6. Water

6.1. Introduction

This chapter considers the impact on water resources which includes: fluvial geomorphology, flood risk, and water quality issues. This chapter assesses the surface and features within the footprint of the Proposed Scheme and hydraulically linked features in the surrounding environment and incorporates the potential effects on the fluvial (freshwater) sections of the Sowy and KSD.

6.2. Regulation and policy background

The following table (Table 6.1) summarises the fundamental pieces of legislation adopted for water.

Table 6.1 Relevant legislation

Legislation	Principal functions of adoption
Water Framework Directive (2000/60/EC)	Introduced a comprehensive river basin management planning system to help protect and improve the ecological health of our rivers, lakes, estuaries and coastal and groundwaters. This is underpinned by the use of environmental standards to help assess risks to the ecological quality of the water environment and to identify the scale of improvements that will be needed to bring waters under pressure back into a good condition.
Water Environment (Water Framework Directive) (England and Wales) Regulations 2003	Transposed the Water Framework Directive to enable water body management in England and Wales.
Floods Directive 2007/60/EC	Addresses the assessment and management of flood risks and entered into force on 26 November 2007. Requires Member States to assess if all water courses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk
Environmental Protection Act 1990	Makes provision for the improved control of pollution to the air, water and land by regulating the management of waste and the control of emissions
Water Resources Act 1991	Regulates water resources, water quality and pollution, and flood defence.

Legislation	Principal functions of adoption
Water Act 2003	Regulates water companies to increase the resilience of water supplies to natural hazards such as droughts and floods**.**

A Detailed Water Framework Directive (WFD) Compliance Assessment has been undertaken (see Appendix E) to assess the impacts of the Proposed Scheme on the quality elements of the relevant water bodies. This includes impacts to biology (including fish), chemical, and hydromorphology indicators. This includes a review of the proposed various elements of the Proposed Scheme and a consideration of their impact on the relevant water bodies.

6.3. Methodology

6.3.1. Scope

The scope of assessment as identified in the PEIR for the Proposed Scheme is shown below in Table 6.2.

Table 6.2 Scope of assessment

Scoped in	Scoped out
Impacts to WFD quality elements and requirement for detailed assessment on King's Sedgemoor Drain.	Impacts to River Cary scoped out due to no works affecting a WFD water body
Construction and operational impacts to King's Sedgemoor Drain	
Operational impact to flood risk	
Construction and operational risk of haul road/tracking of plant	

6.3.2. Scope

Three study areas are defined for this assessment as follows:

- Impacts on WFD waterbodies – construction footprint (see Figure 3.1, Appendix A). Upstream and downstream water bodies are not included as the Preliminary WFD Compliance Assessment (Appendix F) identified that impacts of the Proposed Scheme will not propagate that far.
- Impacts on non-WFD waterbodies – construction footprint (see Figure 3.1, Appendix A)
- Flood risk – geographical extent of areas benefitting from flood risk protection from the full River Sowy and King's Sedgemoor Drain Enhancements Scheme, including residential and commercial properties and holdings and infrastructure within Kings Moor, Curry Moor, Hay Moor, Salt Moor and North Moor, King's Sedgemoor and Earlake Moor (Environment Agency, 2015)

6.3.3. Guidance

Our internal guidance (Operating Instruction 488-10) provides an overview of what the regulators will like to see in a WFD compliance assessment and has been used to inform this assessment. Additionally, reference to the WFD Regulations 2003 is also used as this lays out what the regulations consider as assessment.

6.3.4. Establishing the baseline

The baseline information for the study area has been established primarily from a desk-based review of the following sources:

- South West River Basin District River Basin Management Plan (DEFRA, 2015)
- Environment Agency data, including Catchment data explorer (https://environment.data.gov.uk/)

6.3.5. Determination of significance

Water quality and quantity (including WFD status)

The methodology used for assessing the impacts on water resources follows the general approach set out in Chapter 5. The definitions of value/sensitivity and magnitude criteria specifically relevant to impacts on water quality and quantity is set out in Tables 6.3 and 6.4 below.

Table 6.3 Indicative criteria for estimating the value/sensitivity for water resources

Value /sensitivity of the receptor	Criteria
High	Has no capacity to accommodate the proposed form of change. The receptor is of international importance. Likely to be rare with minimal potential for substitution. May also be of high or very high socio-economic importance. A surface water resource of pristine or near pristine water quality, and/or international scale:

Value /sensitivity of the receptor	Criteria
	• 'High' or 'Good' overall WFD water quality status, and/or water feature is a valuable water supply • Protected/designated under EC legislation (Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar site) • Water feature appears in complete equilibrium with natural processes occurring
Medium	Has low to moderate capacity to accommodate the proposed form of change. The receptor is designated and/ or of national importance. Likely to be relatively rare. May also be of high socioeconomic importance. A surface water resource with a measurable degradation in its water quality as a result of anthropogenic factors, and/ or rarity on national scale: • 'Moderate' overall WFD water quality status or considered to exhibit 'Moderate' water quality based on professional judgement • 'Moderate' overall ecology status or potential • Water feature with some natural processes, including varied flow types Modifications and anthropogenic influences having an obvious impact on natural flow regime, flow pathways and processes
Low	Has moderate to high capacity to accommodate the proposed form of change and/ or includes non-statutory sites of regional or local importance designated for water dependent ecosystems. • A surface water resource with poor water quality resulting from anthropogenic factors, where the species diversity of flora and fauna is greatly affected by water quality degradation • 'Poor' overall WFD water quality status or potential, or considered to exhibit 'Poor' water quality based on professional judgement • 'Poor' overall ecology status • Water feature which shows limited evidence of active natural processes with unnatural flow regime or/and uniform flow types and minimal secondary currents

Value /sensitivity of the receptor	Criteria
Negligible	Has high capacity to accommodate the proposed form of change and/ or is non-statutory sites of local importance. A surface water resource with bad water quality resulting from anthropogenic factors, where the species diversity of flora and fauna is greatly affected by water quality degradation: • 'Bad' overall WFD water quality status or potential, or considered to exhibit 'Bad' water quality based on professional judgement • 'Bad' overall ecology status • Water feature which shows no evidence of active natural processes with unnatural flow regime or/and uniform flow types and minimal secondary currents

Table 6.4 Indicative criteria for determining the magnitude of the impact

Magnitude of Impact	Criteria
High	Continuous change, over the whole development area and beyond (i.e. offsite extending into the far-field), of a scale that will change key characteristics or features of the particular environmental aspect's character or distinctiveness. Proposed development results in a reduction (or improvement) in the quality and integrity and/ or loss (or gain) of the water feature, i.e.: • Material changes to the baseline condition of the water feature, hydrology or hydrodynamics, and morphology which may be long-term or permanent • Effects that result in a fundamental change to water quality condition either by a relatively high amount over a long-term period or by a very high amount over an episodic event • Likely to result in a reduction in the overall WFD chemical/ecological classification level and therefore WFD status • Long-term loss or change to designated species/habitats or water supply
Medium	Noticeable, temporary (during the project duration) or infrequent change, over the far-field, of a scale that will

Magnitude of Impact	Criteria
	partially change key characteristics or features of the particular environmental aspect's character or distinctiveness; or continuous change to the near-field environment of a scale that will change key characteristics Proposed development results in a moderate measurable change in the quality and integrity and/or the loss of the water feature, i.e. • Moderate changes to the baseline condition of the water feature hydrology or hydrodynamics, and morphology which may be long-term or permanent • Likely to result in a decline in water quality but not sufficient to change the overall WFD chemical/ecological classification level and therefore WFD status • May result in temporary impacts on designated species/habitats or water supply
Low	Noticeable, temporary (for part of the project duration) change, or barely discernible change for any length of time, over a small area, to key characteristics or features of the particular environmental aspect's character or distinctiveness. Proposed development results in a minor measurable change in the quality or vulnerability of water feature, i.e. • Observable changes to the water feature hydrology or hydrodynamics, and morphology but temporary in nature • A temporary decline in water quality during construction; and/or a slight decline in water quality during operation but insufficient to change the current WFD chemical/ecological classification level and therefore WFD status
Negligible	Changes which are not discernible from background conditions. Proposed development results in an effect on water feature but of insufficient magnitude to affect the use or condition, i.e. • No observable changes to the water feature, hydrology or hydrodynamics and morphology • No measurable change in water quality at any time during construction and/or operation, thus no change to WFD chemical/ecological classification level and therefore WFD status

The nature and characteristics of impacts have been described to enable their magnitude to be determined. The nature of the impacts has first been expressed as:

- Adverse – detrimental or negative impacts on an environmental resource or receptor
- Beneficial – advantageous or positive impact on an environmental resource or receptor

The significance of effect is calculated based on the value/sensitivity of a resource and the magnitude of impact using the matrix shown in Figure 5.1 (p44).

Flood risk

For the assessment of flood risk, a qualitative assessment of the impact of the Proposed Scheme during construction and operation is provided. The Proposed Scheme assessed within this report is Phase 1 of the full River Sowy and King's Sedgemoor Drain Enhancements Scheme, and no flood modelling has been specifically undertaken for this first stage which comprises only enhancements to the capacity of the Sowy/KSD system and does not include operational enhancements to allow the volume of water diverted from the Parrett into the Sowy/KSD system to increase.

6.3.6. Assumptions and Limitations

Assumptions for the assessment of impacts of WFD waterbodies are that no substantial changes in quality assessments have occurred since the 2016 data input to Catchment Data Explorer.

6.4. Existing environment

The Proposed Scheme lies within the Somerset Levels which comprises lowlands, ditches and wetland habitat. The Somerset Levels area comprises floodplains within the 65,000 ha area of the Rivers Axe, Brue, Parrett, Tone and their tributaries. The majority of the area is only a few metres above mean sea level and drains via a large network of ditches, rhynes and rivers, including the Sowy and KSD. A series of WLMPs are in place to control the timing, extent, and duration of floodplain inundation for the management of designated nature conservation sites (considered within Chapter 7).

Water body features

The Proposed Scheme lies within the South West River Basin District (RBD) and within the "King's Sedgemoor Drain - Henley Sluice to mouth" WFD water body. Figure 6.1 in Appendix A illustrates the location of this and associated water bodies.

The Proposed Scheme lies within the waterbody:

- King's Sedgemoor Drain – Henley Sluice to mouth (water body ID GB108052021150).

The connected water bodies scoped into assessment are:

- Cary - source to confluence with KSD (water body GB108052015140)

Baseline details for these water bodies are provided in Appendix E.
In addition to the WFD water bodies listed above, there are also a number of rhynes and ditches discharging into the Cary and KSD

Morphologically, the KSD and Sowy are artificial embanked drainage channels, connected to smaller field drains. These channels are homogeneous in nature and comprise embankments along the floodplain with steep channel sides. They possess very few morphological features. Channels are predominantly straight and exhibit little variation in channel morphology, bed morphology and sediment type. Sediment abundance is high due to the nature of the catchment and water velocities are slow. This is because of the low-lying nature of the landscape, its low elevation not far above sea level, and agricultural soil losses being high resulting in high sediment loading in the channels.

In terms of WFD, the water courses are important for fish, particularly coarse fish, and eels. Although many of the flow control structures on the rhynes have fish pass structures, fish passage is restricted during normal and low flows on the KSD, due to the operation of the KSD water level management structures. During high flows there is enough volume of water for fish to pass through the KSD. Eels migrate through the KSD and beyond via Dunball.

The network of rhynes and ditches in the study area provides suitable habitat for a diverse range of aquatic invertebrates, which are also status elements within WFD classification.

Water quality
In terms of water quality, both generally and for WFD classification purposes, there have been 20 years of steady water quality improvements across the Somerset Levels and Moors catchments; however, phosphate levels remain a concern. There are some local water quality issues in the study catchment due to diffuse and point sources of pollution. Diffuse pollution is primarily caused by high phosphate levels from nutrient enrichment (fertilisers) and private septic tank overflows. Point sources of pollution mainly occur at sewage treatment works.

Weed-cutting activities can also cause significant drops in dissolved oxygen (DO) levels on watercourses and are undertaken by various bodies including Environment Agency and the Internal Drainage Board (IDB). The Environment Agency's Operations Delivery team take DO readings before and during weed cutting to ensure water quality does not deteriorate rapidly. If DO levels drop below 20%, all operations stop immediately, including the operation of pumping stations. This practice helps to prevent fish kills and unnecessary damage to the aquatic environment.

Flooding

On the Somerset Levels and Moors, serious flooding (if defined as >10 properties flooded) was experienced in 1872, 1894, 1929, 1960, 1999, 2000, 2012 and 2013/14, which implies on average serious flooding every 15 years. Extreme flooding of similar scale to 2013/14 was experienced possibly only in 1960 in 142 years of records, which implies extreme flooding once every 70 years on average.

Floodwater in the Somerset Levels and Moors system is managed via a complex of drains, pumps, natural river channels and flood relief systems. The majority of the area is only a few metres above mean sea level. This is a landscape of rivers and wetlands, artificially drained, irrigated and modified to allow productive farming. The levels are mainly used for summer cattle grazing, often in conjunction with hay or silage production. In response to severe flooding in the 1960s the Parrett Flood Relief Channel, combining the Sowy-KSD system, was built in the early 1970s. The system conveys flood flow from the Parrett, just downstream of Langport at Monk's Leaze Clyce, via the Sowy and KSD to the tidal sluice at Dunball in the Parrett Estuary.

The Parrett Flood Relief Channel (Sowy and lower KSD) was designed for moderate winter flooding, but not on the scale of the exceptional flooding experienced in 2013-14. Due to funding constraints, the 1970s as-built scheme was of a reduced capacity (flow of 17 m^3/s) compared with the original scheme design (flow of 30 m^3/s). However, many of the bridges were built or modified to provide the full 30 m^3/s capacity in case the opportunity arose to enlarge the channels in the future.

The Sowy/KSD system is used to reduce flood risk, to drain land in winter and to supply water to agricultural land including designated conservation sites in summer, in accordance with the local WLMP. The system was designed without pumping at Dunball, with the KSD sized to accommodate a degree of tide-locking.

6.5. Likely significant effects

6.5.1. Construction

During construction, there will be some impacts to the aquatic/geomorphic environments. These are outlined in the following sections.

WFD compliance

Impacts are likely to be confined to the channel and floodplain at the areas of work plus the downstream channel. These impacts are likely to include:

- Potential increase in suspended sediment concentrations and release of materials into the water column from construction of embankments, backwaters and two stage channel features
- Increased sedimentation following on from the above
- Compaction of the floodplain from plant tracking across the site, which can change permeability of the substrate, interrupt hydrology of both the riparian zone substrate and the area’s surface, and increase erosion potential
- Impacts to WFD quality elements such as disturbance to fish, invertebrates and macrophytes during construction, due to noise, increased suspended sediment and actual disturbance/removal of existing habitat

Factors with the potential to contribute to these risks include activities in construction compounds, temporary stockpiles of loose material and movement of plant all of which could provide a pathway to the receptor from sediment disturbance, and risk of spillages into the water course, or on adjacent land.

Factors which will undoubtedly contribute to these risks are:

- In-channel construction works. These will increase the risk of reduced oxygen levels from disturbance of sediment within the channel
- Activities associated with the raising and re-profiling of the existing informal flood banks, which will result in some sediment runoff

The KSD and Sowy are of medium sensitivity, and the impact magnitude is medium. Before mitigation, there will be a moderate adverse (i.e. significant) effect upon these receptors.

Surface water (non WFD waterbodies)

This section covering impacts to surface water bodies that are not WFD waterbodies. This includes the Langacre Rhyne, KSD back ditch and other ditches/rhynes within the study area, including Cossington Right Rhyne.

Works to Cossington Right Rhyne and Chilton outfalls could affect the KSD Back Ditch by affecting the amount of water discharging into it via runoff. Headwall raising can reduce connectivity of overwash/runoff between the two. Headwall raising is unlikely to impact on substrate, so should have negligible effect in terms of morphology or sedimentation risks.

The non-WFD surface waters within the study area are of medium sensitivity, and the impact magnitude is medium. Before mitigation, there will therefore be a moderate adverse (i.e. significant) effect upon the receptors.

Flood risk

Construction involves a net removal of soil/sediment from the KSD and Sowy channels associated with the construction of the WFD enhancement features. There is also a substantial amount of material being imported into the area to raise the existing informal flood banks adjacent to the Sowy and KSD channels. There will be short periods during the construction phase, where excavated material will be stockpiled on site prior to placement for permanent works.

The available flood storage volume in the floodplain is not expected to be significantly affected by this temporary stock piling of material; the overall loss of storage capacity will be negligible compared to the total volume. Therefore, the risk of flooding during construction is not expected to change.

6.5.2. Operation

During operation, there will be some beneficial impacts to the aquatic/geomorphic environments of the KSD. These are outlined in the following sections.

Impacts to WFD quality elements and requirement for detailed assessment on the KSD

The Proposed Scheme will result in an increase in channel conveyance by the construction of a two-stage channel and embayments along “King’s Sedgemoor Drain – Henley Sluice to mouth”. This will lead to increased channel and riparian

habitat, and reduced duration and frequency of extreme flooding on the intensive agriculture floodplain.

Additional positive benefits include improving water quality, riparian habitat and hydromorphology due to increasing heterogeneity in the channel, adding backwaters, and improving channel cross section, which will have an overall benefit to the water body and adjacent environment.

Consequently, the Detailed WFD Compliance Assessment (Appendix E, Annex E2) concludes that the Proposed Scheme will improve aquatic habitats, riparian habitat and flow diversity and maintain fish passage. Recognising the artificial (AWB) classification of the water body, the channel structural changes that will be delivered by the scheme are likely to complement progress towards good ecological potential.

There is some potential for adverse residual effects with regard to river processes in the water body after the scheme is completed, i.e. related to ponding of water in the two-stage channel during flood flows. This is an unavoidable consequence of the Proposed Scheme. On balance the establishment of more diverse in-stream habitats is considered to outweigh any adverse effects of ponding of water, especially considering that without the Proposed Scheme the AWB is already largely impounded through the summer months.

In summary, operational impacts will benefit the Sowy and KSD due to the improvement of the aquatic environment and the improvement to the overall hydromorphology. The receptor is medium sensitivity, the impacts will be medium magnitude, and the significance of effects will therefore be moderate beneficial (i.e. significant) effect.

Surface water (non WFD waterbodies)

Works in non WFD water bodies will result in similar impacts to the WFD water bodies. The Proposed Scheme will lead to increased channel and riparian habitat, and reduced flooding on the intensive agriculture floodplain.

In summary, operational impacts will benefit the non WFD water bodies due to the improvement of the aquatic environment and the improvement to the overall hydromorphology where there is a hydrological connection, in particular. The receptor is medium sensitivity, the impacts will be medium magnitude and the significance will therefore be a moderate beneficial (i.e. significant).

Flood risk

With implementation, the frequency of overtopping of banks along the KSD and Sowy within the scheme extents will reduce, with attendant beneficial impacts for flood risk in adjoining lands. The Proposed Scheme will contribute towards the flood risk benefits achieved through the full River Sowy and King's Sedgemoor Drain Enhancements Scheme once implemented, in combination with other measures included within Somerset Levels and Moors Flood Action Plan.

6.6. Mitigation

The following best practice mitigation measures will be applied during construction to reduce the risk of pollution of the water environment:

- Production of an Emergency Pollution Response Plan (EPRP)
- Adherence to best practice pollution prevention
- Polluting materials will not be stored closer than 5m from any watercourse, including storage and compound areas
- Production of a Surface Water Management Plan (SWMP) (including measures to minimise site runoff as agreed with our internal technical specialists)
- Implementation of standard spill/leak control measures (e.g. bunded fuel storage area, spill kits, interceptors)
- Consideration and mitigation of the risk of silt generation from 'just in time' stockpile areas from rainfall/flood events, and of leachate generation from excavated materials, e.g. by the use of impermeable bases, flood bunds, and temporary covering of exposed material.
- Use of silt curtains or booms to minimise sediment dispersal during construction of WFD enhancement features, or if not practicable, implementation of dissolved oxygen monitoring during warmer weather periods
- Use of drip trays, which will be of adequate capacity and regularly maintained
- Fuel storage will be in appropriately bunded areas and refuelling activities will take place in designated areas away from the river
- The contractor shall register for flood warnings and shall ensure that no equipment or potentially polluting materials are left at risk of flooding
- Specific toolbox talks will be given about the risk of water pollution
- Construction of the WFD enhancement feature to be supervised by a suitably experienced Ecological Clerk of Works (ECoW) and a geomorphologist

6.7. Conclusions and summary of residual effects

During construction potential significant effects on water quality during construction will be mitigated through the preparation of a SWMP and use of best practice pollution control measures. Once operational the Proposed Scheme is deemed to have an overall beneficial change in terms of flood risk through its contribution to the full River Sowy and King's Sedgemoor Drain Enhancements Scheme and in combination with other measures implemented under the Somerset Levels and Moors Flood Action Plan. Table 6.5 provides a summary of residual effects, where significant effects (i.e. moderate or above) are predicted in the absence of mitigation.

Table 6.5 Residual effects where significant effects are predicted in the absence of mitigation

Receptor (sensitivity/value)	Nature of impact (magnitude)	Significance (pre-mitigation)	Mitigation	Residual effect
Construction				
WFD water bodies (King's Sedgemoor Drain and Sowy) (medium)	Increase in suspended sediments within water column; disturbance to marginal habitat; risk of reduced oxygen levels in-channel (medium, temporary)	Moderate adverse	Preparation and implementation of a SWMP and EERP Compliance with best practice pollution prevention measures Use of silt curtains/booms or DO monitoring in summer Toolbox talks regarding water quality risks Geomorphologist and ECoW to supervise in channel works	Minor adverse (not significant)
Non-WFD water bodies (Langacre, and other rhynes) (medium)	Increase in suspended sediments within water column; disturbance to marginal habitat; risk of reduced oxygen levels in-channel (medium, temporary)	Moderate adverse	Preparation and implementation of a SWMP and EERP Compliance with best practice pollution prevention measures	Minor adverse (not significant)

Receptor (sensitivity/value)	Nature of impact (magnitude)	Significance (pre-mitigation)	Mitigation	Residual effect
			Use of silt curtains/booms or DO monitoring in summer Toolbox talks regarding water quality risks Geomorphologist and ECoW to supervise in channel works	
Operation				
WFD water bodies (King's Sedgemoor Drain and Sowy) (medium)	Overall improvement due to provision of WFD enhancement features (embayments, two stage channels and backwaters) (medium, permanent)	Moderate beneficial (significant)	None identified	Moderate beneficial (significant)
Non-WFD water bodies (Langacre, and other rhynes) (medium)	Overall improvement due to implementation of works within KSD (medium, permanent)	Moderate beneficial (significant)	None identified	Moderate beneficial (significant)

Receptor (sensitivity/value)	Nature of impact (magnitude)	Significance (pre-mitigation)	Mitigation	Residual effect
Communities and infrastructure benefitting from flood risk protection from the full River Sowy and King's Sedgemoor Drain Enhancements Scheme (N/A -qualitative descriptive assessment only)	Positive contribution towards flood risk alleviation in combination with other measures and future works	Not assessed (qualitative descriptive assessment only)	None identified	Beneficial (qualitative descriptive assessment only)