

Havant Thicket Reservoir Project

Environmental Statement Volume 4 - Appendices

Appendix A15 Water

A15.1 Water Framework Directive (WFD) Assessment

Portsmouth Water Ltd.

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Foreword

by Bob Taylor, Chief Executive of Portsmouth Water

I feel extremely privileged to be the Chief Executive Officer at Portsmouth Water at this moment as we submit our planning application for the Havant Thicket Reservoir.

It has taken some years to reach this stage and as a Havant-based company we're delighted to be in a position to deliver this vital strategic water resource for the South East and create a unique leisure and wildlife environment for local communities.

Portsmouth Water has a long history since 1857 of supplying water to this area, and we've continually maintained a proud record of some of the highest service standards and the lowest water supply charges of all the water companies in England and Wales.

We believe in 'doing the right thing', a belief further embedded in our Community Pledge, launched earlier this year, and our Community Partnership, launched in the Spring which ensures society benefit is considered in all our decisions. Our aim is to make sure our objectives are in line with those of our communities.

Nowhere is this more important than in the development and delivery of a large infrastructure project like a reservoir, the first to be progressed in the South East since the 1970s.

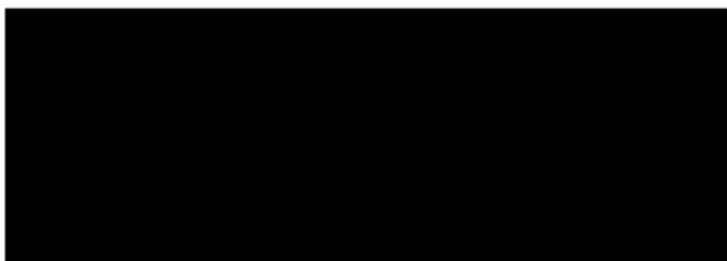
This project has always had the potential to provide many additional benefits, over and above its core purpose of securing vital water supplies for our customers and those of Southern Water – ensuring we're ready for housing growth, climate change and protecting two world-famous rare chalk streams in Hampshire.

We believe we've captured that potential in this application, not least through the creation of a wetland for threatened bird species, extensive tree, hedgerow and wildflower planting, drought resilience and the educational, training and employment opportunities these also bring. Our plans also create a green leisure space with paths and play areas – offering priceless benefits for health and wellbeing – with a visitor centre aimed at bringing communities together.

And with our eye on future challenges, we've also considered the role we'll play in meeting our unique commitment as an industry to become carbon net zero by 2030.

We've listened carefully to the ideas and thoughts of our customers, communities, partners and regulators – held discussion groups, drop-in sessions, delivered talks, chatted on Facebook, spent time with young people and engaged tirelessly with our regulators, environmental organisations and the planning authorities. We believe this is part of the reason we have such strong support.

We think this application embodies not only our hopes and aspirations for the reservoir, but also those of the communities who will benefit and be part of its delivery, and we look forward to continuing to work in partnership with our neighbours over the months and years to come.



Bob Taylor, Chief Executive Officer, Portsmouth Water

1. Introduction

Overview

- 1.1. This WFD assessment follows guidance produced by The Planning Inspectorate in advice note 18 on The WFD in June 2017. This includes three phases of work: i) Preliminary/screening assessment, ii) Scoping assessment and iii) WFD impact assessment. This guidance was specifically designed for Nationally Significant Infrastructure Projects (NSIPs) but is seen as good practice guidance for large infrastructure projects that need to go through the planning process.

This Document

- 1.2. This document presents a Water Framework Directive (WFD) assessment for the proposed Havant Thicket Reservoir (HTR). The aims of the document are split into the various sections detailed below:
- Section 1: provides background information on the WFD legislation.
 - Section 2: provides background information on the Scheme.
 - Section 3: details the WFD screening assessment. This process reviews existing information on the Scheme and assesses which elements may impact water bodies within the water environment. Where potential impacts to water bodies are identified they are screened into the next phase of the assessment.
 - Section 4: documents a scoping assessment that has been undertaken to identify risks of the proposed development's activities to receptors on the relevant water bodies and identification of water bodies whereby a further, more detailed assessment needs to be undertaken. This assessment was agreed with the Environment Agency prior to the works being undertaken on the impact assessment.
 - Section 5: provides details of the impact assessment which was used to assess whether the various scheme elements may cause deterioration to any of the water bodies; affect the ability of water bodies to achieve good status; identification of impacts to any water bodies.
 - Section 6: provides the last stage of the impact assessment, which summarises a separate watercourse mitigation strategy and compensation strategy that has been developed for the Scheme.
 - Section 7: offers conclusions to the assessment.

Legislation background

- 1.3. The WFD (2000) requires all natural water bodies to achieve both Good Chemical Status (GCS) and Good Ecological Status (GES). The River Basin Management Plans (RBMP) outline the actions required to enable natural water bodies to achieve GES. Artificial and Heavily Modified Water Bodies (A/HMWB) may be prevented from reaching GES due to the modifications necessary to maintain their function. They are, however, required to achieve Good Ecological Potential (GEP), through the implementation of a series of mitigation measures outlined in the RBMP.
- 1.4. New activities and schemes that affect the water environment may adversely impact biological, hydromorphological, physico-chemical and/or chemical quality elements (WFD quality elements), leading to a deterioration in water body status. They may also render proposed improvement measures ineffective, leading to the water body failing to meet its WFD objectives for GES/GEP. Under the WFD, activities and schemes must not cause deterioration in water body status or prevent a water body from meeting GES/GEP by invalidating improvement measures.
- 1.5. The overall ecological status of a water body is primarily based on consideration of its biological quality elements and is determined by the lowest scoring of these elements. These biological elements are, however, supported by the physico-chemical and hydromorphological quality elements. Assessment of hydromorphological quality is not explicitly required for a water body to achieve GES or lower. However, to achieve the overall WFD aim of higher than GES, hydromorphological quality must be considered within the classification assessment.

- 1.6. In addition, to achieve the overall WFD aim of GES, a water body must pass a separate chemical status assessment, relating to pass/fail checks on the concentrations of various identified priority/dangerous substances.
- 1.7. A summary of key WFD concepts is presented in Figure 1-1. This includes a definition of what a water body is in relation to this assessment.

WFD Objectives

The WFD is a European Directive which sets out a strategic planning process for the purposes of managing, protecting and improving the water environment. The main objectives of the WFD are to:

- Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters;
- Aim to achieve at least 'Good Status' for all waters by 2015 (2021 or 2027) where fully justified within an extended deadline under Article 4.4;
- Promote sustainable use of water;
- Conserve habitats and species that depend directly on water;
- Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and
- Help reduce the effects of floods and droughts.

The Environment Agency is the Government's lead agency for implementing the WFD and already monitors, advises and manages many aspects of the water environment through regulating discharges, abstractions and processing environmental permits and licenses. The Environment Agency is committed to implementing environmental improvements by reducing the physical impacts of flood risk management activities (within Artificial/Heavily Modified Water Body (A/HMWB)).

WFD Classification

The WFD classification for a defined water body is produced by the assessment of a wide variety of different 'elements' which includes:

- '*biological elements*' such as fish, invertebrates, macrophytes and phyto-benthos (which includes plants, macro-algae, phytoplankton);
- '*supporting elements*' that include chemical measurements such as ammonia, dissolved oxygen, pH, phosphate, copper, zinc and temperature; and
- '*supporting conditions*' (sometimes referred to as hydromorphology) that assess the physical attributes of the water body such as 'quantity and dynamics of flow' and 'morphology'.

The assessment given for each element is also accompanied by a measure of certainty in the result. The status classification is published in the RBMP and provides a baseline condition against which compliance and future improvements can be measured.

WFD Compliance

There are three key objectives against which the impacts of proposed works on a water body need to be assessed to determine compliance with the overarching objectives of the WFD:

- Test 1: The scheme will not cause a deterioration in any element of water body classification.
- Test 2: The scheme will not prevent the WFD status objectives from being reached within the water body or other downstream water bodies.
- Test 3: The scheme will contribute to the delivery of the relevant WFD objectives. In this case, it will be what contribution the scheme can make towards the water body reaching its objective GES through planned RBMP mitigation measures.

The first two obligations must be met to avoid infringement of the WFD. The delivery of the third objective is central to the Environment Agency's implementation of the WFD, where it can be supported through its operational activities. If it is considered that the scheme is likely to cause deterioration in water body status or prevent a water body from meeting its ecological objectives, then an assessment would be made against the conditions listed in Article 4.7 of the WFD. Article 4.7 can be invoked if: 'new modifications' are of overriding public interest and/or the environmental and social benefits of achieving the WFD objectives are outweighed by the benefits of the new modifications to human health, safety and sustainable development; there are no significantly better environmental options that are technically feasible or not disproportionately costly; and, all practicable steps for mitigation have been taken.

A/HMWB

These water bodies cannot achieve GES due to substantial modification, e.g. for flood risk management. Instead, they are required to reach GEP. The presence or absence of a set list of mitigation measures is used as a proxy for biological indicators. If all mitigation measures have been taken, the water body is assigned a preliminary tag of 'GEP or better'. GCS is a prerequisite for GEP. 'Moderate or worse' is used if some mitigation measures are yet to be implemented. HMWBs may therefore have an element rated 'poor' but not be considered 'poor' in overall status.

Hydromorphology

Hydromorphology is a term used in the WFD to describe the processes operating within, and the physical form of, a water body. The term encompasses both hydrological and geomorphological characteristics that, in combination, help support a healthy ecology. Hydromorphology is a supporting condition unless a water body is classified as being of 'high' ecological status. In these cases, hydromorphological elements contribute towards status classification.

Note

The Environment Agency is in the process of developing guidance on the no deterioration requirements of the WFD and how to deal with local deterioration of reaches that have a perceived different status to that of the overall water body. For the purposes of this assessment we will use best judgement to make an appropriate assessment using available data.

Figure 1-1 - Background to WFD

2. Scheme description

Scheme description

- 2.1. Portsmouth Water have plans for a new reservoir at Havant Thicket driven by a deficit in water resources in the South East. The site of the reservoir is located between Havant, Leigh Park and Rowlands Castle and has an area of approximately 160 ha, with a 5 km perimeter (Figure 2-1). The site is currently largely used for animal grazing with public access via a bridleway across the middle of the site, a permissive path around the outside perimeter and along the 'Avenue'. Water used to fill the reservoir will be excess water from Havant and Bedhampton Springs, pumped via a new inlet/outlet pipeline between the HTR and Bedhampton pumping station.

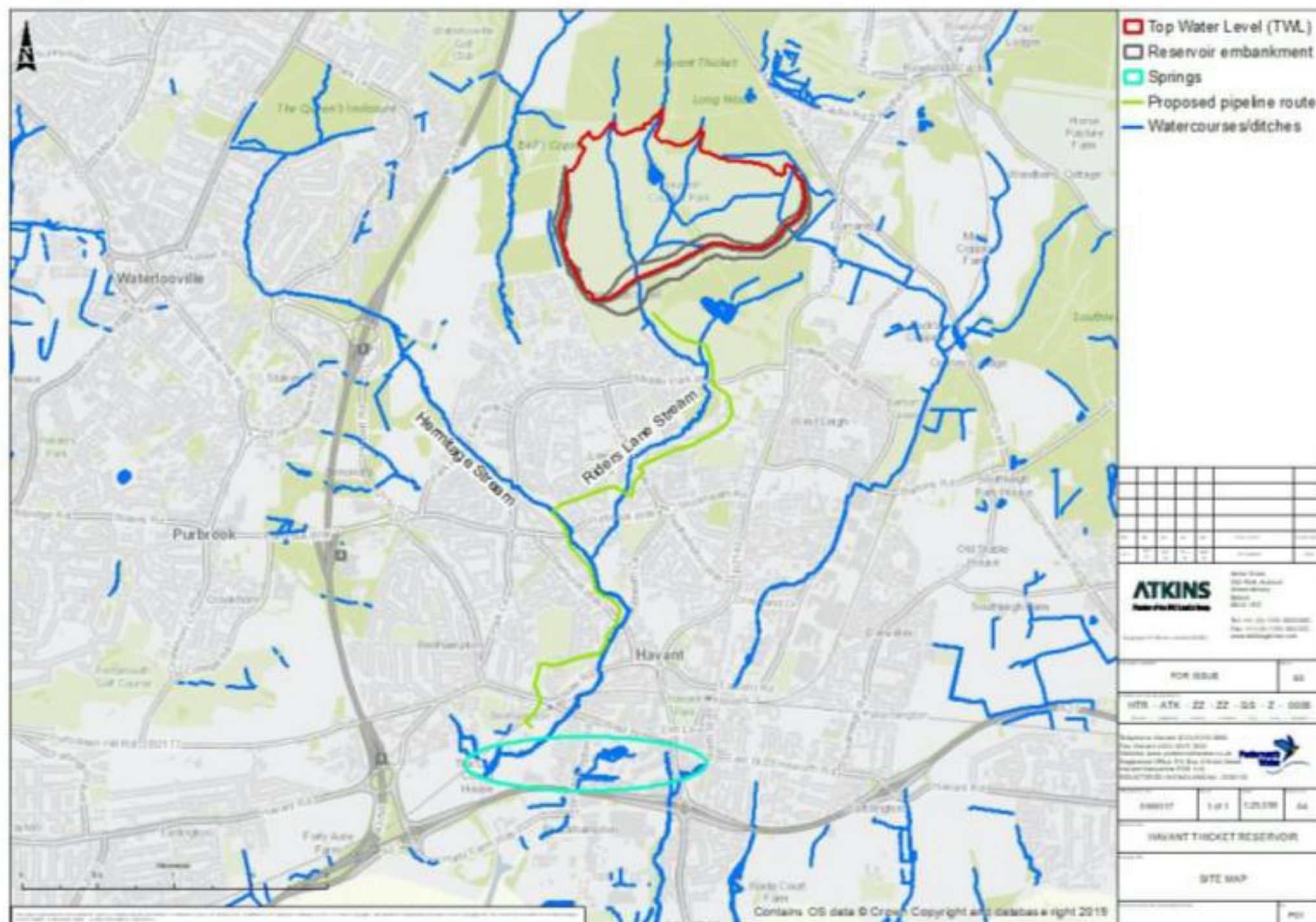


Figure 2-1 - Location map

3. Screening assessment

WFD water body screening

- 3.1. There are a number of WFD water bodies within the vicinity of the Scheme (Figure 3-1).
- 3.2. The proposed location of the works lies within the area covered by South East RBMP. It is within the East Hampshire management catchment and East Hampshire Rivers operational catchment. Three unnamed water bodies flow through the site of the proposed reservoir and so will be lost to the Scheme (Figure 2-1). Although they are not WFD water bodies they constitute the headwaters of the Riders Lane Stream which subsequently flows into Hermitage Stream which is a WFD assessed surface water body around 1.5 km downstream of the reservoir footprint (Table 3-1). The same goes for Park Lane Stream which is also a tributary of the Hermitage stream and flows to the west of the proposed reservoir location before flowing into Hermitage Stream. The Hermitage Stream will also be crossed by the inlet/outlet pipeline between HTR and Bedhampton pumping station. The River Lavant (Table 3-2) is also a WFD surface water body and flows to the east of the Scheme.
- 3.3. Hermitage stream flows south into Langstone Harbour which is a WFD assessed transitional water body (Table 3-3), therefore, this may also be impacted by the development.
- 3.4. Groundwater bodies (East Hants Chalk, East Hants Lambeth Group, South Hants Lambeth Group and Chichester Chalk) are also present in the vicinity of the Scheme (Table 3-4 to Table 3-7).

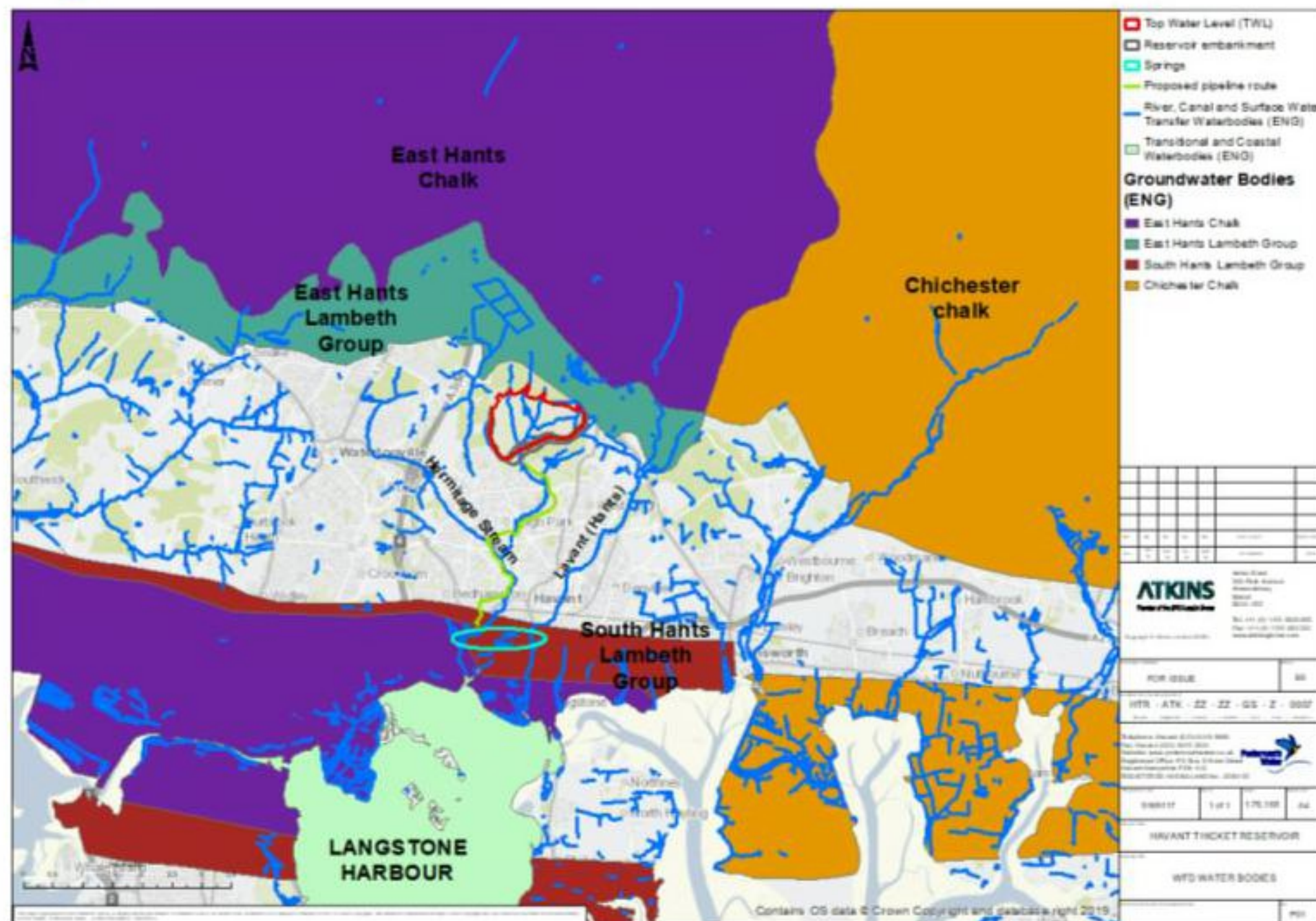


Figure 3-1 - WFD water bodies

Existing WFD baseline and water body description

Surface water bodies

3.5. Hermitage stream is designated as heavily modified and is therefore has an objective of achieving Good Ecological Potential (GEP). Its current overall classification as of 2016 is moderate, however it is currently unclear as to how this status has been derived as biological quality elements are poor, namely fish¹. The objective for the water body is to achieve GEP by 2027. These data were taken from the Environment Agency's Catchment Data Explorer (2019). The current reasons for not achieving GEP (RNAG)² according to the EA are:

- Point source - misconnections in the Domestic General Public category responsible for reactive phosphorus³ and invertebrates; and
- Physical modification – barriers (sector under investigation) for fish, flood protection structures (urban and transport) for invertebrates, other (urban and transport, Local and Central Government) for mitigation measures assessment.

Table 3-1 - Hermitage Stream WFD surface water body

Water body name	Hermitage Stream	
Water body ID	GB107042016370	
National Grid Reference	SU6994708585	
River Basin District	South East	
Management catchment	East Hampshire	
Operational catchment	East Hampshire Rivers	
A/HMWB	Heavily Modified	
Classification	2016 Cycle 2	Objectives
Overall Water Body	Moderate	Good (2027)
Ecological	Moderate	Good (2027)
Supporting elements (Surface Water)	Moderate	Good (2027)
Biological quality elements	Poor	Good (2027)
Fish	Poor	Good (2027)
Invertebrates	Moderate	Good (2027)
Hydromorphological supporting elements	Supports Good	Supports Good
Hydrological regime	Supports Good	Supports Good
Physico-chemical quality elements	Moderate	Good
Acid Neutralising Capacity	High	Good
Ammonia	High	Good
Biochemical Oxygen Demand	High	-
Dissolved Oxygen	High	Good
pH	High	Good
Reactive phosphorus	Moderate	Good

¹ Assumed that fish status is not being used to drive overall ecological status based on EA professional judgement from the outcome of investigations currently being undertaken, as identified on catchment data explorer. Confirmation being sought as to why fish are not driving '1 out all out' standard approach.

² The term RNAG is also used for reasons for not achieving good status as well as GEP.

³ Recorded as "phosphate" or "orthophosphate" by the Environment Agency but referred to as reactive phosphorus here for consistency.

Temperature	High	Good
Specific pollutants	High	High
Chemical	Good	Good
Priority substances	Does not require assessment	Does not require assessment
Other Pollutants	Does not require assessment	Does not require assessment
Priority hazardous substances	Good	Does not require assessment

3.6. The River Lavant (Hants) is not designated as artificial or heavily modified and is expected to achieved Good Ecological Status (GES). Its current classification as of 2016 is poor. The objective is for the river to reach GES by 2027. These data were taken from the Environment Agency's Catchment Data Explorer (2019). The current RNAG are:

- Physical modification – barriers creating ecological discontinuity for fish
- Physical modification – urbanisation through urban development for fish

Table 3-2 - River Lavant (Hants) WFD surface water body

Water body name	Lavant (Hants)	
Water body ID	GB107042016420	
National Grid Reference	SU7252807491	
River Basin District	South East	
Management catchment	East Hampshire	
Operational catchment	East Hampshire Rivers	
A/HMWB	Not designated artificial or heavily modified	
Classification	2016 Cycle 2	Objectives
Overall Water Body	Poor	Good (2027)
Ecological	Poor	Good (2027)
Biological quality elements	Poor	Good (2027)
Fish	Poor	Good (2027)
Invertebrates	High	Good
Hydromorphological supporting elements	Supports Good	Supports Good
Hydrological regime	Supports Good	Supports Good
Physico-chemical quality elements	High	Good
Ammonia	High	Good
Dissolved Oxygen	High	Good
pH	High	Good
Phosphate	High	Good
Temperature	High	Good
Chemical	Good	Good
Priority substances	Does not require assessment	Does not require assessment
Other Pollutants	Does not require assessment	Does not require assessment
Priority hazardous substances	Does not require assessment	Does not require assessment

Relevant local target measures

- 3.7. No relevant local target measures were found on Catchment Data Explorer, but the Hermitage Stream and River Lavant are named in the South East RBMP (2015). As a contribution to environmental outcomes for 2021 a restoration project is planned with funding being sought to address water quality, fish failures and to improve the constrained concrete channel. Additional plans dependent on funding include running misconnection awareness and identification campaigns along the Hermitage Stream and to address water quality and channel modifications on the remaining downstream reaches of the Hermitage Stream through Havant.

Transitional water bodies

- 3.8. Langstone Harbour is a WFD assessed transitional water body downstream of Lavant (Hants), Hermitage Stream. The harbour has numerous designations: Langstone Harbour SSSI, Chichester and Langstone Harbour SPA, Solent Maritime SAC, and Chichester and Langstone Harbour Ramsar site. Langstone Harbour also has a number of protected areas: Solent Maritime (Habitats and Species Directive), Chichester Harbour – Emsworth Channel (Shellfish Water Directive), Solent & Isle of Wight Lagoons (Habitats and Species Directive), Portsmouth Harbour (Shellfish Water Directive) and Portsmouth Harbour (Urban Waste Water Treatment Directive). Its current WFD status (2016) is moderate. As it is designated as heavily modified it is expected to achieve Good Ecological Potential (GEP) by 2027. These data were taken from the Environment Agency's Catchment Data Explorer (2019). The current RNAG are:
- Unknown – Mercury and its compounds

Table 3-3 - Langstone Harbour WFD transitional water body

Water body name	Langstone Harbour	
Water body ID	GB580705130000	
National Grid Reference	SU6951402666	
River Basin District	South East	
Management catchment	South East TraC	
Operational catchment	Hampshire East TraC	
A/HMWB	Heavily Modified	
Classification	2016 Cycle 2	Objectives (2027)
Overall Water Body	Moderate	Good
Ecological	Moderate	Good
Supporting elements (Surface Water)	Moderate	Good
Biological quality elements	Good	Good (2015)
Invertebrates	Good	Good (2015)
Macroalgae	Good	Good (2015)
Phytoplankton	-	
Hydromorphological supporting elements	Supports good	Supports good (2015)
Hydrological regime	Supports good	Supports good (2015)
Physico-chemical quality elements	Good	Good (2015)
Dissolved inorganic Nitrogen	Good	Good (2015)
Dissolved Oxygen	High	Good (2015)
Specific pollutants	-	Not assessed (2015)
Arsenic	-	-
Copper	-	-

Zinc	-	-
Chemical	Good	Good (2015)
Priority substances	Does not require assessment	Does not require assessment (2015)
Fluoranthene	-	-
Lead and its compounds	-	-
Nickel and its compounds	-	-
Other Pollutants	Does not require assessment	Does not require assessment (2015)
Priority hazardous substances	Good	Good (2015)
Benzo(a)pyrene	-	-
Cadmium and its compounds	-	-
Hexachlorobenzene	Good	Good (2015)
Hexachlorobutadiene	Good	Good (2015)
Mercury and its compounds	-	-

Groundwater bodies

- 3.9. There are four WFD groundwater bodies in the vicinity of the Scheme; East Hants Chalk, East Hants Lambeth Group, South Hants Lambeth Group, and Chichester Chalk.
- 3.10. The East Hants Chalk groundwater body is shown on WFD mapping (see Figure 3-1) to occur in two parts (both to the north and to the south of the proposed reservoir) which reflects the areas where the Chalk is outcrop. It should be noted that the Chalk underlies the whole area but is confined by clays in the vicinity of the reservoir. The East Hants Lambeth Group groundwater body is present just north of the reservoir footprint. It overlies the Chalk and contains the headwaters of the three tributaries that flow south into the reservoir site. The South Hants Lambeth Group groundwater body is located to the south of the reservoir site and contains most of the Havant and Bedhampton springs. Finally, the Chichester Chalk groundwater body occurs to the east of the area of interest. The groundwater body WFD status for each of the groundwater bodies is shown in the following tables.
- 3.11. The East Hants Chalk WFD groundwater body has a current (2016 Cycle 2) classification of Poor Status. The current RNAG are:
- Pollution from rural areas (agricultural and rural land management sector)
 - Changes to natural flow and levels of water (Water industry sector).
- 3.12. The East Hants Chalk overall water body objective (2021) is Poor Status. This is due to disproportionate burdens and groundwater status recovery time.

Table 3-4 - East Hants Chalk WFD groundwater body

Water body name	East Hants Chalk	
Water body ID	GB40701G502700	
National Grid Reference	SU7047805738	
Classification	2016 Cycle 2	Objectives
Overall Water Body	Poor	Poor (2015)
Quantitative	Poor	Poor (2015)
Quantitative status elements	Poor	Poor (2015)
Quantitative Saline Intrusion	Good	Good (2015)
Quantitative Water Balance	Poor	Poor (2015)
Quantitative GWDTEs test	Good	Good (2015)

Quantitative Dependent Surface Water Body Status	Poor	Good (2027)
Chemical (GW)	Poor	Good (2027)
Chemical Status element	Poor	Good (2027)
Chemical Drinking Water Protected Area	Poor	Good (2027)
General Chemical Test	Poor	Good (2027)
Chemical GWDTEs test	Good	Good (2015)
Chemical Dependent Surface Water Body Status	Good	Good (2015)
Chemical Saline Intrusion	Good	Good (2015)

- 3.13. The East Hants Lambeth Group WFD groundwater body has a current (2016 Cycle 2) classification of Poor Status. The objective for the water body is to achieve Good Status by 2021. These data were taken from the Environment Agency's Catchment Data Explorer (2019). The current RNAG are not clearly defined but appear to be related to abstraction and flow.

Table 3-5 - East Hants Lambeth Group WFD groundwater body

Water body name	East Hants Lambeth Group	
Water body ID	GB40702G500800	
National Grid Reference	SU5923714708	
Classification	2016 Cycle 2	Objectives
Overall Water Body	Poor	Good (2021)
Quantitative	Poor	Good (2021)
Quantitative status elements	Poor	Good (2021)
Quantitative Saline Intrusion	Good	Good (2015)
Quantitative Water Balance	Good	Good (2015)
Quantitative GWDTEs test	Good	Good (2015)
Quantitative Dependent Surface Water Body Status	Poor	Good (2021)
Chemical (GW)	Good	Good (2015)
Chemical Status element	Good	Good (2015)
Chemical Drinking Water Protected Area	Good	Good (2015)
General Chemical Test	Good	Good (2015)
Chemical GWDTEs test	Good	Good (2015)
Chemical Dependent Surface Water Body Status	Good	Good (2015)
Chemical Saline Intrusion	Good	Good (2015)

- 3.14. The South Hants Lambeth Group WFD groundwater body has a current (2016 Cycle 2) classification of Good Status and the objective is to remain at Good Status.

Table 3-6 - South Hants Lambeth Group WFD groundwater body

Water body name	South Hants Lambeth Group	
Water body ID	GB40702G503700	
National Grid Reference	SU5990705044	
Classification	2016 cycle 2	Objectives
Overall Water Body	Good	Good (2015)
Quantitative	Good	Good (2015)
Quantitative status elements	Good	Good (2015)
Quantitative Saline Intrusion	Good	Good (2015)
Quantitative Water Balance	Good	Good (2015)
Quantitative GWDTEs test	Good	Good (2015)
Quantitative Dependent Surface Water Body Status	Good	Good (2015)
Chemical (GW)	Good	Good (2015)
Chemical Status element	Good	Good (2015)
Chemical Drinking Water Protected Area	Good	Good (2015)
General Chemical Test	Good	Good (2015)
Chemical GWDTEs test	Good	Good (2015)
Chemical Dependent Surface Water Body Status	Good	Good (2015)
Chemical Saline Intrusion	Good	Good (2015)

3.15. The Chichester Chalk WFD groundwater body has a current (2016 Cycle 2) classification of Poor Status. The current RNAG are:

- Pollution from rural areas (agricultural and rural land management sector)
- Changes to natural flow and levels of water (Water industry sector).

3.16. The Chichester Chalk overall water body objective (2015) is Poor Status. This is due to disproportionate burdens and groundwater status recovery time.

Table 3-7 - Chichester Chalk WFD groundwater body

Water body name	Chichester Chalk	
Water body ID	GB40701G505200	
National Grid Reference	SU7523505506	
Classification	2016 Cycle 2	Objectives
Overall Water Body	Poor	Poor (2015)
Quantitative	Poor	Poor (2015)
Quantitative status elements	Poor	Poor (2015)
Quantitative Saline Intrusion	Good	Good (2015)
Quantitative Water Balance	Poor	Poor (2015)
Quantitative GWDTEs test	Good	Good (2015)
Quantitative Dependent Surface Water Body Status	Poor	Good (2027)

Chemical (GW)	Poor	Good (2027)
Chemical Status element	Poor	Good (2027)
Chemical Drinking Water Protected Area	Poor	Good (2027)
General Chemical Test	Poor	Good (2027)
Chemical GWDTEs test	Good	Good (2015)
Chemical Dependent Surface Water Body Status	Good	Good (2015)
Chemical Saline Intrusion	Good	Good (2015)

Water body screening

- 3.17. This section assesses where the design of the Scheme may impact the WFD water bodies. This assessment screens in the WFD water bodies and as part of this process relevant key components of the Scheme referred to hereafter as 'scheme elements' in this report. It also screens out those water bodies that are not impacted by the Scheme and the scheme elements that are not likely to impact the WFD water bodies. The WFD water bodies and scheme elements that are screened in are taken forward to the Scoping assessment in Section 4 and the Impact Assessment in Section 5.

Scheme elements

- 3.18. There are several scheme elements that may have an impact on the quality elements within the WFD water bodies and associated tributaries in the vicinity of the Scheme (Figure 3-2).
- 3.19. The current understanding of these elements is as follows:
- The reservoir footprint – covers 160 ha of land
 - A pipeline to pump water from the Havant and Bedhampton Springs – this will have three watercourse crossings; one on the Hermitage Stream, one on the Riders Lane Stream and one on the unnamed tributary from The Lake to Riders Lane Stream. It is assumed for the purpose of this assessment that the open cut method will be used to lay the pipeline across the rivers with temporary coffer dams and over pumping of the watercourse.
 - The capacity of Riders Lane Stream needs to be increased in case of the need for emergency drawdown and as a result three culverts (Middle Park Way, Dunsbury Way and Purbrook Way) will need to be upgraded. At Middle Park way the existing culvert is a 1540mm circular culvert, an additional online 1200mm circular culvert will be added adjacent to the current one. At Dunsbury Way there is currently a 1450mm culvert, an additional online 1200mm culvert will be added adjacent to the existing culvert. At Purbrook Way there is currently 3x900mm culverts, an addition 2x900mm culverts will be added adjacent to the existing culverts.
 - 2no. access roads are being taken forward currently. Neither the north or south option require new water course crossings, instead utilising existing road crossings.
 - A compensation flow will be released from the reservoir into Riders Lane Stream. The extent nature of the compensation flow has not yet been agreed, but will be one of the following: 1) using factored gauged flow data from the Hermitage Stream; 2) a naturalised ephemeral profile from Catchmod (a hydrological model), or; 3) a hybrid profile adjusting the naturalised Catchmod profile to include a continual flow during summer months (or more prolonged flow through summer months). This compensation flow will leave the reservoir at the control house and enter Riders Lane Stream ~150m from the toe of the embankment.
 - Extension of 2no. culverts as part of works to the Forestry England track that crosses HS1 and HS2 north of the reservoir.
 - A construction compound located adjacent to Riders Lane Stream
 - Routine drawdowns will be required during operation for inspection and maintenance of the emergency drawdown infrastructure. Routine drawdowns are assumed to be 10% of the

emergency drawdown flow and be required twice a year. This equates to $0.70\text{m}^3/\text{s}$ on the Riders Lane Stream. No gauged flows for Riders Lane Stream are available. However, mean daily Q5 downstream at the Hermitage Stream gauging station is $0.883\text{ m}^3/\text{s}$. The routine drawdown flows are therefore likely to be result in high flows within Riders Lane Stream. However, these flows may be within the 'normal' flow thresholds for the watercourse given that QMED is $8.95\text{ m}^3/\text{s}$ for the Hermitage Stream and flood modelling indicates that QMED for Riders Lane Stream is approximately $3.0\text{ m}^3/\text{s}$.

- 3.20. Table 3-8 below outlines the scheme elements and any potential impacts on the WFD water bodies. Figure 3-2 displays the locations of these scheme elements.

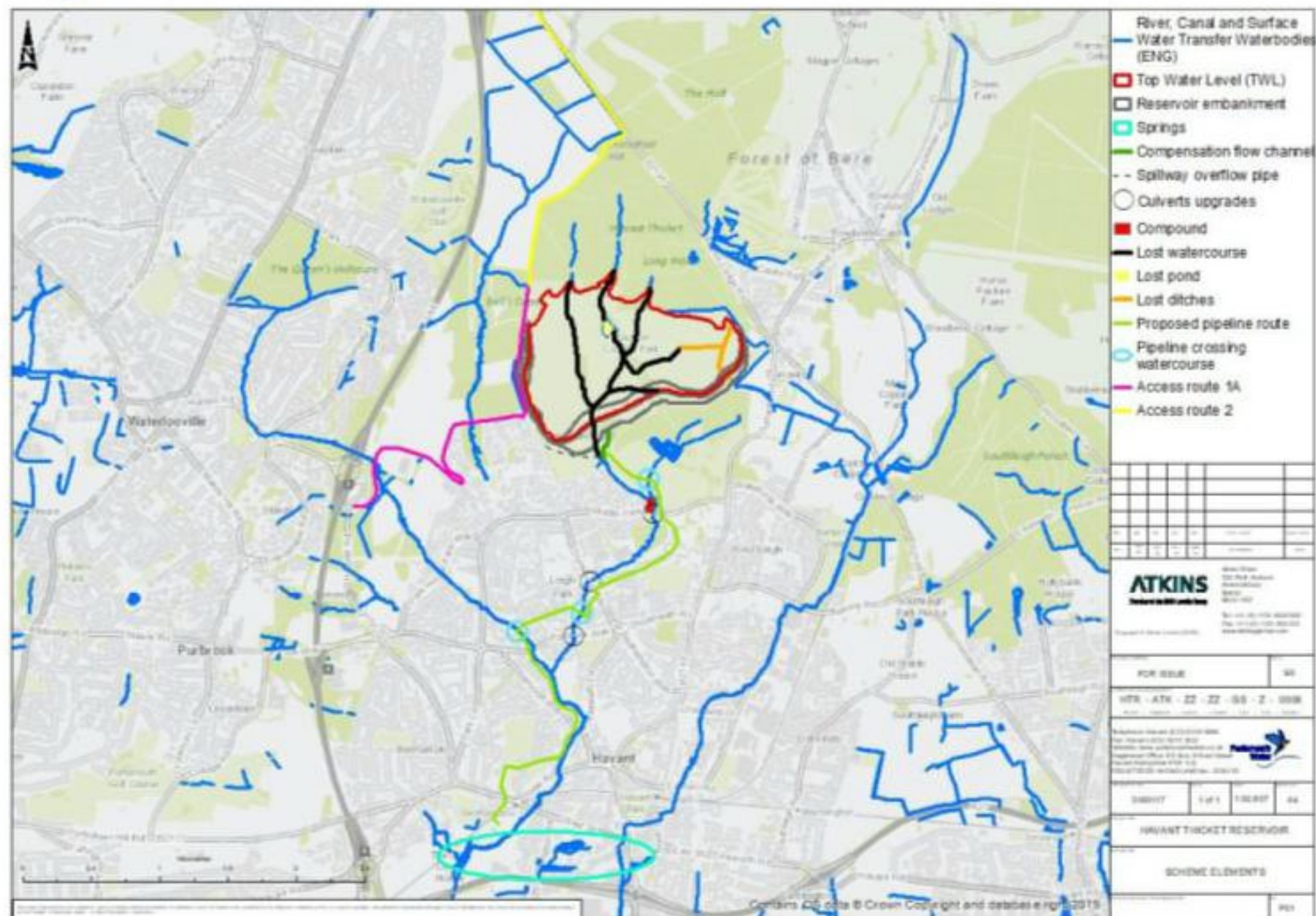


Figure 3-2 - Scheme elements

Table 3-8 - Scheme elements

Scheme element	Description	Potential impacts
Reservoir footprint	Loss of 3.7 km of open watercourse and 0.8 km of ditch network (0.65 km into Lavant and 0.15 km into Riders Lane Stream).	- Moderated flow into Riders Lane Stream and subsequently Hermitage Stream. - Loss of riparian zone, channel and floodplain function and morphological diversity, sediment continuity and aquatic habitat for macrophytes, phytobenthos, macroinvertebrates and fish leading to loss of abundance and species. - Loss of ditch and therefore reduced flow into the Lavant catchment
	Loss of approximately 0.65 ha ephemeral pond.	- Loss of open water habitat for aquatic species such as macrophytes and macroinvertebrates. - Changes in flow and sediment regime.
New pipeline from Bedhampton pumping station to the new reservoir	The proposed route of the pipeline to transfer water from Bedhampton pumping station to the reservoir will have three watercourse crossings.	- Temporary impacts on flow, sediment and aquatic ecology. - No permanent impacts expected.
Pumping of water from Havant and Bedhampton Springs	Water will be pumped from Bedhampton pumping station to the reservoir when the water has reached the surface. The outflows of the springs into Hermitage Stream will retain an MRF under licensing agreements.	- Changes in water quality of Riders Lane stream due to changes in source of water. - Changes to groundwater quantity as a result of surface water/groundwater interaction in the catchment. - Potential changes in quantity, and quality, of water reaching Langstone Harbour.
Compensation flow channel	Loss 0.1 km of loss at the top of Riders Lane Stream	- Reduced flow into Riders Lane Stream and subsequently Hermitage Stream. - Loss of riparian zone, channel and floodplain function and morphological diversity, sediment continuity and aquatic habitat for macrophytes, phytobenthos, macroinvertebrates and fish leading to loss of abundance and species.
Culvert upgrade	Increased capacity at three culverts along Riders Lane Stream	- Temporary impacts on flow, sediment and aquatic ecology. - No permanent impacts expected.

Scheme element	Description	Potential impacts
New access roads		- No new crossings will be built as part of the Scheme. - All measures along the road crossings will need to be constructed in line with the requirements set out within the EA's General Guide to Prevention of Pollution (PPG 1), Works and maintenance in or near water (PPG5) and Maintenance of structures over water (PPG23) and Control of water pollution from construction sites CIRIA 532. The PPGs contain a mix of regulatory requirements and good practice advice. They have been withdrawn by the EA but are still considered good practice advice to avoid pollution of watercourses. - No further assessment will be undertaken.
Extension of 2no. culverts on HS1 and HS2		As these are within the footprint of the reservoir, under top water level (TWL), these sections are included in the watercourse loss calculations and therefore won't be assessed.
Temporary compound directly adjacent to Riders Lane Stream		- Works to the compound will need to ensure that the Riders Lane Stream and the immediate riparian corridor are not impacted by the Scheme. It is recommended that no trees or shrubs that are currently alongside the river are removed during the compound construction and operation. It is equally important that the requirements set out within the EA's General Guide to Prevention of Pollution (PPG 1), Works and maintenance in or near water (PPG5) and Maintenance of structures over water (PPG23) and Control of water pollution from construction sites CIRIA 532 are followed both during construction and operation. The PPGs contain a mix of regulatory requirements and good practice advice. They have been withdrawn by the EA but are still considered good practice advice to avoid pollution of watercourses. - No further assessment will be undertaken

Scheme element	Description	Potential impacts
The emergency discharge testing	Potential for large flows to be released down Riders Lane Stream and Hermitage Stream twice annually	- Increased capability of the streams to incite geomorphic change - Physical harm/disturbance to invertebrates/fish associated with high flows

Screening conclusion

- 3.21. The outcomes of the screening assessment are shown in Table 3-9 below. The initial screening conclusions were presented to and agreed with the Environment Agency (EA) in a meeting held on the 27/01/20 and updated following the design fix on the 22/05/20. There has been one change since the meeting; following further data review, the East Hants Lambeth Group groundwater body has been screened back in.
- 3.22. Hermitage Stream and its tributaries will be directly impacted by the construction of the reservoir and associated pipeline works. The current extent of these impacts is unknown, so as a result, will be screened into the next phase of assessment. The River Lavant may also be impacted by the Scheme as a result of the loss of headwater ditches that drain into the system, therefore this is also screened in. There are no lake WFD water bodies in the vicinity of the site.
- 3.23. The potential for effects of the Scheme on Langstone Harbour, the transitional water body and a number of associated designated sites has also been screened into the assessment.
- 3.24. There is no perceived impact on the Chichester Chalk groundwater body as it occurs to the north and east of the Scheme, respectively and therefore this has been screened out. The East Hants Lambeth Group groundwater body is present just north of the reservoir footprint and contains the headwaters of the three tributaries that flow south into the reservoir site. As there could be potential impacts from construction works, this water body has been screened into the next phase of the assessment. The reservoir lies within the East Hants Chalk groundwater body; however, at the location of the reservoir the Chalk is confined under a layer of clay. As the impacts on this water body are currently unknown it will be screened into the next phase of assessment. Finally, the South Hants Lambeth Group groundwater body is located to the south of the reservoir site and contains most of the Havant and Bedhampton springs. Although it is proposed that the reservoir will be filled under the current permitted abstraction from the Havant and Bedhampton Springs, the potential for any impact from pipeline construction or on surface water- groundwater interaction is unknown and has therefore also been screened into the next phase of the assessment.
- 3.25. If there were to be a new/temporary source to facilitate more rapid initial filling of the reservoir the impacts would need to be assessed. There is potential that pumping water from this source may have a temporary impact on groundwater quality and quantity.

Table 3-9 - Waterbody screening outcome

Water body	Outcome of screening assessment
Hermitage Stream	Screened in
River Lavant	Screened in
Langstone Harbour	Screened in
East Hants Lambeth Group	Screened in
Chichester Chalk	Screened out
East Hants Chalk	Screened in
South Hants Lambeth Group	Screened in

- 3.26. In conclusion, the water bodies of Hermitage Stream, River Lavant, Langstone Harbour, East Hants Chalk, East Hants Lambeth Group and South Hants Lambeth Group have been taken forward to the scoping phase for further assessment.

4. Scoping assessment

- 4.1. As outlined in the previous section, Langstone Harbour (transitional water body), East Hants Chalk, East Hants Lambeth Group and South Hants Lambeth Group (groundwater bodies), Hermitage Stream and River Lavant (surface water body) were screened in for further assessment.
- 4.2. The following technical section sets out the further assessment that was required on these water bodies to assess the impact of the Scheme. This is taken forward in the impact assessment in Section 5.

Surface water bodies

- 4.3. The WFD scoping assessment considers the Hermitage Stream, and its tributary Riders Lane Stream along with the five unnamed watercourses that flow through the footprint of the reservoir and the River Lavant. The impact assessment reviews the WFD status for water bodies and establishes the nature and anticipated magnitude of the effects of Scheme components on this water body and its associated tributaries, taking into account both temporary and permanent effects.

Geomorphology

- 4.4. To assess the baseline conditions of the watercourses the walkover survey undertaken on the 20/11/19 was used to delineate the watercourses into homogenous reaches and assess the current morphological conditions. The information collected has been used to assess the impact of Scheme elements on the geomorphology of the watercourses, relevant mitigation measures identified, and the residual effect identified. In addition to the walkover survey, MoRPh surveys were undertaken on the 26/06/20, 29/06/20 and 02/07/20. The full results of the MoRPh surveys can be found in Appendix A15.4 Biodiversity Net Gain for Rivers in ES Volume 4.

Ecology

- 4.5. River Habitat Surveys (RHS) and invertebrate surveys were carried out by ARUP in 2008 to inform the initial Environmental Statement (ES) for the proposed reservoir. Figure 4-1 shows the locations where each of the survey types were undertaken; this covers Hermitage Stream, Park Lane Stream, Riders Lane Stream and two locations on the unnamed watercourses. Park Lane Stream is not considered as part of this WFD assessment as the Scheme would not impact this watercourse.

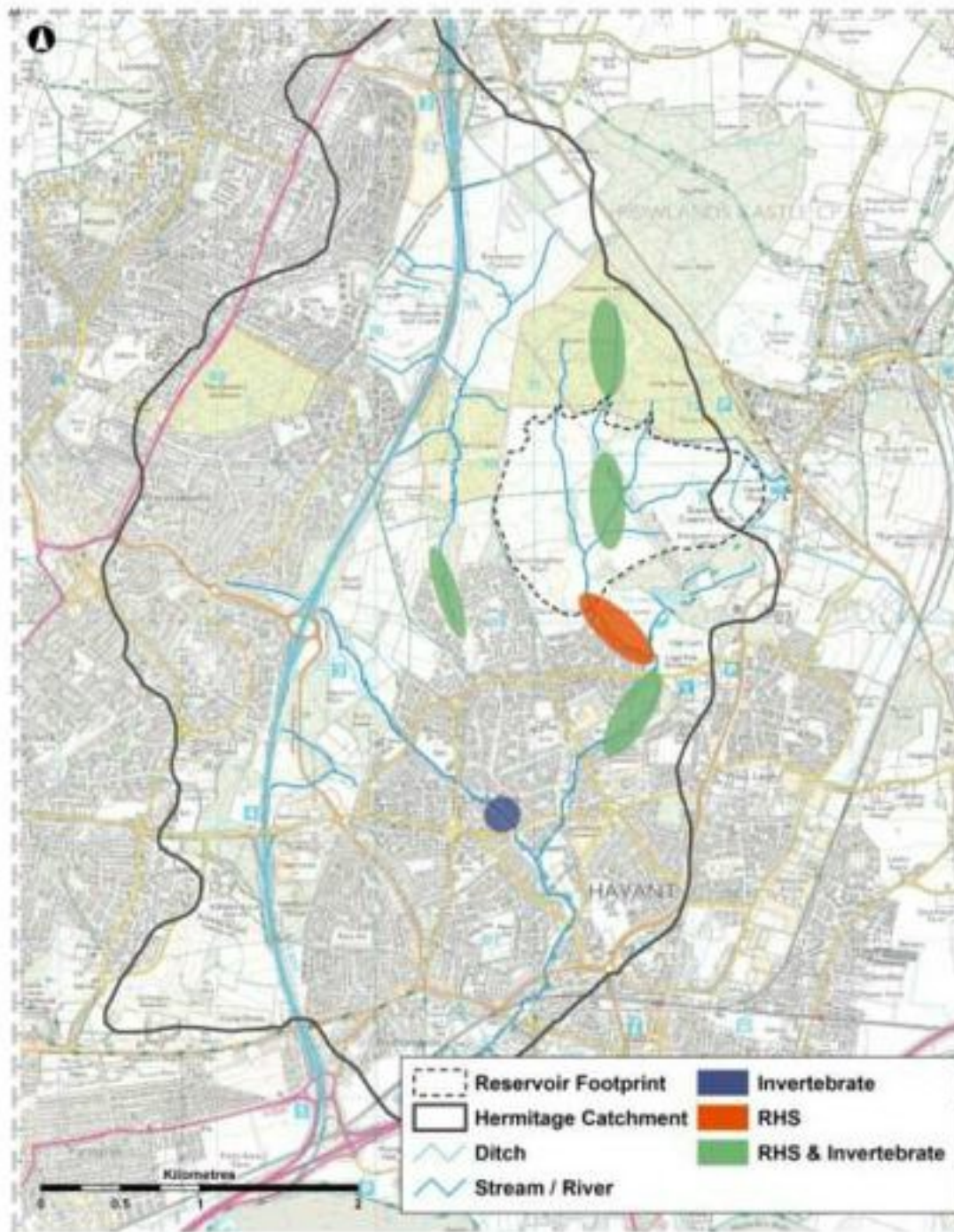


Figure 4-1- Existing survey location and details (taken from ARUP, 2009)

- 4.6. In addition, opensource fish, invertebrate, and macrophytes survey data from the Hermitage Stream are available from the EA database⁴. The most recent EA survey data for the Hermitage Stream are:
- Invertebrate surveys – 2018
 - Fish surveys – 2012
 - Macrophyte survey – 2012
- 4.7. Further detail and interpretation of aquatic ecology background records is provided in the Appendix A9.3 Aquatic Ecology of the ES Volume 4.
- 4.8. As part of the WFD impact assessment the results of the above surveys have been reviewed to understand the ecological baseline conditions of the watercourse.
- 4.9. Following meetings with the EA on the 05/03/20 and the 20/03/20 it was agreed that further invertebrate surveys were required to provide up to date information on the invertebrate communities within the watercourses potentially affected by the Scheme. These were carried out on the 14/04/20 at the eight locations shown in Figure 4-2. These locations were distributed across the catchment to provide a representative spread of surveys across the range of habitat typologies.
- 4.10. These surveys provide a suitable baseline of invertebrate species in the headwaters and Riders Lane Stream for the EIA of the Scheme.

⁴ Environment Agency Ecology and Fish Data Explorer. Accessed online from: <https://environment.data.gov.uk/ecology-fish/>.

- 4.11. The surveys were undertaken in accordance with the EA's new Monitoring Intermittent Streams index (MIS-index) method that is being trialled for invertebrate surveys for ephemeral catchments. This includes a modified 3-minute kick sample to allow for the assessment of ephemeral species during low flows. The samples were then sent and identified by an accredited laboratory. The MIS-index method details were sent to PW and Atkins on the 23/03/20.
- 4.12. The impact of scheme elements on the ecology of the WFD surface water body have been assessed, relevant mitigation measures identified, and any residual effect identified.



Water quality

- 4.13. The WFD impact assessment has reviewed the water quality modelling work that has been undertaken as part of the project to assess the impact of the reservoir on the water quality downstream of the reservoir. The impact of scheme elements on the water quality of the WFD surface water body has been assessed, relevant mitigation measures identified, and any residual effect identified.

Flow

- 4.14. Assessment of the impact of the decreased flow as a result of watercourse loss has been undertaken following discussions around the nature of the compensation discharge from the reservoir into Riders Lane Stream. The impact of scheme elements on the flow within the WFD surface water body has been assessed, relevant mitigation measures identified, and the residual effect identified.

Transitional water bodies

- 4.15. The WFD impact assessment of Langstone Harbour follows the 'Clearing the Waters for All' guidance. The impact of scheme elements on the WFD transitional water body has been assessed, relevant mitigation measures identified, and any residual effect identified.

Groundwater bodies

- 4.16. The WFD scoping assessment considers the East Hants Chalk, East Hants Lambeth Group and South Hants Lambeth Group groundwater bodies. The groundwater assessment reviews the WFD status for the three groundwater bodies and establishes the nature and anticipated magnitude of the effects of scheme components on these groundwater bodies, taking into account both temporary and permanent effects.
- 4.17. The WFD groundwater assessment has reviewed:
- geological and hydrogeological information (BGS solid and drift geology mapping, geological open source data, aquifer properties manual etc.)
 - WFD status and catchment information (EA Catchment Explorer, Defra Magic website)
 - information on the proposed HTR Scheme; and
 - information obtained from the EA and Portsmouth Water through data requests
- 4.18. The WFD groundwater assessment considers relevant information from other parts of the HTR project (e.g. geological inception report, results of GI investigation) to confirm Chalk depths, nature of overlying material and extent to which shallow groundwater may be present (perched). A conceptual understanding of the groundwater bodies and associated surface water catchments has been developed to determine potential impact from planned construction and operation of the reservoir. This includes consideration of impact from any dewatering undertaken during construction and changes in reservoir water levels during operation.
- 4.19. A precautionary risk-based approach has been used for the assessment, using a colour coding "Red, Amber, Green" (RAG) system. The impact of scheme elements on the WFD groundwater body have been assessed, relevant mitigation measures identified, and any residual effect identified.
- 4.20. The details of the risk-based assessment are provided in Appendix B of this report.

5. Impact assessment

- 5.1. The WFD impact assessment focusses of four key areas, namely:
- Potential deterioration in quality elements;
 - Ability to achieve good status;
 - Impacts on other water bodies; and
 - Mitigation measures necessary to mitigate against any impacts.
- 5.2. These will be assessed for the surface water bodies, transitional water bodies and groundwater bodies defined in the screening phase of the assessment. As a result of the complexity of the Scheme the mitigation and compensation measures are summarised in Section 6.

Surface water bodies

- 5.3. As outlined in Section 3, Hermitage Stream is a HMWB with moderate potential (including an overall ecological potential of moderate). River Lavant is not designated as artificial or heavily modified and is currently achieving poor status.
- 5.4. Hermitage Stream and its associated tributaries will potentially be impacted by a number of elements. The predominant impact on the water body is the loss of 3.8 km of headwater stream within (3.7 km) and immediately downstream (0.1 km) of the footprint of the proposed reservoir. Further scheme elements, such as the construction of a new pipeline also have the potential to impact the water body downstream. The sections below outline potential impacts on each of the WFD elements within the surface water body. Background records and observations from field surveys have been used to inform this assessment as outlined in Section 4. Table 5-1 and Figure 5-1 shows the delineation of the reaches assessed within the following sections. The reaches were defined by virtue of their geomorphological and ecological characteristics for the specific purpose of this WFD Impact assessment.

Table 5-1 - Delineated reach descriptions

Reach	Description	Photo
HS1	This headwater stream has been artificially straightened in the past so is therefore relatively straight for all of its length. The upper part flows through mature woodland before flowing south into open grassland. There is a section further downstream that flows through another part of mature woodland before again becoming exposed. The channel is around 1-1.5m wide, lacks morphological diversity along much of its length and is typically homogenous. A MoRPh survey was undertaken in this reach and scored a river condition of moderate.	

Reach	Description	Photo
HS2	This headwater stream has also been historically straightened and for most part lacks morphological diversity and is typically homogenous. As with HS1 the upper part of HS2 also flows through mature woodland before becoming exposed and flowing through open woodland. It then flows back into ancient woodland known as the avenue where it flows into a pond that is 0.65ha in size. There is an outfall from the pond which continues to discharge in HS2 where it flows back into open grassland before converging with HS1. HS2 is also around 1-1.5m wide and 1m deep. Three MoRPh surveys were undertaken along this reach results in two moderate and one fairly good condition scores.	
HS3	HS3 also flows through mature woodland in its upper parts before flowing out into open grassland. This headwater stream is smaller than HS2 and HS1 and is more typical of a homogenous ditch. HS3 flows south into the avenue where it joins HS2. The width of the channel is ~1m. A MoRPh survey was undertaken in this reach and scored a river condition of moderate.	
HS4	The whole footprint of HS4 is within the footprint of the proposed reservoir. It flows west across open grassland until it reaches the avenue. Within the avenue HS4 has been artificially diverted northwards to flow into HS2. For its entirety HS4 is homogeneous, straight and lacking any morphological diversity. It is 0.5m wide and deep.	

Reach	Description	Photo
HS5	HS5 is the smallest of the headwater streams and again is entirely within the footprint of the reservoir. It flows east from the avenue and into HS2. As with HS4, it is a homogenous ditch type headwater stream which follows a straight path with limited morphological diversity. It is 0.5m wide and deep.	
Riders Lane Stream to Great Copse	Riders Lane Stream from where it is formed as the three headwater streams converge to the woodland of Great Copse is largely straight and lacks morphological diversity. The upper section flows through open grassland and is lined with hedge rows before then flowing adjacent to a housing estate through slightly more mature woodland. Riders Lane Stream then flows through a large culvert under Middle Park Way before flowing into Great Copse woodland. The stream in this reach is ~2-3m wide. A MoRPh survey was undertaken in this reach and scored a river condition of moderate.	
Riders Lane Stream through Great Copse	Through Great Copse woodland, Riders Lane Stream is more sinuous, with evidence of bank erosion and features such as pool and riffle sequences are present. This section is the most morphological diverse and natural section of the stream. The stream in this reach is ~2-3m wide. A MoRPh survey was undertaken in this reach and scored a river condition of fairly good.	

Reach	Description	Photo
Riders Lane Stream from Great Copse to confluence with the Hermitage Stream	From the Great Copse woodland to the confluence with Hermitage Stream, Riders Lane Stream flows through a large urban area, in parts through residential gardens. As a result, the stream is largely modified and straightened, however there is evidence of processes such as bank erosion occurring. The stream in this reach is ~2-3m wide.	
Hermitage Stream upstream of the confluence with Riders Lane Stream to Middle Park Way	Hermitage Stream upstream of the confluence with Riders Lane Stream has historically straightened with concrete bed and bank installed to reduce the flood risk of the surround urban area. However, this reach has been partially restored with the concrete banks removed and naturalised. The concrete bed remains in place but now has wooden beams on the bed of the river to increase hydraulic diversity. As a result of the restoration effects this reach offers a little bit more morphological variation but is still constrained vertically and lacks lateral movement and natural processes. The channel through this reach is ~3-4m wide.	
Hermitage Stream downstream of confluence with Riders Lane Stream to the six weir system	From the confluence with Riders Lane Stream the Hermitage stream has a concrete channel, both bed and banks, until the 6-weir system which marks the start of the tidal limit. It largely flows through urban areas and the concrete channel limits any real morphological variation. The channel through this reach is ~9-10m wide. A MoRPh survey was undertaken in this reach and scored a river condition of poor.	

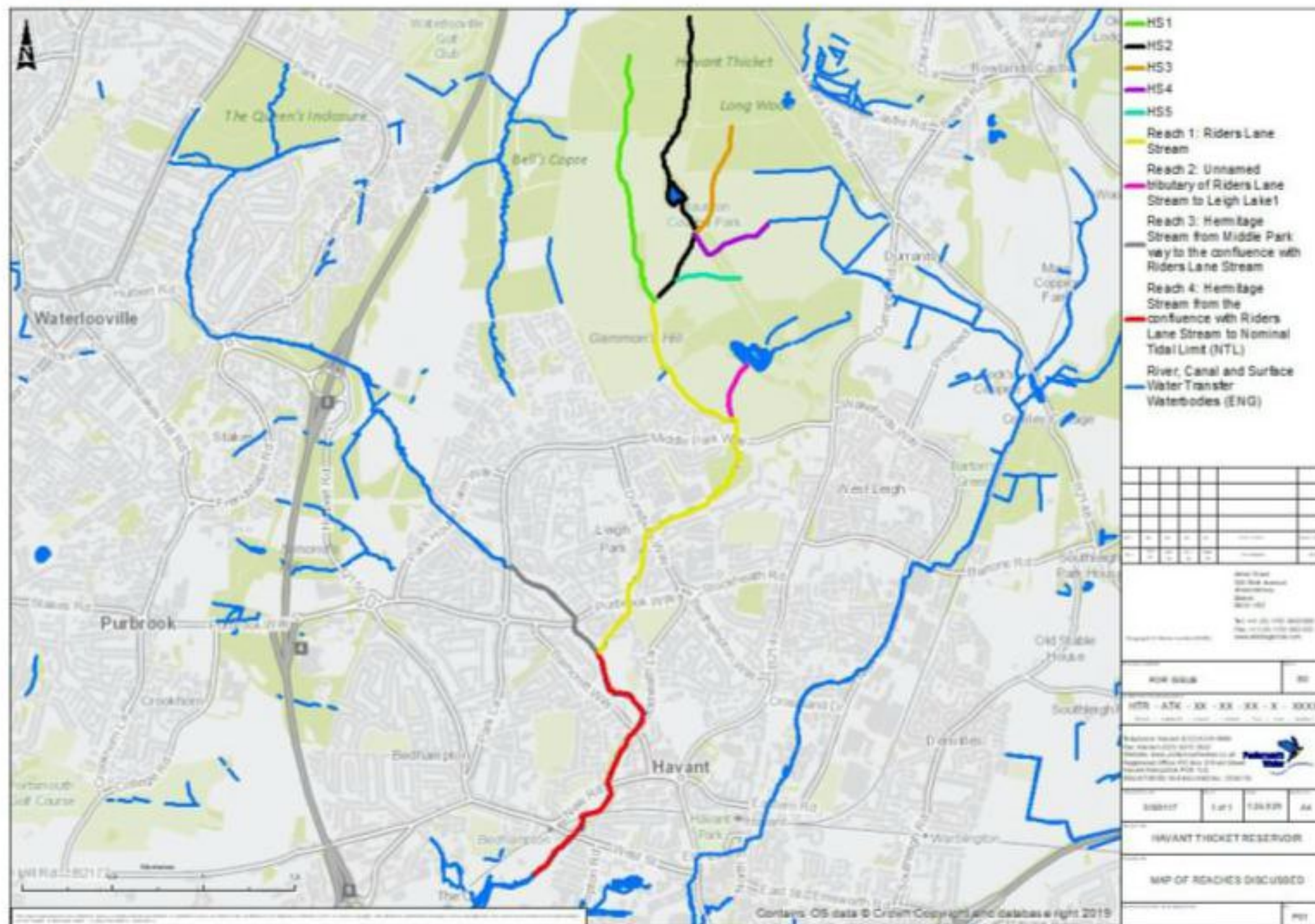


Figure 5-1 - Study reaches

Biological Quality Elements

Fish

- 5.5. Fish are currently at poor status within the Hermitage Stream water body. This status is derived from monitoring on the Hermitage Stream itself, and not the tributary systems.

Reservoir footprint

- 5.6. The proposed reservoir sits within the Hermitage Stream surface water body catchment. As a result, there is expected to be the wholesale loss of 3.7 km of headwater stream within the footprint of the proposed reservoir and a further loss of 0.1 km directly downstream, above where the compensation flow will be established.
- 5.7. The baseline flow conditions of the headwater streams and upper reaches of Riders Lane Stream are ephemeral. As such, the headwaters are considered sub optimal habitat for fish, due to frequent channel drying. They may still provide limited habitat for potentially low numbers of 'minor' species, that are resilient to environmental disturbance and can quickly recolonise, such as stickleback (*Gasterosteidae* species), but these populations are unlikely to be significant.
- 5.8. In addition to the ephemeral nature of the watercourses, a number of barriers within the water body may limit fish passage into these headwater systems, including a six-step weir at SU 70641 06289 and several culverts throughout the Havant area. Physical barriers causing ecological discontinuity are listed as a RNAG within the water body. The proposed reservoir is considered to cause further severance of watercourse habitat through creation of a barrier between Riders Lane Stream downstream of the embankment and the retained headwater streams, upstream of the proposed reservoir. However, as previously stated, since these retained headwaters are likely to be sub-optimal habitat for fish and are not considered to provide suitable rearing or spawning habitat which would support the maintenance of the overall water body's fish population, the impacts are likely to be minor.
- 5.9. Nonetheless, given the importance of these headwater systems, in supporting the wider water body habitat through for instance the provision of re-colonisation pathways for invertebrates and macrophytes, there is the potential for the direct loss of watercourse extent and further severance of habitat to have a **minor adverse effect on fish populations at the water body scale**.

Compensation flow

- 5.10. To alleviate the potential effects of changes to the natural hydrological regime downstream of the reservoir resulting from the loss of incoming sources, a compensation flow will be established in Riders Lane Stream. The exact annual and/or monthly flow regime of the compensation flow into Riders Lane Stream is yet to be determined, but at present there are three options being explored.
- 5.11. EA monitoring within the Hermitage Stream indicates that European eel (*Anguilla anguilla*), bullhead (*Cottus gobio*) and three-spined stickleback (*Gasterosteus aculeatus*) are present within the Hermitage Stream. The option that gets taken forward will largely be dependent on the ecological requirements of the downstream habitats and communities, as such, the compensation flow is **not expected to result in any adverse effects on fish populations at the water body scale**. There is the **potential for a minor beneficial effect** on fish if a continual flow is opted for, given that this could increase the length of watercourse habitat available to fish during summer months.

Culvert upgrade

- 5.12. Three culverts within the Riders Lane Stream require upgrades to increase their capacity to facilitate emergency reservoir drawdown. The design includes the retention of existing culverts and the construction of additional new culverts adjacent to these.
- 5.13. There is potential for a minor temporary disturbance to fish as a result of culvert construction. However, since the existing culverts are to remain in-situ, there is not expected to be any loss of habitat. Any new culverts should be designed in such a way as to provide local improvements to fish habitat and passage, as such there is potential for a **minor beneficial effect** on fish.

Pipeline footprint

- 5.14. The proposed pipeline has three watercourse crossings within the Hermitage Stream water body catchment (Figure 3-2).

5.15. These crossings, in Reach 1, Reach 2 and Reach 3 (in Figure 5-1) will route the pipeline under watercourses via an open cut trench construction method. There is the potential for the new pipeline crossings to have a minor adverse effect on the biological quality elements within the water body, including fish, through the creation of temporary barriers and/or a reduction in local habitat availability. However, no permanent habitat loss is expected as the channel beds would be reinstated to facilitate fish passage. Following installation of the pipeline, opportunities should be taken to enhance the watercourse in these locations.

5.16. Given the short-term nature of the works to install the pipeline crossings and that channel beds will be restored, impacts on fish are likely to be **minor** and lead to **no deterioration in WFD status of the fish element**.

Emergency discharge valve test

5.17. Non-emergency routine drawdowns will be required during operation for inspection and maintenance of the emergency drawdown infrastructure. Routine drawdowns are assumed to be 10% of the emergency drawdown flow and be required twice a year. This equates to 0.70m³/s on the Riders Lane Stream and 0.4m³/s on the Hermitage Stream. Due to uncertainties surrounding the hydrology within Riders Lane Stream, as a result of the lack of hydrological monitoring data, it is difficult to determine the potential effects this flow may have on fish. However, in light of gauged flows from the Hermitage Stream and flood modelling for the Scheme, it is understood that these discharges are relatively large for the system. Nonetheless, given the flashy nature of the water body, these flows are likely to be within 'normal' flow thresholds for the water body.

5.18. It is considered likely that there could be a minor temporary adverse effect on fish within the water body, but there is recognition that high flows are also an important mechanism for the maintenance of habitat diversity and quality. As such, these effects are not likely to cause a deterioration in fish status at the waterbody scale.

Invertebrates

5.19. The current status for invertebrates is moderate within the Hermitage Stream water body. This status is derived from monitoring on the Hermitage Stream itself, and not the tributary systems.

Reservoir footprint

5.20. The proposed reservoir is expected to result in the wholesale loss of 3.7 km of headwater stream and an additional 0.1 km loss of Riders Lane Stream associated with the loss of incoming flows. Aquatic invertebrate surveys undertaken in April 2020 indicate that these headwater streams support a diverse range of invertebrate species (68 different taxa were recorded within invertebrate monitoring sites 1-5, which are located immediately upstream and within the reservoir). This includes Nationally Scarce taxa and taxa indicative of groundwater upwelling which are detailed within Chapter 9 Biodiversity in the ES Volume 2, and Appendix A9.3 Aquatic Ecology of the ES Volume 4, where they are also considered for their conservation status.

5.21. The watercourses being lost due to the reservoir footprint are considered to intrinsically provide important invertebrate habitat and are also valuable for supporting the wider water body through the provision of re-colonisation pathways, thus giving diversity and resilience within the system. As such, there is potential for the direct loss of watercourse extent to cause **a deterioration in invertebrate status at the water body scale**.

Compensation flow

5.22. The compensation flow option that gets taken forward will largely be dependent on the ecological requirements of the downstream habitats and communities. The water quality model outputs show that water quality downstream of the reservoir will improve as a result of the Scheme. As such, the compensation flow is **not expected to result in any adverse effects on invertebrate populations at the water body scale**.

Culvert upgrade

5.23. The design includes the retention of existing culverts and the construction of additional new culverts adjacent to these. No direct loss of invertebrate habitat is anticipated. With construction mitigation in place (e.g. best practice pollution prevention measures) this is **not considered to have an effect on invertebrates at the water body scale**.

Pipeline footprint

- 5.24. The three pipeline crossings will route the pipeline under watercourses via an open cut trench construction method. There is the potential for the new pipeline crossings to have a minor localised adverse effect on invertebrates, through a temporary reduction in local habitat availability. However, no permanent habitat loss is expected as the channel beds would be reinstated to facilitate fish passage. Following installation of the pipeline, opportunities should be taken to enhance the watercourse in these locations.
- 5.25. Given the short-term nature of the works to install the pipeline crossings and that channel beds will be restored, impacts on invertebrates are likely to be **minor** and lead to **no deterioration in WFD status of the invertebrate element**.

Emergency discharge valve test

- 5.26. Non-emergency routine drawdowns will be required during operation for inspection and maintenance of the emergency drawdown infrastructure. Further details on these drawdowns are provided in paragraph 5.17 above.
- 5.27. It is considered likely that there could be a minor temporary adverse effect on invertebrates within the water body, but it is also recognised that high flows are an important mechanism for the maintenance of habitat diversity and quality. As such, these effects are not likely to cause a deterioration in invertebrate status at the waterbody scale.

Macrophytes and phytobenthos

- 5.28. The water body is currently not assessed for macrophytes and phytobenthos, however the element is still protected under the WFD and therefore an assessment of potential for deterioration from existing conditions has been undertaken. Existing conditions have been determined using professional judgement, observations from the walkover survey and review of historical EA data.

Reservoir footprint

- 5.29. The proposed reservoir is expected to result in the wholesale loss of 3.7 km of headwater stream and an additional 0.1 km of Riders Lane Stream associated with the loss of incoming flows. Despite some sections of the headwater streams being sub-optimal habitat for aquatic plants, due for instance to shading within The Avenue, the headwaters as a whole are considered to be important for macrophytes and phytobenthos within the water body. Marginal macrophytes, including sedges and rushes were observed during walkover survey, and vegetation surveys undertaken for the biodiversity assessment (see Chapter 9 Biodiversity in ES Volume 2) returned records for noteworthy marginal plant species, including creeping forget-me-not (*Myosotis secunda*), floating club rush (*Eleogiton fluitans*) and marsh St John's wort (*Hypericum elodes*) in and around Upper Lake, which is connected to Headwater Stream 2 (HS2). As such, the loss of headwater streams under the footprint of the reservoir is considered likely to result in a loss of macrophyte and phytobenthos habitat within the water body catchment.
- 5.30. These watercourses provide both direct habitat for macrophytes and phytobenthos and are likely to be valuable to the wider water body through the provision of re-colonisation pathways and for supporting the water body's invertebrate assemblage, thus providing diversity and resilience within the system. Therefore, there is the potential for the direct loss of watercourse extent within the reservoir footprint to cause **a deterioration in macrophytes and phytobenthos at the water body scale**.

Compensation flow

- 5.31. Downstream of the reservoir, Riders Lane Stream and Hermitage Stream flow through a predominantly urban catchment and have been subject to historical modification which limits macrophyte growth through for instance the creation of artificial bed substrates, steep banks and incised channels. Much of Riders Lane Stream is also shaded by riparian trees further limiting in-channel vegetation growth.
- 5.32. A review of EA data identified one macrophyte survey site on the Hermitage Stream (Site ID 81176) at SU7100007540 which was surveyed on 17/09/2012. This site is not affected by changes in hydrology associated with the compensation flow.
- 5.33. The EA survey indicates that this location, has a moderately diverse macrophyte community comprised of predominantly common marginal species including water mint (*Mentha aquatica*),

yellow flag iris (*Iris pseudacorus*), branched bur-reed (*Sparganium erectum*) and lesser pond sedge (*Carex acutiformis*). However, it is noted that the survey site is located immediately upstream of the confluence with Riders Lane Stream (SU7100007540; within Reach 3) in a section of the Hermitage Stream which has undergone targeted restoration work to remove artificial concrete banks and improve marginal habitats. Therefore, the survey undertaken on 17/09/2012 is not considered to be representative of the Hermitage Stream water body as a whole and is expected to represent a more diverse macrophyte assemblage that further downstream (Reach 4) or within the Riders Lane Stream (Reach 1).

- 5.34. The mix of species recorded is likely to be a direct result of the restoration works, but some of the taxa are likely to occur elsewhere in the water body too. Yet, given that Reach 1 and Reach 4 have significant pressures from urban land use, such as the concrete bed and banks within the Hermitage Stream, miss-connections within the sewage network and the presence of invasive non-native species, namely Himalayan balsam (*Impatiens glandulifera*), it is expected that macrophyte abundance and possibly overall diversity would be reduced compared to the restored reach. The compensation flow option that gets taken forward will largely be dependent on the ecological requirements of the downstream habitats and communities. Subsequently, changes in flow within Reach 1 and Reach 4 associated with the compensation flow are unlikely to result in any noticeable changes in macrophyte communities within these reaches.

- 5.35. Furthermore, the water quality model outputs show that water quality downstream of the reservoir will improve as a result of the Scheme. As such, the compensation flow is **not expected to result in any adverse effects on macrophytes and phytobenthos at the water body scale**.

Culvert upgrade

- 5.36. The design includes the retention of existing culverts and the construction of additional new culverts adjacent to these. There may be localised losses of riparian vegetation associated with the three culvert upgrades, however this is **not considered to have an effect on macrophytes and phytobenthos at the water body scale**.

Pipeline footprint

- 5.37. The three pipeline crossings will route the pipeline under watercourses via an open cut trench construction method. There is the potential for the new pipeline crossings to have a minor localised adverse effect on macrophytes and phytobenthos, through a temporary reduction in local habitat availability.
- 5.38. Given the short-term nature of the works to install the pipeline crossings and that channel beds will be restored, impacts on macrophytes and phytobenthos are likely to be **minor** and lead to **no deterioration in WFD status of the invertebrate element**.

Emergency discharge valve test

- 5.39. Non-emergency routine drawdowns will be required during operation for inspection and maintenance of the emergency drawdown infrastructure. Further details on these drawdowns are provided in paragraph 5.17 above.
- 5.40. There could be a minor temporary effect on macrophytes within the water body as a result of emergency discharge valve tests, however these effects are not likely to cause a deterioration in invertebrate status at the waterbody scale.

Summary for biological quality elements

- 5.41. Overall, there is the potential for the loss of 3.8 km of watercourse to cause a deterioration in biological quality elements at the water body scale. In the context of the wider water body, the habitat potentially being lost to the Scheme is distinct. It both supports a wide range of taxa and accounts for c.42% of headwaters within the whole water body. Given the uniqueness of the habitat typology being lost in comparison to the remainder of the water body, there are limited practical options for mitigation and thus there remains a risk of deterioration at a water body scale and hence an Article 4.7 test accompanies the planning application. Mitigation options are considered in Section 6. Any mitigation will need to be agreed with the EA.
- 5.42. To alleviate the potential effects of changes in the natural hydrology within the downstream watercourses, a compensation flow will be established. Three options are being investigated for the compensation flow, however, given that the compensation flow will be set with reference to

ecological flow requirements, it is not considered likely to have an adverse effect on biological quality elements at the water body scale.

- 5.43. There is further potential for localised minor impacts to biological quality elements associated with three pipeline crossings and the widening of three culverts. However, the scale and temporary nature of these effects, along with appropriate mitigation is not considered to cause a deterioration in biological quality elements.

Hydromorphology supporting elements

- 5.44. The current status of the Hermitage Stream is moderate, with the Hydromorphological supporting elements assessed as supporting good as of 2015. Table 5-1 shows the morphological baseline for the assessed reaches.
- 5.45. The baseline flow conditions of the headwater streams and upper reaches of Riders Lane stream are currently understood to be largely ephemeral, however this is underpinned by a lack of flow monitoring data. The current understanding is that the headwater streams are wet and relatively during the winter months and dry in summer, but the discharge of these are unknown. The top part of Riders Lane is also known to be ephemeral and the exact location of the perennial head is unknown. From there the rest of Riders Lane and Hermitage Stream is perennial with a flow gauge located at the bottom of Hermitage Stream which has a QMED flow of 8.95m³/s.

Reservoir Footprint

- 5.46. There is a direct loss of 3.7 km of headwater stream and part of Riders Lane Stream as a result of the reservoir footprint and an additional 0.1 km loss directly downstream of the reservoir as a result of the new compensation flow channel. This loss equates to 18.5% of the whole linear length of the water bodies within the Hermitage Stream catchment, 44% of Riders Lane Stream and 42% of all headwater streams within the catchment. The loss will additionally have a direct impact on the hydromorphology of the remaining watercourses. There is a significant loss in habitat which has the potential to affect the integrity of the water body, **risking deterioration to the WFD hydromorphology supporting element status meaning that it may no longer support good status.**
- 5.47. The retained headwaters will flow into the reservoir body in the north once the Scheme is constructed. The construction of the reservoir will create a permanent discontinuity in the system as the reservoir will create a barrier to any sediment continuity. This will also impact the remainder of Riders Lane Stream downstream of the reservoir footprint as sediment from the headwaters will no longer be transferred downstream to these receiving reaches. The loss of connectivity could result in potential water body deterioration and, thus the loss could **risk deterioration to the WFD hydromorphology supporting element status meaning that it may no longer support good status.**
- 5.48. Due to the scale of the reservoir this section of the water body is likely to be required to be re-designated by the Environment Agency as a lake water body.

Compensation Flow

- 5.49. Despite the loss of the headwater streams that flow into Riders Lane Stream and subsequently Hermitage Stream, there will be a compensation flow out of the reservoir and into Riders Lane Stream. The flow out of this headwater catchment is only ~10% of the size of Heritage Stream catchment and therefore this flow makes up a small percentage of the overall flow in Hermitage Stream. Nonetheless, the compensation flow will aim to provide the same volume of water per annum that would naturally occur without the reservoir.
- 5.50. The exact annual and/or monthly flow regime of the compensation flow into Riders Lane Stream is yet to be determined but at present there are three options being explored. The option that gets taken forward will largely be dependent on the results of the invertebrate surveys undertaken on the streams and the continuous flow monitoring to give more realistic volumetric flow data. If the streams, in particular Riders Lane, is found to have rare and/or important ephemeral species then the intermittent nature of the stream will be retained. If there are no rare and/or important species found, then the annual discharge of the stream may be split to return an amount of flow all year round which may benefit the hydromorphology of Riders Lane Stream.
- 5.51. There will be no sediment continuity retained between the retained headwaters and Riders Lane Stream and therefore there will be no sediment input to the downstream river. This may result in

localised changes to morphology until a new equilibrium is reached but will not have a water body scale impact.

- 5.52. None of the elements outlined above are seen to risk deterioration to the **WFD hydromorphology supporting element status** of the water body and depending which compensation flow method is taken forward may provide a small benefit to the hydromorphology. However, **further assessment** will be required once the compensation flow is agreed on.

Culvert upgrade

- 5.53. At three culverts along Riders Lane Stream additional culverts will be added adjacent to the existing culverts to increase the capacity of the channel in case of emergency drawdown. The design of these culverts is not yet finalised, but to maximise and habitat and fish passage connectivity benefits any new culverts would need to have depressed invert (e.g. 100mm below bed level) so that a natural bed can form within them once constructed. Once the designs have been finalised **further assessment** will need to be undertaken following confirmation of the design of these structures to assess the potential impacts on hydromorphology and any subsequent effect on WFD compliance, however as they will be designed in such a way to not have a negative impact on the watercourse no risk to deterioration is anticipated.

Pipeline footprint

- 5.54. The new pipeline that will be constructed to pipe water from Bedhampton and Havant Springs to the reservoir will cross the watercourses in three places in Reaches 1, 2 and 3 (Figure 5-1). The method for laying the pipe will be open cut and require a cover dam and over pumping. This method will provide the opportunity to reinstate some better habitats as part of demobilisation; both riparian and in-channel (river bed). The open cut method will have a temporary impact on hydromorphology during construction but following demobilisation and reinstatement of the watercourse there will be **no risk to deterioration of WFD hydromorphology supporting element status**.

Emergency discharge valve test

- 5.55. The emergency drawdown valve will be tested twice annually with 0.7m³/s entering Riders Lane Stream and 0.4m³/s entering Hermitage Stream. Due to uncertainties surrounding the hydrology, as a result of the lack of hydrological monitoring, it is difficult to determine the impact of this flow. It is concluded therefore that this may incite increased geomorphic processes such as bank erosion on a local scale and would need careful management should it occur. This is unlikely to cause deterioration of **WFD hydromorphology supporting element status** at a water body scale.

Summary for hydromorphological support elements

- 5.56. Overall, there is likely to be a loss of 3.8 km of watercourse as a result of the Scheme. This represents a significant reduction in linear watercourse length within the catchment. The construction of the reservoir will also create a permanent discontinuity in the system as the reservoir will create a barrier to any sediment continuity.
- 5.57. The scale of the loss, and disconnection of the sediment continuity, which both support in providing the geomorphologic template for the habitat, means that there is the **potential for a deterioration in the hydromorphology supporting element status** at the water body scale. Mitigation options to offset this loss are considered in Section 6.
- 5.58. The impacts associated with the pipeline crossing, access roads and culvert adjustments are unlikely to cause any deterioration in status, but this will need to be revisited once the design parameters are set. If these features are appropriately designed, there could be localised benefit to the watercourse at these locations.

Physico-chemical supporting elements

- 5.59. The currently status of the Hermitage Stream is moderate, with the same status given to physico-chemical quality elements.
- 5.60. The only physico-chemical element to not achieve good/high status is Phosphates.
- 5.61. There will be no change to water quality of the headwater streams retained upstream of the Reservoir.

Reservoir footprint

- 5.62. The footprint of the reservoir itself will have no impact on any physico-chemical elements.

Compensation flow

- 5.63. The following section details the key chemicals considered that can affect WFD classification in the compensation flow out of the reservoir and to the downstream receiving waters.

Temperature

- 5.64. It is unlikely that the compensation flow discharge from the reservoir into the Riders Lane Stream will result in 3 degrees change after mixing, which is the WFD standard for classification as applied by UKTAG guidance; defined by the 98-percentile value.

pH

- 5.65. Further calculations of changes in pH have not been carried out because the Environment Agency did not require further work in this area following the review of the previous calculations by R.M. Walls. This showed, very little change in pH is likely to occur.

Phosphorus

- 5.66. It is anticipated that the change in phosphorus will be -85% in Riders Lane, and less -2.25% in the Hermitage Stream, so there will be no change in WFD status.
- 5.67. However, because phosphate standards are derived from alkalinity and it is predicted there will be a 429% increase in alkalinity just downstream of the reservoir in Riders Lane Stream and 7.7% increase at the WFD assessment point on the Hermitage Stream, therefore a change in status may be observed here.

Ammonia

- 5.68. Ammonia concentrations are expected to decrease by 49% in Riders Lane Stream, downstream of the reservoir, and 6% in the Hermitage Stream.
- 5.69. Although there is some uncertainty about the predicted concentrations due to the difficulty in predicting concentrations in the reservoir, it is expected that the WFD status will remain high after the Scheme is implemented.

Dissolved oxygen and BOD

- 5.70. BOD is predicted to decrease 15% downstream of the reservoir, in the Riders Lane Stream, and 1% at New Road. Any change in BOD levels is likely to be an improvement on the current status.
- 5.71. Dissolved Oxygen will remain high after the development.
- 5.72. This involves a caveat where it is assumed that the compensation flow has a high oxygen concentration and isn't taken from deeper, lower oxygenated water.

Specific pollutants

- 5.73. Modelling has been undertaken for both iron and manganese. There is a substantial decline in both chemicals downstream of the reservoir with 66% and 68% respectively in the Riders Lane Stream, and 20% and 32% respectively at New Road.
- 5.74. These results would be an overall improvement, so either no change or improvements in compliance is anticipated.
- 5.75. During construction there may be temporary impacts on the watercourses as a result of the installation of the new culverts and the pipeline, but no residual impacts are anticipated.

Pipeline footprint

- 5.76. During construction there may be temporary impacts on the watercourses as a result of the installation of the new culverts and the pipeline, but no residual impacts are anticipated.

Summary for physico-chemical support elements

- 5.77. The water quality model outputs show that water quality downstream of the reservoir will improve as a result of the Scheme. As a result, there is **no risk of a deterioration on WFD status** of the receiving water bodies.

- 5.78. Calcium, nitrate, alkalinity, electrical conductivity and total dissolved solids are the only chemicals to show a substantial increase as a result of the Scheme, but these do not affect the WFD classification or are specific pollutants or priority hazardous substances therefore have no implications for WFD status.

Transitional water bodies

- 5.79. In line with the 'Clearing the Waters for All' guidance, a scoping exercise was undertaken to identify the potential risks that these activities may pose to the WFD receptors within the Langstone Harbour water body. These WFD receptors are defined by the Government guidance as the following:
- Hydromorphology
 - Biology – habitats
 - Biology – fish
 - Water quality
 - Protected areas
- 5.80. Besides these receptors, which are based on the water body's quality elements, and in line with the Government guidance, the scoping exercise also considered the potential risk of introducing and / or spreading:
- Invasive non-native species (INNS).
- 5.81. Because the activities identified during the screening stage pose the same type of risk – this is, potential changes in quantity and /or quality of the water reaching Langstone Harbour – they were assessed together against the Langstone Harbour water body based on the scoping template of the Environment Agency ('WFD scoping template').
- 5.82. To support this assessment, the relevant 'water body table' was consulted to establish the status of the water body and its elements. Magic maps (<http://magic.defra.gov.uk/MagicMap.aspx>) were used to find information about the location and size of the WFD habitats and protected areas.
- 5.83. For full details of the assessment please refer to the Scoping Stage provided in Appendix A of this report. The potential risks identified in the scoping stage are summarised in Table 5-2.

Table 5-2 - Potential risks to the Langstone Harbour WFD receptors

WFD receptors	Potential risk to receptor	Issues for impact assessment
Hydromorphology	No	-
Biology – habitats	Yes. Possible	Possible risk of changes in water quality and water quantity having a footprint of 0.5 km ² or larger. Impact assessment of the results from water quality modelling and 'compensation flow' options will inform this issue further.
Biology – fish	Yes. Possible	Potential risk of changes in water quality and quantity resulting in an impact to normal fish behaviour. Impact assessment of the results from water quality modelling and 'compensation flow' options will inform this issue further.
Water quality	Yes. Possible	Possible risk of changes in water quality near the springs to affect water quality. Impact assessment of the results from water quality modelling and 'compensation flow' options will inform this issue further.

Protected areas	Yes. Possible	Possible risk of impacting qualifying features of several WFD protected areas located within 2 km of the location of the springs. Impact assessment will inform this issue further.
Invasive non-native species	No	-

Assessment of impacts to WFD receptors

- 5.84. Langstone Harbour is a heavily modified water body, with current Moderate potential, and the objective to achieve Good potential by 2027. The key characteristics for the Langstone Harbour water body are summarised in Table 3-3.
- 5.85. The Langstone Harbour water body is located within the Hampshire Transitional and Coastal Operational Catchment. The issues preventing waters in this catchment reaching good status, are linked to waste water pollution, physical modification and pollution from rural areas (agriculture and rural land management).
- 5.86. At present, there are no measures within this operational catchment which the predicted improvements in the status of water bodies are based upon. Measures may have been identified and shown to be worthwhile in an economic appraisal, but funding has not yet been secured to progress these measures, and information on these measures is not available (Environment Agency, Catchment Data Explorer – April 2020).
- 5.87. The impact assessment for each receptor identified during the scoping stage as being at risk from the proposed activities, is presented in the following sections.

Biology – habitats

- 5.88. Langstone Harbour has been heavily modified to offer coastal and flood protection. It is frequently used for fishing and recreation, and its natural environment is dominated by tidal movements, which regularly expose large areas of mud beds and soft sediments.
- 5.89. Two WFD habitats of higher sensitivity are present in Langstone Harbour: intertidal seagrass, approximately 130 ha; and saltmarsh, approximately 72 ha.
- 5.90. Seagrass is an important aquatic plant which offers habitat and refuge to small marine life, slows down water movement and helps maintain the chemical balance in the marine environment. While more abundant than saltmarsh in the harbour, seagrass in Langstone Harbour is clustered in only four locations, mainly south of the Farlington Marshes, at Rod Rithe in the west of Hayling Island, in the south of the harbour, and a few square meters are found between South Binness Island and Baker's island.
- 5.91. Saltmarsh grows in intertidal areas and is an important habitat for birds and for regulating flooding and sediment movement within the harbour. In Langstone Harbour, saltmarsh is scattered around several locations, but the largest concentrations are found on North Binness Island, South Binness Island, Long Island, and Baker's Island, with other large areas located south and north east of Farlington Marshes and around the former oyster farms in Hayling Island.
- 5.92. The location of these habitats is shown in Figure 5-2.



Figure 5-2 - WFD habitats of higher sensitivity in Langstone Harbour (taken from Magic Map)

- 5.93. Four WFD habitats of lower sensitivity are present in Langstone Harbour: Cobbles, gravel, and shingle, approximately 25 ha; intertidal soft sediment, approximately 1,390 ha; rocky shore, approximately 10.9 ha; and subtidal soft sediment, approximately 383 ha.
- 5.94. The saltmarsh and seagrass habitats are controlled by the saline influence of the tides and less by the freshwater input from the Hermitage stream. The changes in volume of freshwater input to Langstone Harbour caused by the Scheme will be within the limits of the water extraction licence, and under its agreed conditions which will ensure that sufficient water continues to flow to support the habitats within the harbour (Minimum Residual Flow).
- 5.95. The saltmarsh areas are located at a distance from the Hermitage stream and will be used to experiencing some degree of variation in the general freshwater concentration in the harbour (seasonal, rain, streams input). The changes in freshwater input caused by the Scheme (quantity and quality) are small and potentially imperceptible within the natural variations occurring in this large water body, and thus unlikely to impact these tidal habitats.
- 5.96. The intertidal seagrass beds are located more than 2 km away from the Hermitage stream and unlikely to be affected by any change in water quantity and quality caused by the Scheme.
- 5.97. Lower sensitivity areas will not be affected by the potential changes in water quality. Potential changes of freshwater input caused by the Scheme are too small to modify the structure or morphology of the sediments, shingle and rocks comprising the lower sensitivity habitats to a degree that it would cause detrimental effects to these habitats.

Biology - fish

- 5.98. There are several fish species present in Langstone Harbour. A few commercial fishing boats operate in the harbour and numerous recreational anglers fish from the shore. Because it is an important nursery area for bass, there are a number of fishing restrictions in place (size, closed season).

- 5.99. Surveys carried out between 2012 and 2017 show the presence of 39 different fish species, with the predominance of bass, sand goby, grey mullet, and herring⁵. Mackerel, pollack, sand eels, and seabream are also common in the harbour. The fish caught at Bedhampton aggregates wharf as part of these fish surveys (June 2017 data), indicate a strong dominance of grey mullet (*Liza sp*).
- 5.100. Although useful, these discreet surveys only provide a snapshot of the fish in Langstone Harbour, and data are often affected by changes in the methodology (e.g. net deployment at different stages of the tide or at different locations over the years).
- 5.101. Data about fish migration collected by the Environment Agency on Hermitage stream in 2012, shows presence of bullheads (*Cottus gobio*), and European eels (*Anguilla anguilla*); (survey location: Barncroft Way, ID:43142; the most recent data publicly available and the survey point closest to the water springs). While there is no conservation concern regarding the state of the non-migratory bullhead species, European eels are critically endangered.
- 5.102. Fish as WFD receptor, are often threatened by structures in the water such as mill hatches and weirs impounding sections of the streams and obstructing normal fish passage. The water quality issues and low flow can also act as a barrier to fish migration.
- 5.103. The proposed abstraction of water from the springs will not involve the installation or use of any new structure in the Hermitage stream that could obstruct fish migration.
- 5.104. The water quality modelling results (February 2020) suggest that the overall water quality will improve downstream of the Scheme as a result of the new reservoir. This is likely to have a positive effect on fish species, both those potentially using the Hermitage stream for migration (e.g. European eels) and those in Langstone Harbour (e.g. seabreams, bass, sand goby, etc.). A reduction of nitrogen load input into Langstone Harbour linked to the proposed new reservoir, will favour a drop in the emergence of harmful algal bloom episodes, which have detrimental effects on fish, and which have a history of occurring in the Langstone Harbour water body.
- 5.105. Furthermore, the volume of water flow will be maintained and managed within the water extraction licence limits, by regulating the water taken from the springs to fill up the reservoir, and the compensation flow regime, which will mimic natural seasonal variations, with potential benefits of extra water in the summer months. Changes in the water input to Langstone Harbour will not be significant enough to change the depth or water flow in a way that what would impact normal fish behaviour.
- 5.106. The Scheme is not expected to result in negative impacts to fish.

Biology – Water Quality

- 5.107. Langstone Harbour is a tidal inlet almost completely land locked, with a narrow channel connecting it to the Solent. This channel is flanked by two sand spits and has strong currents which allow substantial exchange of water with the Solent. The harbour is tidal dominated with approximately 70% of the harbour being exposed during ebb tide.
- 5.108. Despite being widely used for recreation (e.g. fishing, sailing), the water quality in the harbour is Good, in part due to the introduction of several improvement measures within the harbour, such as managing and regulating new developments and recreational activities, improving the water sewage treatment plant outfall, encouraging responsible disposal of waste that could affect storm water discharges, promoting good boating practice, and an information campaign aimed to visitors of the designated sites.
- 5.109. The Environment Agency regularly tests the water for bacterial and heavy metal content, and investigates pollution incidents within the harbour.
- 5.110. The Hermitage stream provides freshwater input to the harbour at a rate of 0.1-0.2 m³/s (mean) and 7 m³/s (peak)⁶. As part of the Scheme, different options for a flow regime were modelled based on historic data from gauging stations, to provide the highest environmental benefit.
- 5.111. The preferred option for the flow regime is a hybrid flow that resembles natural conditions but that also provides a minimal flow during summer months in which watercourses normally run dry. This extra flow of water in the summer months will provide a source of drinking water for wildlife,

⁵ Langstone Harbour Small Fish Survey 2012-2017. Langstone Harbour Board, Southern IFCA, University of Portsmouth, and RSPB. Series available at <http://www.langstoneharbour.org.uk/environment-fish-survey.php>

⁶ Lymington Technical Services Ltd. Marine licence application Ref. MLA/2016/00507/1 – Bedhampton Approach Channel Navigational Dredging, 2017.

including animals, birds and insects and is likely to improve water quality conditions in Langstone Harbour (generally, more water is better for the water body quality elements).

- 5.112. Water quality modelling results (February 2020)⁷ suggest that the overall water quality downstream of the reservoir will improve as result of the Scheme. The modelling results show that there will be a reduction in turbidity and the nitrate (nitrogen) load input to Langstone Harbour. Nitrogen load is expected to be reduced by approximately 6.7%, improving water quality and benefiting the habitats and species of the protected sites. This is because the water emerging from the springs, which usually flows directly into the Hermitage stream, and which has large volumes of nitrogen, will partially be prevented from flowing directly into the Hermitage stream and part of it will be pumped to the reservoir instead, where the water will naturally denitrify, reducing overall input of nitrate load into the Langstone Harbour water body.
- 5.113. Furthermore, the new reservoir, a water body of approx. 8,700million litres, will provide a buffering effect downstream from elements coming from the catchment, helping to smooth out peaks of elements input such as iron, manganese and magnesium which currently arise from the three small streams located by the site of the proposed reservoir. Water discharged from the reservoir will therefore be of a more consistent quality.
- 5.114. Changes in temperature downstream of the reservoir were also assessed; this indicates that the mixing of the compensation water with the Riders Lane stream is extremely unlikely to result in a change of temperature immediately below the confluence of the streams greater than 3°C; the WFD threshold. Changes further downstream will be less because of increased dilution.
- 5.115. The output of the mass balance calculations is that water quality downstream of the reservoir will improve. Consequently, there is no risk of a deterioration in WFD status. The only chemicals that show a substantive increase in concentrations are calcium (potentially beneficial for biodiversity), nitrate, nitrite, alkalinity, electrical conductivity and total dissolved solids. BOD should be reduced downstream once the reservoir is in place due to the greater opportunity for oxidisation of organic matter whilst water is stored in the reservoir. However, none of these determinands affect WFD classification or are specific pollutants or priority hazardous substance so have no implications for WFD status. None of the changes identified during the water quality modelling are of concern with regards to water quality and WFD classification.
- 5.116. The Scheme is expected to have beneficial impacts to the water quality of Langstone Harbour.

Biology – Protected areas

- 5.117. There are four WFD protected areas within 2 km of the freshwater springs and the freshwater input point from Hermitage stream into Langstone Harbour. These protected areas are:
- Langstone Harbour Shellfish Waters;
 - Langstone Harbour Nutrient Sensitive area;
 - Solent Maritime Special Areas of Conservation (SAC); and
 - Chichester and Langstone Harbours Special Protection Area (SPA).
- 5.118. Several types of shellfish are collected in Langstone Harbour, including oysters, mussels, cockles and winkles. Filter feeding bivalve molluscs retain and accumulate various microorganism from the surrounding water and the microbiological safety of shellfish for human consumption depends on the quality of the water from which the shellfish is harvested. In Langstone Harbour the sources of pollution affecting water quality for shellfish are linked to discharges from sewer outfall and other pipes, rivers and streams draining the surrounding area and residential settlements, the livestock on Farlington Marshes and wildlife such as flocks of birds, and boats using the harbour⁸.

⁷ Atkins. February (2020). Havant Thicket Winter Reservoir Storage, Early Start Studies. Water Quality Study – Water Quality Modelling Report, Portsmouth Water. 5165942/DG/61/1024.

⁸ Portsmouth City Council, 2014. Shellfish Local Action Plan - Shellfish Beds Portsmouth and Langstone Harbour - Appendix 1. Available at <https://democracy.portsmouth.gov.uk/documents/s5469/ecs14Nov14DM%20shellfish%20appx%201%20shellfish%20local%20action%20plan.pdf>

- 5.119. To protect shellfish, besides existing bylaws restricting size and season for the local extraction of these shellfish, a large area of Langstone Harbours has been officially classed for the protection of bivalve mollusc production (under EU Regulation 854/2004) - Langstone Harbour Shellfish Waters.
- 5.120. Langstone Harbour Nutrient Sensitive Area [Eutrophic] - water bodies and their quality elements can be affected by the emissions of waste water treatment plants, with areas affected by eutrophication or having a surface water abstraction affected by elevated nitrate concentrations.
- 5.121. Langstone Harbour has been designated a nutrient sensitive area (with focus on nitrate concentration, not phosphate), with the objective to reduce water pollution caused by nitrate from agricultural sources and to prevent further such pollution.
- 5.122. The Solent Maritime SAC covers large parts of the Solent estuarine system and has been designated to protect the following qualifying features: Spartina swards, Atlantic salt meadows, inundated sandbanks, mudflats, and coastal lagoons. The site is located approximately 1 km south of the Bedhampton and Havant water springs and connected through the Hermitage stream.
- 5.123. The Chichester and Langstone Harbour SPA covers two large estuarine basins. The site is located approximately 1 km south of the Bedhampton and Havant water springs and connected through the Hermitage stream.
- 5.124. Chichester and Langstone Harbours, together with Portsmouth Harbour to the west, form one of the most sheltered intertidal areas on the south coast of England. The Chichester and Langstone Harbour SPA contains extensive intertidal mudflats and sandflats with areas of seagrass beds, saltmarsh, shallow coastal waters, coastal lagoons, coastal grazing marsh and shingle ridges and islands. These habitats support internationally and nationally important numbers of overwintering and breeding bird species.
- 5.125. Shellfish waters are designated to protect areas of shellfish growth and production, mainly from pollution such as agricultural run-off (e.g. chemicals from pesticides) and discharges from sewage treatment works (e.g. coliform bacteria such as *E. coli*). The potential changes in water input caused by the Scheme are unlikely to alter the water quality elements necessary for shellfish production in this protected area.
- 5.126. The water quality modelling (February 2020) shows that nitrate inputs to the harbour will be reduced once the reservoir is operational, and thus it is likely to benefit the objectives of the Langston Harbour as a nutrient sensitive area for nitrate.
- 5.127. The Solent Maritime SAC qualifying features are not reliant on the freshwater discharge from the Hermitage stream, and the changes in quality and quantity of water input caused by the Scheme are unlikely to significantly affect this protected area.
- 5.128. The Chichester and Langstone Harbour SPA qualifying features are not reliant on the freshwater discharge from Hermitage stream, and the changes in quality and quantity of water input caused by the Scheme are unlikely to significantly affect this protected area.

Cumulative effects

- 5.129. The potential changes in water quantity and quality caused by the Scheme are unlikely to cause deterioration in the status of the Langstone Harbour water body when acting in combination with other activities in the area. The changes to the water caused by the Scheme do not have the scale to cause deterioration.
- 5.130. Pressures to the water body, linked to abstraction levels and changes in water will continue to be regulated and managed by the Environment Agency which would consider any potential cumulative effect alongside the Scheme.

Risk of jeopardising WFD measures to prevent status deterioration

- 5.131. The Scheme was assessed to establish the likelihood of jeopardising the waterbodies to achieve their target status.
- 5.132. As mentioned before, there are no actions to deliver WFD objectives specific to the Hampshire Transitional and Coastal Operational Catchment, nor targeted for the Langstone Harbour water body. However, there are some actions at the East Hampshire Catchment level that could interact with the Langstone Harbour water body as it includes the land around the harbour, and it also covers the Hermitage stream. Priority issues in the catchment are diffuse pollution, heavily modified river channels reducing fish passage and habitat and landfill sites near protected areas. The list of actions is shown in Table 5-3.

- 5.133. The South East River Basin Management Plan (RBMP) also sets out a number of measures to be developed between local partners in the East Hampshire Catchment (catchment partnership measures)⁹:

Contribution to environmental outcomes for 2021 - (South East RBMP, 2015)

- 3 projects are planned on the River Hamble to improve fish passage and habitat quality, and to reduce diffuse pollution impacts on the river and downstream estuary (Wangfield Lane fish refuge and habitat creation; Durley Mill fish pass; and Upper Hamble river restoration). Portsmouth Water are contributing £30,000 and bids are currently being prepared for landfill tax and Heritage Lottery Funding (up to £300,000 over 3 years).
- The Meon Valley Partnership is working to get the Meon to good status by tackling invasive non-native plants, diffuse pollution and low flow issues. Habitat improvement works are planned to mitigate the concrete-lined channels at East Meon and the impacts of rural land use. More fish passage improvements are also intended.
- A river restoration project on Hermitage Stream is planned to address water quality, fish failures and to improve the constrained concrete channel. Designs are prepared and construction money is being sought by a funding officer.
- On the River Alver the local partnership is planning to improve water quality that is affected by the surrounding landfill, keep water levels high and stable enough to support the upstream wetland and improve flood defences.

- 5.134. The Scheme is not considered to have an adverse impact on any of the actions set out in Table 5-3 or the catchment partnership measures and would not adversely affect the achievement of the WFD objectives. Portsmouth water is actively contributing towards the control/management of diffuse source inputs through catchment management measures.

⁹ Environment Agency (2015). South East river basin district – River Basin Management Plan. Updated 2018. Accessed at <https://www.gov.uk/government/publications/south-east-river-basin-district-river-basin-management-plan>

Table 5-3 - Actions to deliver WFD objectives in the East Hampshire Catchment area¹⁰

Water body name	Measure reference code	Measure category 1	Measure category 2	Measure category 3	Description	Lead organisation	Key Type of Measure (KTM)
GB107042016250 - Main River Hamble	5.1.1	To improve modified habitat	Removal or easement of barriers to fish migration	Enable fish passage (e.g. fish pass)	Fish pass at Calcot Hatches	Environment Agency	KTM5 - Improving longitudinal continuity (e.g. establishing fish passes, demolishing old dams)
GB107042016250 - Main River Hamble	2.3.1	To control or manage diffuse source inputs	Mitigate/Remediate diffuse pollution impacts on receptor	Riparian management	Agricultural diffuse pollution measures		KTM2 - Reduce nutrient pollution from agriculture
GB107042016250 - Main River Hamble	5.1.1	To improve modified habitat	Removal or easement of barriers to fish migration	Enable fish passage (e.g. fish pass)	Fish pass at Durley Mill	Wild Trout Trust	KTM2 - Reduce nutrient pollution from agriculture
GB107042016280 - Upper Hamble	2.3.1	To control or manage diffuse source inputs	Mitigate/Remediate diffuse pollution impacts on receptor	Riparian management	Agricultural diffuse pollution measures		KTM6 - Improving hydromorphological conditions of water bodies other than longitudinal continuity
GB107042016250 - Main River Hamble	2.3.1	To control or manage diffuse source inputs	Mitigate/Remediate diffuse pollution impacts on receptor	Riparian management	Agricultural diffuse pollution measures		KTM5 - Improving longitudinal continuity (e.g. establishing fish passes, demolishing old dams)
GB107042016280 - Upper Hamble	5.3.7	To improve modified habitat	Improvement to condition of channel/bed and/or banks/shoreline	Increase in-channel morphological diversity	Habitat improvement	Portsmouth Water	KTM2 - Reduce nutrient pollution from agriculture

¹⁰ Environment Agency, Catchment Data Explorer – April 2020. East Hampshire Management Catchment. [and] East Hampshire River Operational Catchment. Accessed at <https://environment.data.gov.uk/catchment-planning/ManagementCatchment/3034>

Summary of residual impacts

- 5.135. There will be some changes to the water quality and flow caused by the Scheme, but these changes will be very small and likely to be within the natural variations of the harbour, where habitats are used to them. There may be a positive impact to receptors in the harbour from the expected improvement in the overall water quality as a result of the denitrification effect in the new reservoir.

Conclusion

- 5.136. The Scheme lies within the South East RBMP. The new reservoir is important infrastructure that will contribute to the secure and more efficient supply of drinking water to businesses and communities in the South East of England. The South East RBMP acknowledges the importance to protect water quality without precluding abstraction of freshwater and changes to natural flow and levels of water, which are regulated by the Environment Agency through different permits and licences.
- 5.137. Elements from the proposed Havant Thicket Reservoir Scheme, which include pumping of water from the Havant and Bedhampton springs; and changes in the volume and frequency of flow of water from the reservoir into the Riders Lane stream (also known as 'compensation flow') – both activities, which could cause potential changes in quantity and quality of the water reaching Langstone Harbour, have been assessed against the WFD objectives for the transitional water body: Langstone Harbour.
- 5.138. Against a baseline understanding, the water body has been assessed with respect to the following:
- Potential to cause deterioration in any of the WFD quality elements.
 - Impact on critical or sensitive habitats or species to cause deterioration.
 - Potential to contribute to a cumulative effect alongside additional pressures to cause deterioration.
 - Impact on waterbody improvement measures and the ability to meet WFD objectives.
- 5.139. The key findings are outlined in Table 5-4.

Table 5-4 - Summary of findings – Transitional water body assessment

Water body	Parameter	Assessment
Langstone Harbour	Potential to cause deterioration in WFD quality elements	Based on the assessment of the water quality modelling, proposed compensation flow options, and desk study of the area and the water body, the proposed activities will have negligible impact on the water body quality elements, and will not reduce the status of any quality elements, and thus, do not pose a risk for status deterioration.
	Potential to impact on critical or sensitive habitats or species	No. The assessment concluded that the potential changes caused by the Scheme (quantity and quality) are very small and potentially imperceptible within the natural variations occurring in the water body, and thus unlikely to impact its habitats and species.
	Potential to cause cumulative impacts	No. In the case of further applications for water abstraction or activities which could cause changes to water input to Langstone Harbour, these will be overseen by the Environment Agency which should mitigate against the potential cumulative impact risk.
	Potential to impact on planned WFD actions and/or mitigation measures	No. The Scheme has not potential to impact the planned WFD improvement and/or mitigation measures.
	Need for detailed compliance assessment	No. The assessment concluded that the Scheme will not cause deterioration in any of the elements of the water body classification, nor will it prevent the water body (and its neighbours) to achieve its WFD objectives, and a detailed assessment of the Scheme in regard to specific WFD quality elements is not required.

- 5.140. The Scheme will not cause deterioration of the quality elements or supporting habitats of transitional water bodies, nor will it hinder their improvement measures nor their ability to meet WFD objectives.

Groundwater bodies

- 5.141. Two groundwater bodies were initially screened into the groundwater assessment; the East Hants Chalk groundwater body and the South Hants Lambeth Group groundwater body. Upon further investigation, it was identified that a third groundwater body, the East Hants Lambeth Group needed to be included in the impact assessment and this was subsequently screened back in.
- 5.142. The proposed reservoir lies within the East Hants Chalk groundwater body; however, at the location of the reservoir, the Chalk is confined under a layer of clay. The East Hants Chalk groundwater body is currently at Poor Status both for both quantitative and chemical elements (Table 3-4).
- 5.143. The headwaters of the intermittent watercourses which are mapped as traversing the proposed reservoir footprint lie within the East Hants Lambeth Group groundwater body. The East Hants Lambeth Group groundwater body is currently at Poor Status as a result of Poor quantitative groundwater elements (chemical elements are classed as Good status, see Table 3-5)
- 5.144. The South Hants Lambeth Group groundwater body occurs to the south of the proposed reservoir, in the vicinity of Havant and Bedhampton Springs. The South Hants Lambeth Group groundwater body is currently at Good Status both for both quantitative and chemical elements (Table 3-6)
- 5.145. The assessment of potential impacts on the WFD chemical and quantity elements for all three groundwater bodies based on the scheme elements are presented in Appendix B of this report.
- 5.146. A summary of potential impacts is provided in Table 5-5, Table 5-6 and Table 5-7.

Table 5-5 - Summary Impact Assessment for the East Hants Chalk groundwater body

WFD quality elements (Status and RNAG)	Impact of scheme elements on East Hants Chalk groundwater body
Quantitative (GW)	
Poor	Access roads
- Groundwater Abstraction	<u>Construction</u> The Chalk is not at outcrop in the areas where access roads are proposed and any earthworks associated with the access roads are not anticipated to directly encounter the Chalk or affect the quantitative status of the East Hants Chalk groundwater body.
	<u>Operation</u> No impacts on the quantitative status of the East Hants Chalk groundwater body are anticipated when the reservoir and permanent access road become operational.
	Reservoir footprint
	<u>Construction</u> The proposed reservoir sits within the East Hants Chalk groundwater body, although earthworks are not anticipated to directly encounter the Chalk as the GI results (Atkins, 2020a) indicate the Chalk to be 30 to 70m below ground (NB depth varies across the site). During construction some overlying deposits will be removed. The sandy layers within these deposits will have some shallow perched groundwater within them, however this are not believed to be in hydraulic continuity with the underlying Chalk groundwater body. As the reservoir construction is not expected to cause any connection to the underlying Chalk, no quantitative impacts on the East Hants Chalk groundwater body are anticipated.
	<u>Operation</u>

	The proposed reservoir will be constructed with impermeable material to prevent leakage, therefore there should be no impact from the presence of the constructed reservoir on the quantitative status of the East Hants Chalk groundwater body (normally confined at this location anyway). Any changes in reservoir levels during operation should not affect the quantitative status of the East Hants Chalk groundwater body.
	Pipeline footprint <u>Construction</u> The majority of the proposed pipeline route is across the confined Chalk and earthworks associated with pipeline construction are not anticipated to directly encounter the Chalk or have any impact on the East Hants Chalk groundwater body. However, the southern tip of the proposed pipeline is close to the Chalk outcrop. Chalk groundwater appears at the surface at many nearby locations as springs. The Chalk is covered by Lambeth Group and/or superficial drift deposits at this location. Depending on the depth of excavation and the geology at any given location, Chalk groundwater may be encountered and due to the structure of the Chalk, this may be under artesian pressure. Encountering the artesian chalk groundwater may adversely affect springs located in the East Hants Chalk groundwater body. If dewatering is required, this may result in temporary and localised impacts. Assuming design and construction is to industry standards, this risk to the groundwater body should be mitigated. <u>Operation</u> Once the pipeline is constructed, it is assumed that Chalk groundwater flow will not be obstructed, therefore impacts are likely to be negligible at the water body scale.
	Reservoir filling <u>Construction</u> The proposed reservoir will be fed by flow captured from the Havant and Bedhampton springs. This major spring outfall is used as an abstraction source by Portsmouth Water. Unlike most groundwater abstractions, the supply is not pumped. Instead, the spring water is collected by gravity in catchpits. As the spring water is naturally brought to the surface and discharged as surface water, rather than being actively pumped from the Chalk aquifer, its use does not have an impact on the Chalk groundwater body. As the Chalk aquifer naturally discharges groundwater through springs which then flows out to the sea, the proposed reservoir filling should not affect the quantitative status of the East Hants Chalk groundwater body. <u>Operation</u> The proposed reservoir will need to be topped up at intervals. This is not anticipated to have any impacts on the East Hants Chalk groundwater body, as described above.
Chemical (GW)	
Poor - Poor nutrient management - Agricultural and land management	Access roads <u>Construction</u> Although the Chalk is not at outcrop in the area where the access roads are proposed, part of the proposed access road from the north is within SPZ1 and in the vicinity of mapped surface karst features. The proposed access road from the north and the north western part of the haulage road around the reservoir both run close to the mapped outcrop of the East Hants Chalk and the deposits overlying the Chalk are likely to be thin in this area. The access roads pose an increased risk to groundwater contamination. Contaminated runoff and infiltration into the Chalk has the potential to adversely affect Chalk

	groundwater quality. Assuming design and construction is to industry standards, this risk to the groundwater body should be mitigated. <u>Operation</u> When the reservoir is established, increased traffic on access roads leading to the reservoir has the potential to have a detrimental impact on the chemical status of the groundwater body if runoff is contaminated. Assuming that appropriate controls are put in place for road drainage as part of the drainage management plan, this risk to the groundwater body should be mitigated.
	Reservoir footprint <u>Construction</u> As discussed in the section on quantitative groundwater section above, earthworks are not anticipated to directly encounter the Chalk as the GI results (Atkins, 2020a) indicate the Chalk to be 30 to 70m below ground. However, during construction some overlying deposits will be removed and potentially dewatered. These activities may create pathways for potentially contaminated runoff to pass into shallow groundwater. This could potentially find a flow pathway to the Chalk aquifer. The works therefore have the potential to have a detrimental impact on the chemical status of the groundwater body. Assuming design and construction is to industry standards and best practice pollution prevention guidance is followed, this risk to the East Hants Chalk groundwater body should be mitigated. <u>Operation</u> The proposed reservoir will be constructed with impermeable material to prevent leakage, therefore there should be no impact from the presence of the constructed reservoir on the chemical status of the East Hants Chalk groundwater body (confined at this location anyway).
	Pipeline footprint <u>Construction</u> As discussed in the section on quantitative groundwater above, the majority of the proposed pipeline route is across the confined Chalk, except for the southern tip of the proposed pipeline route which is close to the Chalk outcrop. Pipeline construction could result in contaminated surface water run-off and / or infiltration into superficial deposits and potentially into the Chalk. This could have a detrimental impact on the chemical status of the East Hants Chalk groundwater body. Assuming design and construction is to industry standards and best practice pollution prevention guidance is followed, this risk to the groundwater body should be mitigated. <u>Operation</u> Once the pipeline is constructed, it is assumed that there will be no interaction with Chalk groundwater, therefore no impacts on the chemical status of the East Hants Chalk groundwater body.
	Reservoir filling As discussed in the section on quantitative groundwater above, the use of Havant and Bedhampton springs to fill the proposed reservoir should not affect the East Hants Chalk groundwater body.

Table 5-6 - Summary Impact Assessment for the East Hants Lambeth Group groundwater body

WFD quality elements (Status and RNAG)	Impact of scheme elements on East Hants Lambeth Group groundwater body
Quantitative (GW)	
Poor - Quantitative Dependent Surface Water Body Status (poor) - No further reason given	Access Roads <u>Construction</u> The proposed access road from the north is mapped to run across the Lambeth Group outcrop as is the north western part of the haulage road around the reservoir. Any excavations required for the access roads may encounter shallow groundwater. However, earthworks associated with the access roads are expected to be minimal and shallow depth and therefore are not expected to affect groundwater levels within the groundwater body. <u>Operation</u> No impacts on the quantitative status of the East Hants Lambeth Group groundwater body are anticipated when the reservoir and permanent access road become operational.
	Reservoir footprint <u>Construction</u> Installation of the coffer dams and creation of the wetland bund may have an impact on shallow groundwater in the East Hants Lambeth Group groundwater body. Although this element is outside the mapped extent of the East Hants Lambeth Group groundwater body, it could potentially influence it, as the most eastern edge of the bund is located close to the edge of the mapped WFD groundwater body. However, the topography and drainage is such that water levels in this groundwater body should be minimally affected and no impact is expected on a water body scale. <u>Operation</u> The wetland bund may alter local shallow groundwater flow and raise shallow groundwater levels around the bund. As the headwater streams will have nowhere to discharge to, this may affect groundwater levels locally. However, water levels in this groundwater body should be minimally affected and no impact is expected on a water body scale.
	Pipeline footprint The proposed pipeline route lies entirely to the south of the East Hants Lambeth Group groundwater body and will not affect this groundwater body.
	Reservoir filling The proposed reservoir filling has no connection with the East Hants Lambeth Group groundwater body and will not affect this groundwater body.
Chemical (GW)	
Good	Access Roads <u>Construction</u> As stated above (in quantitative groundwater section), some of the access roads run across the Lambeth Group outcrop. The access roads pose an increased risk to groundwater contamination. Contaminated runoff and infiltration into the East Hants Lambeth Group has the potential to cause deterioration to the groundwater body. Assuming design and construction is to industry standards and best practice pollution prevention guidance is followed, this risk to the groundwater body should be mitigated. <u>Operation</u> When the reservoir is established, increased traffic on access roads leading to the reservoir has the potential to have a detrimental impact on the chemical status of the groundwater body if runoff is contaminated. Assuming that

	appropriate controls are put in place for road drainage as part of the drainage management plan, this risk to the groundwater body should be mitigated.
	Reservoir footprint <u>Construction</u> Temporary earthworks associated with the creation of haulage routes, coffer dams and the wetland bund may create a contamination pathway to the East Hants Lambeth Group groundwater body. Although much of the work is outside the mapped WFD groundwater body, the local nature of the deposits present is variable. The most eastern edge of the wetland bund is located close to the edge of the mapped WFD groundwater body. Any contaminated runoff could potentially pollute the groundwater body. Assuming design and construction is to industry standards and best practice pollution prevention guidance is followed, this risk to the groundwater body should be mitigated. <u>Operation</u> When the reservoir is established, no impacts on the groundwater chemical status of the East Hants Lambeth Group groundwater body are anticipated.
	Pipeline footprint The proposed pipeline route lies entirely to the south of the East Hants Lambeth Group groundwater body and does not affect this groundwater body.
	Reservoir filling The proposed reservoir filling has no connection with the East Hants Lambeth Group groundwater body and will not affect this groundwater body.

Table 5-7 - Summary Impact Assessment for the South Hants Lambeth Group groundwater body

WFD quality elements (Status and RNAG)	Impact of scheme elements on South Hants Lambeth Group groundwater body
Quantitative (GW)	
Good	Access Roads The reservoir and access roads lie much further to the north than the South Hants Lambeth Group groundwater body and do not affect this groundwater body.
	Reservoir footprint The reservoir footprint is much further to the north than the South Hants Lambeth Group groundwater body and does not affect this groundwater body.
	Pipeline footprint <u>Construction</u> The southern end of the proposed pipeline sits on the South Hants Lambeth Group groundwater body which overlies the Chalk aquifer. If dewatering is required as part of any excavations, this may have a localised impact on groundwater. Depending on the depth of excavation and the geology at any given location, shallow groundwater in the Lambeth Group may be encountered or Chalk groundwater under artesian pressure. If dewatering is required, this may result in temporary and localised impacts. Assuming design and construction is to industry standards and best practice pollution prevention guidance is followed, this risk to the groundwater body should be mitigated. <u>Operation</u> Once the pipeline is constructed, it is assumed that groundwater flow will not be obstructed, therefore impacts are likely to be negligible at the water body scale.
	Reservoir filling

	Construction The proposed reservoir will be fed by flow captured from the Havant and Bedhampton springs. This water is sourced from the East Hants Chalk groundwater body. Unlike most groundwater abstractions, the supply is not pumped. Instead, the spring water is collected by gravity in catchpits. As the spring water is naturally brought to the surface and discharged as surface water, rather than being actively pumped from the Chalk aquifer, its use does not have an impact on the Chalk groundwater body. It will therefore not have any impact on the South Hants Lambeth Group groundwater body either. Operation The proposed reservoir will need to be topped up at intervals. This is not anticipated to have any impacts on the South Hants Lambeth Group groundwater body, as described above.
Chemical (GW)	
Good	Access Roads The reservoir and access roads lie much further to the north than the South Hants Lambeth Group groundwater body and do not affect this groundwater body.
	Reservoir footprint The reservoir footprint is much further to the north than the South Hants Lambeth Group groundwater body and does not affect this groundwater body.
	Pipeline footprint Construction As discussed above, the southern end of the pipeline crosses the South Hants Lambeth Group outcrop as well as superficial deposits that lie on top of the groundwater body. Construction may create contamination pathways through the superficial deposits which may in turn infiltrate the groundwater body. Due to the heterogeneity of the superficial deposits, and the uncertainty of their field-scale distribution, the extent to which this may occur is unknown. Assuming design and construction is to industry standards and best practice pollution prevention guidance is followed, this risk to the groundwater body should be mitigated. Operation Once the pipeline is constructed, it is assumed that there will be no interaction with groundwater, therefore impacts are likely to be negligible at the water body scale.
	Reservoir filling As discussed in the section on quantitative groundwater above, the proposed reservoir filling will not affect the groundwater body.

6. Mitigation and Compensation Strategy

Mitigation and Compensation Strategy

- 6.1. The Outline Biodiversity Mitigation and Compensation Strategy has been developed to provide mitigation and compensatory habitat for scheme impacts on the terrestrial and aquatic environment, and also to support in the overall Biodiversity Net Gain metric that is being developed for the Scheme by providing an appropriate amount of suitable watercourse improvement. This will need to be approved by the EA.
- 6.2. There are two types of mitigation required for the Scheme from a WFD perspective. Those that are permanent, and thus need to have mitigation in place to off-set the impacts and those that are likely to be temporary, primarily related to pollution prevention that can be mitigated against during construction by standard good practices. The permanent impacts will be considered within the Mitigation and Compensation Strategy as ultimately these will have operational impacts and thus have the potential to affect the WFD water body status. Mitigation that is being developed is aligned to the water body mitigation measures identified for the relevant water body.
- 6.3. Compensation is being developed as part of the plan to provide compensation for the watercourse that are being lost as part of the Scheme's footprint. This includes 3.7 km of watercourse which is ephemeral in nature.
- 6.4. From a watercourse, and WFD compliance, perspective, the principal aim of the project would be to leave behind the riverine habitat in the catchment in an overall improved state than when the Scheme started. The potential for this to be achieved is through the development and implementation of a suite of measures to mitigate against the impacts of the Scheme providing betterment where possible. The detail behind these measures will be detailed in the plan that is being developed but a summary of agreed decisions is detailed below.
- 6.5. The Mitigation and Compensation Strategy will inform a mitigation and compensation plan, which is still under development. From a watercourse perspective, this includes improvements to the following components which have already agreed in principle with the Environment Agency and to be delivered as part of the Scheme.
 - Improvements to the headwater streams upstream of the reservoir through in-channel enhancements through the addition of wood into the channel following opening up of the canopy
 - Improvements to the channel around pipeline crossings on the Lake Stream, Riders Lane Stream and Hermitage Stream where impacted
 - Local habitat and fish passage connectivity improvements to culverts in Riders Lane Stream where capacity is being increased
 - New channel to take compensatory flow from reservoir to Riders Lane Stream
- 6.6. There are ongoing discussions around the remaining mitigation options, which could include improvements to the main Hermitage Stream; and/or improvements to headwater streams within the wider Hermitage Stream catchment. It is recognised that the loss on-site cannot be replicated and that offsetting through the various measures may not balance this loss and therefore this is a potential risk of deterioration of the water body and thus a derogation is being sought under Article 4.7 test.

Pollution prevention measures

- 6.7. From a watercourse perspective, a list of generic pollution prevention measures has been incorporated as required in the REAC as part of the Outline Environmental Management Plan (OEMP) in Appendix A2.1 in ES Volume 4, which will form a basis for the detail design development and the management of construction activities across the site. For this assessment we have assumed that they will all be implemented.
- 6.8. The REAC also contains recommendations for habitat restoration and improvements for all in-channel work.

7. Conclusions

- 7.1. The WFD assessment has followed the three stages of the WFD assessment as outlined in the Planning Inspectorate in advice note 18 on The WFD in June 2017. This includes three phases of work: i) Preliminary/screening assessment, ii) Scoping assessment and iii) WFD impact assessment.
- 7.2. The WFD assessment considered the impacts of the reservoir and associated pipeline on wide ranging environments which included the following water bodies which were screened in from the preliminary assessment:
- Hermitage Stream (GB107042016370)
 - River Lavant (Hants) WFD surface water body
 - Langstone Harbour transitional water body
 - East Hants Lambeth groundwater body
 - East Hants Chalk groundwater body
 - South Hants Lambeth Group groundwater body
- 7.3. At the start of the WFD assessment a series of tests were set out to assess compliance against, namely:
- Test 1: The Scheme will not cause a deterioration in any element of water body classification.
- Test 2: The Scheme will not prevent the WFD status objectives from being reached within the water body or other downstream water bodies.
- Test 3: The Scheme will contribute to the delivery of the relevant WFD objectives. In this case, it will be what contribution the Scheme can make towards the water body reaching its objective GES through planned RBMP mitigation measures.
- 7.4. For Test 1 of the water bodies assessed only the Hermitage Stream was identified as being of a concern when considering whether the Scheme is likely to cause a deterioration in WFD elements. The other water bodies when assessed noted that the Scheme would not cause a deterioration in the WFD elements or in some instances there was the potential for a positive impact particularly when considering water quality.
- 7.5. With regard to the Hermitage Stream, the main concern is the loss of 3.7 km of headwater habitat of the Riders Lane Stream and a further 0.1 km at the top of Riders Lane Stream. Along with the scale of the loss the latest invertebrate surveys have revealed that, in the context of the wider water body, the habitat potentially being lost is distinct in context of these supporting a range of specialist taxa indicative of groundwater supply and ephemeral flow conditions, including some near threatened, nationally notable and scarce species.
- 7.6. From a scale perspective, the length of watercourse lost also accounts for c. 42% of headwaters and 18% of entire length of watercourse within the whole water body, which will affect ecological functioning in terms of resource cycling, (re)colonisation potential and resilience. It is physically not possible to re-create this lost water body length.
- 7.7. From a scheme perspective, it is considered that the only elements of the Scheme that has the **potential to cause deterioration at a water body scale** are excavations and site water management associated with construction of the reservoir embankment. The pipeline, access road and associated infrastructure are not considered to have the potential to cause the deterioration of a water body scale.
- 7.8. For Test 2, none of the WFD water body summary actions identified in the Environment Agency's extended WFD water body summary would be prevented from occurring and thus the Scheme is likely to pass this test.
- 7.9. For Test 3, the commitments in the watercourse mitigation and compensation strategy will ensure that the Scheme will contribute to the relevant WFD objectives and thus the Scheme will pass this test.
- 7.10. Given the factors noted above it is considered that while for all the other water bodies considered no deterioration is considered likely there remains a concern that on the Hermitage Stream water body the **potential for deterioration at a water body scale** remains for invertebrates,

hydromorphology, macrophytes and phytobenthos. This cannot be readily mitigated or compensated against despite the mitigation and compensation offered as part of the watercourse mitigation and compensation strategy. Thus, there is a risk that for the Scheme Test 1 cannot be met and thus from a WFD perspective a **potential for deterioration at a water body scale** cannot be ruled out, meaning an Article 4.7 derogation will need to be prepared.

Appendices



Appendix A. Transition water bodies

A.1. Scoping stage

Water Framework Directive assessment: scoping template for activities in estuarine and coastal waters

Use this template to record the findings of the scoping stage of your Water Framework Directive (WFD) assessment for an activity in an estuary or coastal water.

If your activity will:

- take place in or affect more than one water body, complete a template for each water body
- include several different activities or stages as part of a larger project, complete a template for each activity as part of your overall WFD assessment

The [WFD assessment guidance for estuarine and coastal waters](#) will help you complete the table.

Your activity	Description, notes or more information
Applicant name	Portsmouth Water Limited
Application reference number (where applicable)	<i>(Not applicable)</i>
Name of activity	Pumping of water from Havant and Bedhampton springs; and changes in volume and / or frequency of flow of water into Langstone Harbour as part of the 'compensation flow'.
Brief description of activity	To fill and regularly replenish the new Havant Thicket Reservoir, water will be pumped from the Havant and Bedhampton springs, which are located approximately 4 kilometres downstream of the proposed reservoir. Volume and / or frequency of flow of water input into Langstone Harbour may also be affected by changes in the 'compensation flow' coming from the reservoir into the Riders Lane stream, Hermitage stream and ultimately into the harbour.
Location of activity (central point XY coordinates or national grid reference)	Grid Reference SU 70594 06363. (location of the springs). 470594 Easting (X). 106363 Northing (Y). (Lat 50.852487; Long -0.99851936).
Footprint of activity (ha)	Variable surplus water within water abstraction licence limits to be determined. New reservoir footprint area will be around 106 ha.
Timings of activity (including start and finish dates)	Tentative timings:

Your activity	Description, notes or more information
	Use of spring water for reservoir first filling: Start –Q4 2027 Finish– Q4 2028 (end of reservoir first filling); spring water will continue to be used to fill up the reservoir in the future according to water supply needs. Compensation flow: Start – 2025 (during start of main construction phase, i.e. excavation, embankment, etc.) Finish – continued flow
Extent of activity (for example size, scale frequency, expected volumes of output or discharge)	Variable surplus water within water abstraction licence limits to be determined. Water from springs will be used for first filling of the reservoir, and then according to water supply needs, most likely, by using water surplus during winter and spring to refill the reservoir and enable fresh water supply during the summer and autumn months. Exact compensation flow to be determined, between available options.
Use or release of chemicals (state which ones)	No.

Water body ¹	Description, notes or more information
WFD water body name	<i>Langstone Harbour</i>
Water body ID	<i>GB580705130000</i>
River basin district name	<i>South East</i>
Water body type (estuarine or coastal)	<i>Estuarine</i>
Water body total area (ha)	<i>1890.75</i>
Overall water body status (2015)	<i>Moderate</i>
Ecological status	<i>Moderate</i>
Chemical status	<i>Good</i>
Target water body status and deadline	<i>Good by 2027</i>

Water body ¹	Description, notes or more information
Hydromorphology status of water body	<i>Supports Good</i>
Heavily modified water body and for what use	<i>Yes, it is a HMWB used for coastal protection and flood protection</i>
Higher sensitivity habitats present	<i>Intertidal seagrass 130.80 (ha); and saltmarsh 72.67 (ha)</i>
Lower sensitivity habitats present	<i>Cobbles, gravel, and shingle 24.94 (ha); intertidal soft sediment 1388.93 (ha); rocky shore 10.85 (ha); subtidal soft sediment 382.67 (ha)</i>
Phytoplankton status	<i>- (Not available)</i>
History of harmful algae	<i>Yes</i>
WFD protected areas within 2 km	<i>Yes. Langstone Harbour Shellfish Waters; Langstone Harbour Nutrient Sensitive Area; Solent Maritime SAC; Chichester and Langstone Harbours SPA.</i>

¹ Water body information can be found in the Environment Agency's catchment data explorer and the water body summary table. Magic maps provide additional information on habitats and protected areas. Links to these information sources can be found in the WFD assessment guidance for estuarine and coastal waters.

Specific risk information

Consider the potential risks of your activity to each of these receptors: hydromorphology, biology (habitats and fish), water quality and protected areas. Also consider invasive non-native species (INNS).

Section 1: Hydromorphology

Consider if hydromorphology is at risk from your activity.

Use the water body summary table to find out the hydromorphology status of the water body, if it is classed as heavily modified and for what use.

Consider if your activity:	Yes	No	Hydromorphology risk issue(s)
Could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status	Requires impact assessment	Impact assessment not required	<i>No. The Langstone Harbour water body does not have a hydromorphology 'high status'.</i>
Could significantly impact the hydromorphology of any water body	Requires impact assessment	Impact assessment not required	<i>No. The activity is unlikely to have a significant impact on the hydromorphology of the water body.</i>
Is in a water body that is heavily modified for the same use as your activity	Requires impact assessment	Impact assessment not required	<i>No. The water body is heavily modified for coastal protection and for flood risk protection.</i>

Record the findings for hydromorphology and go to section 2: biology.

Section 2: Biology

Habitats

Consider if habitats are at risk from your activity.

Use the water body summary table and Magic maps, or other sources of information if available, to find the location and size of these habitats.

Higher sensitivity habitats ²	Lower sensitivity habitats ³
chalk reef	cobbles, gravel and shingle
clam, cockle and oyster beds	intertidal soft sediments like sand and mud
intertidal seagrass	rocky shore
maerl	subtidal boulder fields
mussel beds, including blue and horse mussel	subtidal rocky reef
polychaete reef	subtidal soft sediments like sand and mud
saltmarsh	
subtidal kelp beds	
subtidal seagrass	

² Higher sensitivity habitats have a low resistance to, and recovery rate, from human pressures.

³ Lower sensitivity habitats have a medium to high resistance to, and recovery rate from, human pressures.

Consider if the footprint ⁴ of your activity is:	Yes	No	Biology habitats risk issue(s)
0.5 km ² or larger	Yes to one or more – requires impact assessment	No to all – impact assessment not required	<i>The magnitude of the footprint of changes in water quality and quantity is unlikely to be 0.5 km² or larger, but this will be considered in further assessment.</i>
1% or more of the water body's area			No.
Within 500 m of any higher sensitivity habitat			<i>No. Closest higher sensitivity habitat – saltmarsh – is located more than 500m away.</i>
1% or more of any lower sensitivity habitat			No.

⁴ Note that a footprint may also be a temperature or sediment plume. For dredging activity, a footprint is 1.5 times the dredge area.

Fish

Consider if fish are at risk from your activity, but only if your activity is in an estuary or could affect fish in or entering an estuary.

Consider if your activity:	Yes	No	Biology fish risk issue(s)
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary	Continue with questions	Go to next section	<i>Activities are not inside an estuary or the harbour. However, some fish may migrate from/to the harbour pass the location of the proposed activities.</i>
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	Requires impact assessment	Impact assessment not required	<i>The potential changes in water quality and quantity are unlikely to impact normal fish behaviour. Assessment of the results from water quality modelling and 'compensation flow' options will inform this issue further.</i>
Could cause entrainment or impingement of fish	Requires impact assessment	Impact assessment not required	No.

Record the findings for biology habitats and fish and go to section 3: water quality.

Section 3: Water quality

Consider if water quality is at risk from your activity.

Use the water body summary table to find information on phytoplankton status and harmful algae.

Consider if your activity:	Yes	No	Water quality risk issue(s)
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Requires impact assessment	Impact assessment not required	<i>The potential changes in water quality near the springs are unlikely to last longer than a spring neap tidal cycle within this water body. Assessment of the results from water quality modelling and 'compensation flow' options will inform this issue further.</i>
Is in a water body with a phytoplankton status of moderate, poor or bad	Requires impact assessment	Impact assessment not required	<i>No. There is no information available on the status of the phytoplankton in the Langstone Harbour water body, as no status assessment has yet been undertaken by the EA.</i>
Is in a water body with a history of harmful algae	Requires impact assessment	Impact assessment not required	<i>The activity is outside the Langstone Harbour water body. However, as this water body has a history of harmful algae, this issue will be taken for further assessment.</i>

Consider if water quality is at risk from your activity through the use, release or disturbance of chemicals.

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	Yes	No	Water quality risk issue(s)
The chemicals are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment	Impact assessment not required	No.
It disturbs sediment with contaminants above Cefas Action Level 1	Requires impact assessment	Impact assessment not required	No.
If your activity has a mixing zone (like a discharge pipeline or outfall) consider if:	Yes	No	Water quality risk issue(s)

The chemicals released are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment ⁵	Impact assessment not required	No.
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⁵ Carry out your impact assessment using the Environment Agency's surface water pollution risk assessment guidance, part of Environmental Permitting Regulations guidance.

Record the findings for water quality go on to section 4: WFD protected areas.

Section 4: WFD protected areas

Consider if WFD protected areas are at risk from your activity. These include:

- special areas of conservation (SAC)
- special protection areas (SPA)
- shellfish waters
- bathing waters
- nutrient sensitive areas

Use Magic maps to find information on the location of protected areas in your water body (and adjacent water bodies) within 2 km of your activity.

Consider if your activity is:	Yes	No	Protected areas risk issue(s)
Within 2 km of any WFD protected area ⁶	Requires impact assessment	Impact assessment not required	Yes. The following -WFD - protected sites are located within 2 km of the location of the springs: Langstone Harbour Shellfish Waters; Langstone Harbour Nutrient Sensitive Area; Chichester and Langstone Harbours SPA; and Solent Maritime SAC.

⁶ Note that a regulator can extend the 2 km boundary if your activity has an especially high environmental risk.

Record the findings for WFD protected areas and go to section 5: invasive non-native species.

Section 5: Invasive non-native species (INNS)

Consider if there is a risk your activity could introduce or spread INNS.

Risks of introducing or spreading INNS include:

- materials or equipment that have come from, had use in or travelled through other water bodies
- activities that help spread existing INNS, either within the immediate water body or other water bodies

Consider if your activity could:	Yes	No	INNS risk issue(s)
Introduce or spread INNS	Requires impact assessment	Impact assessment not required	<i>No. There will be no works carried out in the location of the Havant and Bedhampton springs, or other location near the Langstone Harbour water body as part of this Scheme which could pose a risk of introducing or spreading INNS.</i>

Record the findings for INNS and go to the summary section.

Summary

Summarise the results of scoping here.

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	No	-
Biology: habitats	Yes. Possible	Possible risk of changes in water quality and water quantity having a footprint of 0.5 km ² or larger. Impact assessment of the results from water quality modelling and 'compensation flow' options will inform this issue further.
Biology: fish	Yes. Possible	Potential risk of changes in water quality and quantity resulting in an impact to normal fish behaviour. Impact assessment of the results from water quality modelling and 'compensation flow' options will inform this issue further.

Water quality	Yes. Possible	Possible risk of changes in water quality near the springs to affect water quality. Impact assessment of the results from water quality modelling and 'compensation flow' options will inform this issue further.
Protected areas	Yes. Possible	Possible risk of impacting qualifying features of several -WFD - protected sites located within 2 km of the location of the springs. Impact assessment will inform this issue further.
Invasive non-native species	No	-

If you haven't identified any receptors at risk during scoping, you don't need to continue to the impact assessment stage and your WFD assessment is complete.

If you've identified one or more receptors at risk during scoping, you should continue to the impact assessment stage.

Include your scoping results in the WFD assessment document you send to your activity's regulator as part of your application for permission to carry out the activity.

Appendix B. Groundwater Body Assessment

B.1. Assessment Methodology

B.1.1. Table B-1 shows the decision matrix used for assessing effect on groundwater status class.

Table B-1 - Decision matrix for assessing effect on groundwater status class

Type of effect	Effect of Scheme component on WFD element	Overall effect of Scheme on WFD element	Overall effect of Scheme on water body status	Examples	Outcome
Green – No impact	No measurable change to groundwater levels or quality.	No measurable change to any WFD elements.	No measurable change to any WFD elements.	Foundation works above the water table.	No change.
Yellow –Localised/ temporary adverse effect	Impacts when taken on their own have the potential to lead to a minor localised or temporary effect.	Combined impacts have the potential to lead to a minor localised or temporary effect on the WFD element.	Combined impacts have the potential to lead to a minor localised or temporary effect on the WFD element. No change to groundwater body status.	Foundation works below the water table, but drainage returned to ground within the same groundwater body and surface water catchment.	No change in status of WFD water body when balanced against mitigation measures embedded in the design.
Amber –Adverse widespread or prolonged effect	Impacts when taken on their own have the potential to lead to a widespread or prolonged effect.	Combined impacts have the potential to have an adverse effect on the WFD element.	Combined impacts have the potential to have an adverse effect on the WFD element, but not change its status at groundwater body scale.	Dewatering of cutting reduces baseflow to tributary but no adverse effects at scale of whole surface water body.	Adverse effect but risk of status change needs to be considered with any additional mitigation measures.
Red – Adverse effect on overall WFD status of water body	Impacts when taken on their own have the potential to lead to a significant effect.	Combined impacts in combination with others will have a significant adverse effect on the WFD element.	Combined impacts in combination with others will have an adverse effect on the WFD element AND change its status at the groundwater body scale.	Dewatering of cutting reduces baseflow to surface water body with adverse effects at scale of whole surface water body.	Decrease in status of WFD water body when balanced against additional mitigation measures.

B.2. Groundwater WFD Assessment

- B.2.1. The impact of the proposed work on three groundwater bodies (East Hants Chalk, East Hants Lambeth Group, South Hants Lambeth Group) has been considered. The assessment for each groundwater body is shown in a separate table.
- B.2.2. The assessment for the East Hants Chalk Groundwater Body is shown in Table B.2. The main potential impacts are associated with construction and operation of the access roads (potential chemical impacts), the construction of borrow pits in the reservoir footprint (potential chemical impacts) and the southern part of the pipeline construction (quantitative and chemical impacts).
- B.2.3. The assessment for the East Hants Lambeth Group is shown in Table B.3. The main potential impacts are associated with construction and operation of the access roads (potential chemical impacts) and the construction of the coffer dams and wetland bund (quantitative and chemical impacts).
- B.2.4. The assessment for the South Hants Lambeth Group is shown in Table B.4. The main potential impacts are associated with the southern part of the pipeline construction (quantitative and chemical impacts).

Table B-2 - East Hants Chalk Groundwater Body (GB40701G502700) WFD assessment table

GB40701G502700		Quantitative Impacts	Chemical Impacts
East Hants Chalk Groundwater body	Current status (2016)	Poor	Poor
	Status objective	Poor (2015)	Good by 2027

Scheme element	Phase	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
Access roads (Summary of Works: An access road suitable for taking construction traffic before joining to the public highway. Access roads to be located in Red Line boundary of reservoir).	Q3 2021	The Chalk is not at outcrop in the area where the access roads are proposed. The East Hants Chalk Groundwater Body is mapped in two parts where the Chalk is at outcrop on either limb of the Chichester syncline. The Chalk in-between occurs at depth and is confined by Palaeogene deposits (the covered/confined Chalk is not shown as part of the groundwater body, although the Chalk aquifer is continuous). The Chalk outcrop (northern portion of the mapped groundwater body) occurs to the north of the reservoir red line boundary. The cover of Palaeogene deposits is initially thin and thickens to the south. Water levels in the northern mapped waterbody are reported to be between 1 and 85 mbgl (data from EA OBHs). To the south, the groundwater	No impacts identified as a result of scheme element. Any earthworks associated with the access roads expected to be minimal and shallow depth and therefore are not expected to affect groundwater levels within the groundwater body.	Earthworks / spills in the construction and use of access roads may have an adverse impact on groundwater quality in the East Hants Chalk groundwater body. The start of the proposed access road from the north is within SPZ1 and in the vicinity of mapped surface karst features. This means that any potential spills could travel rapidly through the Chalk aquifer and impact outlet springs including the Havant and Bedhampton springs. The remainder of the proposed access road from the north is mapped to run close to the mapped outcrop of the East Hants Chalk, as is the north western part of the haulage road around the reservoir. The Palaeogene deposits overlying the Chalk are likely to be thin in this area. The access roads will pose an increased risk to

Scheme element	Phase	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
		levels in the waterbody are under artesian pressure.		groundwater contamination. Contaminated runoff and infiltration into the Chalk has the potential to adversely impact groundwater quality.
Construction Compound	Q3 2021	London Clay Formation, overlying the Lambeth Group, then White Chalk Group. This is outside the mapped extent of the East Hants Chalk Groundwater Body.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element. Any earthworks are very unlikely to affect groundwater within the Chalk due to its confined nature.	No impact identified to groundwater quality for the East Hants Chalk groundwater body as a result of this scheme element. Any contaminated surface runoff will flow downslope (south) to where the groundwater body becomes even more deeply confined thus decreasing the risk of contamination infiltration further.
Borrow pits (Borrow pits constructed in the reservoir footprint for construction of embankment and clay blanket. Upon completion there is to be a clay seal within the borrow pits).	Q2 2022	London Clay Formation, overlying the Lambeth Group, then White Chalk Group. This is outside the mapped extent of the East Hants Chalk Groundwater Body.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element.	Borrow pits are located on a confined portion of the groundwater body in the reservoir footprint and are not anticipated to directly encounter the Chalk. However, during construction some overlying deposits will be removed and may potentially require dewatering. The heterogenous nature of the overlying deposits mean that the excavation work may create pathways

Scheme element	Phase	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
				for potentially contaminated runoff to pass into shallow groundwater. This could potentially find a flow pathway to the Chalk aquifer. The works therefore have the potential to have an adverse impact on the East Hants Chalk groundwater body.
Clay blanket (Summary of Works: Clay Blanket to be laid around the South-West corner of the embankment after topsoil has been stripped in the location)	Q2 2022	London Clay Formation, overlying the Lambeth Group, then White Chalk Group. This is outside the mapped extent of the East Hants Chalk Groundwater Body.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element.
Embankment, Dam Culvert and Control House	Q3 2022	London Clay Formation, overlying the Lambeth Group, then White Chalk Group. This is outside the mapped extent of the East Hants Chalk Groundwater Body.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element.
Coffer dams (Summary of Works: Cofferdams will be installed to prevent the flow of water through the site whilst construction is	Q1 2022	Harwich Formation overlying Lambeth Group and White Chalk. This is outside the mapped extent of the East Hants Chalk Groundwater Body.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element.

Scheme element	Phase	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
taking place. Three number cofferdams will be constructed on the tributaries from Havant Thicket to the Riders Lane Stream.)				
Wetland bund (Summary of Works: constructed in a similar manner to the embankment (without the need of conveyors to transport material))	Q3 2022	London Clay Formation, overlying the Lambeth Group, then White Chalk Group. This is outside the mapped extent of the East Hants Chalk Groundwater Body.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element.
Construction Compound and Visitor Centre	Q3 2021	London Clay Formation, overlying the Lambeth Group, then White Chalk Group. This is outside the mapped extent of the East Hants Chalk Groundwater Body.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element. Any contaminated surface runoff will flow downslope (south) to where the groundwater body becomes even more deeply confined thus decreasing the risk of contamination infiltration further. Emplacement of foundations may create rapid vertical flows, however the foundations are not anticipated to extend into the Chalk.

Scheme element	Phase	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
Pipeline	Q1 2021	The majority of the pipeline is located within the Chichester Syncline. The London Clay Formation is at outcrop, overlying the Lambeth Group and the Chalk. The southern tip of the pipeline red line boundary is located on the Lambeth Group and is very close to the mapped extent of the East Hants Chalk groundwater body. The Chalk groundwater is under artesian pressure, with springs present at the most southerly point of the proposed pipeline.	Dewatering of trial pits or excavations may have a localised temporary impact on Chalk groundwater during construction in the southern part of the pipeline where the Chalk is closer to the ground surface. This is dependent on the depth of excavation and the geology at any given location. Encountering the artesian Chalk groundwater may adversely affect springs located in the East Hants Chalk groundwater body.	Earthworks may result in contaminated surface water run-off and / or infiltration into superficial deposits. Though the pipeline is not directly overlying the East Hants Chalk group, the proximity of the waterbody to the works poses a risk and is therefore included in the WFD assessment. Any infiltration of contaminated waters into the East Hants Chalk group could have an adverse impact on groundwater quality.
Reservoir Filling from Havant and Bedhampton springs	Q4 2024	White Chalk overlain by superficial deposits. The Bedhampton springs are not located within the mapped extent of the East Hants Chalk groundwater body, however, there is no notable change in geology to define the boundary between the East Hants Chalk and South Hants Lambeth waterbody. The lack of definition in the geological mapping and the arbitrary split between the East Hants Chalk and South Hants Lambeth waterbody suggest that there is some hydraulic continuity. The Chalk groundwater is	No impacts identified as a result of the scheme element. Water collected from the springs is not pumped i.e. water is obtained from gravity fed catch pits and piped to the reservoir. There are no anticipated effects on the Chalk groundwater body from diverting some of the natural outflow into the reservoir.	No impacts on the East Hants Chalk groundwater body have been identified as a result of this scheme element.

Scheme element	Phase	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
		under artesian pressure at this location, with springs throughout the area.		

Table B-3 - East Hants Lambeth Group Groundwater Body (GB40702G500800) WFD assessment table

GB40702G500800 East Hants Lambeth Group groundwater body		Quantitative Impacts	Chemical Impacts
Current status (2016)		Poor	Good
Status objective		Good (2021)	Good (2015)

Scheme element	Phase (when scheme element is first expected to be established)	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
Access roads (Summary of Works: An access road suitable for taking construction traffic before joining to the public highway. Access roads to be located in Red Line boundary of reservoir).	Q3 2021	The groundwater body (East Hants Lambeth Group) is mapped as covering the northern portion of the reservoir red line boundary. In the northern part of this area, the Lambeth Group is at outcrop and directly overlies the Chalk. Slightly further south (within the same groundwater body), the Harwich Formation is at outcrop, overlying both the Lambeth Group and the Chalk. Shallow groundwater is present within the Lambeth Group and Harwich Formation. This is thought to be hydraulically separate from the	No impacts identified as a result of scheme element. Any earthworks associated with the access roads expected to be minimal and shallow depth and therefore are not expected to affect groundwater levels within the groundwater body.	Earthworks / spills in the construction and use of access roads may have an adverse impact on the East Hants Lambeth Group groundwater body. The proposed access road from the north is mapped to run across the Lambeth Group outcrop as is the north western part of the haulage road around the reservoir. This will pose an increased risk to groundwater contamination. Infiltration of contaminated waters into the groundwater body has the potential to affect groundwater quality.

Scheme element	Phase (when scheme element is first expected to be established)	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
		underlying Chalk groundwater levels.		
Construction Compound	Q3 2021	London Clay Formation, overlying the Lambeth Group. This is outside the mapped extent of the East Hants Lambeth Groundwater Body.	No impacts on the East Hants Lambeth Group groundwater body have been identified as a result of this scheme element. Any earthworks are very unlikely to intersect the groundwater table due to its confined nature.	No impact identified to groundwater quality for the East Hants Lambeth Group groundwater body as a result of this scheme element. Any contaminated surface runoff will flow downslope (south) to where the groundwater body becomes even more deeply confined thus decreasing the risk of contamination infiltration further. Emplacement of foundations may create rapid vertical flows, however this is not anticipated to encounter the groundwater body.
Borrow pits (Borrow pits constructed in the reservoir footprint for construction of embankment and clay blanket. Upon completion there is to	Q2 2022	London Clay Formation, overlying the Lambeth Group. This is outside the mapped extent of the East Hants Lambeth Groundwater Body.	No impacts on the East Hants Lambeth Group groundwater body have been identified as a result of this scheme element.	No impacts on the East Hants Lambeth Group have been identified as a result of this scheme element. Borrow pits are located on a confined portion of the groundwater body in the reservoir footprint. There is not considered to be any risk of contaminated surface runoff moving from the borrow pits and

Scheme element	Phase (when scheme element is first expected to be established)	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
be a clay seal within the borrow pits).				infiltrating into the Lambeth Group groundwater body at outcrop, as a result of the downslope topography.
Clay blanket (Summary of Works: Clay Blanket to be laid around the South-West corner of the embankment after topsoil has been stripped in the location)	Q2 2022	London Clay Formation, overlying the Lambeth Group. This is outside the mapped extent of the East Hants Lambeth Groundwater Body.	No impacts on the East Hants Lambeth Group groundwater body have been identified as a result of this scheme element.	No impacts on the East Hants Lambeth Group groundwater body have been identified as a result of this scheme element.
Embankment, Culvert and Control House	Q3 2022	London Clay Formation, overlying the Lambeth Group. This is outside the mapped extent of the East Hants Lambeth Groundwater Body.	No impacts on the East Hants Lambeth Group groundwater body have been identified as a result of this scheme element.	No impacts on the East Hants Lambeth Group groundwater body have been identified as a result of this scheme element.
Coffer dams (Summary of Works: Cofferdams will be installed to prevent the flow of water through the site whilst construction is	Q1 2022	Harwich Formation overlying Lambeth Group. There is a window where the Lambeth Group is exposed. However, this is outside the mapped	Scheme element may impact shallow groundwater in the East Hants Lambeth Group groundwater body. Although this element is outside the mapped extent of the East Hants Lambeth Group groundwater body, it	Temporary earthworks associated with coffer dams may create a contamination pathway to the East Hants Lambeth Group groundwater body. Although the work is outside the mapped WFD groundwater body, the local nature of the

Scheme element	Phase (when scheme element is first expected to be established)	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
taking place. Three number cofferdams will be constructed on the tributaries from Havant Thicket to the Riders Lane Stream.)		extent of the East Hants Lambeth Groundwater Body.	could potentially influence it by altering shallow groundwater flow, groundwater-surface water interactions and groundwater levels in the local area. However, the topography and drainage is such that water levels in this groundwater body should be minimally affected and no impact is expected on a water body scale.	deposits present is variable. Any contaminated runoff could potentially pollute the groundwater body.
Wetland bund (Summary of Works: constructed in a similar manner to the embankment (without the need of conveyors to transport material))	Q3 2022	Harwich Formation overlying Lambeth Group. There is a window where the Lambeth Group is exposed. However, this is outside the mapped extent of the East Hants Lambeth Groundwater Body.	Scheme element may impact shallow groundwater (through creation of wetland). Although this element is outside the mapped extent of the East Hants Lambeth Group groundwater body, it could potentially influence it as the most eastern edge of the bund is located close to the edge of the mapped WFD groundwater body. The emplacement of a clay bund may alter shallow groundwater flow and groundwater levels in the local area. However, the topography and drainage is such that water levels in this groundwater body should be	Earthworks may have an adverse effect on the chemical status of the East Hants Lambeth Group Groundwater body. Though the bund is to be constructed on the Harwich Formation, the most eastern edge of the bund is located close to the edge of the mapped WFD groundwater body. Any contaminated runoff could potentially pollute groundwater body.

Scheme element	Phase (when scheme element is first expected to be established)	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
			minimally affected and no impact is expected on a water body scale.	
Construction Compound and Visitor Centre	Q3 2021	London Clay Formation, overlying the Lambeth Group. This is outside the mapped extent of the East Hants Lambeth Groundwater Body.	No impacts have been identified as a result of this scheme element. Any earthworks are very unlikely to intersect the groundwater table due to its confined nature.	No impact identified to groundwater quality as a result of this scheme element. Any contaminated surface runoff will flow downslope (south) to where the groundwater body becomes even more deeply confined thus decreasing the risk of contamination infiltration further. Emplacement of foundations may create rapid vertical flows, however this is not anticipated to encounter the groundwater body.
Pipeline	Q1 2021	London Clay Formation, overlying the Lambeth Group. Within the Chichester Syncline. This is outside the mapped extent of the East Hants Lambeth Groundwater Body.	No impacts on the East Hants Lambeth Group groundwater body have been identified as a result of this scheme element due to the deeply confining nature of the London Clay.	No impacts on the East Hants Lambeth Group groundwater body have been identified as a result of this scheme element due to the deeply confining nature of the London Clay.

Scheme element	Phase (when scheme element is first expected to be established)	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
Reservoir Filling from Havant and Bedhampton springs	Q4 2024	Southern tip of the pipeline lies on Lambeth group and White Chalk. South Hants Lambeth Group waterbody is located at the southern tip of the pipeline. Groundwater is under artisanal pressure here with springs located throughout.	No impacts on the East Hants Lambeth Group groundwater body have been identified as a result of this scheme element	No impacts on the East Hants Lambeth Group groundwater body have been identified as a result of this scheme element

Table B-4 - South Hants Lambeth Group Groundwater Body (GB40702G503700) WFD assessment table

GB40702G503700 South Hants Lambeth Group groundwater body		Quantitative Impacts	Chemical Impacts
	Current status (2016)	Good	Good
	Status objective	Good (2015)	Good (2015)

Scheme element	Phase	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
Access roads (Summary of Works: An access road suitable for taking construction traffic before joining to the public highway. Access roads to be located in Red Line boundary of reservoir).	Q3 2021	Access roads encounter Lambeth Group. Harwich Formation, London Clay and Bognor Sands Formation. This occurs to the north of (and in a separately defined groundwater body to) the South Hants Lambeth Group groundwater body.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.
Construction Compound	Q3 2021	London Clay Formation, overlying the Lambeth Group. This is outside the mapped extent of the South Hants Lambeth Group groundwater body.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.

Scheme element	Phase	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
Borrow pits (Borrow pits constructed in the reservoir footprint for construction of embankment and clay blanket. Upon completion there is to be a clay seal within the borrow pits).	Q2 2022	London Clay Formation, overlying the Lambeth Group. This is outside the mapped extent of the South Hants Lambeth Group groundwater body.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.
Clay blanket (Summary of Works: Clay Blanket to be laid around the South-West corner of the embankment after topsoil has been stripped in the location)	Q2 2022	London Clay Formation, overlying the Lambeth Group. This is outside the mapped extent of the South Hants Lambeth Group groundwater body.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.
Embankment, Dam Culvert and Control House	Q3 2022	London Clay Formation, overlying the Lambeth Group. This is outside the mapped extent of the South Hants Lambeth Group groundwater body.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.

Scheme element	Phase	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
Coffer dams (Summary of Works: Cofferdams will be installed to prevent the flow of water through the site whilst construction is taking place. Three number cofferdams will be constructed on the tributaries from Havant Thicket to the Riders Lane Stream.)	Q1 2022	Harwich Formation overlying Lambeth Group. This is outside the mapped extent of the South Hants Lambeth Group groundwater body.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.
Wetland bund (Summary of Works: constructed in a similar manner to the embankment (without the need of conveyors to transport material))	Q3 2022	Harwich Formation overlying Lambeth Group. There is a window where the Lambeth Group is exposed. However, this is outside the mapped extent of the East Hants Lambeth Group groundwater body.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.
Construction Compound and Visitor Centre	Q3 2021	London Clay Formation, overlying the Lambeth Group. This is outside the mapped extent of the South Hants Lambeth Group groundwater body.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.

Scheme element	Phase	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
Pipeline	Q1 2021	The majority of the pipeline is located within the Chichester Syncline. The London Clay Formation is at outcrop, overlying the Lambeth Group and the Chalk. The southern tip of the pipeline red line boundary is located on the Lambeth Group outcrop. The WFD waterbody of South Hants Lambeth Group is mapped as running East-West under the southern tip of the pipeline. It is likely that there is a mixture of shallow groundwater and confined Chalk groundwater along the southern most part of the proposed pipeline route. In places the Chalk and Lambeth Group may be in hydraulic continuity. Chalk groundwater is under artesian pressure, with springs present at the most southerly point of the proposed pipeline.	Dewatering of trial pits or excavations may have a localised temporary impact on groundwater during construction in the southern part of the pipeline where the Lambeth Group is at outcrop. This is dependent on the depth of excavation and the geology at any given location.	Earthworks may result in contaminated surface water run-off and / or infiltration into the Lambeth Group. The southern tip of the pipeline directly overlies the South Hants Lambeth Group groundwater body. Any infiltration of contaminated waters into the South Hants Lambeth Group groundwater body could have an adverse impact on groundwater quality.

Scheme element	Phase	Summary of local geology and water table (based on BGS 1:50,000k mapping)	Quantitative Impacts	Chemical Impacts
			Saline or other intrusions of poor quality water due to groundwater abstraction; Impact on the ecological status of surface water bodies; Impact on the condition of groundwater dependent terrestrial ecosystems; Impact on the groundwater body water balance.	Pollution concentrations; Quality impact on groundwater abstractions; Impact on the chemical and ecological status of surface water bodies; Nutrient concentration impact on GWDTEs; Drinking Water Protected Areas; A general quality assessment.
Reservoir Filling from Havant and Bedhampton springs	Q4 2024	Lambeth Group overlying White Chalk. The Havant and Bedhampton springs are located within the mapped extent of the South Hants Lambeth Group groundwater body. There is, however, no notable change in geology to define the boundary between the East Hants Chalk and South Hants Lambeth waterbody. The lack of definition in the geological mapping and the arbitrary split between the East Hants Chalk and South Hants Lambeth Group waterbody suggests that there is some hydraulic continuity between the two. The Chalk groundwater is under artesian pressure at this location, with springs throughout the area.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.	No impacts on the South Hants Lambeth Group groundwater body have been identified as a result of this scheme element.

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