage of Strategy development once the total area of habitat loss, both direct loss via encroachment and indirect losses by altering tidal water levels and impedance of habitat "rollback" has been predicted using hydraulic modelling, habitat characterisation and geomorphological appraisal.

The further work for Strategy implementation should include identifying the type of habitat that could be lost as a result of coastal squeeze. At this early stage of design we have assumed a worst case scenario that encroachment will be in the intertidal zone. A targeted, Phase 1 Habitat Survey should be completed at EIA stage to characterise habitats and confirm the type and quality of habitat which has the potential to be impacted directly and indirectly. Alongside ecological work, a geomorphological appraisal would be necessary to confirm whether the estuary's form and adjacent hinterland would permit the rollback of intertidal habitats under rising sea levels i.e. steep river bank gradients may limit the likelihood of rollback.

It would be prudent to ascertain when the habitat losses are likely to occur. A separate modelling exercise is recommended for Strategy implementation during the EIA phase in order to estimate the projected coastal squeeze under the future baseline and with development scenarios. It is not considered possible or appropriate to estimate the potential habitat losses at this stage of the project because more detailed baseline information and design is required than is currently available at the time of writing.

5.3 Fish passage

Measures will need to be included in the detailed design of the flap on the Brislington Brook outfall, the culvert on the open section of the Brislington Brook and the over-pumping when the Brislington Brook cannot discharge under gravity to ensure that fish passage generally and eel/lamprey passage in particular is preserved. There are several standard guides and methodologies for designing such features that will need to be followed during detailed design[15].

Works to Netham Weir sluice gates could also provide opportunity to improve eel passage at this structure, but net positive measures (i.e. those that are not strictly required to avoid a likely significant effect or adverse effect on integrity) more properly belong in the SEA report or other supporting documentation, rather than in the HRA.

[15] http://www.ecrr.org/Publications/tabid/2624/mod/11083/articleType/ArticleView/articleId/3317/Default.aspx
http://www.southampton.ac.uk/engineering/research/projects/fish_passage_upstream_over_gauging_structures.page
http://www.sciencedirect.com/science/article/pii/S092585741630129X

6. Other Plans and Projects

It is a requirement of the Conservation of Habitats & Species Regulations 2010 (as amended) that impacts are not considered wholly in isolation but that any in combination and cumulative effects are identified when the Strategy is considered alongside other projects and plans. In this case, one particularly relevant other project and plan is known: the Shoreline Management Plan for the Severn Estuary.

The Shoreline Management Plan sets coastal defence policy for a wide area including the European designated sites discussed in Section 3. The Shoreline Management Plan has had its own Habitats Regulation Assessment which has been able to conclude either that there will be no adverse effects or that there are "imperative reasons of overriding public interest" (IROPI) and that any adverse effects can be compensated for.

Other relevant plans and strategies in the area include the Severn Estuary Strategy, Bristol City Council Local Plan, and Bristol Central Area Plan. These are discussed in turn below:

- The Severn Estuary Strategy: The TFRMS is likely to work in combination with The Severn Estuary Strategy to reduce the level of flood risk and coastal erosion across the wider region. There is likely to be positive effects for biodiversity, population, health and material assets, soil and water through the delivery of these strategies, and some potential adverse impacts such as coastal squeeze and encroachment impacts on key habitats.
- Bristol City Council Local Plan: The TFRMS complements and supports Bristol City's Local Plan, as there are flood risk issues which exist in some parts of the city which are proposed for future housing delivery, including the city centre.
- Bristol Central Area Plan: The TFRMS is supportive of the Plan's aspirations. Further work should be carried out during EIA work to ensure that any adverse impacts of the delivery of the Strategy are mitigated so that the objectives of the Central area plan are not compromised.

Therefore, provided any defences in the Severn Estuary take appropriate precautions with regard to timing or works and noise mitigation, there would be no in combination effect.

7. Conclusion

Provided the precautionary measures outlined in Section 5 are followed in devising the details of the Strategy and subsequent planning applications, it can be concluded that the Strategy, at this preliminary study level, will not result in a likely significant effect on any European sites either alone or in combination with other projects and plans. No Appropriate Assessment of the preferred option would therefore be required.

This conclusion will need to be reviewed for the HRA(s) of the planning applications, once the precautionary measures outlined in Section 5 have been further developed and incorporated into the Strategy and its construction methodology, in order to confirm the conclusion of no likely significant effect.

Appendix C Outline Preliminary WFD Assessment

The following information provides introduction to the Outline Preliminary WFD Assessment for the River Avon Flood Risk Management Strategy.The Water Framework Directive (WFD) aims to protect and enhance the quality of the water environment across all European Union (EU) member states. It takes a holistic approach to the sustainable management of water by considering the interactions between surface water, groundwater and water-dependent ecosystems.

Under the WFD, surface water body status is classified on the basis of chemical or ecological status or potential, with groundwater bodies classified on the basis of qualitative and quantitative status. The term 'ecological potential' is used as it may be impossible for the water body to achieve good ecological status because of modification for a specific use, such as navigation or flood protection.

River Basin Management Plans (RBMP) are produced for River Basin Districts (RBD), of which the study area lies within the Severn RBD area. Each RBMP produced by EU member states have objectives that water bodies within the RBD must achieve good ecological status or good ecological potential by 2021 or 2027.

To ensure compliance with the WFD, decision makers must consider whether proposals for new developments have the potential to:
• cause a deterioration of a water body from its current status or potential; and/or
• prevent future attainment of good status or potential where not already achieved.

In addition Article 4.9 of the WFD requires that the scheme is consistent with the objectives of other EU environmental legislation. Compliance will be achieved through the undertaking of the Habitats Risk Assessment.
Temporary impacts are not considered to result in deterioration in WFD status; additionally maintenance activities associated with on-going defences are not considered to require WFD assessment at this time. Additional maintenance works defined in future scope or works will require a screening exercise.
Impacts are not considered to constitute deterioration of status of the water body if it:
• is only impacted for a short time period (European Commission guidance does not define 'a short time period' and as such it is assumed as those effects that would not persist for more than half of a RBMP cycle period (less than 3 years));
• recovers within a short time period; and/or
• recovers without the need for any restorative measures.
The River Avon Tidal flood Management Strategy has selected the following preferred option for flood risk management:
- Low Defences during 2015-2030 (Epoch 1) (Entrance Lock, Netham, Bathurst Dam, Totterdown),
- Low Defence with maintenance and additional defences in new locations if required from 2030 to 2065 (Epoch 2) (Cumberland Road and Cumberland Road East, Commercial Road, Clarence Road, Cattle Market Road),
- Upgrade to High Defences from 2065 to 2115 (Epoch 3).

Low Defences
The implementation of Low Defences involves identifying low spots in the existing defences and then raising the existing defence levels or constructing new floodwalls or similar defences (e.g. embankments) in these locations. Low defences represent an adaptive approach to sea level rise and would be constructed with a shorter term design life than high defences.

The potential impacts and mitigation measures to be employed would be similar to those for High defences.

High Defences

The implementation of High Defences involves identifying low spots in the existing defences and then raising the defence crest levels or constructing new floodwalls or similar defences (i.e. embankments) in these locations.

The piling involved for any high defences has the potential to intercept groundwater levels, however there are currently no groundwater SPZ in the scheme area, and no groundwater abstractions close to the River Avon that would be likely to be affected and as such impact to groundwater is scoped out of this WFD assessment. This statement should be reassessed in the future as new groundwater abstraction licences could be granted near the River Avon, within the Triassic Groundwater body that could potentially be impacted by piling.

If the proposed raised or new defence is set back from river water body, then it will not alter the morphological regime or the water quality, and therefore would not require WFD assessment. The impact of flood waters being contained within the water body are considered to be temporary and unlikely to have a significant impact to the water body due to its low frequency. A separate modelling exercise, as part of a review of potential coastal squeeze implications, is recommended to quantify this at a later stage of the Project. Please refer to the HRA and SEA for more information on coastal squeeze. The replacement or raising of existing lock gates would be unlikely to cause any change or deterioration to WFD objectives as the works will be undertaken within the existing footprint of the defence or landwards and would not impact the waterbody.

Detriment Measures

Numerical modelling has found that implementation of the Strategy's main defences, which have been assessed for WFD, would lead to an increased risk of flooding (detriment) in three areas - Netham, Bower Ashton and Bedminster, and therefore detriment mitigation works have been included in The Strategy to resolve the issue. Proposals in these areas are at an early stage of development, and further investigations, design and WFD assessment will be required to confirm and refine proposals. The following information highlights where WFD assessment will be required for these measures:

DM1 Bower Ashton

This proposal involves the raising of the existing bank. It is not considered that this measure would require WFD assessment.

DM2 Totterdown

This involves raising of private defences which have recently been constructed. It is not considered that this measure would require WFD assessment.

DM3 Bedminster

Detriment Mitigation in the form of Property Level Protection is proposed to be installed into approximately seven properties. It is not considered that this measure would require WFD assessment.

DM4 Netham

This involves raising the existing sheet piled defence to prevent overtopping to a height of 10.4 m. This may need a WFD assessment for the River Avon and potentially the Bristol Floating Harbour.

DM5 Netham

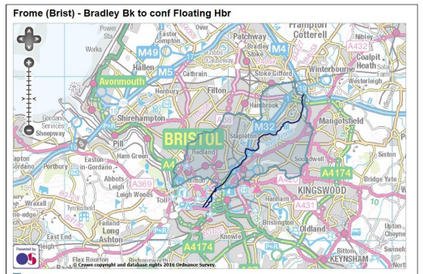
This measure involves the following:

- Flap the Brislington Brook outfall;
- Culvert the open section of Brislington Brook or raise defences around it;
- Provide overpumping when Brislington Brook cannot discharge under gravity; and
- Property Level Protection measures will be installed to a small number of properties.

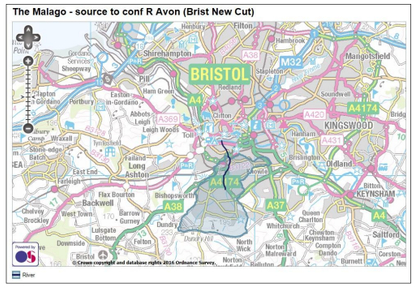
Location, watercourse and NGR (insert two NGRs if linear site)	Outline description of preferred option if known or type of options being considered if preferred option is yet to be defined	Water bodies screened in and why	Waterbodies screened out and why	Baseline data for those waterbodies screened in (From 2015 data provided in EA Catchment Management Tool)	3.1 Preliminary assessment of deterioration	3.2. Assessment of cumulative effects	3.3. Sensitive/critical habitats check	Is the water at Good Ecological Status (GES)/Good Ecological Potential (GEP)	If water body not at GES or GEP will the proposed works prevent GES/GEP being achieved?	3.4 Will the scheme impact on the ability to deliver proposed water body measures? Why/why not?	Mitigation measures to limit impact of scheme	3.5 Can scheme deliver improvement measures to GES/GEP? Why/why not?	Conclusions
Bristol Avon (E:354934 N:175281)	The prefered option would be to install Low defences until 2065 and upgdrade to High Defences during the period 2065 -2115.	Bristol Avon GB530905415405 Work in water body is proposed in preferred option		Bristol Avon Waterbody ID: GB530905415405 Type: Transitional Water Current Status or potential: Moderate (2015) Objective: Good (2021) Hydromorphological designation and use: heavily modified for the use of flood protection , navigation, ports and harbours. Reasons for failing (if failing): N/A Length/area of water body: none provided in catchment tool Protected Areas: Eutrophic sensitive areas, Nitrate vulnerable zones, Horseshoe Bend SSSI, Severn Estuary Ramsar, SAC, Avon Gorge SSSI, Avon Gorge Woodlands SAC Protected Area Objectives: Mitigation measures in place and those not implemented: N/a Ecological: Moderate Biological - High (macroalgae) Hydromorphological Elements: supports-good Hydrological Regime: supports-good Specific Pollutants: High (Iron) Supporting Elements (Surface Water): Moderate (2015) Objectives: Good (2021) Mitigation Measures Assessment: Good Chemical: Good Other Pollutants: does not require assessment Priority hazardous substances: does not require assessment Priority substances: does not require assessment	*Will the scheme cause deterioration to any of the WFD elements at the water body level on a non temporary basis? Need to understand the length/area of water body and how it will be affected by the proposed works.* A potential impact from new piled walls and piling on the hydrological regime cannot be ruled out.	*Consider existing pressures, recent schemes, local knowledge and other planned schemes. Provide details of the sources of information to provide a justification for the conclusion made.* Sheet piling is likely to cause temporary impacts as a result of noise and vibration and scour during construction that could disturb sensitive ecological species and may need mitigation. Piling may mobilise sediment into the water column through piling activities in potentially contaminated areas, further investigation will be required to quantify any mitigation requirements.	*Although the extent of a scheme may be minimal it may fall on critical or sensitive habitats or species in the water body. If the proposed scheme is on habitats that are critical to the individual biological quality elements or on a particularly sensitive habitat then further investigation is required. Critical habitats could be those of unique importance or offering a rare combination of features that are critical to the ecological health of the water body. Sensitive habitats are those which are sensitive to change e.g. internationally designated sites for nature conservation.* The new piled walls are likely to result in a loss of priority habitat of intertidal zone and mudflats. Further WFD assessment will be required, and mitigation to ensure no net loss.	Moderate - Good by 2021	Works are unlikely to prevent good status being achieved for the water body, however further WFD assessment and proposal of mitigation measures will be required for potential localised impacts identified	The scheme will not restrict the ability to deliver waterbody improvements. The scheme is an investment opportunity that could be used to improve aquatic habitats.	Mitigation will be required for loss of habitat. Construction method statements should be used to plan and minimise non-temporary impacts during sheet piling construction. A code of construction practice should be adopted to minimise temporary impacts on waterbodies from mobilisation of contaminated sediments	Overall the nature and scale of the scheme is unlikely to have a significant impact or influence on progress towards WFD GEP, due to the nature and timescales of the project	The scheme is low in impacts in WFD terms, and is designed to improve flood defence for wider social benefits. Further WFD assessment and mitigation will be required to address loss in priority habitats and to identify other mitigation measures required to ensure no non-temporary impacts on status of water body. Suitable mitigation and/or compensation may be required within the water body and this should be planned in close consultation with Natural England, the Environment Agency and other key stakeholders.
Frome (Bristol) (E:361839 N:176158)			Frome (Brist) - Bradley Bk to conf Floating Hbr GB109053027840 Scoped out as no intended development in this water body	Frome (Brist) - Bradley Bk to conf Floating Hbr Waterbody ID: GB109053027840 Type: River Current Status or potential: Moderate (2015) Objective: Good (2027) Hydromorphological designation and use: heavily modified Reasons for failing (if failing): N/A Length/area of water body: 11.75 km Protected Areas: none Protected Area Objectives: n/a Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2021): Good Biological - High (Fish, Invertebrates, Macrophytes) Hydromorphological Elements: Not-high Hydrological Regime: Supports-good Physico-Chemical Elements: Good High (Ammonia, Dissolved Oxygen, pH, temperature), Good (Phosphate) Specific Pollutants: High (Copper, Zinc), Moderate (Triclosan) Objective (2021): Good Supporting Elements (Surface Water): Moderate - Objective (2021): Good Mitigation Measures Assessment: Moderate or less - Objective (2021): Good Chemical: Good Other Pollutants: does not require assessment Priority hazardous substances: Good (Cadmium and its compounds, Di(2-ethylhexyl)phthalate, Nonylphenol, Tributyltin compounds) Priority substances: Good (Lead, Nickel and their compounds)								
The Malago - source to conf R Avon (Bris New Cut) (E:358425 N:170630)			The Malago - source to conf R Avon (Brist New Cut) GB109053021970 Scoped out as no intended development in this water body (developments on the other side of the river)	The Malago - source to conf R Avon (Brist New Cut) Waterbody ID: GB109053021970 Type: River Current Status or potential: Moderate (2014) Objective: Good (2027) Hydromorphological designation and use: heavily modified Reasons for failing (if failing): N/A Length/area of water body: 3.47 km Protected Areas: none Protected Area Objectives: n/a Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2027): Good Biological - Moderate (Invertebrates) Hydromorphological Elements: Supports good Hydrological Regime: Supports-good Mitigation Measures Assessment: Moderate or less - Objective (2027): Good Physico-Chemical Elements: Moderate High (Ammonia, pH, temperature), Good (Dissolved Oxygen), Moderate (Phosphate) Specific Pollutants: High (Triclosan) Supporting Elements (Surface Water): Moderate - Objective (2027): Good Chemical: Good Other Pollutants: does not require assessment Priority hazardous substances: does not require assessment Priority substances: does not require assessment								
Trym - source to conf R Avon (Brist) (E:356310 N:178667)			Trym - source to conf R Avon (Brist) GB109053027530 Scoped out as no intended development in this water body	Trym - source to conf R Avon (Brist) Waterbody ID: GB109053027530 Type: River Current Status or potential: Moderate (2015) Objective: Good (2027) Hydromorphological designation and use: heavily modified Reasons for failing (if failing): N/A Length/area of water body: 7.88 km Protected Areas: none Protected Area Objectives: n/a Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2027): Good Biological - Bad - Moderate (Invertebrates), Bad (Fish). Objective (2027): Moderate Hydromorphological Elements: supports Good Hydrological Regime: Supports-good Physico-Chemical Elements: Moderate - Objective (2021): Good High (Ammonia, Dissolved Oxygen, pH, temperature), Moderate (Phosphate) Specific Pollutants: High (Triclosan) Supporting Elements (Surface Water): Moderate - Objective (2027): Good Mitigation Measures Assessment: Moderate or less - Objective (2027): Good Chemical: Good (2015) Other Pollutants: does not require assessment Priority hazardous substances: does not require assessment Priority substances: does not require assessment								

BRISTOL AVON

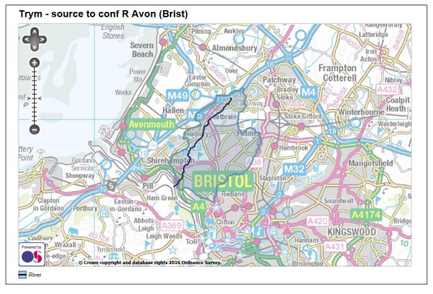
Frome (Brist) - Bradley Bk to conf Floating Hbr



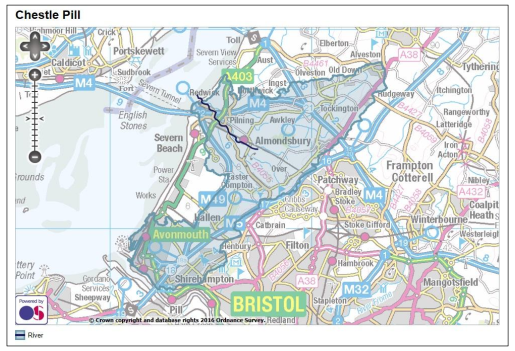
The Malago - source to conf R Avon (Brist New Cut)

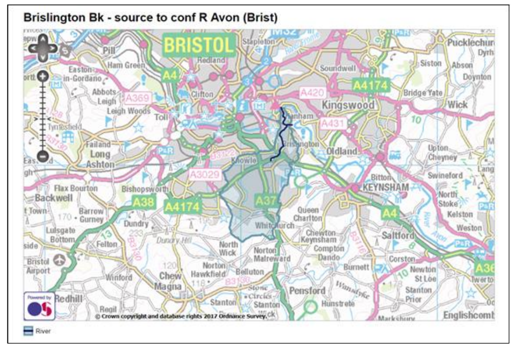


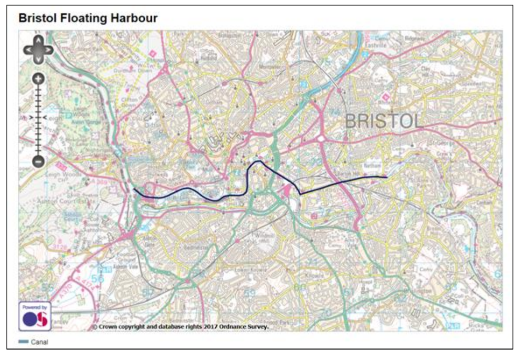
Trym - source to conf R Avon (Brist)

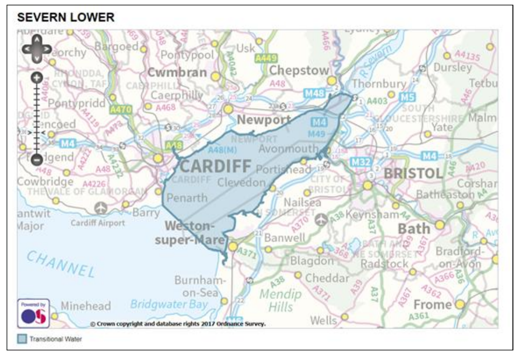


Location, watercourse and NGR (insert two NGRs if linear site)	Outline description of preferred option if known or type of options being considered if preferred option is yet to be defined	Water bodies screened in and why	Waterbodies screened out and why	Baseline data for those waterbodies screened in (From 2015 data provided in EA Catchment Management Tool)	3.1 Preliminary assessment of deterioration	3.2. Assessment of cumulative effects	3.3. Sensitive/critical habitats check	Is the water at Good Ecological Status (GES)/Good Ecological Potential (GEP)	If water body not at GES or GEP will the proposed works prevent GES/GEP being achieved?	3.4 Will the scheme impact on the ability to deliver proposed water body measures? Why/why not?	Mitigation measures to limit impact of scheme	3.5 Can scheme deliver improvement measures to GES/GEP? Why/why not?	Conclusions
Chestle Pill (E:355491 N:185213)			Chestle Pill GB109054026650 Scoped out as no intended development in this water body	Chestle Pill Waterbody ID: GB109054026650 Type: River Current Status or potential: Moderate (2015) Objective: Good (2027) Hydromorphological designation and use: artificial Reasons for failing (if failing): N/A Length/area of water body: 4.43 km Protected Areas: none Protected Area Objectives: n/a Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2027): Good Biological - Poor - Poor (Fish), Moderate (Invertebrates), Good (Macrophytes and Phytobenthos). Objective (2027): Good Hydromorphological Elements: Supports-good Hydrological Regime: Supports-good Physico-Chemical Elements: Moderate - Objective (2027): Moderate High (Ammonia, pH, temperature), Poor (Dissolved Oxygen, Phosphate) Specific Pollutants: Cycle 2 not assessed Supporting Elements (Surface Water): Moderate - Objective (2021): Good Mitigation Measures Assessment: Moderate or Less. Objectives (2021): Good Chemical: Good Other Pollutants: does not require assessment Priority hazardous substances: does not require assessment Priority substances: does not require assessment									
Brislington Bk - source to conf R Avon (Brist) (E:362145 N:171058)			Brislington Bk - source to conf R Avon (Brist) GB109053021980 Scope out for the preferred option for flood risk management. Needs to be scoped in for the detimental measures.	Brislington Brook - source to confluence River Avon (Brist) Waterbody ID: GB109053021980 Type: River Designation: heavily modified Current Status or potential: Overall Water Body - Moderate (2015) Objective: Good (2027) Reasons for failing (if failing): N/A Length/area of water body: 4.045 km Protected Areas:Avon Valley Woodland (LNR), Stockwood Open Space (LNR) Protected Area Objectives: Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2027): Good Biological - Poor - Poor (Invertebrates), Moderate (Macrophytes and Phytobenthos). Objective (2027): Good Hydromorphological Elements: Supports-good Hydrological Regime: Supports-good Physico-Chemical Elements: Moderate - Objective (2027): Good High (Ammonia, pH, temperature, dissolved Oxygen), Poor (Phosphate) Specific Pollutants: Cycle 2 High Triclosan Supporting Elements (Surface Water): Moderate - Objective (2027): Good Mitigation Measures Assessment: Moderate or Less. Objectives (2027): Good Chemical: Good Other Pollutants: does not require assessment Priority hazardous substances: does not require assessment Priority substances: does not require assessment									
Bristol Floating Harbour (E:359188 N: 172636)			Bristol Floating Harbour GB70910601 Scope out for the preferred option for flood risk management. Needs to be scoped in for the detimental measures.	Bristol Floating Harbour Waterbody ID: GB70910601 Type: Canal Designation: heavily modified Current Status or potential: Overall Water Body - Moderate (2015) Objective: Good (2027) Reasons for failing (if failing): N/A Length/area of water body: 6.045 km Protected Areas: None Protected Area Objectives: n/a Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2027): Good Biological - Not assessed Hydromorphological Elements: Not assessed Hydrological Regime: Not assessed Physico-Chemical Elements: Moderate - Objective (2027): Good High (Ammonia, pH, temperature, Dissolved Oxygen), Moderate (Phosphate) Specific Pollutants: Cycle 2 not assessed Supporting Elements (Surface Water): Moderate - Objective (2027): Good Mitigation Measures Assessment: Moderate or Less. Objectives (2027): Good Chemical: Good Other Pollutants: does not require assessment Priority hazardous substances: does not require assessment Priority substances: does not require assessment									
Severn Lower (E:330553 N: 173336)			Severn Lower GB530905415401 Scoped out as significantly downstream from the flood defence work.	Bristol Floating Harbour Waterbody ID: GB530905415401 Type: Transitional Water Designation: heavily modified for the use of flood protection Current Status or potential: Overall Water Body - Moderate (2015) Objective: Good (2027) Reasons for failing (if failing): N/A Length/area of water body: 6.045 km Protected Areas: Severn Estuary SSSI, SPA and Ramsar, Protected Area Objectives: n/a Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2021): Good Biological - Moderate - Moderate (Angiosperms), Good (Fish and Invertebrates), High (Phytoplancton). Objective (2021): Good Hydromorphological Elements: Not assessed Hydrological Regime: Not assessed Physico-Chemical Elements: Good - Objective: N/A High (Dissolved Oxygen), Good (Dissolved organic Nitrogen) Specific Pollutants: Cycle 2 High (Arsenic, Copper, iron, Zinc) Supporting Elements (Surface Water): Moderate - Objective (2021): Good Mitigation Measures Assessment: Moderate or Less. Objectives (2021): Good Chemical: Fail. Objective (2021) : Good Other Pollutants: does not require assessment Priority hazardous substances: Fail - Fail (BDPE, Mercury), Good (Benzo(a)pyrene, Cadmium, Hexachlorobenzene, Hexachlorobutadiene, Nonylphenol) Priority substances: Good - Good (Fluoranthene, Lead, Nickel, Trichloromethane)									



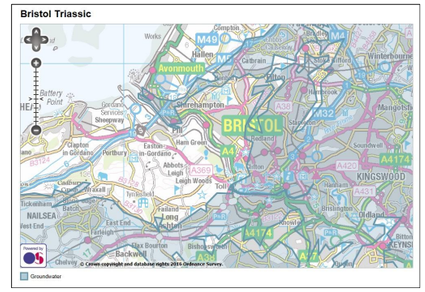




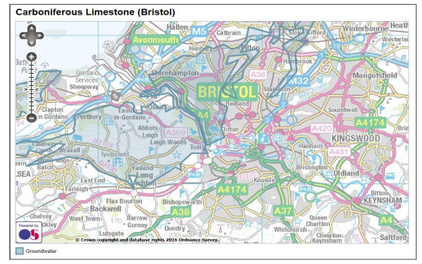


Location, watercourse and NGR (insert two NGRs if linear site)	Outline description of preferred option if known or type of options being considered if preferred option is yet to be defined	Water bodies screened in and why	Waterbodies screened out and why	Baseline data for those waterbodies screened in (From 2015 data provided in EA Catchment Management Tool)	3.1 Preliminary assessment of deterioration	3.2. Assessment of cumulative effects	3.3. Sensitive/critical habitats check	Is the water at Good Ecological Status (GES)/Good Ecological Potential (GEP)	If water body not at GES or GEP will the proposed works prevent GES/GEP being achieved?	3.4 Will the scheme impact on the ability to deliver proposed water body measures? Why/why not?	Mitigation measures to limit impact of scheme	3.5 Can scheme deliver improvement measures to GES/GEP? Why/why not?	Conclusions
Bristol Triassic (E:347438 N:169605)			Bristol Triassic GB40902G804800 Scoped out as there are currently no receptors in this groundwater body	Bristol Triassic Waterbody ID: GB40902G804800 Type: Groundwater Designation: Secondary A and B Current Status or potential: Overall Water Body - Poor (2015) Objective: Good (2027) Reasons for failing (if failing): natural conditions Length/area of water body: Protected Areas: Drinking Water Protection Area (at Risk), Severn Estuary Ramsar, SAC Protected Area Objectives: Mitigation measures in place and those not implemented: N/a Quantitative - Good Dependent Surface Water Body Status - Good GWDTEs test - Good Saline Intrusion - Good Water Balance - Good Chemical (GW) - Poor Dependent Surface Water Body Status - Good Drinking Water Protected Area - Poor - Objective (2027): Good natural conditions recovery time GWDTEs test - Good Saline Intrusion - Good General Chemical Test - Good Groundwater Supporting Elements: Prevent and Limit Objective: Active Trend Assessment: Upward trend									
Carboniferous Limestone (Bristol) (E:352380 N:173645)			Carboniferous Limestone (Bristol) GB40901G806800 Scoped out as no intended development in this water body	Carboniferous Limestone (Bristol) Waterbody ID: GB40901G806800 Type: Groundwater Designation: Principal and Secondary A Current Status or potential: Overall Water Body - Good (2015) Objective: Good (2021) Reasons for failing (if failing): N/A Length/area of water body: Protected Areas: Drinking Water Protection Area (Probably not at Risk), Avon Gorge SSSI, Avon Gorge Woodlands SAC Protected Area Objectives: none Mitigation measures in place and those not implemented: N/a Quantitative - Good Dependent Surface Water Body Status - Good GWDTEs test - Good Saline Intrusion - Good Water Balance - Good Chemical (GW) - Good Dependent Surface Water Body Status - Good Drinking Water Protected Area - Good GWDTEs test - Good Saline Intrusion - Good General Chemical Test - Good Groundwater Supporting Elements: Prevent and Limit Objective: Active Trend Assessment: No-trend									
Portishead Mercia Mudstone (E:352607 N:176081)			Portishead Mercia Mudstone GB40902G805300 Scoped out as no intended development in this water body	Portishead Mercia Mudstone Waterbody ID: GB40902G805300 Type: Groundwater Designation: Secondary B Current Status or potential: Overall Water Body - Good (2015) Objective: Good (2021) Reasons for failing (if failing): N/A Length/area of water body: Protected Areas: Drinking Water Protection Area (Probably not at Risk) Protected Area Objectives: none Mitigation measures in place and those not implemented: N/a Quantitative - Good Dependent Surface Water Body Status - Good GWDTEs test - Good Saline Intrusion - Good Water Balance - Good Chemical (GW) - Good Dependent Surface Water Body Status - Good Drinking Water Protected Area - Good GWDTEs test - Good Saline Intrusion - Good General Chemical Test - Good Groundwater Supporting Elements: Prevent and Limit Objective: Active Trend Assessment: No-trend									

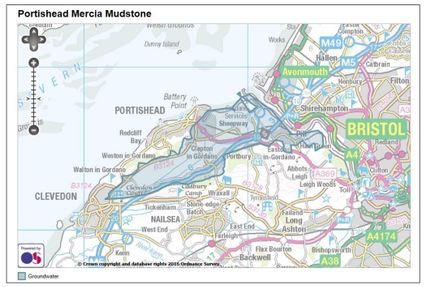
Bristol Triassic



Carboniferous Limestone (Bristol)



Portishead Mercia Mudstone



Water Framework Directive Assessment

Water Body ID	Water Body Type	Water Body Name	River Basin District	Outline Preliminary Assessment Completed
GB530905415405	Transitional Water	Bristol Avon	Severn	Yes
GB109053027840	River	Frome (Brist) - Bradley Bk to conf Floating Hbr	Severn	Screened Out
GB109053021970	River	The Malago - source to conf R Avon (Brist New Cut)	Severn	Screened Out
GB109053027530	River	Trym - source to conf R Avon (Brist)	Severn	Screened Out
GB109054026650	River	Chestle Pill	Severn	Screened Out
GB40902G804800	Groundwater Body	Bristol Triassic	Severn	Screened Out as no receptors
GB40901G806800	Groundwater Body	Carboniferous Limestone (Bristol)	Severn	Screened Out
GB40902G805300	Groundwater Body	Portishead Mercia Mudstone	Severn	Screened Out

Surface Water Assessment Matrix

Effect	Description/criteria	Examples	Outcome
Major beneficial	Impacts that taken on their own or in combination with others have the potential to lead to the improvement in the ecological status or potential of a WFD quality element for the entire waterbody	Creation of significant areas riparian habitats (for example, within a river diversion) which enhance the value of the waterbody.	Increase in status of one or more WFD element giving rise to a predicted rise in status class for that waterbody.
Minor /localised beneficial	Impacts when taken on their own or in combination with others have the potential to lead to a minor localised or temporary improvement that does not affect the overall WFD status of the waterbody or any quality elements	Minor habitat creation measures such as creation of marginal berms up/downstream of a structure.	Localised improvement, no change in status of WFD element
Green (no impact)	No measurable change to any quality elements.	Macrophytes: Clear span bridge which causes light shading Invertebrates: Changes to flow with no likely effect in macroinvertebrate community/contamination in area with highly tolerant invertebrate community (e.g. ASPT <4) Fish: Minor, temporary encroachment.	No change
Yellow - Localised/temporary adverse effect	Impacts when taken on their own or in combination with others have the potential to lead to a minor localised or temporary deterioration that does not affect the overall WFD status of the waterbody or any quality elements. Consideration will be given to habitat creation measures.	Invertebrates: Estimated loss in diversity of invertebrates for e.g. < 100 m of waterbody/or X% of waterbody surface (due to habitat loss, changes to flow etc.) Fish: Localised loss of fish habitat/numbers of fish Macrophytes/phytoplankton: Loss of macrophytes/diatoms due to shading from a bridge or other structure. Temporary loss of invertebrates/macrophytes etc. during channel re-alignment	Localised deterioration, no change in status of WFD element when balanced against mitigation measures embedded in the scheme.
Orange - adverse effect on class of WFD element	Impacts when taken on their own or in combination with others have the potential to lead to the deterioration in the WFD status class of one or more biological quality elements, but not in the overall status of the waterbody. Consideration will be given to habitat creation measures.	Invertebrates: Likely significant drop in invertebrate diversity over e.g. > 300 m or X% of waterbody surface (due to habitat loss/siltation or combination of various impacts etc.) Fish: Obstruction to upstream migration of fish to spawning grounds in a salmonid river therefore affecting fish in whole of WFD waterbody Macrophytes/phytoplankton: Loss of macrophytes/diatoms for a significant length of water due to shading from a long (e.g. > 200 m) culvert or other similar structure	Decrease in status of WFD element when balanced against positive measures embedded in the scheme.
Red – adverse effect on overall WFD class of waterbody	Impacts when taken on their own or in combination with others have the potential to lead to the deterioration in the ecological status or potential of a WFD quality element, which then lead to a deterioration of status/potential of waterbody	Any change in status of an element that leads to an overall deterioration of WFD class of waterbody – this colour is only assigned when the positive benefits from mitigation for that waterbody are outweighed by negative impacts.	Decrease in status of overall WFD waterbody status when balanced against positive measures embedded in the scheme.

Risk screening of potential to cause deterioration of current WFD Ecological status

	Transitional Water	Scheme Elements	Preferred Route Alignment based on Front Alignment Option						Overall impact	Further WFD Assessment or Mitigation (to retain or promote good status)
	GB530905415405	Phase (Construction / Operation)	Construction	Construction	Construction	Construction	Operation	Operation		
	Bristol Avon	Identified quantitative impacts	Noise and vibration from piling	Temporary landtake	Pollution due to discharges	Scour	Permanent landtake for new sheet piled wall	Change to hydraulics		
Hydromorphological	**Hydrological Regime:** Quantity and dynamics of water flow	Predicted change to status elements	No measureable change to element	No measureable change to element anticipated	No measureable change to element anticipated	No measureable change anticipated	No measureable change anticipated	No measureable change anticipated	No significant impact anticipated	None Required
	Hydrological Regime: Connection to groundwater bodies		No measureable change to element	No measureable change to element anticipated	Possible minor impact from piling into groundwater at the foreshore locations, where there is the possibility of mobilising contaminated sediments.	Possible minor impact from piling activities in the Foreshore areas.	New piled walls will have possible minor impacts in the connection of groundwater to surface water at Clarence Road, Commercial Road, Cattle Market Road west and Netham area, but it is unlikely that there would be any significant impact at the waterbody scale. Overall, impacts are considered unlikely but cannot be ruled out at this stage as groundwater levels in the areas are not known.	Possible minor loss of groundwater baseflow. However water quality is expected to be dominated by upstream sandstone catchment. Overall, impacts considered unlikely but cannot be ruled out at this stage.	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage. Further Site Investigation is proposed at the detailed design stage to make sure that the introduction of a sheet piled wall will not prevent groundwater flow towards the River Avon, or increase risk of groundwater flooding from mounding of groundwater behind the wall. If found to exist suitable mitigation will be incorporated into the design to prevent the build up of groundwater behind the new piled structure.
	River Continuity: Migration of aquatic organisms		Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Works to Netham water sluice gates could provide an opportuniy to improve eel passage at this structure and it would benefit waterbodies upstream of Netham.
	River Continuity: Sediment transport		No measureable change to element	There is potential for minor impacts due to changes in local hydraulics and substrate transport at the perimeter of the land take required for construction of river frontage pile walls (Clarence road, Commercial Road, Netham and Cattle Market Road west), but unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	There is potential for scour local to works in the foreshore, but this is unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	No significant impact anticipated at waterbody scale	No significant impact anticipated	None Required
	Morphological conditions: River depth and width variation		No measureable change to element	There is potential for minor impacts due to changes in local hydraulics and substrate transport at the perimeter of the land take required for construction of river frontage pile walls (Clarence road, Commercial Road. Netham and Cattle Market Road west), but unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated	No significant impact anticipated	No significant impact anticipated	None Required
	Morphological conditions: Estuarine depth variation		No measureable change to element anticipated	There is potential for minor impacts due to changes in local hydraulics and substrate transport at the perimeter of the land take required for construction of river frontage pile walls (Clarence road, Commercial Road, Netham and Cattle Market Road west), but unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated	No significant impact anticipated	No significant impact anticipated	None Required
	Morphological conditions: Structure and substrate of the river bed		No measureable change to element anticipated	There is potential for minor impacts due to changes in local hydraulics and substrate transport at the perimeter of the land take required for construction of river frontage pile walls (Clarence road, Commercial Road. Netham and Cattle Market Road west), but unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	There is potential for scour local to works in the foreshore, but this is unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	No significant impact anticipated at waterbody scale	No significant impact anticipated	None Required
	Morphological conditions: Quantity, structure and substrate of the Estuary bed		No measureable change to element anticipated	There is potential for minor impacts due to changes in local hydraulics and substrate transport at the perimeter of the land take required for construction of river frontage pile walls (Clarence road, Commercial Road, Netham and Cattle Market Road west), but unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	There is potential for scour local to works in the foreshore, but this is unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	No significant impact anticipated	No significant impact anticipated	None Required
	Morphological conditions: Structure of the riparian zone/intertidal zone		No measureable change to element anticipated	There is potential for minor impacts due to changes in local hydraulics and substrate transport at the perimeter of the land take required for construction of river frontage pile walls (Clarence road, Commercial Road, Netham and Cattle Market Road west), but unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	There is potential for scour local to works in the foreshore, but this is unlikely to be significant at waterbody scale, and likely to recover naturally	New walls could have the potential for some minor detrimental impacts on the structure of the intertidal zone compared to existing conditions at the Clarence Road, Commercial Road, Cattle Market Road west, and Netham areas. Where new walls are constructed this could result in a loss of intertidal environment, this is unlikely to be significant at the water body scale, however mitigation may be required to ensure no net loss in environment.	No significant impact anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage. The potential loss of intertidal environments will need to be quantified and if required mitigation included to ensure no net loss in priority ecological environments.
	Tidal Regime: Freshwater flow		No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated	No significant impact anticipated at waterbody scale and therefore no measureable change to element anticipated	No significant impact anticipated	No significant impact anticipated	None Required
	Tidal Regime: Wave exposure		No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated	No significant impact anticipated at waterbody scale and therefore no measureable change to element anticipated	No significant impact anticipated at waterbody scale and therefore no measureable change to element anticipated	No significant impact anticipated	None Required
Biological	**Macroalgae and angiosperms**		Insensitive to impact. No measureable change to element anticipated	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel, however overall, impacts are considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage.
	Benthic invertebrate fauna: Composition		Insensitive to impact. No measureable change to element anticipated	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel, however overall, impacts are considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage.
	Benthic invertebrate fauna: Abundance		Insensitive to impact. No measureable change to element anticipated	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel, however overall, impacts are considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage.
	Fish fauna: Species composition and abundance		Possible temporary effects from piling in foreshore area. Mitigation will be needed depending on methodology and timing.	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel, however overall, impacts are considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage.
	Fish fauna: Presence of type-specific disturbance sensitive species		Possible temporary effects from piling in foreshore area. Mitigation will be needed depending on methodology and timing.	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel, however overall, impacts are considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage.
	Fish fauna: Age structure of fish communities		Possible temporary effects from piling in foreshore area. Mitigation will be needed depending on methodology and timing.	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel, however overall, impacts are considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage.
Critical sensitive habitats/species	**Priority habitats and species:** Various species using mudflats		Possible temporary effects from piling in foreshore area.	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel. This is unlikely to be significant at the water body scale, however mitigation may be required to ensure no net loss in environment.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage. The potential loss of intertidal environments will need to be quantified and if required mitigation included to ensure no net loss in priority ecological environments.
	Priority habitats and species: Intertidal mudflat		No measureable change to element anticipated	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel. This is unlikely to be significant at the water body scale, however mitigation may be required to ensure no net loss in environment.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage. The potential loss of intertidal environments will need to be quantified and if required mitigation included to ensure no net loss in priority ecological environments.
Physico-chemical elements	**Dissolved Oxygen**		No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated (impacts mitigated through CoCP and best practice for design, construction and operations). There is the potential that the scheme could result in the mobilisation of sediment into the water column through piling activities in potentially contaminated areas. Contaminants attached to the mobilised sediments could enter the water column and have the potential to impact water quality within the WFD waterbody, impacts are considered unlikely but cannot be ruled out at this stage	No measureable change to element anticipated (no structures in river channel)	Possible impact on surface water run-off (and therefore water quality) into River Avon. Impacts considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No measureable change to element anticipated (no structures in river channel)	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage. Further Site Investigation is proposed at the detailed design stage to clarify the potential for contaminated land in the area of new piling proposed.
	Dissolved Inorganic Nitrogen									
	pH									
	Oxygen balance									
	Acid neutralising capacity									
	Temperature									
	Transparency									
Chemical	**Pollution by all priority hazardous substances identified as being discharged into the water body**									
	Pollution by other priority substances identified as being discharged in significant quantities into the water body									

CEMP: Construction Environmental Management Plan
CoCP: Code of Construction Practice