REVISED

Didcot Garden Town HIF 1 Scheme

Environmental Statement

Volume III

Appendix 14.2: Water Framework Directive (WFD) Assessment

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1. Introduction

1.1 Background

1.1.1 This Water Framework Directive (WFD) Assessment has been prepared by AECOM in support of a planning application and accompanying Environmental Statement (ES) for the Didcot Garden Town Housing Infrastructure Fund (HIF 1) Scheme (hereafter referred to as the 'Scheme').

1.1.2 Oxfordshire County Council (OCC) proposed package of strategic transport improvements are vital elements of Didcot's development as a "Garden Town". The transportation package includes:

- A4130 Widening – The proposed improvement to the A4130 includes dualling widening between Milton Gate eastwards to the proposed Didcot Science Bridge. The proposal also includes the provision of new and improved pedestrian and cycling facilities.
- Didcot Science Bridge – A new road bridge link from the proposed A4130 Widening scheme, over the A4130, Great Western Railway and Milton Road connecting back to the A4130 north of Purchas Road roundabout, including pedestrian and cycling infrastructure.
- Didcot to Culham River Crossing – a new road between Culham near the Science Centre to Didcot's A4130 perimeter road, including pedestrian and cycling infrastructure.
- Clifton Hampden Bypass – a new road between the A415, Abingdon Road, at the Culham Science Centre and B4015, Oxford Road, north of Clifton Hampden village.

1.1.3 A full description of the Scheme can be found in ES Chapter 2: The Scheme.

1.2 The Water Framework Directive

1.2.1 The legislative context for the Water Framework Directive (WFD) is summarised in Section 2: Overview of the Water Framework Directive. The overarching aim of the WFD is to protect and enhance the water environment. Consequently, this WFD assessment is presented as an appendix to ES Chapter 14: Road Drainage and the Water Environment, although it is also of relevance to ES Chapter 9: Biodiversity, and elements of other ES chapters.

1.2.2 This report comprises a full WFD compliance assessment. Sufficient Scheme information, baseline and assessment are presented herein for the WFD to be understood as a standalone report. However, for concise reporting, some details drawn from the respective ES chapters are not repeated. For example, the WFD encompasses water quality, and the outcomes relevant to WFD as presented in ES Chapter 14: Road Drainage and the Water Environment are summarised here without detailed descriptions of analytical methods. Similarly, only key WFD compliance information is repeated from ES Chapter 9: Biodiversity and supporting aquatic ecology report (ES Appendices 9.5).

1.3 The Scheme

1.3.1 The 'Scheme' consists of four highway schemes, namely: i) the A4130 Widening; ii) Didcot Science Bridge; iii) Didcot to Culham River Crossing; and iv) Clifton Hampden Bypass.

1.3.2 An overview of the Scheme and affected water bodies is presented in Annex A.

A4130 Widening

1.3.3 This part of the Scheme comprises a dual carriageway from a point approximately 250 m east of Milton Interchange at the junction with Milton Gate, eastwards for approximately 1.6 km to the proposed eastern roundabouts connecting into the future development at Valley Park and the Science Bridge scheme.

1.3.4 Several new drainage structures are required where the A4130 crosses Meadow Brook, Stert Brook, Cow Brook, and a ditch adjacent to Backhill Lane.

1.3.5 There will also be new balancing ponds that control highway runoff quantity and quality from new highways surfaces before discharging to drainage ditches and watercourses.

Didcot Science Bridge

1.3.6 This section of the Scheme is a new north-south bridge from the proposed Science Bridge roundabout, over the Great Western Mainline Railway, the existing A4130 and Milton Road, into the former Didcot A Power Station site. The proposed Science Bridge Link Road will connect the bridge with the A4130 Northern Perimeter Road north of the Purchas Road/ Hawksworth roundabout, close to the existing Southmead Industrial Estate.

1.3.7 There will be new balancing ponds that control runoff highway quantity and quality from new highways surfaces before discharging to drainage ditches and watercourses.

1.3.8 An existing culvert on Moor Ditch will be replaced with a new, shorter culvert as part of the Scheme.

Didcot to Culham River Crossing

1.3.9 This part of the Scheme includes a new link road between the A4130 at the existing Collett roundabout junction (Didcot) and the A415 at Culham. It includes two new bridges: one over the River Thames and one over the Hanson private railway sidings near Appleford level crossing.

1.3.10 The bridge over the River Thames is central to a new viaduct across the Thames floodplain including an area of ongoing gravel pit restoration to aquatic habitat known as the Hanson Finger Lakes. There will be a small length of culvert at the tie-in of viaduct to ground-level highway.

1.3.11 There will be new balancing ponds that control highway runoff quantity and quality from new highways surfaces before discharging to drainage ditches and watercourses.

Clifton Hampden Bypass

1.3.12 This part of the Scheme will provide a new single carriageway link between the A415 at Culham Science Centre and the B4015 Oxford Road, to the north of Clifton Hampden.

1.3.13 This section of the Scheme does not cross any perennial watercourses but does include several new drainage structures for existing drainage ditches that are typically dry and are not aquatic habitats.

1.3.14 There will be new balancing ponds that control highway runoff quantity and quality from new highways surfaces before discharging to drainage ditches.

2. Overview of the Water Framework Directive

2.1.1 The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, commonly referred to as the Water Framework Directive or the WFD, aims to protect and enhance the water environment.

2.1.2 The WFD takes a holistic approach to sustainable management of the water environment by considering interactions between surface water, groundwater and water-dependent ecosystems. Ecosystem conditions are evaluated according to interactions between classes of biological, chemical, physico-chemical and hydromorphological elements known as 'Quality Elements'.

2.1.3 Under the WFD, 'water bodies' are the basic management units, defined as all or part of a river system or aquifer. Waterbodies form part of a larger 'river basin district' (RBD), for which 'River Basin Management Plans' (RBMPs) are used to summarise baseline conditions and set broad improvement objectives. RBMPs are produced every six years, in accordance with the river basin management planning cycle. The current RBMPs at the date of this assessment are the 2015 Cycle 2 plans. The Cycle 2 plans are due to be updated to Cycle 3 plans, but the latter are not yet available.

2.1.4 In England, the Environment Agency (EA) is the competent authority for implementing the WFD, although many objectives are delivered in partnership with other relevant public bodies and private organisations, for example local planning authorities, water companies, rivers trusts, and private landowners and developers.

2.1.5 The EA is also responsible for managing flood risk and other activities on Main Rivers. Local planning authorities or drainage boards are responsible for consenting certain activities on Ordinary Watercourses. Local planning authorities are responsible for highways drains, and landowners are responsible for ditches and watercourses and piped watercourses and culverts. While the EA is ultimately responsible for the WFD on any water body, local authorities are required to plan and consent WFD related activities on Ordinary Watercourses.

2.1.6 As part of its regulatory and statutory consultee role on planning applications and environmental permitting (under the Environmental Permitting Regulations (England and Wales) 2016), the EA and WFD-partnering organisations, must consider whether proposals for new developments have the potential to:

- Cause a deterioration of any quality element of a water body from its current status or potential; and/ or
- Prevent future attainment of good status or potential where not already achieved.

2.1.7 In determining whether a development is compliant or non-compliant with the WFD objectives for a water body, the EA and partnering organisations must also consider the conservation objectives of any Protected Areas (i.e. Natura 2000 sites or water dependent Sites of Special Scientific Interest) and adjacent WFD water bodies, where relevant.

2.1.8 Regulation 17 of the Water Environment Regulations 2017 (i.e. the WFD) states that, like other public bodies, local authorities have a statutory duty to "*have regard to the River Basin Management Plan"* and *"any supplementary plans"* covering proposed activities when exercising its functions.

2.1.9 Local authorities must therefore reflect water body improvement priorities as outlined in RBMPs. Key local authority functions which can contribute to WFD objectives include:

- Local planning policies;
- Development management and building control functions;
- Green infrastructure plans;
- Highways design;
- Drainage, flood risk management and sustainable drainage system (SuDS) functions; and
- Planning applications.

2.1.10 The EA and OCC must therefore consider whether proposals for the Scheme have potential to:

- Cause deterioration in the ecological status/ potential classification of any water body (e.g. from Moderate to Poor);
- Prevent any waterbody from meeting its future objective of Good ecological status/ potential;
- Cause failure to meet Good groundwater status or result in a deterioration of groundwater status; and
- Prevent the implementation of mitigation measures which define the hydromorphological designation of heavily modified waterbodies.

3. Assessment Methodology

3.1 Approach to WFD

3.1.1 There are no fixed methods for WFD assessment. The nature of the water environment and the breadth of the legislation mean that assessments are tailored to proposals on a case by case basis.

3.1.2 The following general guidance is available which has been applied for this assessment:

- EA (2016a). Water Framework Directive risk assessment. How to assess the risk of your activity (Ref 1).
- EA (2016b). Protecting and improving the water environment. Water Framework Directive compliance of physical works in rivers (Ref 2).
- The Planning Inspectorate (2017). Advice Note eighteen: The Water Framework Directive (Ref 3).

3.1.3 A stepwise approach consisting of Screening, Scoping and Impact assessment stages is generally followed in order to: (a) rationalise the levels of WFD assessment and impact mitigation that are required; and (b) verify that proposals meet the requirements of the WFD. The general approach is described in The Planning Inspectorate (2017). Advice Note eighteen: The Water Framework Directive (Ref 3) and is briefly summarised below.

3.1.4 This report comprises a full WFD assessment, covering elements of all three stages outlined below (i.e. screening, scoping and impact assessment).

Stage 1: Screening

3.1.5 Screening identifies the zone of influence of a proposed development, and if proposed activities pose a risk to the water environment. It is used to identify if there are activities that do not require further consideration for WFD objectives, for example activities which have been ongoing since before the current RBMP plan cycle and which have thus formed part of the baseline.

3.1.6 In this case, the Scheme involves upgrades to existing infrastructure as well as the construction of new infrastructure, so historic watercourse realignments and drainage systems can be screened out of the assessment.

Stage 2: Scoping

3.1.7 Scoping is used to identify any potential impacts of the proposed activities to specific WFD receptors and their water quality elements. This involves review of WFD impact pathways, shortlisting which WFD water bodies and quality elements could or could not be affected by proposed activities, and collecting baseline information from the relevant RBMP on the status and objectives for each water body.

3.1.8 The Scheme has potential to interact with a number of existing highway and drainage land drainage systems, but many of these are dry until activated by rainfall runoff. As such, each watercourse crossing was reviewed at baseline for whether it could support aquatic habitats. Dry ditches were screened out of further assessment as unable to support WFD biological objectives, but were still considered in terms of potential pollution pathways to connecting water bodies.

Stage 3: Impact Assessment

3.1.9 This involves rationalised assessment of water bodies and quality elements that could be affected by proposed activities, to identify any areas of WFD non-compliance. Proposed activities are reviewed in terms of both positive and negative impacts, and the baseline mitigation measures, enhancements, and contributions to the WFD objectives described in the RBMP. Any proposed activities with potentially deleterious impacts are reviewed simultaneously with their corresponding mitigation proposals, to determine a net effect on WFD objectives.

Mitigation Commitment

3.1.10 Proposed mitigation activities relied upon to demonstrate compliance at any of the stages referred to above must be appropriately defined and sufficiently secured. Mitigation could be secured through planning licence conditions, Development Consent Orders (DCOs), or other legally binding methods.

Derogation under Regulation 19 of The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

3.1.11 Where the potential for deterioration of water bodies is identified, and it is not possible to mitigate the impacts to a level where deterioration can be avoided, additional assessment is needed in the context of the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 Regulation 19, which covers procedures for derogation.

3.1.12 A failure to prevent deterioration from high status to good status of a body of surface water is not a breach of the environmental objectives set for it under Regulation 19 if:

- The failure is the result of new sustainable development activities, and
- All practicable steps are taken to mitigate the adverse impact on the status of the waterbody; and
- The reasons for the modifications or alterations, or for the sustainable development activities, are of overriding public interest; or the benefits to the environment and to society of achieving the environmental objectives are outweighed by the benefits of the new modifications or alterations, or of the sustainable development activities, to human health, to the maintenance of human safety, or (in the case of modifications or alterations) to sustainable development; and
- The beneficial objectives served by the modifications or alterations, or by the sustainable development activities, cannot, for reasons of technical feasibility or disproportionate cost, be achieved by other means which are a significantly better option.

3.1.13 There is no evidence at this stage that Regulation 19 will be necessary, and it is not recommended that derogation is viewed as an option for the Scheme.

3.2 WFD Data

3.2.1 Relevant data have been collected from the EA's Catchment Data Explorer[1] and various other online resources, as well as site inspection reports and design reports. Site specific data have also been collected from:

[1] https://environment.data.gov.uk/catchment-planning/. Accessed August 2022

- Scheme designs
- Site visits
- ES chapters
- Ordnance Survey maps
- Aerial photography
- Historic maps
- Geology and soil data
- Defra MAGIC maps

3.3 Low Risk Activities

3.3.1 Certain activities on or near waterbodies are considered low risk by the Environment Agency (2016b) (Ref 2), as summarised in Table 3.1. If the Scheme or components of the Scheme meet the criteria in Table 3.1, they may be screened out of any further assessment.

Table 3-1: WFD Low Risk Activities

Activity	Type of Modification
Low impact maintenance activities (encourage removal of obstructions to fish/ eel passage)	Re-pointing (block work structures)
	Void filling ('solid' structures)
	Re-positioning (rock or rubble or block work structures)
	Replacing elements (not whole structure)
	Re-facing
	Skimming/ covering/ grit blasting
	Cleaning and/or painting of a structure
Temporary works	Temporary scaffolding to enable bridge re-pointing
	Temporary clear span bridge with abutments set-back from bank top
	Temporary coffer dam (if eel/ fish passage not impeded)
	Temporary flow diversion (if fish/ eel passage not impeded) such as flumes and porta-dams
	Repair works to bridge or culvert which do not extend the structure, reduce the cross-section of the river or affect the banks or bed of the river, or reduce conveyance
	Excavation of trial pits of boreholes in byelaw margin
	Structural investigation works of a bridge/ culvert/ flood defence such as intrusive tests, non-intrusive surveys
Bridges	Permanent clear span bridge, with abutments set-back from bank top
	Bridge deck/ parapet replacement/ repair works
	Replacing road surface on a bridge
Service crossing	Service crossing below the riverbed, installed by directional drilling or micro tunnelling if more than 1.5 m below the natural bed line of the river
	Service crossing over a river. This includes those attached to the parapets of a bridge or encapsulated within the bridge's footpath or road
	Replacement, installation or dismantling of service crossing/ high voltage cable over a river
Other structures	Fishing platforms
	Fish/ eel pass on existing structure (where <2% water body length is impacted)
	Cattle drinks
	Mink rafts
	Fencing (if open panel/ chicken wire) in byelaw margin

4. Baseline Assessment

4.1 Overview

4.1.1 WFD data for the water bodies screened in for assessment have been gathered from the EA's Catchment Data Explorer. Additional baseline data have been assessed for local water environment biology, hydromorphology and chemistry/ physico-chemistry. Further baseline detail is also provided in ES Chapter 14: Road Drainage and the Water Environment.

4.2 Study Area

General Site Characteristics

4.2.1 Land use along the route of the Scheme is generally agricultural, and comprises a mixture of arable, sheep and equine pasture. The area is crossed by existing roads including the A4130 and A415, as well as minor roads or lanes.

4.2.2 There are several significant business and industrial parks in the area. To the north of the A4130, The Milton Park development is a prominent feature of the area, including business and industrial units. To the north of Clifton Hampden is the Culham Science Centre (CSC), again featuring business units and research facilities.

4.2.3 The former Didcot A Power Station site will be crossed by the Scheme. The Great Western Railway Line crosses the Scheme in a west to east orientation, adjacent to the A4130. The Cherwell Valley line, which connects Didcot Parkway station to Oxford on a north-south orientation, lies adjacent to the Scheme alignment.

4.2.4 A significant portion of the Didcot to Culham River Crossing route is used for quarrying of materials for, or the production of, cement products. The resulting restoration has created ponds associated with quarrying in the region around Appleford, but these are generally avoided by the Scheme.

4.2.5 The Didcot to Culham River Crossing section of the Scheme crosses areas of infilled land west and south-west of Appleford that are related to the presence of historic landfill sites. The Site also crosses the Sutton Courtenay Landfill licenced waste management facility between Appleford Sidings.

4.2.6 The topography of the study area varies between 60 metres Above Ordnance Datum (mAOD) towards the south, around the A4130 Widening, falling towards the River Thames to 49 mAOD and then increasing again to 53 mAOD to the north of the Scheme (although there are isolated areas with heights up to 58 mAOD). Overall, the study area is generally low-lying and flat.

4.2.7 The Proposed Scheme red line boundary and local watercourses are shown in Figure 4.1.

4.2.8 Reference numbers in Figure 4.1 are aquatic ecology survey locations, which were used as the basis of WFD screening, as described below for each WFD water body.

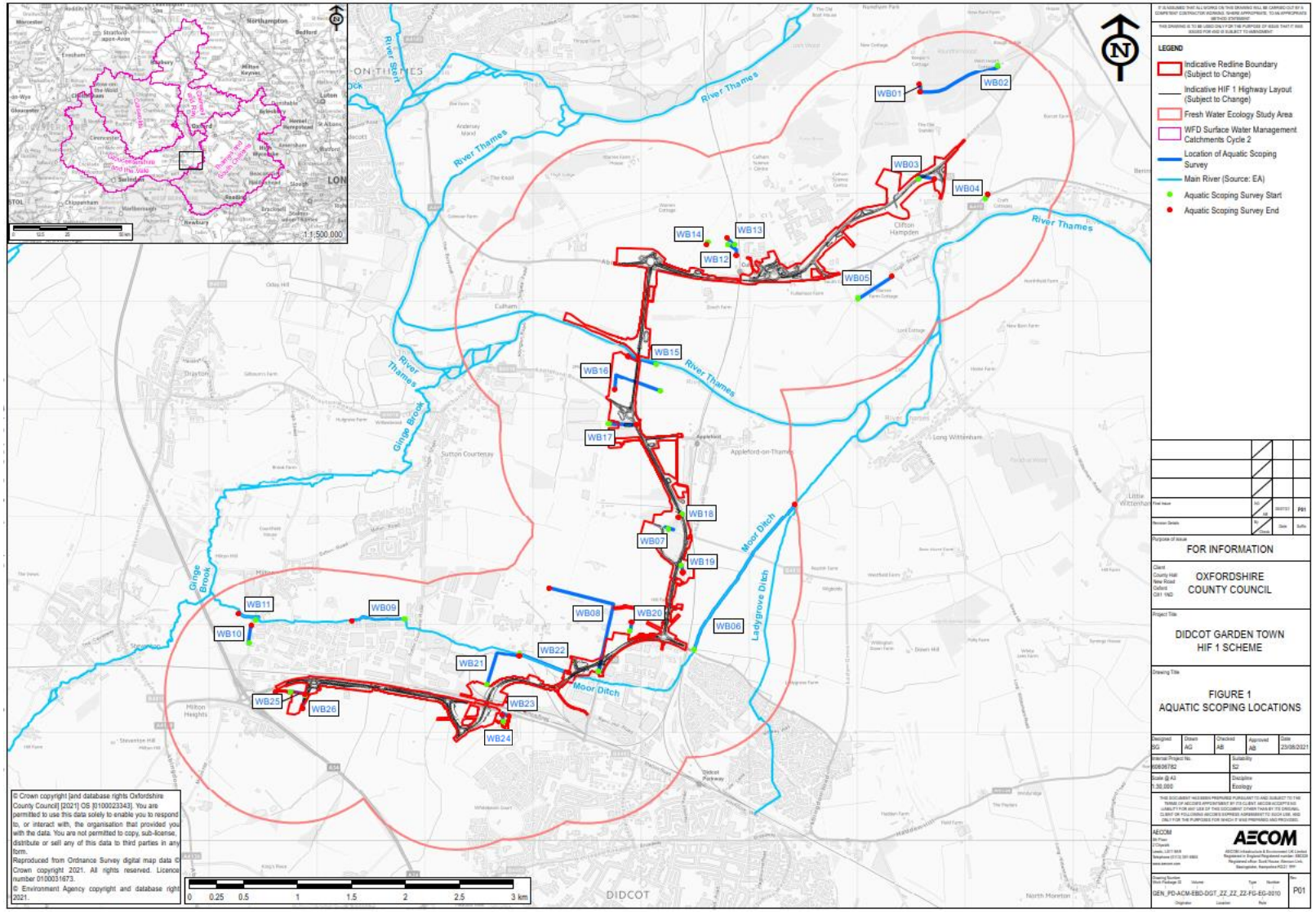


Figure 4.1 Proposed Scheme red line boundary and local watercourses

4.2.9 WFD baseline summaries and assessments presented below are based on hydromorphological walkovers and aquatic ecology surveys. Details of the rationalisation of survey and sampling locations are presented in:

- Environmental Statement Volume III Appendix 4.1: EIA Scoping Report and Scoping Opinion
- Environmental Statement Volume III Appendix 9.1: Preliminary Ecological Appraisal Report
- Environmental Statement Volume III Appendix 9.4: Aquatic Ecology Survey Report

4.2.10 Water quality assessments are also summarised below, the details of which are described in full in:

- Environmental Statement Volume I Chapter 14: Road Drainage and Water Environment
- Environmental Statement Volume III Appendix 14.3: Assessment of Routine Road Runoff and Accidental Spillages

4.3 Moor Ditch and Ladygrove Ditch WFD Water Body (Moor Ditch, Stert Brook and Meadow Brook)

WFD Classification and Proposed Mitigation Measures

4.3.1 Moor Ditch in the study area (see Annex A) is classified as the Moor Ditch and Ladygrove Ditch (GB106039023630) water body. WFD data are summarised in Table 4.1 from the EA's Catchment Data Explorer[2].

Table 4-1: Summary of WFD quality elements for the Moor Ditch and Ladygrove Ditch water body

WFD Parameter	Status/ Summary
Water Body ID	GB106039023630
Water Body Name	Moor Ditch and Ladygrove Ditch
Water Body Type	River
Water Body Length / Area	8.398 km / 26.87 km^2
Hydromorphological Designation	Not designated artificial or heavily modified.
Overall Ecological Status	Poor in 2015 (RBMP cycle 2); Poor in 2019 (most recent data)
Current Overall Status	Poor in 2015 (RBMP cycle 2); Poor in 2019 (most recent data)
Status Objective (overall)	Moderate in 2027 (Disproportionate burdens; no known technical solution is available)
Biological Quality Elements	Poor for Invertebrates and Macrophytes and Phytobenthos in 2015. Macrophytes improving to Moderate in 2019. Invertebrates subject to land drainage pressures associated with agriculture, urban developments and transport and sewage discharges.

[2] https://environment.data.gov.uk/catchment-planning/WaterBody/GB106039030334. Accessed May 2021.

WFD Parameter	Status/ Summary
Physico-chemical Quality Elements	Moderate in 2015 and 2019 due to Phosphates associated with point source pollution from trade and sewage treatment. Other measured elements are Good to High quality conditions.
Hydromorphological Quality Elements	Support Good potential
Chemical	Good in 2015 and Fail in 2019, although this is due to monitoring of priority hazardous substances introduced in 2019 and does not necessarily indicate deterioration. Failing substances are Polybrominated diphenyl ethers (PBDE), Perfluorooctane sulphonate (PFOS) and Mercury.
RBMP Priority Issues for the Ock Operational Catchment	Improve the status of invertebrates and engaging landowners to adjust land management practices to reduce diffuse pollution.

4.3.2 The water body has alternative local names, and several tributaries, which are labelled in the maps comprising Annex A, and summarised as follows:

- Moor Ditch is the main river of the waterbody. In the RBMP, Moor Ditch and Ladygrove Ditch are not differentiated, and combined they originate near Quab Hill before discharging to the River Thames at Long Wittenham. On OS maps, the watercourse is only named Moor Ditch after emerging from a culvert beneath the A4130 and Milton Park Estate in the vicinity of the power station.
- Ladygrove Ditch is a tributary to Moor Ditch, and will not be impacted by the Proposed Scheme, so is not discussed further.
- Stert Brook is the same watercourse as Moor Ditch, but on OS maps the watercourse is named as Stert Brook south of Milton Park Estate and the A4130.
- Cow Brook is a tributary to Moor Ditch, originating near Harwell and flowing north including through culverts beneath the A4130 and Milton Road, before confluencing with Moor Ditch near the power station cooling towers.
- An unnamed ditch at structure A4130_1 appears to be an artificial drain with direct and permanent aquatic connectivity to Moor Ditch, also south of the Milton Park Estate.
- Meadow Brook is a tributary to Moor Ditch, located south of the power station before being culverted beneath the A4130 and recently deculverted and realigned through the redeveloped power station.

4.3.3 The discussion below focusses on Moor Ditch as the primary channel of the waterbody. Local watercourse names are also used in places used to help clarify which parts of Moor Ditch are being assessed. Refer to maps in Annex A.

4.3.4 Specific locations along the route of Proposed Scheme are labelled from WB01 to WB26 in Figure 4.1. These are locations on Moor Ditch, or locations of minor, unnamed drains and ponds.

4.3.5 Each of the labelled features are discussed in turn under headings of WB01, etc, in the section below on Moor Ditch and Adjacent Water Features Aquatic Ecology. First, a general overview of the physical character of the Moor Ditch is summarised in Moor Ditch Hydromorphology.

Moor Ditch Hydromorphology

4.3.6 Moor Ditch is a typical lowland arable watercourse, not designated artificial or heavily modified, but highly modified within the urban study area (Figure 4.2). Locally it is straightened and trapezoidal, over-wide and over-deep due to historic flood management for an urbanised floodplain and has low base flow. There are areas of gravel habitat suitable for fish within Moor Ditch, but within the study area, gravel is sparse due to the channel realignment, numerous culverts and other impoundments, which impact morphological and biotic passage continuity. Water treatment is evident in the form of oil interceptors and trash screens, which reflects locally poor chemical as well as physical habitat quality.

Figure 4.2: Representative photographs of Moor Ditch at the existing culvert

4.3.7 Stert Brook i.e. Moor Ditch south of the A4130, is an arable watercourse, but highly modified and straightened with low base flow and low diversity of aquatic macroinvertebrates and macrophytes, and heavily shaded (Figure 4.3).

Figure 4.3: Representative photographs of Stert Brook south of the A4130

4.3.8 Meadow Brook is a typical lowland watercourse lined with hedgerows (Figure 4.4). Turbidity was high at the time of observation and baseflow was low. Throughout the Site, the brook is highly modified being uniform, straightened and trapezoidal, over-wide and over-deep. The bed was not visible, but is likely to naturally have gravels, although these will be overlain with excess silt deposits.

Figure 4.4: Representative photographs of Meadow Ditch south of the A4130

Moor Ditch and Adjacent Water Features Aquatic Ecology

Overview

4.3.1 The current WFD status of the Moor Ditch and Ladygrove Ditch water body is Poor overall, with Ecological status Poor and Chemical status Fail.

4.3.2 Aquatic habitat networks in the various watercourses comprising the water body are connected, but species movement is restricted between Stert Brook, Moor Ditch and Meadow Brook due to existing culverts. Baseline aquatic ecology surveys (Appendix 9.5 of the ES) found little biodiversity in Stert Brook and Meadow Ditch, but Moor Ditch, the main river of the waterbody, is more species rich.

Stert Brook

4.3.3 Baseline aquatic ecology surveys for the ES (refer to ES Chapter 9: Biodiversity) identified only one scoring species (*Apium nodiflorum*). Invertebrates scored as moderate by Community Conservation Index (CCI), while Percentage of Sediment-sensitive Invertebrates (PSI) score indicated heavy sedimentation in spring, and Lotic-invertebrate Index for Flow Evaluation (LIFE) shows high sensitivity to flow in autumn.

Meadow Brook

4.3.4 Baseline aquatic ecology surveys for the ES identified habitat of limited value (refer to ES Chapter 9: Biodiversity).

Moor Ditch

4.3.5 Baseline aquatic ecology surveys for the ES identified habitat of limited value (refer to ES Chapter 9: Biodiversity).

4.3.6 Aquatic macroinvertebrate indices calculated across the ditch indicate a variety of biological water quality conditions from poor to very good.

4.3.7 Physical habitat in Moor Ditch is low energy, in a straight channel on a low gradient, and with little diversity. The channel has been realigned, over-deepened and culverted in numerous places and, as a result, suffers from areas of fine silt deposition. The entire surveyed stretch consisted of run habitat with no dynamic fluvial processes.

4.3.8 The riparian area throughout the Site was predominantly vegetated with broadleaved trees, scrub and tall ruderal vegetation. Himalayan balsam *Impatiens glandulifera* was recorded at numerous locations along the ditch. Otter spraint was present at several locations and was composed primarily of signal crayfish *Pacifastacus leniusculus* remains, evidence the site supports protected mammal species.

4.3.9 The macrophyte assemblage varied between bad and high WFD status and there was a low diversity of taxa, likely caused by the variation in shading conditions across the ditch.

4.3.10 Bullhead *Cottus gobio* records exist in Moor Ditch and their eDNA has been identified. Bullhead is an Annex II species under the Habitats Directive which means they are a species of Community interest (i.e. endangered, vulnerable, rare or endemic in the European Community) whose conservation requires the designation of special areas of conservation. Bullhead is also a UK Biodiversity Action Plan (BAP) priority species.

4.3.11 White-clawed crayfish *Austropotamobius pallipes* are considered absent from the study area due to the presence of signal crayfish. Signal crayfish were observed in Moor Ditch at several locations.

4.3.12 Invasive Non-Native Species identified during surveys and desk study included Nuttall's waterweed *Elodea nuttallii*, Himalayan balsam, Asian clam *Corbicula fluminea,* Demon shrimp *Dikerogammarus haemobaphes*, Flatworm *Dugesia tigrine*, Caspian mud shrimp *Chelicorophium curvispinum*, signal crayfish, New Zealand pigmyweed *Crassula helmsii* and curly pondweed *Potamogeton crispus*.

WB6

4.3.13 Moor Ditch was surveyed from Ladygrove Bridge for 1.64 km to where a tributary joins the watercourse at NGR SU 53423 93110. Representative photographs are shown in Figure 4.5. This section of Moor Ditch is bordered on the left by grazing pasture and on the right by scrub and arable land. There is a sewage treatment works final effluent discharge point upstream of Ladygrove Bridge.

4.3.14 The watercourse is heavily modified at Ladygrove Bridge where a major bridge crossing and associated bank reinforcement are present The channel has been historically straightened and there is a second road crossing at NGR SU 53021 92641.

Figure 4.5 Representative photographs of Moor Ditch at WB6

4.3.15 The channel width was variable across the surveyed reach, ranging from 1.5 m to 4 m and had an estimated average depth of 0.4 m (maximum 0.6 m). Downstream of the bridge the banks comprised earth and the right bank was higher than the left. Flow was 0.25 – 0.5 m/s with little habitat variability (run was the only habitat present).

4.3.16 The water was slightly turbid at some locations and the substrate was predominantly sand with silt and some exposed gravels. The bank structure was relatively complex with trees, scrub, reeds and broadleaved herbs. There was 2 – 3 m of scrub along the right bank for the entire surveyed reach and intermittent broadleaved trees on the left. There was some erosion on the left bank.

4.3.17 A variety of macrophytes, typical of lowland rivers were present including fool's watercress, sedge Carex sp., submerged reeds, reedmace Typha latifolia and common club rush *Schoenoplectus lacustris*. Macrophytes, overhanging vegetation and woody debris provided instream habitat for fish and macroinvertebrates. Coarse fish of varying sizes were observed along the surveyed reach.

4.3.18 This section of Moor Ditch has the potential to support protected and/or notable species, due to its close proximity with the River Thames.

WB7

4.3.19 WB07 is an artificial lake located on the corner of Appleford Crossing, adjacent to a quarry and landfill site (Figure 4.6). There is no obvious inlet or outlet and no direct connection with Moor Ditch was observed.

4.3.20 The water was very clear and the substrate around the margins was composed of cobbles. The pond was approximately 243 x 157 m. There was a large amount of litter in the pond.

4.3.21 WB07 is bordered by scrub and immature trees with an area of bare gravel where the waterbody was surveyed. There was no visible inlet or outlet. Two invasive non-native species of macrophyte were observed at the site, New Zealand pigmyweed *Crassula helmsii* and Nuttall's waterweed *Elodea nuttallii*.

4.3.22 It is possible that this waterbody could support protected and/or notable species.

Figure 4.6 Representative photographs of an artificial lake near Moor Ditch at WB7

4.3.23 The CCI characterised the aquatic macroinvertebrate assemblage as having moderate (CCI: 12.1 & 13.4) conservation value. One Notable (but not RDB) species of beetle was recorded, *Berosus affinis*. Species from the family Coenagrionidae were recorded in Autumn and Spring/Summer. Species such as *Coenagrion pulchellum* are regarded as nationally rare or notable and are listed in the citation of the Cothill Fen SAC and SSSI. Little Wittenham SAC and SSSI is designated in part for the wide diversity of dragonflies and damselflies, including breeding populations of the brown hawker *Aeshna grandis*, migrant hawker *Aeshna mixta* and emperor dragonfly *Anax imperator*. Species from the family Aeshnidae were recorded in Autumn and Spring/Summer. Emperor dragonfly were recorded in Autumn.

4.3.24 The PSI score was indicative of heavily sedimented conditions (PSI: 1.8 & 1.9). The LIFE score suggests the aquatic macroinvertebrate community had a low sensitivity (LIFE: 5.7 & 5.9) to reduced flow conditions. The community assemblage indicates biological water quality was poor (WHPT ASPT: 4.0 & 4.2).

WB8

4.3.25 WB08 flows clockwise around the power station before joining Moor Ditch at the A4130 (Figure 4.7). At the time of survey, there was no access to the waterbody as it is within the security fence at the power station, however it was visible at some

locations. A 1.25 km section of the watercourse was surveyed from a Public Rights of Way (PRoW) between NGR SU 51601 91567 and SU 51147 92339.

4.3.26 WB09 is a modified channel that has been realigned around the power station. An outfall was visible on the watercourse on the opposite side of the power station. The riparian area was relatively well developed along most of the surveyed reach with broadleaved trees and scrub. There were some areas with uniform, grassy banks as pictured below. It was not possible to collect physicochemical water quality data as the channel was within the security fence of the power station.

4.3.27 It is not possible to comment on the macrophyte assemblage or presence/absence of fish as the watercourse could not be accessed.

4.3.28 It is possible that this watercourse could contain protected and/or notable species.

Figure 4.7 Representative photographs of an unnamed ditch at WB8

WB9

4.3.29 Moor Ditch (WB09) flows east with Milton Park Estate on the right side of the channel and arable land on the left. The riparian area is vegetated with trees and scrub on the left bank for a width of approximately 5 m. A 500 m stretch of Moor Ditch (WB09) was surveyed from a PRoW in Milton Park Estate.

Figure 4.8 Representative photographs of Moor Ditch at WB9

4.3.30 This section of the ditch is heavily modified, with multiple outfalls from the industrial estate located on the right bank. A major bridge has recently been installed with mammal passes on either side. Evidence of habitat management exists either side of the bridge where coir matting has been fixed to the banks to stabilise and encourage growth of riparian vegetation. There was some bank reinforcement in the form of sheet piling on the left bank for approximately 10 m.

4.3.31 The average wetted width was 2 m and maximum width was 6m at the bridge. The average channel depth was 0.25 m with an estimated maximum depth of 0.15 m at the bridge. There was little habitat variability as flow was homogeneous throughout, however features including overhanging vegetation and detritus were present. The substrate was composed of a thick layer of soft silt with a very small area of exposed gravel upstream of the bridge. The gravels may have been deposited as part of mitigation associated with the bridge. Gravel was absent from the rest of the surveyed reach. The banks were relatively steep throughout with the right bank higher than the left, to encourage floodwater into the adjacent field.

4.3.32 Fool's watercress was present in low abundance at an open section of the channel. No fish were observed during the survey.

4.3.33 It is possible that this section of Moor Ditch supports protected and/or notable species.

WB10

4.3.34 WB10 is a roadside drainage ditch that runs parallel to High Street in Milton (Figure 4.9). The waterbody begins at an outfall and runs north-south for approximately 160 m along High Street before joining Moor Ditch at NGR SU 48425 92046. Arable land lies to the west and Milton Estate to the east.

4.3.35 The channel is straightened along the roadside and the channel form is homogeneous throughout. There was no perceptible flow and the water was clear. The average wetted width was 1 m and depth 0.05 m. The substrate was comprised entirely of silt and was covered in leaf litter. The left banktop was vegetated with scrub and the right banktop was a concrete path.

4.3.36 No macrophytes were recorded in the channel and no fish were observed.

4.3.37 It is likely this ditch dries out during warm, dry weather and is not considered suitable habitat for protected and/or notable species

Figure 4.9 Representative photographs of an unnamed ditch Moor Ditch at WB10

WB11

4.3.38 This section of Moor Ditch is upstream of Milton Park Estate. The surveyed reach was approximately 200 m and was located between the A34 and High Street. WB11 flows through grazing pasture, arable fields and land dominated by scrub before passing below High Street.

4.3.39 The section adjacent to High Street is heavily modified with a concrete bank on the left. The rest of the channel was more naturalised with shallow, vegetated banks. There was little habitat variability in the surveyed reach and run was the only habitat type present. The substrate was predominantly soft silt with some gravels overlain with silt. The average wetted width was 2 m (maximum 4 m) and depth was 0.25 m (maximum 0.30 m). Riparian vegetation consisted predominantly of scrub on both banks, with trees scattered along the left bank.

4.3.40 Macrophytes were present throughout the waterbody and included starwort Callitriche sp., fool's watercress, sedge, water forget-me-not *Myosotis scorpioides*, reeds and grasses. No fish were observed during the walkover survey.

4.3.41 This section of Moor Ditch is likely to support protected and/or notable species

Figure 4.10 Representative photographs of an unnamed ditch Moor Ditch at WB11

4.3.42 WB12 to WB17 (cf. Figure 4.1) are located further north due to the order in which they were surveyed as different components of the Proposed Scheme were developed.

WB18

4.3.43 Waterbody 18 is a ponded area of water located next to the railway sidings leading into the Hanson quarry site (Figure 4.11). There is a culvert that opens up from beneath the railway and flows into the pond, it is not known if there is an outlet.

4.3.44 Several macrophytes were observed including duckweed Lemna sp., rush Juncus sp. and reedmace. There were trees growing in the pond, suggesting it periodically dries or the water level is normally much lower. No fish were observed during the survey. The riparian area was composed of broadleaved trees, scrub and semi-improved grassland.

4.3.45 It is possible that this site has could support protected and/or notable species.

Figure 4.11 Representative photographs of a pond near Moor Ditch at WB11

4.3.46 The CCI characterised the aquatic macroinvertebrate assemblage as having low (CCI: 4.3) to moderate (CCI: 9.3) conservation value in spring and autumn respectively. Species from the family Coenagrionidae were recorded in Autumn and Spring/Summer. Species such as *Coenagrion pulchellum* are regarded as nationally rare or notable and are listed in the citation of the Cothill Fen SAC and SSSI. One individual from the Stratiomyidae family was recorded in Autumn. *Stratiomys chamaeleon* is noted under the Cothill Fen SAC and SSSI, which is uncommon and listed in the Red Data Book of Invertebrates.

4.3.47 The PSI score was indicative of heavily sedimented conditions (PSI: 0.0 & 14.3). The LIFE score suggests the aquatic macroinvertebrate community had a low sensitivity (LIFE: 5.8 & 6.0) to reduced flow conditions. The community assemblage indicates biological water quality was moderately impacted (WHPT ASPT: 4.6).

WB19

4.3.48 Waterbody 19 is a large pond located south of Appleford Crossing in a garden (Figure 4.12). The pond was approximately 100 x 50 m. It was not possible to assess the depth or substrate composition however, the margins were predominately silt. Dissolved oxygen was good at 75.3 %.

4.3.49 A number of macrophytes were recorded along the margins and in the water including reedmace, common reed and common club rush *Schoenoplectus lacustris*. No fish were observed during the survey. The riparian area was composed of scattered trees, tall herbs and scrub.

4.3.50 It is possible that this waterbody could support protected and/or notable species.

Figure 4.12 Representative photographs of a pond at WB19

4.3.51 The CCI characterised the aquatic macroinvertebrate assemblage as having moderate (CCI: 8.6) to high (CCI: 18.3) conservation value in spring and autumn respectively. One Notable (not RDB) species of beetle was recorded, *Peltodytes caesus. Peltodytes caesus* is classified as Nationally Scarce (neither Red List nor Near Threatened) which means it occurs in 16-100 hectads in Great Britain. Species from the family Coenagrionidae were recorded in Autumn and Spring/Summer. Species such as *Coenagrion pulchellum* are regarded as nationally rare or notable and are listed in the citation of the Cothill Fen SAC and SSSI. Little Wittenham SAC and SSSI is designated in part for the wide diversity of dragonflies and damselflies, including breeding populations of the brown hawker and migrant hawker. Species from the family Aeshnidae were recorded in Autumn.

4.3.52 The PSI score was indicative of heavily sedimented conditions (PSI: 2.5 & 5.6). The LIFE score suggests the aquatic macroinvertebrate community had a low sensitivity (LIFE: 5.5 & 5.9) to reduced flow conditions. The community assemblage indicates biological water quality was poor, polluted or impacted (WHPT ASPT: 4.0 & 4.2).

WB20

4.3.53 Waterbody 20 is an agricultural drainage ditch located in arable land. A short section approximately 10 m in length held water and the rest of the ditch was dry (Figure 4.13). The waterbody was located within a hedgerow and was heavily shaded. The substrate was composed of earth and was soft.

4.3.54 The CCI characterised the aquatic macroinvertebrate assemblage as having moderate (CCI: 9.0) conservation value. No protected or notable species were recorded.

4.3.55 The PSI score was indicative of slightly sedimented conditions (PSI: 71.4). The LIFE score suggests the aquatic macroinvertebrate community had a low sensitivity (LIFE:

5.0) to reduced flow conditions. The community assemblage indicates biological water quality was poor, polluted or impacted (WHPT ASPT: 4.2).

Figure 4.13 Representative photographs of a ponded ditch at WB20

WB21

4.3.56 Waterbody 21 is a series of ditches located in the Didcot A Power Station land (Figure 4.14). The ditches have been excavated to collect run off from the site during decommissioning. The ditches flow into one main ditch that eventually flows into Moor Ditch at approximate grid reference SU 50874 91719. One of the ditches was visibly turbid, with high levels of sediment. It was not possible to collect water quality readings at this site

4.3.57 There were stands of reedmace and other macrophytes in the largest ditch that flows into Moor Ditch. Vegetation was absent from the smaller waterbodies. No fish were observed during the survey.

4.3.58 It is unlikely this site supports protected and/or notable species due to water quality issues and continued disturbance from the earth works.

Figure 4.14 Representative photographs of ditches at WB21

WB22

4.3.59 This section of Moor Ditch is located within Didcot A Power Station. The waterbody is heavily modified and channelised through the site, with a concrete substrate and left bank (Figure 4.15). The bank profile is steep and high (approximately 5 m on left bank and 7 m on right bank). Sections of the ditch are culverted through the site. The average wetted width was 1.5 m and this was consistent throughout the site. Flow was 0.25 – 0.5 m/s and the water was clear. It was not possible to get water quality readings at the site.

4.3.60 Fool's watercress *Apium nodiflorum* was the only macrophyte observed and there is very limited habitat for fish as the channel is reinforced with concrete and culverts are present either end of the power station. The riparian area was limited to either grass or artificial material.

4.3.61 It is unlikely that this section of Moor Ditch supports any protected and/or notable aquatic species.

Figure 4.15 Representative photographs of a ditch at WB22

WB23

4.3.62 Waterbody 23 (Figure 4.16) is a small area of ditch that receives flow from a balancing pond located in a new housing estate (Great Western Park) south of the A4130. The waterbody exits a culvert under the A4130 where it is open for approximately 0.14 km before continuing under the A4130. The waterbody is parallel to the A4130 and is bordered by parkland to the south. The water was clear and flow was 0.1 – 0.25 m/s.

Figure 4.16 Representative photographs of a ditch at WB23

4.3.63 Reedmace, fool's watercress, willowherb Epilobium sp. and rush Juncus sp. were present throughout the channel, covering 90 % of the water. No fish were observed during the survey.

4.3.64 It is considered unlikely the site supports protected and/or notable species.

WB24

4.3.65 WB24, located at SU 50644 90985 is a balancing pond, assumed to discharge through a culvert beneath the A4130 and Milton Road and into Meadow Brook. There is no ecological connectivity with Meadow Brook, it is unlikely the site supports protected and/or notable species.

WB25

4.3.66 WB25, located at SU 48813 91369 is a small ditch, heavily overgrown to the extent that it could not be photographed.

4.3.67 The CCI characterised the aquatic macroinvertebrate assemblage as having low (CCI: 4.5) conservation value. No protected or notable species were recorded.

4.3.68 The PSI score was indicative of heavily sedimented conditions (PSI: 7.1). The LIFE score suggests the aquatic macroinvertebrate community had a low sensitivity (LIFE: 4.8) to reduced flows. The community assemblage indicates biological water quality was very poor (WHPT ASPT: 2.6).

WB26

4.3.69 WB26, located at Backhill Lane (SU 48875 91284) is a small ditch, heavily overgrown to the extent that it could not be photographed.

4.3.70 The CCI characterised the aquatic macroinvertebrate assemblage as having fairly high (CCI: 10.5) conservation value. No protected or notable species were recorded.

4.3.71 The PSI score was indicative of sedimented conditions (PSI: 28.6). The LIFE score suggests the aquatic macroinvertebrate community had a moderate sensitivity (LIFE: 6.6) to reduced flows. The community assemblage indicates biological water quality was poor, polluted or impacted (WHPT ASPT: 3.9).

Moor Ditch and Ladygrove Ditch Water Body Water Quality

4.3.72 A programme of water quality sampling was undertaken to inform the baseline, and included sampling locations on Moor Ditch, Meadow Brook and Stert Brook. The aim of the sampling was primarily to provide data to enable the assessment of routine road runoff and accidental spillages (HEWRAT and M-BAT analysis) to be undertaken (see Appendix 14.3). As such, the determinands focused on dissolved metals, dissolved calcium, pH, dissolved organic carbon (DOC) and total hardness. Site visits were undertaken on 3rd June 2020, 7th July 2020, 3rd August 2020 and 7th September 2020. Results are presented in Table 4-2.

4.3.73 The data shows that all of the watercourses monitored were slightly alkaline and across the monitored sites total hardness ranged between 275 and 403 mg$CaCO_3$/l, with Stert Brook having the highest average total hardness over the four visits (338.7 mg$CaCO_3$/l). Stert Brook had the highest DOC with a mean of 6.71 mg/l. Meadow Brook had the lowest DOC with a mean of 3.12 mg/l. Dissolved metals are generally low, however dissolved copper was somewhat elevated at all of the sites, with mean values ranging between 2.95µg/l in Stert Brook to 4.05µg/l in Moor Ditch.

4.3.74 The EA's Water Quality Archive website[3] also contains surface water quality data for the Moor Ditch. Summary water quality data for the years 2009 – 2019 is presented in ES Appendix 14.5: Water Quality Data Tables. Samples on Moor Ditch are regularly taken above Didcot Sewage Treatment Works (STW) (NGR: SU 51599 91495) and at the B4016 in Appleford (NGR: SU 53032 92646).

4.3.75 Above the STW, the data indicated Moor Ditch to be slightly alkaline and well oxygenated. Concentration of nitrates and phosphate are lower than expected considering the main land use is agriculture although still somewhat elevated. Data from prior to 2008 showed elevated metal concentrations (e.g. copper and zinc).

4.3.76 Downstream of the STW and Southmead industrial estate at Appleford, the water quality appears to deteriorate, with increased concentrations of nitrogen compounds, which are in more than double the concentration of those measured upstream. Concentrations of phosphorus are also higher, while levels of oxygen are slightly less. The concentration of copper and zinc are high with 10th percentile values of 2.74µg/l and 8.33µg/l, respectively. For a full summary of the data refer to ES Appendix 14.5: Water Quality Data Tables.

[3] https://environment.data.gov.uk/water-quality/view/landing. Accessed July 2022.

Table 4-2: Results of water quality sampling on the Moor Ditch and Ladygrove Ditch WFD waterbody

Determinand	Units	Limit of Detection	WFD EQS	Moor Ditch (SU 48760 92010)			Stert Brook (SU 49480 91430)			Meadow Brook (SU 50910 64160)		
				Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
pH	pH Units	N/A		8.1	8.90	8.33	8.2	8.4	8.25	8.2	8.4	8.27
DOC	mg/l	0.1		2.59	2.59	3.65	4.9	7.65	6.71	2.59	3.47	3.12
Hardness - Total	$mgCaCO^3/l$	1		275	275	291.33	306	369	338.67	310	403	356.5
Arsenic (dissolved)	µg/l	0.15	50 (long term average)	1.72	2.3	2.07	4.72	6.57	5.70	2.74	3.47	3.105
Cadmium (dissolved)	µg/l	0.02	0.25*	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Calcium (dissolved)	mg/l	0.012		88	120	109.50	110	140	130	120	160	143.33
Chromium (dissolved)	µg/l	0.2	3.4 (long term mean)	<0.2	0.3	0.30	0.3	0.4	0.35	<0.2	<0.2	<0.2
Copper (dissolved)	µg/l	0.5	1 (bioavailable – long term mean)	2.9	5.5	4.05	2.1	4.4	2.95	2.2	5.1	3.33
Lead (dissolved)	µg/l	0.2		<0.2	<0.2	<0.2	0.3	0.9	0.53	0.5	0.5	0.5
Magnesium (dissolved)	mg/l	0.005		3	13	5.65	3.7	5.4	4.6	3.8	4.6	4.2
Mercury (dissolved)	µg/l	0.05	0.07**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel (dissolved)	µg/l	0.5	4*	1	2.2	1.375	2.9	6	4.1	1.6	2.5	2
Selenium (dissolved)	µg/l	0.6		0.6	0.7	0.65	0.7	0.9	0.77	0.8	1.1	0.93
Zinc (dissolved)	µg/l	0.5	10.9 + ambient for the catchment (bioavailable) *	1.8	2.1	2	1	6.9	2.75	1.4	3.6	2.67

*AA = Annual Average (AA) EQS, **MAC = Maximum Allowable Concentration (MAC) EQS

4.4 Thames (Evenlode to Thame) WFD Water Body (River Thames)

WFD Classification and Proposed Mitigation Measures

4.4.1 The River Thames in the study area is the Thames (Evenlode to Thames) (GB106039030334) water body of the Thames RBMP. WFD data in Table 4-3 are summarised from the EA's Catchment Data Explorer[4].

4.4.2 The connecting waterbody downstream is Thames Wallingford to Caversham (GB106039030331) which is approximately 5 km downstream of the Scheme.

Table 4-3: Summary of WFD quality elements for the River Thames (Thames (Evenlode to Thame)) water body

WFD Parameter	Status/ Summary
Water Body ID	GB106039030334
Water Body Name	Thames (Evenlode to Thame)
Water Body Type	River
Water Body Length / Area	63.863 km/ 14.959 km^2
Hydromorphological Designation	Not designated artificial or heavily modified
Overall Ecological Status	Moderate in 2015 (RBMP cycle 2); Moderate in 2019 (most recent data)
Current Overall Status	Moderate in 2015 (RBMP cycle 2); Moderate in 2019 (most recent data)
Status Objective (overall)	Moderate in 2015 (Unfavourable balance of costs and benefits; disproportionate burdens; no known technical solution is available)
Biological Quality Elements	Moderate due to invertebrates and fish in 2015. Monitoring data suggests an improvement in fish to Good in 2019. Suspected presence of North American Signal Crayfish - an invasive non-native species is preventing invertebrates from being considered Good.
Physico-chemical Quality Elements	Moderate in 2015 and 2019, due to Phosphates associated with point source pollution from continuous sewage discharge and diffuse source pollution from poor nutrient management and poor livestock management. High quality conditions for other measured variables.
Hydromorphological Quality Elements	Supports Good
Chemical	Fail in 2015 and 2019 due to three priority hazardous substances; Polybrominated diphenyl ethers (PBDE), Perfluorooctane sulphonate (PFOS), and Mercury (Fail).
RBMP Priority Issues for the Ock Operational Catchment	Improve the status of invertebrates and engaging landowners to adjust land management practices to reduce diffuse pollution.

[4] https://environment.data.gov.uk/catchment-planning/WaterBody/GB106039030334. Accessed May 2021.

Thames Local Hydromorphology

4.4.3 At the proposed location of the Scheme crossing the River Thames occupies a single thread channel of approximately 40 m width (Figure 4.17). The channel has been realigned historically over several kilometres, is impounded and regulated for navigation. This results in a low energy almost laminar flow, with little of the flow dynamics that would otherwise be present in a well-developed floodplain river. According to the National River Flow Archive website (accessed March 2021) it has a Q95 flow (i.e. flow that is exceeded 95% of the time) of 2.5 m^3/s. The River Thames is well connected to its floodplain, although channel modifications suggested lower connectivity than would occur naturally. Water depths meant that the bed was not visible, but no riffles, pools or point bars were evident due to the navigation impoundment. Silt appears excessive in the modified flow regime and due to catchment land uses.

Figure 4.17: River Thames at the proposed Scheme crossing

Thames Local Aquatic Ecology

4.4.4 The surveyed stretch of the River Thames was generally unmodified and in a semi-natural condition. The character of the river was similar either side of the Scheme crossing point and the river had a well-developed riparian area with mature willow and alder trees for most of the surveyed stretch. There were overhanging boughs along the river margins, providing habitat diversity and allochthonous inputs to the river.

4.4.5 The current WFD status of the River Thames (Evenlode to Thame) is Moderate overall, with Ecological status Moderate and Chemical status Fail. The aquatic macroinvertebrate community was characteristic of moderate to good biological water quality across summer and autumn.

4.4.6 European eel is known to be present in the River Thames, which is a species of principal importance. Brown trout is also recorded in the River Thames and likely to be present in the study area.

4.4.7 Three aquatic macroinvertebrates, (refer to ES Chapter 9: Biodiversity) species of conservation interest (although not protected) were recorded: trumpet ramshorn snail and two species of water scavenger beetle (*Berosus affinis* and *Peltodytes caesus)*. These species are Notable (not RDB) under the CCI. *Peltodytes caesus* is classified as Nationally Scarce. White-clawed crayfish *Austropotamobius pallipes* are considered absent from the study area due to the presence of signal crayfish.

4.4.8 No wetland plant or aquatic macrophyte species were recorded that are afforded statutory protection.

4.4.9 INNS identified during surveys and desk study included Nuttall's waterweed, Himalayan balsam, Asian clam, Demon shrimp, Flatworm *Dugesia tigrine*, Caspian mud shrimp, signal crayfish, New Zealand pigmyweed and curly pondweed.

4.4.10 WB01 to WB02 (cf. Figure 4.1) are located outside of the Proposed Scheme boundary in Roundhill Wood north of Clifton Hampden. Both are up-gradient and upstream of the Proposed Scheme and therefore are not considered to be at risk and have not been assessed further.

WB03

4.4.11 WB03 is an agricultural drainage ditch (Figure 4.18) located in arable land to the south of Roundhill Wood. WB03 flows east from NGR SU 54571 96130 before flowing through a culvert and diverting south along a field boundary at NGR SU 54719 91630. Only the eastwest section of the ditch could be accessed from a PRoW where a 140m section of the watercourse was surveyed.

4.4.12 WB03 was dry at the uppermost section and where water was present it was very shallow (average depth of 0.05 m, maximum 0.07 m). The water was not deep enough to collect physico-chemical water quality readings. There was very little flow in the eastwest section of the ditch and the substrate was composed of earth. Flow increased in the north-south section where exposed gravels were present. The banks were very steep (80-90°) and were moderately diverse with trees, grasses and scrub. The average flow was estimated at less than 0.10 m/s.

4.4.13 Terrestrial vegetation (willowherb Epilobium sp., brambles, willow Salix sp., and oak Quercus sp.) was choking the east-west channel and heavily shading the water. Broadleaved trees and scrub bordered the north-south channel and the bankface was bare in places.

4.4.14 Aquatic macrophytes were absent from the channel, suggesting the ditch dries out during period of dry weather. No fish were observed.

4.4.15 WB03 is unlikely to support protected and/or notable aquatic species.

Figure 4.18: Ditch in the River Thames catchment area near the Proposed Scheme crossing

WB04

4.4.16 WB04 is a tributary of the River Thames and could only be accessed along the A415 where is passes beneath the road in a culvert (Figure 4.19). Upstream of the survey site the land is predominantly arable and downstream it flows through a small area of woodland before entering the River Thames approximately 200 m downstream.

4.4.17 This section of the waterbody is heavily modified with concrete reinforcement on the left-hand bank where it enters the culvert. The substrate comprised earth, gravel and silt with estimated average flows of 0.10 – 0.25 m/s upstream of the culvert and less than 0.10 m/s downstream where the channel widens. The average wetted width was 1 m and channel depth was 0.10 m.

4.4.18 Terrestrial vegetation (grasses, nettles and ivy Hedera sp.) was growing in the channel downstream of the culvert, suggesting the channel is dry for sustained periods. No aquatic macrophytes or fish were observed during the walkover.

4.4.19 It is not possible to comment on the quality of aquatic habitats in WB04 as access was limited. It is considered unlikely that this waterbody could support protected and/or notable species.

Figure 4.19: Local (partly dry) tributary to the River Thames near the Proposed Scheme

WB05

4.4.20 WB05 is a roadside drainage ditch that flows along a farm track, south of the A415. The ditch flows east-west before joining an unnamed tributary of the River Thames. A 400 m section of the ditch was surveyed from a PRoW. WB05 had an average wetted width of 1 m (maximum 3.5 m) and depth of 0.15 m (maximum 0.50 m). The channel became wider towards the end of the surveyed reach and the habitat changed from a run to having no perceptible flow. The water was slightly turbid and the substrate was predominantly soft silt with a small amount of gravel. The banks were steep and generally covered with scrub. There was a hedgerow running along the left bank which had recently been cut back and there was one minor pedestrian bridge crossing. The average flow was estimated at less than 0.10 m/s.

4.4.21 Several species of macrophyte were present including fool's watercress *Apium nodiflorum*, brooklime *Veronica beccabunga* and gypsywort *Lycopus europaeus*. Overall macrophyte cover was approximately 15 % of the surveyed reach and overhanging riparian vegetation was present for approximately 30 %. Detritus was abundant and there was some woody debris. No fish were observed during the walkover survey.

4.4.22 It is possible this waterbody supports protected and/or notable species.

Figure 4.20: Ditch in the River Thames catchment area near the Proposed Scheme

4.4.23 WB12, WB13 and WB14 (cf. Figure 4.1) were visited in the course of baseline surveys, but lie outside the Proposed Scheme red line boundary, and have no visible connectivity to the River Thames or its tributaries, so have not been assessed further.

WB15

4.4.24 This section of the River Thames is north of Appleford Road at the crossing point of the proposed Scheme (Figure 4.21). The adjacent land is used for arable crops and the Thames path runs along the northern side of the river. The average wetted width was 20 m and glide was the predominant habitat type. It was not possible to estimate depth or substrate composition. The Thames is well connected to its floodplain in this location and a series of wetlands exist to the south

4.4.25 No macrophytes or fish were observed during the survey. The riparian area was covered with scattered broadleaved trees, scrub and grasses.

4.4.26 There are recent desk study records of protected fish (European eel and brown/sea trout) in the River Thames located close to the survey location.

Figure 4.21: River Thames at the proposed Scheme crossing

WB16

4.4.27 Waterbody 16 is a wetland area (Figure 4.22) to the south of the River Thames and lies within the floodplain. The area is part of the restoration plan for the Hanson quarry site. At the time of survey, it was evident restoration works were still underway. The area is not directly connected to the River Thames, and is presumably supplied from subsurface groundwater connectivity, although a large fluvial event could also inundate the area. The surrounding land was semi-improved grassland with some scrub and shrubs around the margins of the waterbody. It was not possible to access the water to collect water quality readings.

4.4.28 There were some reeds present in the waterbody and large flocks of birds were observed around the wetland area. It likely that this site could support protected and/or notable species, but in WFD terms, being an artificial gravel pit in the River Thames floodplain, it has no ecological connection to the River Thames watercourse.

Figure 4.22: Flooded gravel pits next to the River Thames near the proposed Scheme crossing

WB16

4.4.29 Waterbody 16 is a fish pond located at SU 52398 93544 adjacent to Appleford railway station. It is an artificial gravel pit some 500m from the River Thames, presumably supplied by groundwater, with no open channel connectivity to the Thames.

4.5 Groundwater (Vale of White Horse Chalk Groundwater Body)

4.5.1 The nearest part of the nearest groundwater body, the Vale of White Horse District Council Chalk Groundwater Body GB40601G60100, is to the south of the A4130, and does not underly the Scheme. The waterbody is at Poor Status, with Poor Chemical status and Good GW Quantitative Status elements respectively. Local groundwater conditions are summarised below, suggesting limited connectivity to the WFD groundwater body.

4.5.2 **A4130 Widening:** The superficial geology in the study area comprises mostly secondary undifferentiated head deposits, although there is also some Secondary A (Alluvium) to the north. The bedrock geology comprises mostly of the Gault Formation, which is designated as unproductive strata.

4.5.3 **Didcot Science Bridge:** There are two members of the secondary A aquifer separated by the secondary undifferentiated head deposits near the power station. The Summertown-Radley sand and gravel are located to the west of the power station and to the east is the Wolvercote sand and gravel. The bedrock geology comprises of mostly the Gault Formation, which is designated as unproductive strata.

4.5.4 **Didcot to Culham River Crossing:** The superficial geology in the study area comprises secondary A deposits with predominantly Northmoor Sand and Gravel Member Lower Facet, although there is also some Wolvercote sand and gravel member towards the south and Alluvium along the River Thames. The bedrock geology comprises mostly of the Gault Formation, which is designated as unproductive strata, with some Lower Greensand Formation which is designated as a Secondary A aquifer towards the A415 to the north of the crossing. The groundwater vulnerability is described as a minor aquifer with medium vulnerability in most areas, however vulnerability increases to high around the River Thames.

4.5.5 This part of the Scheme will pass across ground modified by anthropogenic activities associated with historic landfilling west and south-west of Appleford. There is a risk that this ground may be contaminated and contain landfill leachate. The surrounding superficial geology (permeable sands and gravels) could therefore, in theory, facilitate horizontal and vertical migration of leachate into the nearby waterbodies. This is assessed in Section 5.2 (Stage 1: Water Bodies Screened Out; Groundwater Bodies and Groundwater – Surface Water Connectivity).

4.5.6 **Clifton Hampden Bypass:** The superficial geology in the study area comprises secondary A deposits with Summertown-Radley sand and gravel member. The bedrock geology comprises of the Lower Greensand Group which is designated as a Secondary A aquifer. The groundwater vulnerability in the area is described as a minor aquifer with medium vulnerability in most areas, however vulnerability increases to high to the north of the A415 and around the River Thames.

4.5.7 The superficial deposits present in the study area are Secondary Aquifers. Lower Greensand Formation aquifers at the Didcot to Culham River Crossing and the Clifton Hampden Bypass are associated with alluvial and terrace gravel deposits. These are permeable layers with a moderate to high primary permeability, capable of supporting water supplies and minor channel habitats at a local rather than strategic scale.

4.5.8 Secondary (undifferentiated) aquifers are associated with the head deposits present across the study area. These aquifers are defined where it has not been possible to provide an A or B category, but groundwater – surface water connectivity is likely to be limited.

4.5.9 There are no groundwater Source Protection Zones in the study area and no groundwater abstractions have been identified within 1km of the site. The site is however, located within a Nitrate Vulnerable Zone.

5. Stage 1 Screening and Stage 2 Scoping Assessment

5.1 Stage 1: Water Bodies Screened In

5.1.1 The Scheme crosses several WFD surface water bodies, which are therefore screened into this WFD assessment. Local watercourse names for the WFD water bodies are summarised in Table 5.1.

Table 5-1: WFD water bodies crossed by The Scheme

Local Watercourse Name	WFD Water Body Name	WFD Operational Catchment	WFD Management Catchment	WFD River Basin District	WFD River Basin Management Plan
Meadow Brook	Moor Ditch and Ladygrove Ditch	Ock	Gloucestershire and the Vale	Thames	Thames
Stert Brook					
Cow Brook					
Moor Ditch					
A4130 Southern Ditch					
Ditch Adjacent to Backhill Lane					
River Thames	Thames (Evenlode to Thame)				

5.2 Stage 1: Water Bodies Screened Out

Surface Water Bodies

5.2.1 The Scheme crosses an area of permanent aquatic habitat in the River Thames floodplain known as the Hanson finger lakes, which is the subject of ongoing aquatic and terrestrial habitat restoration by Hanson Aggregates. In the Thames RBMP, the Hanson finger lakes are not classified as WFD lakes, and therefore they are not assessed in this WFD assessment.

5.2.2 It is emphasised that the Scheme places high value on the Hanson finger lakes, which are classified as Habitat of Principal Importance of Eutrophic Standing Water (refer to ES Chapter 9: Biodiversity). The area is subject to detailed impact and mitigation planning in accordance with the ecological and biodiversity objectives of the Scheme. This includes integration of Hanson Aggregates' ongoing restoration plans with the effects of the Scheme, and ongoing consultation between Hanson Aggregates, OCC, AECOM, the EA and Natural England. This is being delivered through habitats, ecology and biodiversity legislation rather than the WFD.

5.2.3 The Scheme affects several other small ponds in the southerly River Thames floodplain that are not WFD lakes and therefore screened out of this assessment. These are also managed for the Scheme under habitats, ecology and biodiversity legislation.

5.2.4 The Scheme crosses numerous surface drainage ditches, including those parallel to the existing A4130, and numerous ditches crossed by the route of the Clifton Hampden Bypass. These ditches are artificial features that are typically dry and are not aquatic habitats, so they are also screened out of the assessment.

5.2.5 In summary, and with reference to the aquatic ecology sampling locations shown in Figure 4.1, the ponds and dry or ephemeral watercourses and ditches that are within the vicinity of the Proposed Scheme, but have been screened out of WFD assessment, are summarised in Table 5-2. Perennial waterbodies that are screened in to WFD assessment are also listed.

5.2.6 Additionally, the following potential WFD impact pathways to connecting water bodies have been screened out of the assessment as follows:

- Ginge Brook and Mill Brook (GB106039023660) are tributaries of the River Thames that flow from the confluence (SU 4792 9870) of Mill Brook (an Ordinary Watercourse) and Ginge Brook (a Main River). These waterbodies are scoped out because they are upstream of the proposed River Thames crossings.
- An unnamed watercourse upstream of Moor Ditch to the east of the railway line has been scoped out of the assessment since it will not be impacted by the alignment of the Scheme.
- Several Ordinary Watercourses to the south of Long Wittenham have been scoped out as they are not crossed by the Scheme. The Scheme does not overlie any WFD groundwater body, although local groundwater risks and connections to and between surface water bodies have been assessed (refer to ES Chapter 14: Road Drainage and the Water Environment). The VoWHDC Chalk groundwater body is a short distance (ca. 300 m) from the south-east boundary of the Scheme at the A4130, but ground generally rises to the south-east and it is considered that there are no significant risks from the Scheme to the water body.

Table 5-2 Surface Water WFD Screening Summary

WFD Water body	Local Watercourse Name and Feature Type	Aquatic Ecology Sampling Location	Screen In or Out?	Justification
Thames (Evenlode to Thame) Water Body	Unnamed ditch	WB01	Out	Forestry ditch with no obvious tributary connection to the River Thames. Outside and upslope of the Proposed Development boundary, and not at risk.
Thames (Evenlode to Thame) Water Body	Unnamed ditch	WB02	Out	Forestry ditch with no obvious tributary connection to the River Thames. Outside and upslope of the Proposed Development boundary, and not at risk.
Thames (Evenlode to Thame) Water Body	Unnamed ditch	WB03	Out	Agricultural ditch, ephemeral, mainly dry, not considered suitable habitat for protected and/or notable species
Thames (Evenlode to Thame) Water Body	Unnamed ditch	WB04	Out	Ephemeral, partly dry, presumably artificially deepened and extended if it had natural origins. Not considered suitable habitat for protected and/or notable species

WFD Water body	Local Watercourse Name and Feature Type	Aquatic Ecology Sampling Location	Screen In or Out?	Justification
Thames (Evenlode to Thame) Water Body	Unnamed ditch	WB05	Out	Highway ditch, ephemeral, only connects to the Thames via another unnamed tributary which appears partly dry from aerial images. Not considered to be a connected habitat to the Thames.
Moor Ditch and Ladygrove Ditch Water Body	Moor Ditch (river)	WB06	In	Aquatic habitat
n/a (although in Moor Ditch and Ladygrove Ditch Water Body catchment area)	Unnamed artificial lake	WB07	Out	Not a WFD water body, no observed connection to other water features
Moor Ditch and Ladygrove Ditch Water Body	Unnamed watercourse (river)	WB08	In	Aquatic habitat, included as tributary of Moor Ditch
Moor Ditch and Ladygrove Ditch Water Body	Moor Ditch (river)	WB09	In	Aquatic habitat
Moor Ditch and Ladygrove Ditch Water Body	Unnamed ditch	WB10	Out	Artificial highway drain, ephemeral, not considered suitable habitat for protected and/or notable species
Moor Ditch and Ladygrove Ditch Water Body	Moor Ditch (watercourse)	WB11	In	Aquatic habitat
Thames (Evenlode to Thame) Water Body	Unnamed ditch	WB12	Out	Outside the Proposed Scheme red line boundary, and have no visible connectivity to the River Thames or its tributaries
Thames (Evenlode to Thame) Water Body	Unnamed ditch	WB13	Out	Outside the Proposed Scheme red line boundary, and have no visible connectivity to the River Thames or its tributaries
Thames (Evenlode to Thame) Water Body	Unnamed ditch	WB14	Out	Outside the Proposed Scheme red line boundary, and have no visible connectivity to the River Thames or its tributaries
Thames (Evenlode to Thame) Water Body	River Thames	WB15	In	Aquatic habitat
n/a (although within Thames (Evenlode to Thame) Water Body	Hansen Gravel Pits / Finger Lakes	WB16	Out	Artificial lake in Thames floodplain, but with no connectivity with the river other than via groundwater or fluvial inundation
n/a (although within Thames (Evenlode to Thame) Water Body catchment area)	Unnamed pond	WB17	Out	Not a WFD water body, some habitat value, but no observed connection to other water features

WFD Water body	Local Watercourse Name and Feature Type	Aquatic Ecology Sampling Location	Screen In or Out?	Justification
n/a (although in Moor Ditch and Ladygrove Ditch Water Body catchment area)	Unnamed pond	WB18	Out	Not a WFD water body, some habitat value, but no observed connection to other water features
n/a (although in Moor Ditch and Ladygrove Ditch Water Body catchment area)	Unnamed pond	WB19	Out	Not a WFD water body, some habitat value, but no observed connection to other water features
Moor Ditch and Ladygrove Ditch Water Body	Unnamed ditch	WB20	Out	Artificial agricultural ditch, ephemeral, mainly dry, not considered suitable habitat for protected and/or notable species
Moor Ditch and Ladygrove Ditch Water Body	Unnamed ditch	WB21	Out	Artificial ditches in the former power station cut for decommissioning. Ephemeral, partly dry. Some connectivity to Moor Ditch, but not considered suitable habitat for protected and/or notable species
Moor Ditch and Ladygrove Ditch Water Body	Moor Ditch (river)	WB22	In	Aquatic habitat
Moor Ditch and Ladygrove Ditch Water Body	Unnamed ditch	WB23	Out	Artificial ditch linked with housing estate balancing pond. Ephemeral, partly dry. No significant connectivity to Moor Ditch, not considered suitable habitat for protected and/or notable species
n/a (although in Moor Ditch and Ladygrove Ditch Water Body catchment area)	Unnamed pond	WB24	Out	Balancing pond discharging to long culvert outflow. Ephemeral, partly dry. No significant connectivity to Meadow Brook or Moor Ditch, not considered suitable habitat for protected and/or notable species
Moor Ditch and Ladygrove Ditch Water Body	Unnamed ditch	WB25	Out	Artificial highway drain, ephemeral, not considered suitable habitat for protected and/or notable species
Moor Ditch and Ladygrove Ditch Water Body	Unnamed ditch	WB26	Out	Artificial highway drain, ephemeral, not considered suitable habitat for protected and/or notable species

Groundwater Bodies and Groundwater – Surface Water Connectivity

5.2.7 The Vale of White Horse District Council Chalk Groundwater Body GB40601G60100, is screened out, because it does not underly the Scheme, and because no water connectivity or impact from the Scheme is expected for the reasons summarised below.

5.2.8 It is recognised that there is ground modified by anthropogenic activities associated with historic landfilling west and south-west of Appleford. This is the restored Sutton Courtenay Landfill / Quarry Complex, which is categorised as 'Waste Landfilling; >10 T/D with Capacity >25,000T Excluding Inert Waste'. In theory, this ground may be contaminated and contain landfill leachate. The surrounding superficial geology (permeable sands and gravels) could facilitate horizontal and vertical migration of leachate into the nearby waterbodies. Poor management and storage of the potentially contaminated soils could result in silt laden sediment entering nearby waterbodies.

5.2.9 Risks and mitigation from the Sutton Courtenay Landfill are described in the Ground Investigation Report that was submitted with the planning application. This describes how the Appleford siding bridge will carry a new road link over railway sidings and onto the landfill area. Due to the thickness of made ground in the landfill complete excavation of made ground is unfeasible. Significant cuttings are not proposed and piled foundations are not required at the landfill area, and so the landfill cap will be undisturbed. Material will be laid over the area to create a small, raised section of earth which will become the base for the road. Drainage blankets are proposed, which will also provide a stable platform for road construction, and controlling drainage of the pavement capping layer to prevent degradation of clay formations by surface water ingress will be designed as necessary.

5.2.10 Construction Environment Management in the construction phase, and Sustainable Drainage Systems in the operational phase, will avoid or mitigate any residual risks of contaminant mobilisation from the landfill to either surface water or groundwater. Sustainable Drainage Systems include water quantity and quality treatment controls, as described in ES Chapter 14: Road Drainage and the Water Environment, and DGT HIF 1 Scheme Drainage Strategy (AECOM, 2021) (Ref 4).

5.2.11 Accordingly, potential WFD impact pathways from the area of Sutton Courtenay Landfill to connecting surface and groundwater water bodies have been screened out of further assessment.

5.3 Stage 1: WFD Low Risk Activity Screening

5.3.1 Low risk WFD activities are summarised in Table 3.1. These are typically temporary work or maintenance activities for existing structures, but significantly, low risk activities also include permanent clear span bridges with abutments set-back from the bank top.

5.3.2 On the basis of Table 3.1, the proposed watercourse activities in the Moor Ditch and Ladygrove Ditch water body are not considered to be low risk activities, so these are screened in Stage 2: Scheme Element WFD .

5.3.3 The clear span crossing of the River Thames is considered to be a low risk activity, so is screened out at this point, for the reasons summarised below.

5.3.4 The General Arrangement drawings submitted with the planning for the proposed crossing of the River Thames are reproduced in Figure 5.1. Low risk activity screening for the proposed crossing of the River Thames is summarised in Table 5-3.

5.3.5 The design elements pertinent to WFD and low risk activities associated with the River Thames crossing are as follows:

- The crossing of the main channel is a clear span of approximately 65 m compared with an approximate 40 m banktop channel width.
- There are no abutments close to banktop, and the nearest viaduct piers are set back at least 7 m.
- The deck invert is approximately 4.1 m above the typical water level, as determined from the standard headwater elevation at Clifton Lock (46.802 m AOD). This is for navigation clearance as well as freeboard above flood levels. The deck invert is approximately 600 mm above the modelled 1% Annual Exceedance Probability (AEP) flood level.

Table 5-3: WFD Low Risk Activity Screening

Scheme Area	WFD Water Body	Watercourse - Aquatic baseline	Structure name	Culvert Type	Centroid Grid Reference	Dimensions (Width x Height) (approx.)	Length (m) (approx.)	Screen In or Out	Screening Justification
River Thames Crossing	Thames (Evenlode to Thame)	River Thames	River Thames Crossing	Clear span bridge	451969,194470	17.9 x 4.7 (nominal)	65 m main span across 40 m wide river	Screen Out	**Aquatic and high value habitat, but the proposed crossing is clear span bridge with deck level high above water. This is a WFD low risk activity – refer to Table 3-1.**

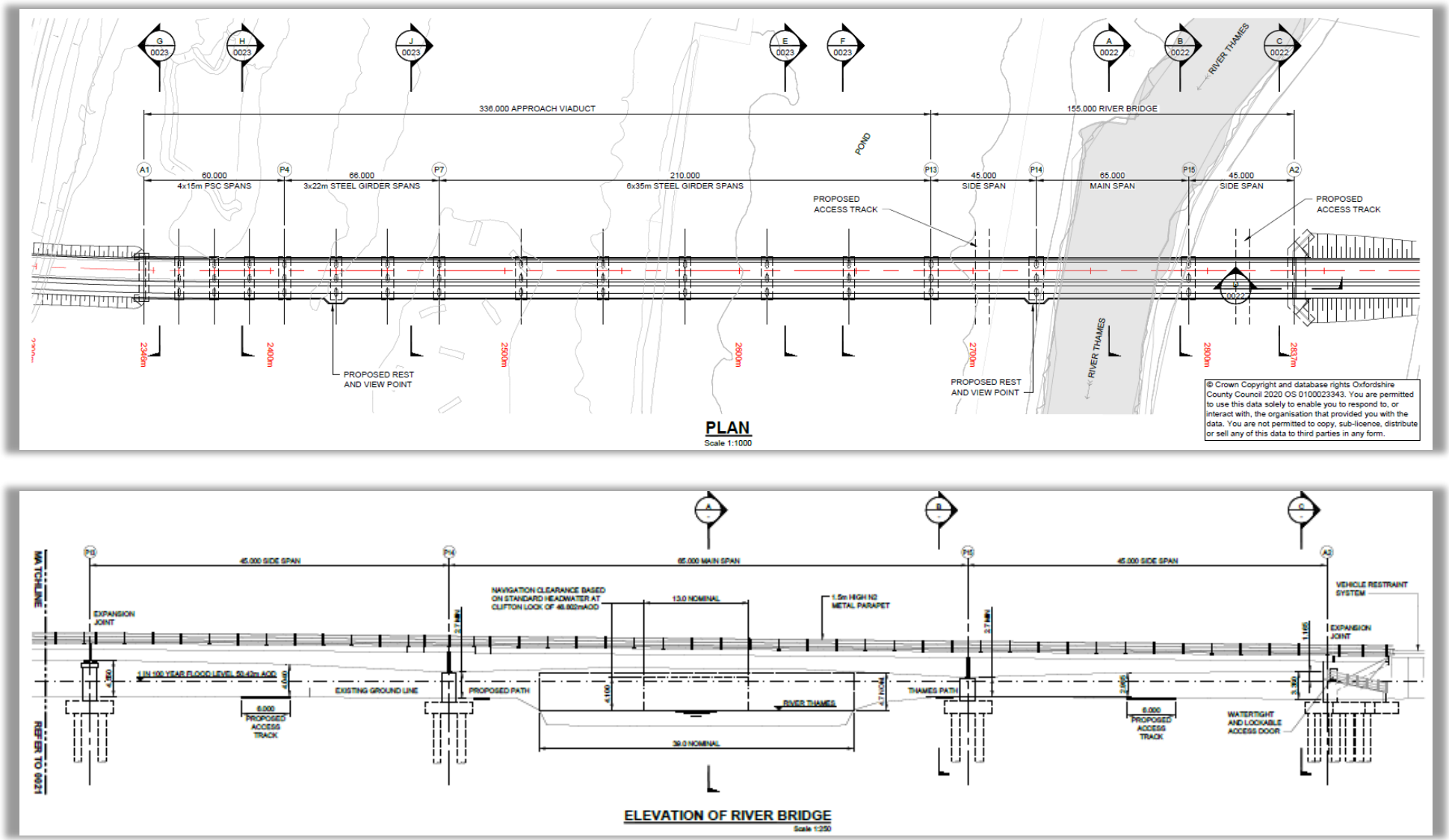


Figure 5.1: Excerpts of the River Thames crossing general arrangement drawings (May 2021)

5.4 Stage 1: Statutory Designated Site WFD Screening

5.4.1 The Scheme does not cross any sites statutorily designated for biodiversity value. However, the ES Chapter 9: Biodiversity identifies several statutory sites within the potential zone of influence of the Scheme. These are screened for WFD quality elements in Table 5-4.

5.4.2 In summary, Table 5-4 indicates that no WFD objectives at statutory designated sites are at risk from the Scheme.

Table 5-4: WFD screening of statutory designated sites in the vicinity of the Scheme

Statutory Site Name	Reason(s) for Designation	Distance (km) and direction to closest point of Scheme; and relationship to the Scheme (approx.)	WFD Screening
Culham Brake Site of Special Scientific Interest (SSSI)	National – SSSI. Small area (1.5 ha) of willow carr by the Thames contains one of the largest British populations of a Red Data Book species, Summer Snowflake *Leucojum aestivum*.	1.2 km north-west of Didcot to Culham River Crossing. Upstream from the Scheme boundary, so unlikely to be affected. No designated features that are also WFD quality elements.	Screen Out
Little Wittenham SAC (and SSSI)	International – SAC. Site supports one of the largest known breeding populations of Great Crested Newt *Triturus cristatus* in the UK. The site also supports an outstanding breeding assemblage of other amphibians (which includes Smooth Newt *Lissotriton vulgaris*, Common Frog *Rana temporaria* and Common Toad *Bufo bufo*) and of dragonflies and damselflies.	3.1 km south-east of Clifton Hampden Bypass. Wetlands are directly connected to the River Thames and downstream from the Scheme. No designated features that are also WFD quality elements. The Thames river crossing is a low risk to WFD elements.	Screen Out
Cothill Fen SAC (and SSSI)	International – SAC. Lowland valley mire contains one of the largest surviving examples of alkaline fen vegetation in central England, a region where fen vegetation is rare.	6.7 km north-west of Didcot to Culham River Crossing. No ecological connections between the SAC/SSSI and the Scheme.	Screen Out

5.5 Stage 1: Non-Statutory Designated Site WFD Screening

5.5.1 The Scheme does not cross any sites non-statutorily designated for biodiversity value. However, ES Chapter 9: Biodiversity identifies several statutory sites within the potential zone of influence of the Scheme. These are screened for WFD quality elements in Table 5-5.

In summary, Table 5-5 indicates that no WFD objectives at non-statutory designated sites are at risk from the Scheme.

Table 5-5: WFD screening of non-statutory designated sites in the vicinity of the Scheme

Non-statutory Site Name	Reason(s) for Designation	Distance (km) and direction to closest point of Scheme; and relationship to the Scheme (approx.)	WFD Screening
Furze Brake Local Wildlife Site (LWS)	Furze Brake is set on a gentle south-facing slope to the southwest of Abingdon. This site houses the most important heronry in the upper Thames basin, with nearly 50 active nests. The woodland is predominantly Oak *Quercus* sp. and Ash *Fraxinus excelsior* and there are a range of other species present, with plentiful Birch *Betula*, Wild Cherry *Prunus avium*, Rowan *Sorbus aucuparia* and Hornbeam *Carpinus betulus*. The understorey is quite rich with Spindle *Euonymus europaeus* and Buckthorn *Rhamnus* sp., while the ground flora includes abundant Bluebells *Hyacinthoides non-scripta* with Dog's mercury *Mercurialis perennis* and Moschatel *Adoxa moschatellina*. Yellow-star-of-Bethlehem *Gagea lutea*, which is rare in southern England, has been recorded in the past.	0.2 km north-east of Clifton Hampden Bypass. There are ecological connections between the LWS and the Site area, but there are no designated features that are also WFD quality elements.	Screen Out
Thames Clifton to Shillingford Conservation Target Area (CTA)	Area includes remnants of lowland meadow, wet meadow, small areas of wet woodland, woodland, some limestone grassland and patches of fen habitat. Also includes four gravel pits with eutrophic standing water that is important for wintering wildfowl and breeding Great Crested Newts.	0.4 km south of Clifton Hampden Bypass. The CTA includes wetland directly connected to the River Thames and is downstream from the Scheme. No designated features that are also WFD quality elements. The Thames river crossing is a low risk to WFD elements.	Screen Out
Clifton Hampden Wood LWS	This site is part of a narrow strip of woodland on the northern bank of the River Thames between Clifton Hampden and Burcot. The woodland is mainly wet Ash woodland on the level area near the river, with Beech Fagus sylvatica, Sycamore *Acer pseudoplatanus* Scots Pine *Pinus sylvestris*, Pedunculate Oak *Quercus robur*, Field Maple *Acer campestre* and Horse Chestnut *Aesculus hippocastanum* on the steeper bank. Crack Willow *Salix fragilis* and Alder *Alnus glutinosa* are found beside the river. An important feature of the woodland is the population of the nationally rare Loddon lily (or summer snowflake) comprising perhaps 2,000 - 3,000 mature plants near the river. The Loddon lily population appears healthy with many seedlings. Wet woodland is a priority habitat for conservation in the UK.	0.4 km east of Clifton Hampden Bypass. The LWS is downstream of the Scheme and includes wet woodland directly connected to the River Thames. No designated features that are also WFD quality elements. The Thames river crossing is a low risk to WFD elements.	Screen Out
Clifton Hampden Meadows LWS	Two meadows adjacent to the Thames, consisting of a mosaic of dry rough grassland, swamp and wet grassland areas. Areas of the grassland remain lowland meadow where a number of species typical of this habitat can be seen such as Marsh Marigold *Caltha palustris*, Sneezewort *Achillea ptarmica*, Common Knapweed *Centaurea nigra*, Ragged Robin *Lychnis flos-cuculi* and Brown Sedge *Carex disticha*. There are 15 plant species typical of lowland meadow and 16 species typical of fen habitats.	0.4 km east of Clifton Hampden Bypass. The LWS includes wetland directly connected to the Thames and is downstream from the Scheme. No designated features that are also WFD quality elements. The Thames river crossing is a low risk to WFD elements.	Screen Out

Non-statutory Site Name	Reason(s) for Designation	Distance (km) and direction to closest point of Scheme; and relationship to the Scheme (approx.)	WFD Screening
Kelart's Field potential LWS (pLWS)	A reasonably diverse large semi-improved grassland area with some elements of lowland meadow habitat. Dominant grasses consist of Red Fescue *Festuca rubra*, Yorkshire Fog, Creeping Bent *Agrostis stolonifera*, False Oat-grass *Arrhenatherum elatius*, Perennial Rye-grass *Lolium perenne*, Meadow Foxtail, Sweet Vernal-grass and Crested dogs-tail.	0.7 km west of Didcot to Culham River Crossing. No ecological connections between the pLWS and the Scheme.	Screen Out
Radley Gravel Pits LWS	Variety of terrestrial habitats with large areas of open ground, grassland, scrub, sedge bed and reedbed, and small areas of fen and wet woodland. The open ground includes freely drained and waterlogged areas, with a wide variety of ruderals species both native and introduced. The grassland is recent and lies over former arable or gravel areas. It has species which prefer neutral to calcareous and un-grazed conditions. The scrub is mostly over landfill and is composed of Hawthorn *Crataegus monogyna* and Bramble *Rubus fruticosus* with introduced species such as Buddleia *Buddleja davidii*. The sedge beds are species rich and include many young Willow Salix.	1.2 km north of Didcot to Culham River Crossing. No ecological connections between the LWS and the Scheme.	Screen Out
Thames Radley to Abingdon CTA	This area includes gravel pits with one site rich in aquatic plants. There are also small areas of wet woodland, areas of fen which is important for Lodden Lily *Leucojum aestivum* and important nesting Lapwing *Vanellus* habitat.	1.2 km north of Didcot to Culham River Crossing. No ecological connections between the CTA and the Scheme.	Screen Out
Radley Gravel Pits Extension South LWS	Forms part of Radley Gravel Pits LWS.	1.3 km north of Didcot to Culham River Crossing. No ecological connections between the LWS and the Scheme.	Screen Out
Hayward's Eyot LWS	Low-lying site adjacent to the River Thames in the village of Long Wittenham. Formerly an island, it comprises channels either side of the site, with springs and ponds to the south. A now extinct major channel of the river to the south created the steep bank which now delimits the site on this side. Summer snowflake is found in several locations across the site. This is a Red Data Book species with a very restricted distribution in the UK; this site may carry between five and ten thousand plants, which makes it one of the larger populations. It is also unusual on this site in growing in the open amongst reed and reed sweet grass rather than under willow carr.	1.4 km south-east of Clifton Hampden Bypass. This LWS is adjacent to the River Thames and downstream from the Scheme and comprises relict hydromorphological features of the River Thames. However, the Thames river crossing is a low risk to WFD elements.	Screen Out
Nuneham Arboretum LWS	This site lies on a plateau and was previously a park and contains areas of unimproved grassland, ponds, woodland and parkland.	1.8 km north-east of Clifton Hampden Bypass. No ecological connections between the LWS and the Scheme.	Screen Out

5.6 Stage 2: Scheme Element WFD Scoping

5.6.1 An inventory of drainage structures and watercourse crossing structures has been compiled for the Scheme. Each structure has been reviewed for potential impacts on WFD objectives, as summarised in Table 5.5.

5.6.2 The majority of proposed structures are for drainage ditches that are typically dry. Other proposed structures are for flood alleviation, which will also be typically dry. Neither type of structure will impact perennial water habitats and can therefore be screened out of the WFD assessment.

5.6.3 The DGT HIF 1 Scheme Drainage Strategy (AECOM, 2021) (Ref 4) has been developed to manage surface water runoff in accordance with current highway design standards. The strategy is that drainage will be treated by attenuation features such as balancing ponds and swales and discharged to existing ditches at greenfield rates. Watercourses and other attenuation features will also be landscaped to provide optimal water treatment.

5.6.4 At this preliminary design stage, confirmed details of pond and swale sizing, outfall positions, and headwall designs for receiving watercourses are not available. The assessments in ES Chapter 14: Road Drainage and the Water Environment, including HEWRAT, identifies that preliminary designs pass water quality treatment standards. It is therefore assessed that there will be no runoff impacts from new highways on WFD objectives.

5.6.5 A shortlist of structures that could pose risks to WFD objectives is summarised in Table 5.6. This demonstrates that most of the drainage structures can be scoped out of further WFD assessment.

5.6.6 The elements of the Scheme that have been screened in for impact assessment are summarised in Table 5-7. These comprise new culverts for Scheme crossings of existing watercourses. Impact assessments in terms of risks and mitigation are then summarised below.

Table 5-6: WFD Scoping of Drainage Structures

Scheme Area	WFD Water Body	Watercourse - Aquatic baseline	Structure name	Culvert Type	Centroid Grid Reference	Dimensions (Width x Height) (m) (approx.)	Length (m) (approx.)	Scope In or Out	Scoping Justification
A4130	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	A4130_1	Box Culvert	450549,191225	2 x 2	20.5	Scope In	Potential aquatic habitat, although baseline ecology surveys identified habitat of limited value.
A4130	Moor Ditch and Ladygrove Ditch	n/a	A4130_2	Box Culvert (double pipe)	450508,191125	2 x 2 x 2	78.9	Scope Out	Flood relief culvert parallel to A4130_5 that will typically be dry and will not support aquatic habitat.
A4130	Moor Ditch and Ladygrove Ditch	n/a	A4130_3	Box Culvert (double pipe)	450275,191099	2 x 2 x 1	25.2	Scope Out	Flood relief culvert parallel to A4130_4 that will typically be dry and will not support aquatic habitat.
A4130	Moor Ditch and Ladygrove Ditch	Meadow Brook	A4130_4	Box Culvert	450258,191130	1.5 x 1.5	27.2	Scope In	Aquatic habitat, although baseline ecology surveys identified habitat of limited value.
A4130	Moor Ditch and Ladygrove Ditch	Meadow Brook	A4130_5	Box Culvert	450520,191143	1.5 x 1.35	76.1	Scope In	Aquatic habitat, although baseline ecology surveys identified habitat of limited value.
A4130	Moor Ditch and Ladygrove Ditch	Meadow Brook	A4130_5-Banks	Bank raising adjacent to culverts	450175,191120	0.1 to 0.2 high bank level adjustments	116.0	Scope out	Flood risks assessment identified that only 0.1 m to 0.2 m adjustments to existing bank levels are required for flood management. Not considered significant to WFD and aquatic habitat.
A4130	Moor Ditch and Ladygrove Ditch	Ditch Adjacent to Backhill Lane	A4130_6	Pipe Culvert	448898,191338	0.3 diameter	21.8	Scope out	Ephemeral ditch surveyed as dry in autumn baseline ecology surveys identified habitat of limited value.
A4130	Moor Ditch and Ladygrove Ditch	Ditch Adjacent to Backhill Lane	A4130_7	Pipe Culvert	448904,191486	0.6 diameter	5.7	Scope out	Baseline ecology survey for A4130_6, 20 m away, identified an ephemeral ditch, dry in autumn, with habitat of limited value.

Scheme Area	WFD Water Body	Watercourse - Aquatic baseline	Structure name	Culvert Type	Centroid Grid Reference	Dimensions (Width x Height) (m) (approx.)	Length (m) (approx.)	Scope In or Out	Scoping Justification
A4130	Moor Ditch and Ladygrove Ditch	Stert brook	A4130_8	Box Culvert	449492,191423	1.2 x 1.2	23.7	Scope In	Aquatic habitat. WFD data for this main watercourse of the water body suggested that macrophytes are Good status, but only 1 scoring species was found in local surveys (*Apium nodiflorum*). Invertebrates scored as moderate by CCI, PSI score indicated heavy sedimentation in spring, and LIFE shows high sensitivity to flow in autumn.
A4130	Moor Ditch and Ladygrove Ditch	Cow Brook	A4130_9	Box Culvert	450036,191423	1.2 x 1	24.4	Scope Out	Ephemeral ditch surveyed as dry in spring and autumn.
DSB	Moor Ditch and Ladygrove Ditch	Moor Ditch	BWB Culvert	Pipe Culvert	450977,191465	1.8m Diameter	90.6	Scope Out	Existing culvert beneath the former Didcot A Power Station; this location central to >600 m culvert length. Requirement is to reinforce the existing culvert to construct the proposed highway above, not feasible to daylight this location.
DSB	Moor Ditch and Ladygrove Ditch	Moor Ditch	DSB Moor Ditch Culvert	Pipe Culvert	451365,191542	1.5 x 2.4	40.0 proposed 74.4 existing	Scope In	Aquatic habitat, although baseline ecology surveys identified habitat of limited value.
DSB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	DSB Dry Ditch Culvert	Pipe Culvert	451626,191652	600 mm Diameter	50.8	Scope Out	Dry ditch
River Crossing	Thames (Evenlode to Thame)	River Thames	River Thames Crossing	Clear span bridge	451969,194470	17.9 x 4.7 (nominal)	65 m main span across 40 m wide river	Scope Out	Low risk activity. Aquatic and high value habitat. Proposed crossing is clear span bridge with deck level high above water.
River Crossing	Thames (Evenlode to Thame)	River Thames Floodplain	River Thames Crossing	Culvert / viaduct	451969,194470	17.9 x 4.7 (nominal)	155 m river bridge 336m approach viaduct	Scope In	Restored floodplain habitats in former gravel pits. Aquatic and high value habitat. Proposed crossing is viaduct on piers, with no piers in the Thames channel or on bank tops, and a length of culvert at the tie in with the ground level.

Scheme Area	WFD Water Body	Watercourse - Aquatic baseline	Structure name	Culvert Type	Centroid Grid Reference	Dimensions (Width x Height) (m) (approx.)	Length (m) (approx.)	Scope In or Out	Scoping Justification
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	Station Access Foot Bridge	Box culvert	453087,195214	2.5 x 1.5	11.5	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	West Footpath culvert	Pipe culvert	453140,195228	NA x 0.8	11.0	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	Entrance 1 Culvert	Box culvert	453663,195294	1.8 x 1.2	23.0	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	A415 Connection Culvert	Box culvert	453608,195362	1.8 x 1.2	24.0	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	A415 West Overland Culvert	Box culvert	453755,195569	1.8 x 1.8	20.0	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	CHB Pond 3 Culvert	Box culvert	453796,195577	1.8 x 1.8	6.4	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	A415 East Watercourse 4 Culvert (crossing)	Box culvert	454734,196212	3.5 x 1.8	35.0	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	Watercourse 3 track foot bridge	timber foot bridge	454576,196158	2.5 x 1.0	6.3	Scope Out	Ephemeral ditch surveyed as dry in Autumn. High CCI score, but no notable species identified. Clear span bridge and low risk activity.
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	Watercourse 4 track foot bridge	timber foot bridge	454717,196237	2.5 x 1.2	6.4	Scope Out	Dry ditch/ clear span bridge and low risk activity
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	Culham Treatment works entrance Culvert	Box culvert	453886,195691	1.8 x 1.5	17.0	Scope Out	Dry ditch

Scheme Area	WFD Water Body	Watercourse - Aquatic baseline	Structure name	Culvert Type	Centroid Grid Reference	Dimensions (Width x Height) (m) (approx.)	Length (m) (approx.)	Scope In or Out	Scoping Justification
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	A415 CSC Culvert	Box culvert	454003,195747	1.2x1.2	19.0	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	CSC Secondary Access Culvert	Box culvert	454026,195836	1.2x1.2	19.0	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	CSC Foot Path Culvert	Box culvert	454153,195847	1.0x1.0	9.0	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	Thame Lane Culvert	Box culvert	454277,195899	0.8x0.8	10.8	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	Farm Access culvert	Box culvert	454375,195864	0.75x0.75	7.5	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	B4015 Culvert	Box culvert	454795,196138	1.5x1.5	23.5	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	B4015 Foot Bridge	timber foot bridge	454779,196106	2.5x0.8	4.8	Scope Out	Dry ditch
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	A415 South Foot Bridge	timber foot bridge	454250,195848	2.5x1.0	16.7	Scope Out	Dry ditch/ clear span bridge and low risk activity.
CHB	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	CHB Flood relief culvert (new)	Pipe culvert (double pipe)		NA x 0.6	330.0	Scope Out	Flood relief culvert, not perennial aquatic habitat.

Table 5-7: Shortlist of Drainage Structures Screened In for WFD Assessment

Scheme Area	WFD Water Body	Watercourse - Aquatic baseline	Structure name	Culvert Type	Centroid Grid Reference	Dimensions (Width x Height) (m) (approx.)	Length (m) (approx.)	Screen In or Out	Screening Justification
A4130	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	A4130_1	Box Culvert	450549,191225	2 x 2	20.5	Scope In	Potential aquatic habitat, although baseline ecology surveys identified habitat of limited value.
		Meadow Brook	A4130_4	Box Culvert	450258,191130	1.5 x 1.5	27.2	Scope In	Aquatic habitat, although baseline ecology surveys identified habitat of limited value.
			A4130_5	Box Culvert	450520,191143	1.5 x 1.35	76.1	Scope In	Aquatic habitat, although baseline ecology surveys identified habitat of limited value.
		Stert Brook	A4130_8	Box Culvert	449492,191423	1.2 x 1.2	23.7	Scope In	Aquatic habitat. WFD data for this main watercourse of the water body suggested that macrophytes are Good status, but only 1 scoring species was found in local surveys (*Apium nodiflorum*). Invertebrates scored as moderate by CCI, PSI score indicated heavy sedimentation in spring, and LIFE shows high sensitivity to flow in autumn.
DSB		Moor Ditch	DSB Moor Ditch Culvert	Pipe Culvert	451365,191542	1.5 x 2.4	40.0 proposed 74.4 existing	Scope In	Aquatic habitat, although baseline ecology surveys identified habitat of limited value.

6. Stage 3: Impact Assessment

6.1 Overview

6.1.1 The Stage 1 screening and Stage 2 scoping assessments in Section 5 identified WFD risks associated with the Scheme as related to new culverts on watercourse aquatic habitats, which are all within the Moor Ditch and Lady Grove Ditch waterbody.

6.1.2 The requirement for new culvert crossings by the Scheme means that there will be an unavoidable loss of open channel habitat within the Moor Ditch and Lady Grove Ditch waterbody. The existing approximate 74.4 m Moor Ditch culvert will be replaced with an approximate 40 m culvert to offset some of this loss, but in total there will be approximately 113.1 m of new culverts and associated loss of open watercourse habitat (refer to Table 6.1). Compared with the approximate 8.398 km water body length (refer to Table 4.1), this is a net loss of approximate 1.3% of the water body open watercourse habitat.

Table 6-1: Cumulative impact of new culverts on open watercourses in the Moor Ditch and Lady Grove Ditch waterbody

Scheme Area	WFD Water Body	Watercourse local name	Structure name	Culvert Type	Dimensions (Width x Height) (m) (approx.)	Length (m) (approx.)
A4130	Moor Ditch and Ladygrove Ditch	Unnamed drainage ditch	A4130_1	Box Culvert	2 x 2	20.5
		Meadow Brook	A4130_4	Box Culvert	1.5 x 1.5	27.2
			A4130_5	Box Culvert	1.5 x 1.35	76.1
		Stert brook	A4130_8	Box Culvert	1.2 x 1.2	23.7
DSB		Moor Ditch	DSB Moor Ditch Culvert	Pipe Culvert	1.5 x 2.4	40.0 proposed
						74.4 existing
Culvert cumulative impact net length for the water body						113.1 m of new culverts
Potential headwall impact lengths						Unknown
Contingency in the WFD assessment for design uncertainty, and for the Scheme objective for 10% biodiversity net gain						>30 m
Recommended minimum length of watercourse enhancements for Scheme mitigation designs and WFD compliance						**150 m**

6.1.3 It may be necessary to construct outfall headwalls along watercourse banks, which will result in addition lengths of watercourse impact. Design details are not available at this stage, so lengths have not yet been assessed. The current Scheme design intent is to construct headwalls in line with channel profiles to prevent any protrusion into the watercourse and impacts in the channels, as well as along the banks. Potentially, if space allows, 'grey' outfall headwalls could be set back from the watercourses, with 'green' connecting ditches that will reduce impacts on the watercourses.

6.1.4 Space along Meadow Brook has been earmarked in the Scheme boundary (within the junction of the A4130 widening and the Science Bridge – refer to Annex A) for watercourse enhancements to mitigate culvert and any headwall impacts. It is identified that approximately 150 m of watercourse enhancements will be required to

mitigate the Scheme impacts on open channel habitats (due to loss of open channels and the impacts of headwalls).

6.1.5 The existing Meadow Brook is highly modified in this location by historic straightening, and is a low quality, uniform and trapezoidal channel. Enhancements of this degraded habitat will therefore be considered to adequately mitigate the loss of open watercourse elsewhere in the water body. Recommendations for the nature of enhancement designs are provided in Section 7: Summary of Mitigation Measures.

6.2 Stage 3 - Biological Impact Risks and Mitigation: Construction

Impact	Mitigation
• Construction of the Scheme will require works in and close to water bodies. This means that there is potential for negative impacts on water quality and biological elements, for example through spillage of hazardous chemicals (such as fuel, grout etc) during construction. • Construction works could mobilise fine sediments which may enter water bodies and have negative impacts on bed habitats. • The potential for in-channel works could mean that flow will need to be diverted while construction works are undertaken. This will have a negative impact on all biological elements within the affected watercourses.	• The Principal Contractor (PC) will mitigate these risks using an approved Construction Environmental Management Plan (CEMP) and appropriate site management techniques (as based upon the Outline Environmental Management Plan (OEMP) as included in the ES – refer to ES Appendix 4.2). • The pollution prevention measures will be based on Good Practice Guidance (GPP). This includes GPP published on the NetRegs website[5]. While these are not regulatory guidance in England, it remains a useful resource for best practice: – GPP 1: Understanding your environmental responsibilities – good environmental practices; – GPP 2: Above ground oil storage; – GPP 3: Use and design of oil separators in surface water drainage systems; – GPP 4: Treatment and disposal of wastewater where there is no connection to the public foul sewer; – GPP 5: Works and maintenance in or near water; – GPP 8: Safe storage and disposal of used oils; – GPP 13: Vehicle washing and cleaning; – GPP 19: Vehicles: Service and Repair; – GPP 20: Dewatering underground ducts and chambers; – GPP 21: Pollution Incident Response Plans; – GPP22: Dealing with spills; and – GPP26: Safe storage – drums and intermediate bulk containers. • Additional good practice guidance for mitigation to protect the water environment can be found in key CIRIA documents and British Standards Institute documents, as listed in ES Chapter 14 Road Drainage and the Water Environment. • The measures outlined below, which will be included in the CEMP and a supporting Water Management Plan (WMP), will be required for the management of fine sediments in surface water runoff as a result of the construction activities: – Reasonably practicable measures will be taken to prevent the deposition of fine sediment or other material in, and the pollution by sediment of, any existing waterbody, arising from construction activities. The measures will accord with the principles set out in industry guidelines including the CIRIA report 'C532: Control of water pollution from construction sites'[6]. Measures may include use and maintenance of temporary lagoons, tanks, seeding / covering of earth stockpiles, earth bunds, straw bales and sandbag walls, proprietary measures (e.g. lamella clarifiers or contained chemical treatment) and fabric silt fences or silt screens as well as consideration of the type of plant used. – A temporary drainage system will be developed to prevent runoff contaminated with fine particulates from entering surface water drains without treatment. This will include identifying all land drains and water bodies on the Site and ensuring that they are adequately protected using drain covers, sandbags, earth bunds, geotextile silt fences, straw bales, or proprietary treatment (e.g. lamella clarifiers). Discharge to such water bodies (directly or indirectly) will only be made with the permission of the EA and with the necessary treatment measures implemented. – Where possible, earthworks will be undertaken during the drier months of the year and will avoid periods of wet weather (if possible) to minimise the risk of generating runoff contaminated with fine particulates. However, it is likely that some working during wet weather periods will be unavoidable, in which case mitigation measures will be implemented to control fine sediment laden runoff.

[5] https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/guidance-for-pollution-prevention-gpps-full-list/ Accessed July 2022
[6] CIRIA (2001) C532: Control of water pollution from construction sites – Guidance for consultants and contractors.

Impact	Mitigation
	– To protect waterbodies from fine sediment runoff, topsoil/subsoil will be stored a minimum of 20 m from any water body on flat lying land (and further if the ground is sloping, subject to ono site risk assessment on observational monitoring) and not within the fluvial floodplain. Where this is not possible, and it is to be stockpiled for longer than a two-week period, the material will either be covered with geotextile mats, seeded to promote vegetation growth. In all situations, runoff from the stockpile will be prevented from draining to a watercourse without prior treatment. If located where there is a risk of flooding, additional measures will be provided to reduce the risk of erosion (e.g. by protecting the base using spaced out concrete blocks, pegged in geotextile sheets, etc.). – Appropriately sized runoff storage areas for the settlement of excessive fine particulates in runoff will be provided. It is likely that treated water will then be pumped under a temporary Water Activity Permit from the EA or to a water treatment works as agreed with the sewerage undertaker. – Mud deposits will be controlled at entry and exit points to the Site using wheel washing facilities and / or road sweepers operating during earthworks activities or other times as considered necessary. – Equipment and plant are to be washed out and cleaned in designated areas within the Site compound where runoff can be isolated for treatment before discharge to surface water drainage under appropriate consent and / or agreement with Environment Agency, or otherwise removed from site for appropriate disposal at a licensed waste facility. – Debris and other material will be prevented from entering surface water drainage, through maintenance of a clean and tidy site, provision of clearly labelled waste receptacles, grid covers and the presence of site security fencing. – The WMP will include details of pre, during and post-construction water quality monitoring. This will be based on a combination of visual observations, frequent in situ testing using water quality probes, and periodic sampling for laboratory analysis. Proposed measures for management of Spillage Risk: – The measures outlined below will be implemented to manage the risk of accidental spillages on site and potential conveyance to nearby waterbodies via surface runoff or land drains. The measures relating to the control of spillages and leaks will be included in the WMP and OEMP and adopted during the construction works: – Fuel will be stored and used in accordance with the Control of Substances Hazardous to Health Regulations 2002, and the Control of Pollution (Oil Storage) (England) Regulations 2001. Particular care will be taken with the delivery and use of concrete and cement as it is highly corrosive and alkaline. – Fuel and other potentially polluting chemicals will either be in self bunded leak proof containers or stored in a secure impermeable and bunded area (minimum capacity of 110% of the capacity of the containers). – Any plant, machinery or vehicles will be regularly inspected and maintained to ensure they are in good working order and clean for use in a sensitive environment. This maintenance is to take place off site if possible or only at designated areas within the Site compound. Only construction equipment and vehicles free of all oil/fuel leaks will be permitted on site. Drip trays will be placed below static mechanical plant. – All washing down of vehicles and equipment will take place in designated areas and wash water will be prevented from passing untreated into watercourses. – All refuelling, oiling and greasing will take place above drip trays or on an impermeable surface which provides protection to underground strata and watercourses, and away from drains as far as reasonably practicable. Vehicles will not be left unattended during refuelling. – As far as reasonably practicable, only biodegradable hydraulic oils will be used in equipment working in or over watercourses. – All fixed plant used on the Site will be self-bunded. – Mobile plant is to be in good working order, kept clean and fitted with plant 'nappies' at all times. – A Pollution Prevention Plan will be prepared and included alongside the CEMP. Spill kits and oil absorbent material will be carried by mobile plant and located at high risk locations across the Site and regularly topped up. All construction workers will receive spill response training and toolbox talks. – The Site will be secure to prevent any vandalism that could lead to a pollution incident. – Construction waste / debris are to be prevented from entering any surface water drainage or water body.

Impact	Mitigation
	– Surface water drains on roads or within the construction compound will be identified and, where there is a risk that fine particulates or spillages could enter them, the drains will be protected (e.g. using covers or sandbags). – Suitable facilities for concrete wash water (e.g. geotextile wrapped sealed skip, container or earth bunded area) will be adequately contained, prevented from entering any drain, and removed from the Site for appropriate disposal at a suitably permitted waste facility. – Water quality monitoring of potentially impacted watercourses will be undertaken to ensure that pollution events can be detected against baseline conditions and can be dealt with effectively. • In addition, any site welfare facilities will be appropriately managed, and all foul waste disposed of by a licensed contractor to a suitably permitted facility. • Works should be timed to avoid fish migration and spawning seasons as far as possible to reduce these impacts. There will be temporary fragmentation of watercourses including Moor Ditch during construction, and this watercourse has been shown to support bullhead. Mitigation including fish rescue and translocation may be required during construction of culverts to relocate fish away from the works areas. • Standard practice bio-security measures will be required to ensure that no invasive species are spread around site or translocated elsewhere. Measures will need to include checks of plant/ vehicles and footwear to ensure clean and clear of potential contaminants with best practice implemented as necessary.

6.3 Stage 3 - Biological Impact Risks and Mitigation: Operation

Impact	Mitigation
• There will be an increased impermeable area as a result of the Scheme which could result in increased road runoff laden with pollutants which could enter water bodies and negatively impact water quality, and in turn, biological elements. • Additional permanent shading from new culverts will have adverse impacts locally on biological elements. However, baseline surveys of the watercourses comprising the Moor Ditch and Ladygrove Ditch waterbody identified generally highly modified watercourses within the study area, with low ecological value. The new culverts are generally adjacent to existing culverts, so are unlikely to cause severe habitat fragmentation compared to the existing baseline. Impacts will be localised and are unlikely to have a significant impact at the water body scale. • New headwalls may be required which will have additional physical impacts on watercourse bank habitats.	• The Drainage Strategy Report (AECOM, 2021) details the drainage design which has been developed in accordance with DMRB, OCC's Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire, and the requirements of the NPPF, alongside advice from environmental practitioners responsible for undertaking water related assessments. The drainage design aims to minimise effects on water quality by using natural storage, treatment and discharge solutions to manage surface water drainage during the operational phases of the Scheme. • The preliminary drainage design is based on the following key assumptions: – Attenuation features for highway drainage will be required to store the 1 in 100 year storm event with a 20% allowance for climate change (and checked that the flood water does not endanger property or life when a 40% climate change allowance is made). – Flood Estimation Handbook (FEH; Ref 14.82) rainfall data has been utilised for the hydraulic design of the drainage systems. The design follows criteria described in the DMRB and OCC Local Standards and Guidance, and ensures no surcharging of the drainage system for the 1 in 1 year return period, and no flooding of the surface of the site for 1 in 30 year return period and flooding only in safe areas for the 1 in 100 year return period. – Surface water runoff from additional impermeable areas will be attenuated and the discharge rate will be restricted to a Qbar flow rate (the mean annual flood flow rate from a rural catchment), with a suitable flow control device to ensure runoff flows and volumes are not more than the existing condition. These will be sized to ensure no flooding in a 1 in 100-year storm event with a 20% allowance for climate change when the discharge is restricted to a Qbar flow rate. – SuDS in the form of swales, dry ponds, wet ponds, ditches and filter drains have been deployed within the various drainage catchments for the Scheme, to treat and attenuate the surface water runoff in accordance with The SuDS Manual which is referred to in DMRB CD532 . SuDS also offer opportunities for ecological habitat creation and landscaping. – Road runoff will be discharged to surface watercourses except for four outfalls on the Didcot to Culham River Crossing section, where water will be discharged to ground via an infiltration basin. – One outfall from the Clifton Hampden Bypass will discharge to a CSC surface water sewer. The proposed connection to the sewer has been attenuated to 5 l/s. The treatment train for every outfall required by the Scheme is presented in Appendix 14.3 Assessment of Routine Road Runoff and Accidental Spillages. • Maintenance requirements have been considered for all surface water attenuation features (ponds, swales, ditches) by providing access to features mainly from local roads SuDS Maintenance and Management Plans will be prepared for each section of the Scheme during the detailed design stage by PC on behalf of OCC. These documents will set out the principles for the long-term management and maintenance of the proposed SuDS and outline who will be responsible for their maintenance and management. These documents will ensure that the company appointed by OCC to manage and maintain the SuDS is provided with a robust inspection and maintenance programme. Optimum operation of the surface water drainage network is important throughout the lifetime of the Scheme, to ensure no future deterioration of water quality or increase in discharge rates. Maintenance requirements are outlined in accordance with recommendations in CIRIA C753 The SuDS Manual. • The specific SuDS treatments ('the SuDS treatment train') that have been built into the design of each drainage catchment for the Scheme are outlined in Appendix 14.3 Assessment of Routine Road Runoff and Accidental Spillage Risk (HEWRAT). The suitability of each of these treatment trains has been assessed using the National Highways (Highways England) Water Risk Assessment Tool (HEWRAT) within Appendix 14.3, and in every case sufficient mitigation has been provided to ensure no adverse impact on the receiving water environment in terms of water pollution (surface water or groundwater). The outfall locations across the Scheme are shown in Figure 14.9 and discussed further within ES Chapter 14 Road Drainage and the Water Environment. An update to the

Impact	Mitigation
	HEWRAT assessment would be undertaken at the detailed design stage to account for any changes made to the proposed drainage treatments and to ensure that all receiving water features remain adequately protected. • Culverts have been designed appropriately to maintain connectivity along watercourses for aquatic species and riparian mammals. Culverts will include mammal ledges of 500 mm width to facilitate passage of riparian mammals such as otters. Culvert inverts will be set 150 mm below bed level to allow continuity of bed substrate habitats, which will maintain longitudinal connectivity for fish and other aquatic fauna. • The existing approximate 74.4 m Moor Ditch culvert will be replaced with an approximate 40 m culvert, a reduction of local culvert length and corresponding increase of open channel habitat of approximately 34.4 m. • Potentially headwalls could be set back from watercourses with green soft ditch connections to the aquatic habitats. • Watercourse enhancements are required for WFD compliance and at least 150 m of watercourse improvements are recommended.

6.4 Stage 3 - Potential Physicochemical Impact Risks and Mitigation

Construction Impacts

Impact	Mitigation
• There are likely to be localised temporary impacts, particularly in terms of runoff containing possible contaminants associated with construction (e.g. cement/ fuel). Construction works could mobilise fine sediments which may enter water bodies and have negative impacts on bed habitats. • Culvert crossings will require in-channel works. This means that there is potential for negative impacts on water quality and biological elements, for example through spillage of hazardous chemicals (such as fuel, grout etc.) during construction.	• The contractor will mitigate these risks using an approved CEMP and WMP and appropriate site management and pollution prevention techniques, as outlined in full in Section 6.3 and in the OEMP (Appendix 4.2) • The CEMP will include measures to reduce the risk of chemical spillages, and should include the use of bunded fuel tanks, spill kits, plant nappies on static plant, and the implementation of an Emergency Response Plan, and the refuelling of plant away from any water bodies.

Operational Impacts

Impact	Mitigation
• There will be an increased impermeable area as a result of the Scheme, which could result in increased road runoff laden with pollutants which could enter water bodies and negatively impact water quality.	• The sustainable drainage design will mitigate runoff quantity from new areas of highways runoff with balancing ponds and swales. Pollution treatment trains will be implemented to control pollutants before attenuated drainage is discharged to water bodies. Refer to Section 6.2 above for further detail, as well as Appendix 14.3 Assessment of Routine Road Runoff and Accidental Spillages (HEWRAT) and Chapter 14 Road Drainage and the Water Environment.

6.5 Stage 3 - Potential Hydromorphological Impact Risks and Mitigation

Construction Impacts

Impact	Mitigation
• Construction works could mobilise fine sediments which may enter water bodies and have negative impacts on bed habitats. • The potential for in-channel works could require the diversion of flows which could have significant impacts on flow patterns and sediment transport.	• The PC will mitigate these risks using an approved CEMP, WMP and appropriate site management techniques as outlined above. • The CEMP will include measures to reduce the risk of chemical spillages, and should include the use of bunded fuel tanks, spill kits, plant nappies on static plant, and the implementation of an Emergency Response Plan, and the refuelling of plant away from any water bodies. • Construction impacts will be temporary and if methods of best practice are employed, this will lead to no permanent negative impacts.

Operational Impacts

Impact	Mitigation
• New highways surfaces will result in increased particulate runoff. • New culverts will permanently reduce the length of open watercourse within the water body. • New headwalls may be required which will have additional physical impacts on watercourse bank habitats.	• The Scheme sustainable drainage design will mitigate runoff quantity from new areas of highways runoff with balancing ponds and swales. Pollution treatment trains will be implemented to control pollutants before attenuated drainage is discharged to water bodies. Refer to Section 6.2 above for further detail, as well as Appendix 14.3 Assessment of Routine Road Runoff and Accidental Spillages (HEWRAT) and Chapter 14 Road Drainage and the Water Environment. • The existing approximate 74.4 m Moor Ditch culvert will be replaced with an approximate 40 m culvert: a reduction of local culvert length and corresponding increase of open channel habitat of approximate 34.4 m. • Potentially headwalls could be set back from watercourses with green soft ditch connections to the aquatic habitats. • Length-for-length watercourse enhancement is required to offset the impacts of new culverts. • Watercourse enhancements are required for WFD compliance and at least 150 m of watercourse improvements are recommended.

6.6 Stage 3 - Potential Groundwater Impact Risks and Mitigation

Construction Impacts

Impact	Mitigation
• Contamination arising from spillages associated with the use and storage of construction chemicals, such as fuels could occur on groundwater bodies during construction works. • Construction activities may also open and modify potential pollutant linkages, including the disturbance of sediments, which may have adverse impacts on groundwater. This could include disturbance of historic landfilling west and south-west of Appleford, where superficial geology (permeable sands and gravels) could facilitate horizontal and vertical migration of leachate. • Excavations, piling, and other sub-surface works could encounter groundwater and increase risk pathways between the surface and groundwater bodies. • The Scheme does not overlie a WFD groundwater body, and local groundwater is Secondary aquifer. There is unlikely to be significant connectivity to the WFD water body.	• The PC will mitigate these risks using an approved CEMP, WMP and appropriate site management techniques. • The CEMP will include measures to manage the formation of excessive sediment in runoff and to reduce the risk of chemical spillages. • Construction impacts will be temporary and if methods of best practice are implemented this will lead to no permanent negative impacts. • Risks and mitigation from the Sutton Courtenay Landfill are described in the Ground Investigation Report that was submitted with the planning application. Due to the thickness of made ground in the landfill complete excavation of made ground is unfeasible. Significant cuttings are not proposed and piled foundations are not required at the landfill area, and so the landfill cap will be undisturbed. Drainage blankets are proposed, which will provide a stable platform for road construction, and control drainage of the pavement capping layer to prevent degradation of clay formations by surface water ingress will be designed as necessary • Additional ground investigations and suitable construction mitigation planning including groundwater management and pollution prevention measures will be required at the appropriate design stage.

Operational Impacts

Impact	Mitigation
• Increased highway runoff containing pollutants associated with vehicles could enter groundwater bodies and negatively impact groundwater quality. • The Scheme does not overlie a WFD groundwater body, and local groundwater is Secondary aquifer. There is unlikely to be significant connectivity to the WFD water body.	• The sustainable drainage design will mitigate runoff quantity from new areas of highways runoff with balancing ponds and swales. Pollution treatment trains will be implemented to control pollutants before attenuated drainage is discharged to water bodies. Refer to Section 6.5 above for further detail, as well as Appendix 14.3 Assessment of Routine Road Runoff and Accidental Spillages (HEWRAT) and Chapter 14 Road Drainage and the Water Environment. In addition, the new drainage system proposed for the Scheme has been designed to prevent and/or minimise the risk of groundwater contamination from highway runoff. Where groundwater levels are high, SuDS features will be lined in such a way that contamination of groundwater is prevented whilst ensuring the liner remains in place. Should the levels be prohibitively high, an alternative surface water connection will be made.

7. Summary of Mitigation Measures

7.1 Mitigation Measures

7.1.1 Mitigation measures have been incorporated into the Scheme design to minimise potential adverse impacts, particularly during the construction phase. The Scheme has been viewed as an opportunity to make improvements to the local environment where possible. Watercourse enhancements to compensate for operational impacts on watercourses (especially new culverts), have been designed to equivalent or greater lengths along the watercourses where possible.

7.1.2 Mitigation measures are as follows:

- Construction of the Scheme will be subject to measures and procedures as defined within the Outline Environmental Management Plan (OEMP) that have been developed for the Scheme (refer to ES Appendix 4.2). The OEMP includes a range of measures to enable compliance with relevant standards and legislation and best practice guidance to appropriately protect riparian and aquatic environments. The measures detailed within the OEMP will be developed into a CEMP and WMP and implemented by the selected construction contractor.
- Construction works would avoid peak fish migration and spawning seasons where practicable.
- Mitigation including fish rescue and translocation may be required during construction of culverts to relocate fish away from the works areas.
- Pollution control measures will be in place for the duration of the works in accordance with the CEMP. These would include designated fuelling areas well away from watercourses, spill kits in all plant/ vehicles on site suitable for fuel and wet trade spillages, and any bowsers for fuelling, pumps, generators, or similar to sit on drip trays to avoid any runoff of fuels. Special care would be taken where in-channel working is required.
- Sediment/ runoff control measures will be required throughout the duration of the construction phase. This will limit the impact of sediment mobilisation or any contaminated runoff.
- Bio-security measures will be required to ensure that no invasive species are spread around site or translocated elsewhere. Measures will include checks of plant/ vehicles and footwear to ensure clean and clear of potential contaminants with best practice implemented as necessary.
- The Scheme sustainable drainage design will mitigate runoff quantity from new areas of highways runoff with balancing ponds and swales. Pollution treatment trains will be implemented to control pollutants before attenuated drainage is discharged to water bodies.
- Culverts will be designed appropriately to maintain connectivity along watercourses for aquatic species and riparian mammals. Culverts will include mammal ledges of 500 mm width to facilitate passage of riparian mammals such as otters. Culvert inverts will be set 150 mm below bed level to allow continuity of bed substrate habitats, which will maintain longitudinal connectivity for fish and other aquatic fauna.
- Length-for-length watercourse enhancements are required to mitigate the impacts of new culverts and headwalls.

- Where practicable, headwalls would be set back from watercourses with green soft ditch connections to the aquatic habitats.
- The existing approximate 74.4 m Moor Ditch culvert will be replaced with an approximate 40 m culvert.
- Watercourse enhancements are required for WFD compliance and at least 150 m of watercourse improvements are required to mitigation for the loss of open channels and the impacts of headwalls.

7.1.3 Given the need for watercourse improvements, space along Meadow Brook has been earmarked in the Scheme boundary (at the junction of the A4130 widening and the Science Bridge) for watercourse enhancements to mitigate culvert and headwall impacts. The existing Meadow Brook is highly modified in this location by historic straightening, and is a low quality, uniform and trapezoidal channel.

7.1.4 The design of watercourse improvements will be undertaken during detailed design of the Scheme. The following measures would be included as far as reasonably practicable:

- Measures to improve the watercourse hydromorphological and ecological conditions (provided this is compatible with flood risk and land drainage functions).
- Natural flood risk measures to support combined WFD, biodiversity and flood management objectives.
- Creation of braided channels in inset floodplains and/ or re-meandering of the watercourse if possible and as far as site extents and design parameters allow.
- Provision of in-channel fluvial geomorphological features such as berms and bars to promote flow sinuosity and width/ depth variation and provide marginal habitat.
- Improvement of morphological flow types such as pools, riffles and runs, to provide aquatic habitat diversity.
- Provision of defined low-flow channels to sustain appropriate flow depths and velocities and improve potential for fish passage.
- Provision of varied channel bank profiles to improve morphological diversity, included areas of shallow-graded channel banks to allow for marginal vegetation growth.
- 7 m wide buffer strip on both sides of the channel if possible, to allow for marginal and riparian habitat improvements.

7.1.5 Watercourse mitigate measures will need to be designed according to flood risk and drainage constraints and within modelled design flood levels and extents.

7.1.6 Such watercourse designs should be undertaken by suitably qualified fluvial geomorphologists, aquatic ecologists, and flood risk specialists, in consultation with the EA Flood Risk and Biodiversity, Geomorphology and Fisheries Officers.

7.2 Summary of Compliance against WFD Objectives

7.2.1 Consideration of the Scheme mitigation in the context of the WFD waterbody objectives is provided in Table 7.1 for Moor Ditch and Ladygrove Ditch. This indicates that the Scheme does not cause deterioration or prevention of future improvement in any WFD element.

Table 7-1: Summary of WFD compliance for the Moor Ditch and Ladygrove Ditch water body, taking into account mitigation measures.

WFD Parameter	Status/ Summary	Residual Impacts and WFD Compliance
Water Body ID	GB106039023630	
Water Body Name	Moor Ditch and Ladygrove Ditch	
Water Body Type	River	
Water Body Length / Area	8.398 km / 26.87 km^2	
Hydromorphological Designation	Not designated artificial or heavily modified.	
Overall Ecological Status	Poor in 2015 (RBMP cycle 2); Poor in 2019 (most recent data)	Given the mitigation measures outlined in Section 6.2 – 6.6 and summarised in Section 7.1, there would be no deterioration or prevention of future improvement against Overall Ecological Status.
Current Overall Status	Poor in 2015 (RBMP cycle 2); Poor in 2019 (most recent data)	Given the mitigation measures outlined in Section 6.2 – 6.6 and summarised in Section 7.1, there would be no deterioration or prevention of future improvement against Current Overall Status.
Status Objective (overall)	Moderate in 2027 (Disproportionate burdens; no known technical solution is available)	Given the mitigation measures outlined in Section 6.2 – 6.6 and summarised in Section 7.1, there would be no prevention of the watercourse achieving Moderate Status by 2027.
Biological Quality Elements	Poor for Invertebrates and Macrophytes and Phytobenthos in 2015. Macrophytes improving to Moderate in 2019. Invertebrates subject to land drainage pressures associated with agriculture, urban developments and transport and sewage discharges.	Given the mitigation included for the Scheme (summarised in Section 7.1), particularly mitigation for biological impact as outlined in Section 6.2 (construction) and 6.3 (operation), the Scheme would not cause deterioration or prevention of future improvement in Biological Quality Elements.
Physico-chemical Quality Elements	Moderate in 2015 and 2019 due to Phosphates associated with point source pollution from trade and sewage treatment. Other measured elements are Good to High quality conditions.	Given the mitigation included for the Scheme (summarised in Section 7.1), particularly mitigation for physico-chemical impact as outlined in Section 6.4 (construction and operation), the Scheme would not cause deterioration or prevention of future improvement in Physico-Chemical Quality Elements.
Hydromorphological Quality Elements	Support Good potential	Given the mitigation included for the Scheme (summarised in Section 7.1), particularly mitigation for hydromorphological impact as outlined in Section 6.5 (construction and operation), the Scheme would not cause deterioration or prevention of future improvement in

WFD Parameter	Status/ Summary	Residual Impacts and WFD Compliance
		Hydromorphological Quality Elements.
Chemical	Good in 2015 and Fail in 2019, although this is due to monitoring of priority hazardous substances introduced in 2019 and does not necessarily indicate deterioration. Failing substances are Polybrominated diphenyl ethers (PBDE), Perfluorooctane sulphonate (PFOS) and Mercury.	Given the mitigation included for the Scheme (summarised in Section 7.1), the Scheme would not cause deterioration or prevention of future improvement in Chemical Quality Elements.
RBMP Priority Issues for the Ock Operational Catchment	Improve the status of invertebrates and engaging landowners to adjust land management practices to reduce diffuse pollution.	The Scheme would not have an adverse impact on these priority issues given implementation of mitigation (which includes for Biological Quality Elements as outlined above)

7.2.2 Consideration of the Scheme mitigation in the context of the WFD waterbody objectives is provided in Table 7.2 for Thames (Evenlode to Thame) water body. This indicates that the Scheme does not cause deterioration or prevention of future improvement in any WFD element.

Table 7-2: Summary of impact to WFD quality elements for Thames (Evenlode to Thame) water body, taking into account mitigation measures water body

WFD Parameter	Status/ Summary	Residual Impacts and WFD Compliance
Water Body ID	GB106039030334	
Water Body Name	Thames (Evenlode to Thame)	
Water Body Type	River	
Water Body Length / Area	63.863 km/ 14.959 km^2	
Hydromorphological Designation	Not designated artificial or heavily modified	
Overall Ecological Status	Moderate in 2015 (RBMP cycle 2); Moderate in 2019 (most recent data)	Given the mitigation measures outlined in Section 6.2 – 6.6 and summarised in Section 7.1, there would be no deterioration or prevention of future improvement against Overall Ecological Status.
Current Overall Status	Moderate in 2015 (RBMP cycle 2); Moderate in 2019 (most recent data)	Given the mitigation measures outlined in Section 6.2 – 6.6 and summarised in Section 7.1, there would be no deterioration or prevention of future improvement against Current Overall Status.
Status Objective (overall)	Moderate in 2015 (Unfavourable balance of costs and benefits; disproportionate burdens; no known technical solution is available)	Given the mitigation measures outlined in Section 6.2 – 6.6 and summarised in Section 7.1, there would be no prevention of the watercourse achieving Moderate Status.

WFD Parameter	Status/ Summary	Residual Impacts and WFD Compliance
Biological Quality Elements	Moderate due to invertebrates and fish in 2015. Monitoring data suggests an improvement in fish to Good in 2019. Suspected presence of North American Signal Crayfish - an invasive non-native species is preventing invertebrates from being considered Good.	Given the mitigation included for the Scheme (summarised in Section 7.1), particularly mitigation for biological impact as outlined in Section 6.2 (construction) and 6.3 (operation), the Scheme would not cause deterioration or prevention of future improvement in Biological Quality Elements.
Physico-chemical Quality Elements	Moderate in 2015 and 2019, due to Phosphates associated with point source pollution from continuous sewage discharge and diffuse source pollution from poor nutrient management and poor livestock management. High quality conditions for other measured variables.	Given the mitigation included for the Scheme (summarised in Section 7.1), particularly mitigation for physico-chemical impact as outlined in Section 6.4 (construction and operation), the Scheme would not cause deterioration or prevention of future improvement in Physico-Chemical Quality Elements.
Hydromorphological Quality Elements	Supports Good	Given the mitigation included for the Scheme (summarised in Section 7.1), particularly mitigation for hydromorphological impact as outlined in Section 6.5 (construction and operation), the Scheme would not cause deterioration or prevention of future improvement in Hydromorphological Quality Elements.
Chemical	Fail in 2015 and 2019 due to three priority hazardous substances; Polybrominated diphenyl ethers (PBDE), Perfluorooctane sulphonate (PFOS), and Mercury (Fail).	Given the mitigation included for the Scheme (summarised in Section 7.1), the Scheme would not cause deterioration or prevention of future improvement in Chemical Quality Elements.
RBMP Priority Issues for the Ock Operational Catchment	Improve the status of invertebrates and engaging landowners to adjust land management practices to reduce diffuse pollution.	The Scheme would not have an adverse impact on these priority issues given implementation of mitigation (which includes for Biological Quality Elements as outlined above)

8. Conclusion and Recommendations

8.1.1 This WFD assessment has reviewed the water bodies that would be affected by the proposed Didcot Garden Town Housing Infrastructure Fund (HIF 1), and mitigation measures embedded in the proposals to manage risks to the water environment.

8.1.2 The majority of the Scheme can be screened out from the need for WFD impact assessment.

- The Scheme does not overlie a WFD groundwater body. Local groundwater connectivity is limited, and no significant risks to WFD groundwater bodies are anticipated (including from disturbance of historic landfilling west and south-west of Appleford).
- Sustainable Drainage Systems will control runoff quantity and quality from the new highway surfaces.
- The Scheme requires a new clear span crossing of the River Thames (Evenlode to Thames) WFD water body (GB106039030334). This is considered a low risk WFD activity without significant impacts on WFD objectives.

8.1.3 The Scheme recognises that there are some unavoidable WFD impacts, but is fully committed to mitigating those impacts.

- The majority of the Scheme is within the Moor Ditch and Ladygrove Ditch WFD water body (GB106039023630). This is not designated as a heavily modified water body, but within the vicinity of the Scheme, the entire watercourse network is highly modified by extensive urbanisation and industry. All river channels in the study are extensively culverted, while the remaining sections of open channel are uniform and trapezoidal, and enlarged for flood and drainage capacity. Developments have encroached into floodplains up to bank tops in most places, and riparian vegetation and habitat corridors are generally absent. There are numerous artificial drains and ditches within the floodplain, many of which are associated with highways and other historic developments, and which are generally dry in most weather conditions without offering significant aquatic habitat.
- The Scheme requires new culvert crossings of Moor Ditch. The new culverts are generally adjacent to existing culverts, so are unlikely to cause any significant habitat network fragmentation compared to the existing baseline. Given the existing highly urbanised and degraded channels, new culverts are unlikely to have a significant impact at the water body scale, and would not prevent future water body improvements since these do not appear feasible in such a densely urban area. New culvert designs will be environmentally sympathetic (more so than existing culverts), and will include allowances for bed habitat continuity and mammal ledges. An existing culvert on Moor Ditch will be shortened to offset new impact lengths as far as possible.
- In total, there will be a net length of approximately 113.1 m of new culverts and corresponding losses of open channel due to the Scheme. Compared with the 8.398 km water body length within the study area, this represents a net loss of 1.3% of the water body open watercourse habitat.
- Drainage outfall headwalls may also need to be constructed along the watercourse banks, which will increase physical impact lengths, but details of headwalls have not yet been developed.
- A commitment to watercourse enhancement on at least a length-for-length basis is required to mitigate the Scheme impacts of unavoidable new culverts and

headwalls for WFD compliance. It is proposed that at least 150 m of watercourse improvements are undertaken along Meadow Brook within the Scheme boundary to mitigate for the loss of open channels and the impacts of headwalls. Following completion of such works there will be no net effect on the water body WFD status.

8.1.4 It is therefore considered that the proposals fully uphold WFD objectives, and no further WFD assessment is required. Mitigation designs inclusive of the environmental measures described above will be WFD compliant.

8.1.5 In accordance with the above, it is concluded that the Scheme with mitigation measures will **not**:

- Cause a deterioration in ecological status / potential of any water body.
- Prevent local water bodies from meeting objectives of good ecological status / potential.
- Prevent or compromise WFD objectives being met in other water bodies.
- Cause failure to meet good groundwater status or result in a deterioration of groundwater status.
- Prevent the implementation of WFD watercourse mitigation measures (as outlined by the Environment Agency) which define the hydromorphological designation of heavily modified water bodies.

9. References

Ref 1 Environment Agency (2016a). Water Framework Directive Risk Assessment. How to assess the risk of your activity. Available at: https://www.gov.uk/government/publications/water-framework-directive-how-to-assess-the-risk-of-your-activity. Last accessed May 2021.

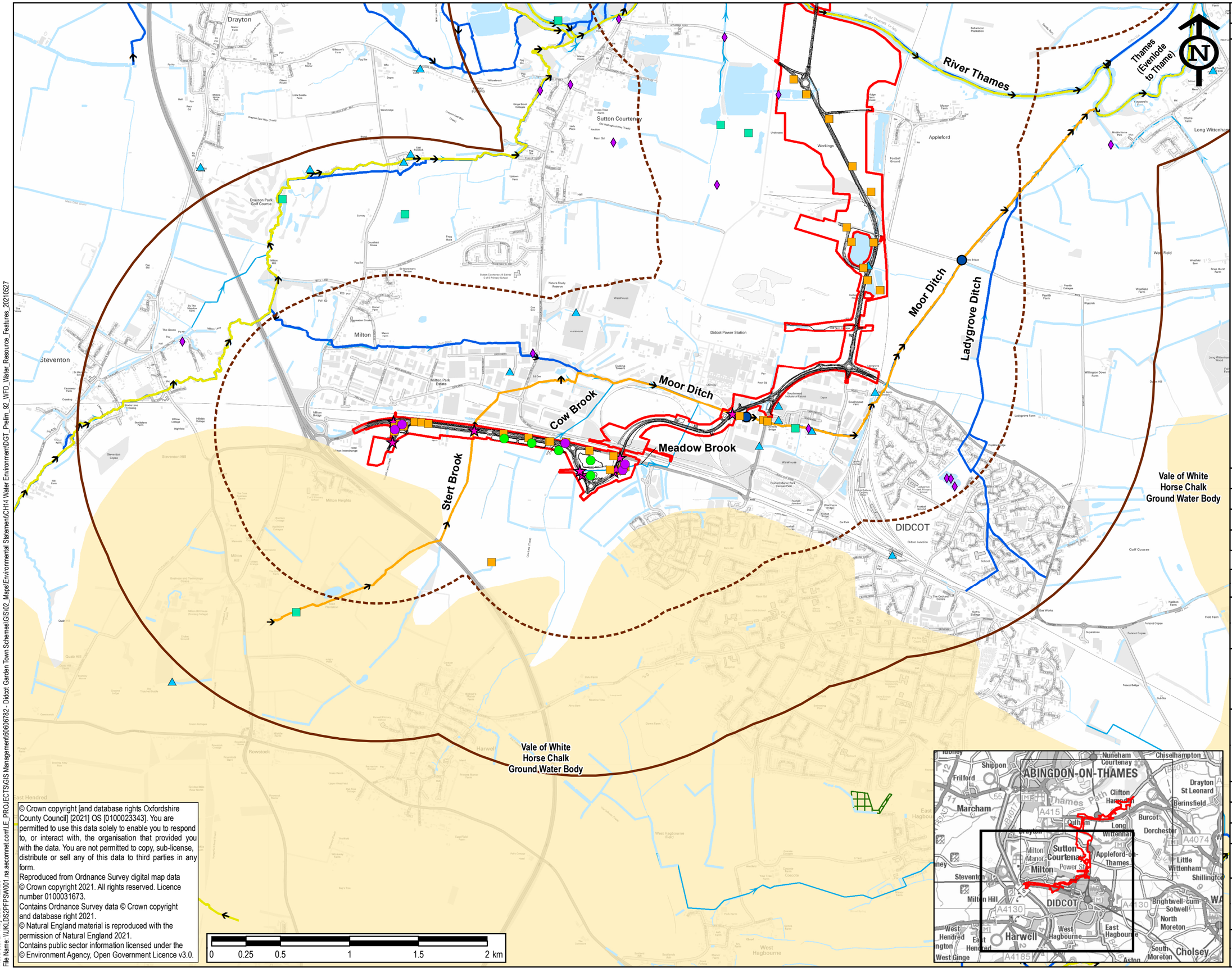
Ref 2 Environment Agency (2016b). Protecting and improving the water environment. Water Framework Directive compliance of physical works in rivers. Environment Agency internal position statement; made available to AECOM as a result of a data request.

Ref 3 The Planning Inspectorate (2017). Advice Note eighteen: The Water Framework Directive. Available from: https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/. Last accessed May 2021.

Ref 4 AECOM (2021) DGT HIF 1 Scheme Drainage Strategy.

Annex A Scheme and Water Body Overview

Plot Date: 27 May 2021 11:22:28
File Name: \\UKLDS2PFPSW001.na.aecomnet.com\LE_PROJECTS\GIS Management\60606782 - Didcot Garden Town Schemes\GIS\02_Maps\Environmental Statement\CH14 Water Environment\DGT_Prelim_92_WFD_Water_Resource_Features_20210527



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

LEGEND

- Indicative Red Line Boundary (Subject to Change)
- Red Line Boundary 1km Buffer
- Red Line Boundary 2km Buffer
- Indicative OCC Highway Design (Subject to Change)
- Third Party Basin
- Pond
- Outfall
- Culvert
- Local Nature Reserve*
- Pollution Incident
- Water Activity Permit
- Abstraction License
- Main River
- Ordinary Watercourse
- Surface Water
- Environment Agency Water Quality Monitoring Location

WFD Surface Water - Ecological Class:
- Moderate
- Poor

WFD Ground Water - Overall Class:
- Poor

NOTE:
*This national dataset is "indicative" not "definitive". Definitive information can only be provided by individual local authorities and you should refer directly to their information for all purposes that require the most up to date and complete dataset.

First Issue	AG / TJ	26/05/21	P01
Revision Details	By / Check	Date	Suffix

Purpose of issue: FOR INFORMATION

Client: OXFORDSHIRE COUNTY COUNCIL
County Hall, New Road, Oxford, OX1 1ND

Project Title: DIDCOT GARDEN TOWN HIF 1 SCHEME

Drawing Title: ANNEX A WATER RESOURCE FEATURES AND DRAINAGE STRUCTURES SHEET 1 OF 2

Designed	Drawn	Checked	Approved	Date
SG	AG	LC	TJ	27/05/2021

Internal Project No. 60606782	Suitability S2
Scale @ A3 1:25,000	Discipline Water

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Drawing Number: Work Package ID	Originator	Volume	Rev
GEN_PD DGT_ZZ_ZZ_ZZ	-ACM	-EWE - - FG - HD - 0010	P01
Location		Type | Role | Number	

Shrivenham Corallian Ground Water Body

Ock and tributaries (Land Brook confluence to Thames)

Culham Brake (SSSI)

Thames (Evenlode to Thame)

River Thames

River Thames or Isis

Moor Ditch

Ladygrove Ditch

Nuneham Park

Burcot

Culham

Sutton Courtenay

Appleford

Long Wittenham

Little Wittenham

Didcot Power Station

0 0.25 0.5 1 1.5 2 km

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LEGEND

- Indicative Red Line Boundary (Subject to Change)
- Red Line Boundary 1km Buffer
- Red Line Boundary 2km Buffer
- Indicative OCC Highway Design (Subject to Change)
- Outfall
- Culvert
- Site of Special Scientific Interest
- Local Nature Reserve*
- Private Water Supply
- Pollution Incident
- Water Activity Permit
- Abstraction License
- Main River
- Ordinary Watercourse
- Surface Water
- Environment Agency Water Quality Monitoring Location

WFD Surface Water - Ecological Class:

- Moderate
- Poor

WFD Ground Water - Overall Class:

- Good
- Poor

NOTE:
*This national dataset is "indicative" not "definitive". Definitive information can only be provided by individual local authorities and you should refer directly to their information for all purposes that require the most up to date and complete dataset.

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Purpose of issue: FOR INFORMATION

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Project Title: DIDCOT GARDEN TOWN HIF 1 SCHEME

Drawing Title: ANNEX A WATER RESOURCE FEATURES AND DRAINAGE STRUCTURES SHEET 2 OF 2

Designed	Drawn	Checked	Approved	Date
SG	AG	LC	TJ	27/05/2021

Internal Project No. 60606782	Suitability S2
Scale @ A3 1:25,000	Discipline Water

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Drawing Number: Work Package ID GEN_PD | Originator -ACM | Volume -EWE - | Location DGT_ZZ_ZZ_ZZ - FG - HD - 0010 | Type | Role | Number | Rev P01

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