AQUIND Limited

AQUIND INTERCONNECTOR

Environmental Statement – Volume 1 – Chapter 19 Groundwater

The Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulation 5(2)(a)

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

Document Ref: 6.1.19

PINS Ref.: EN020022

AQUIND Limited

AQUIND INTERCONNECTOR

Environmental Statement – Volume 1 – Chapter 19 Groundwater

PINS REF.: EN020022

DOCUMENT: 6.1.19

DATE: 14 NOVEMBER 2019

WSP

WSP House

70 Chancery Lane

London

WC2A 1AF

+44 20 7314 5000

www.wsp.com

DOCUMENT

Document	6.1.19 Environmental Statement – Volume 1 – Chapter 19 Groundwater
Revision	001
Document Owner	WSP UK Limited
Prepared By	W. King
Date	8 November 2019
Approved By	A. Gallagher
Date	8 November 2019

CONTENTS

TABLES

FIGURES

Figure 19.1 – Bedrock Geology and Karst Zones

Figure 19.2 – Superficial Geology

Figure 19.3 – Groundwater Monitoring Points

Figure 19.4 – Source Protection Zones

APPENDICES

Appendix 19.1 - Consultation Responses

Appendix 19.2 - Groundwater Resources Baseline

Appendix 19.3 - The Hydrogeology of Kings Pond and Denmead Meadow

Appendix 19.4 - Cumulative Effect Assessment Matrix (Stage 1 & 2)

Appendix 19.5 - Cumulative Effect Assessment Matrix (Stage 3 & 4)

.

19. GROUNDWATER RESOURCES

19.1. SCOPE OF THE ASSESSMENT

19.1.1. INTRODUCTION

19.1.1.1. This chapter reports the outcome of the assessment of likely significant effects arising from the Proposed Development upon groundwater. The Proposed Development that forms the basis of this assessment is described in Chapter 3 (Description of the Proposed Development) of the Environmental Statement ('ES') Volume 1 (document reference 6.1.3).

19.1.1.2. The groundwater assessment considers the potential impacts associated with the following activities:

- Trenching impacts to the relevant groundwater bodies;
- Horizontal Directional Drilling ('HDD') impacts to the relevant groundwater bodies; and
- Converter Station construction and potential impacts to the underlying Chalk aquifer.

19.1.1.3. This chapter assesses the impacts arising from the Proposed Development within the Onshore Components of the Order Limits and the Site only (above Mean Low Water Springs ('MLWS')). Refences to the Order Limits and the Site in this chapter, any appendices to it and plans enclosed to it, is only in relation to the Order Limits and the Site as applicable to the Onshore Components as illustrated in Figure 3.9 of the ES Volume 2 (document reference 6.2.3.9) Figure 3.9.

19.1.2. STUDY AREA

19.1.2.1. For all sections of the Proposed Development, excluding Section 1, the study area encompasses groundwater receptors within a 0.5 km radius of the Proposed Development and groundwater abstractions where subsurface catchment areas are located within 1 km of the Proposed Development.

19.1.2.2. The Section 1 (Lovedean (Converter Station Area)) study area is 5 km to the south, east and west of the Proposed Development. This is because karst features, such as those mapped close to Section 1 can transmit groundwater many kilometres in a day. Karsts are solution features which provide fast flowing conduits for groundwaters to travel.

19.2. LEGISLATION, POLICY AND GUIDANCE

19.2.1.1. This assessment has taken into account the current legislation, policy and guidance relevant to groundwater. These are listed below.

19.2.2. LEGISLATION

The Environmental Protection Act 1990

19.2.2.1. The Environmental Protection Act 1990 ('EPA') defines the structure and authority for waste management and the control of emissions to the environment. Part 1 sets out the regulations whereby the Secretary of State for Food and Rural Affairs can set limits on emissions into the environment. Part 2 deals with regulations surrounding the controlled disposal of waste. It also addresses the regulations surrounding transportation, treatment and storing of waste.

19.2.2.2. The legislation endorses the principle of a 'suitable for use' approach to contaminated land, where remedial action is only required if there are significant risks to human health or controlled waters.

EU Nitrates Directive 1991

19.2.2.3. The EU Nitrates Directive (1991) aims to protect water quality by preventing nitrates from agricultural sources polluting groundwater and surface water and, by promoting the use of good farming practices. The Nitrates Directive has close links to the WFD (2000) and Groundwater Directives (2006). The Groundwater Directive (2006) confirms that nitrate concentrations must not exceed the trigger value of 50 mg/L in order to reach 'Good' status under the WFD.

The Water Resources Act 1991

19.2.2.4. The Water Resources Act 1991 (as amended in 2009) regulates water resources, pollution, water quality and flood defence. The Act aims to prevent and minimise pollution of water. Currently, the EA is responsible for the policing of this Act.

19.2.2.5. Under the Act, it is an offence to cause or knowingly permit any poisonous, noxious or polluting material, or any solid waste to enter any controlled water.

Land Drainage Act (1991) (as amended)

19.2.2.6. The Land Drainage Act (HMSO, 1991) includes environmental duties in relation to drainage and requires that a watercourse is maintained by its owner in such a condition that the free flow of water is not impeded. If a riparian owner fails to carry out their responsibilities under the Land Drainage Act, or if anyone else causes a watercourse to become blocked or obstructed, Local Authorities and Internal Drainage Boards ('IDBs') have powers of enforcement by serving a notice under the Act.

19.2.2.7. The Land Drainage Act (HMSO, 1994) amended the 1991 Act in relation to the functions of IDBs and Local Authorities to further conserve and enhance areas of natural beauty, and to conserve flora, fauna and geological or physiographical features of special interest, as well as taking account of any impacts on the beauty or amenity of any rural or urban area, or on any such flora, fauna or other features.

The Environment Act (1995)

19.2.2.8. The Environment Act (HMSO, 1995)sets out the responsibilities of the Environment Agency (EA) in relation to water pollution, resource management, flood defence and fisheries.

The Drinking Water Directive 1998

19.2.2.9. The Drinking Water Directives (98/83/EC) concerns the quality of water intended for human consumption. Its objective is to protect human health from adverse effects of any contamination of water intended for human consumption.

The Anti-Pollution Works Regulations 1999

19.2.2.10. The Anti-Pollution Works Regulations 1999 allows the EA (‘EA’) to serve notice under Section 161A of the Water Resources Act to a business or person that has caused pollution or has a risk of causing pollution to any watercourse. The notice requires the recipient to conduct preventative works and operations in order to minimise the risk and future risk. Failing to abide by the notice may lead to prosecution.

The Water Framework Directive 2000 and Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

19.2.2.11. The Water Framework Directive (‘WFD’) is a EU Directive which commits EU member states to achieving good qualitative and quantitative status of all water bodies (including coastal waters up to one nautical mile from shore, inland surface water, transitional waters, and groundwater) at six-year intervals. The next objective is to achieve a “good” status by 2021.

19.2.2.12. The WFD is transposed into UK law through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.

The Water Act (2003)

19.2.2.13. The Water Act (HMSO, 2003) aims to encourage the sustainable use of water resources; strengthening the voice of the consumer; a measured increase in competition and finally the promotion of water conservation. The Act made it a statutory obligation on water companies to produce a Water Resources Plan.

The Groundwater Daughter Directive 2006

19.2.2.14. The Groundwater Daughter Directives ('GDD') (2006/118/EC), which were enacted in 2000 and 2006 respectively, replace the original Groundwater Directive (80/68/EEC) which was repealed in 2013. The GDD introduced procedures for assessing the 'Chemical Status' of groundwater as per the WFD and protects groundwater by preventing direct discharge of 'hazardous pollutants' and limiting the direct discharge of non-hazardous pollutants.

The Groundwater (England and Wales) Regulations (2009)

19.2.2.15. The Groundwater (England and Wales) Regulations (HMSO, 2009) are an environmental protection measure which provide enhanced protection for groundwater by preventing the input of 'hazardous' substances into groundwater and limiting the input of 'non-hazardous' pollutants into groundwater.

The Water Act (2014)

19.2.2.16. The Water Act (HMSO, 2014) covers four main areas: making water supplies more resilient to natural hazards such as droughts and floods; creation of a national water supply network to make it easier for water companies to buy and sell water from each other; ensuring access to affordable flood insurance from 2015 via a new industry backed levy; and increasing competition in the water industry by allowing all businesses, charities and public sector customers in England to switch their water and sewage supplier.

The Environmental Damage (Prevention and Remediation) Regulations 2015

19.2.2.17. The Environmental Damage (Prevention and Remediation) (England) Regulations 2015 provides guidance for imminent threats of 'environmental damage' or actual 'environmental damage', related to surface water and groundwater. Guidance is provided to ensure appropriate mitigation measures such as easements when working near waters. In addition, it recommends remediation measures should there be significant effects to cause a change in surface water and groundwater. These Regulations only apply to England up to one nautical mile seaward in England.

The Environmental Permitting (England and Wales) Regulations 2016

19.2.2.18. The Environmental Permitting (England and Wales) Regulations 2016 set out the control requirements for the discharge of water to surface water and groundwater. The Regulations provide details on the permits required for a water discharge to surface waters and groundwater. Water discharge activities as well as groundwater activities are detailed to classify what is acceptable.

19.2.3. PLANNING POLICY

19.2.3.1. Below is a brief summary of the relevant national and local policy:

National Policy

National Policy Statement

- In the s35 Direction letter, the Secretary of State (SoS) directed that the Proposed Development was, by itself nationally significant and that the Overarching National Policy for Energy (EN-1) should apply to the application, setting out the Government's policy for delivery of major energy infrastructure.
- Parts 4 and 5 of EN-1 detail the general principles that will be used in the assessment of applications and sets out how generic physical impacts (i.e. those impacts most likely to arise from the development of any type of energy infrastructure) and means of mitigation measures will be considered.

National Planning Policy Framework

- The National Planning Policy Framework ('NPPF') was first published on 27 March 2012 and updated on 24 July 2018 and 19 February 2019 with the aim of protecting the environment and to promote sustainable growth. There is an overarching presumption in favour of sustainable development that should be the basis of every plan and every decision.

Local Policy

Hampshire County Council Groundwater Management Plan

19.2.3.2. The Groundwater Management Plan ('GWMP') for Hampshire establishes the risk from groundwater flooding and follows a systematic appraisal of potential environmental impacts of policies, plans, strategies and programmes. The GWMP is not a statutory plan and Local Authorities need to decide if a GWMP requires a Strategic Environmental Assessment by making a screening decision. The GWMP follows WFD compliance which establishes a framework for the protection of waterbodies including Groundwater Dependent Terrestrial Ecosystems, and ensures that local measures to reduce flood risk comply with the WFD (see Section 19.2).

Draft Havant Borough Local Plan 2036 (2018)

19.2.3.3. Havant Borough Council has a strategic approach to protecting groundwater. Policy E22 (Aquifer Source Protection Zones) uses land based planning powers to assist in the protection of groundwater and controlled waters. This approach aims to address pollution at its origin in the catchment, thereby preventing deterioration and improving the quality of water in the chalk aquifer which supports abstraction for public water supply.

Portsmouth City Council Local flood risk management strategy

19.2.3.4. The Portsmouth City Council local flood risk management strategy includes for a groundwater flood risk map to highlight areas with risk of groundwater flooding. The strategy includes for a high-level flood risk way forward hierarchy which includes groundwater investigation activities.

East Hampshire District Local Plan Joint Core Strategy (2014)

19.2.3.5. Policy CP25 (Flood Risk) covers development in areas at risk of flooding and identifies that specific areas of the District, overlain by chalk geology, can be prone to groundwater flooding, with a number of the rivers being groundwater fed, with development seeking to avoid areas at risk from, or susceptible to, or have a history of groundwater flooding. Where it is not possible to avoid these areas, development should be designed to incorporate flood resistance and resilience measures.

Winchester District Local Plan Part 1 – Joint Core Strategy (2013)

19.2.3.6. Policy CP17 (Flooding, Flood Risk and the Water Environment) identifies how development shall not cause unacceptable deterioration to water quality or have an unacceptable impact on water quantity (including drinking water supplies). This will be achieved by avoiding flood risk to people and property, ensuring development does not cause unacceptable deterioration to water quality or have an unacceptable impact on water quantity (including drinking water supplies), including through the protection of surface water and groundwater through suitable pollution prevention measures.

Denmead Neighbourhood Plan (2015)

19.2.3.7. Whilst not comprising a specific policy, the Neighbourhood Plan identifies a well evidenced problem with groundwater flooding as a result of local geology and topography. The plan seeks to ensure that development does not make the existing flooding problems any worse.

Winchester City Council Strategic Flood Risk Assessment for Local Development Framework

19.2.3.8. The Winchester City Council strategic flood risk assessment includes historic cases of groundwater flooding and highlights the need for proposed developments to provide assessment of flooding, which includes groundwater flooding.

19.2.4. GUIDANCE

19.2.4.1. Design Manual for Roads and Bridges ('DMRB') Volume 11, Section 3, Part 10 (HD 45/09) (2009) provides guidance on the assessment and management of the impacts that road projects may have on the water environment. These include possible impacts on the quality of water bodies and on the existing hydrology and hydrogeology of the catchments through which roads pass. Although this guidance has been drafted for road assessments it provides a robust methodology for assessing impacts to the water environment and is considered suitable for this assessment.

19.2.4.2. Transport Analysis Guidance ('TAG') Unit A3 Environmental Impact Appraisal - Impacts on the Water Environment (2013) provides guidance for appropriately qualified environmental practitioners/topic specialists on appraising the impact of transport proposals on the built and natural environment, and on people. Although this guidance has been drafted for transport assessments it provides a robust methodology for assessing impacts to the water environment and is considered suitable for this assessment. When using the guidance in this TAG unit, environmental practitioners/topic specialists should refer to current European and UK legislation, regulations and policy and best practice.

19.2.4.3. A number of Construction Industry Research and Information Association ('CIRIA') guidance documents provide guidance on the control of water pollution, these guidance documents are noted below:

- CIRIA Report C532, Control of water pollution from construction sites: Guidance for consultants and contractors;
- CIRIA Report C648, Control of water pollution from linear construction projects: Technical guidance;
- CIRIA Report C649, Control of water pollution from linear construction sites: Site guide; and
- CIRIA Report C753, The SuDS (Sustainable Urban Drainage) Manual.

19.2.4.4. The following Scottish Environment Protection Agency ('SEPA') Pollution Prevention Guidelines ('PPGs')/Guidance for Pollution Prevention ('GPPs') (developed jointly with the EA and the Northern Ireland EA) have also been considered, despite having been withdrawn[1], as they provide some appropriate guidance to the management of pollution prevention in lieu of any replacement guidance on good practice being available:

- PPG1 Understanding your environmental responsibilities – good environmental practices (July 2013);
- GPP2 Above ground oil storage tanks (January 2018);
- PPG3 Use and design of oil separators in surface water drainage systems (April 2006);
- The EA's approach to groundwater protection;
- GPP4 Treatment and disposal of wastewater where there is no connection to the public foul sewer (November 2017);
- GPP5 Works and maintenance in or near water (January 2017);
- PPG6 Working at construction and demolition sites (2012);
- PPG7 Safe storage – the safe operation of refuelling facilities (July 2011);

- GPP8 Safe storage and disposal of used oils (July 2017);
- GPP13 Vehicle washing and cleaning (April 2017);
- PPG18 Managing fire water and major spillages (June 2000);
- GPP21 Pollution incident response planning (July 2017);
- PPG22 Incident response - dealing with spills; (April 2011); and
- PPG26 Safe storage – drums and intermediate bulk containers (March 2011).

19.3. SCOPING OPINION AND CONSULTATION

19.3.1. SCOPING OPINION

19.3.1.1. As detailed within Chapter 1 (Introduction) of the ES Volume 1 (document reference 6.1.1), a Scoping Opinion was received by the Applicant from the Planning Inspectorate (PINS), on behalf of the Sectary of State ('SoS') on 7 December 2018.

19.3.1.2. The scoping opinion highlighted the need for a specific understanding of how the Proposed Development would interact with groundwater and impact Zone of Influence ('ZoI') created. It also highlighted the need for consideration of groundwater users within the ZoI. This has been taken into account and is addressed in this chapter.

Appendix 19.1 (Consultation Responses) of the ES Volume 3 (document reference 6.3.19.1) includes the detailed responses to the PINS Scoping Opinion.

19.3.2. POST PEIR CONSULTATION RESPONSE

19.3.2.1. Following publication of the PEIR, feedback was obtained from a number of statutory consultees including the Environment Agency and Portsmouth Water.

19.3.2.2. The concerns that were raised in relation to pollution of the Chalk and karst features have been addressed in this chapter. Other concerns with regards to working in the Chalk and karstic areas have since been mitigated through embedded mitigation measures, as set out later in this chapter.

19.3.2.3. The consultation responses also highlighted any abstraction licenses will not be disapplied unless exemption applies.

19.3.2.4. Appendix 19.1 (Consultation Responses) summarises the responses to the consultation in relation to this topic and how these have been addressed.

19.3.3. ELEMENTS SCOPED OUT OF THE ASSESSMENT

19.3.3.1. The elements shown in Table 19.1 were not considered to give rise to likely significant effects at the scoping stage and have been scoped out of the assessment of the Proposed Development:

Table 19.1 – Topics and elements scoped out of the assessment at Scoping

Element Scoped Out	Justification
Groundwater quality of flow impacts to the London Clay Formation for all Stages	The London Clay Formation is an aquitard. At this location it is composed of stiff clay and will not transmit groundwater unless sand units are encountered, and these will be finite in lateral extent and capacity.
Groundwater flow/quantity impacts through the operation of the Converter Station, Horizontal Directionally Drilled Onshore Cable Route or trenched Onshore Cable Route.	Once the Onshore Cable Route has been installed no active groundwater dewatering will be required to maintain dry conditions for Onshore Cable Route; The trenched Onshore Cable Route installation in all sections will introduce a 400 mm thick cement bound sand layer between 0.9 m and 1.3 m below ground level with native compressed backfill replaced above until surface. The replaced ground materials are permeable, apart from the 400 mm thick cement, and therefore there no groundwater quantity impact to any groundwater bodies is anticipated. The HDD alignment installation will introduce four <36-inch diameter bentonite based clay tubes into the ground, preventing groundwater ingress or egress. These tubes will introduce small hydraulic barriers in the aquifers, however, no groundwater quantity impact is anticipated. At the Converter Station site attenuation ponds are proposed to cycle all the collected rainfall to ground to ensure no groundwater recharge losses arise because of the Proposed Development. Therefore, operational impacts to groundwater flow/quantity have been scoped out of the ES.
Groundwater quality impacts through the operation of the Converter Station, Horizontal Directionally Drilled Onshore Cable Route or trenched Onshore Cable Route	All proposed trenching and HDD ground materials will be inert so no groundwater quality impacts anticipated; The trenched Onshore Cable Route installation will introduce a 400 mm thick cement bound sand layer between 0.9 and 1.3 m below ground level with native compressed backfill replaced above until surface. All introduced ground materials will be inert and therefore no operational impacts are

	envisaged. Trenched alignment groundwater quality impacts have therefore been scoped out of this assessment The HDD Onshore Cable Route installation will introduce four <36-inch diameter bentonite based clay tubes into the ground, preventing groundwater ingress or egress. These ground materials are inert and therefore these groundwater quality impacts have therefore been scoped out of this assessment Embedded mitigation measures for the proposed Converter Station attenuation pond includes for the capture of on-site hydrocarbons and passive remediation for any contamination release (not anticipated). Therefore, operational impacts to groundwater quality have been scoped out of the ES

19.3.4. IMPACTS SCOPED INTO THE ASSESSMENT

Construction (and Decommissioning) Stage

19.3.4.1. The following impacts are considered to have the potential to give rise to likely significant effects during construction of the Proposed Development and have therefore been considered within this ES:

- Groundwater flow impacts arising from the construction of the Converter Station, HDD and trenched Onshore Cable Route; and
- Groundwater quality impacts arising from the construction of Converter Station, HDD and trenched Onshore Cable Route.

Decommissioning Stage

19.3.4.2. The approach to decommissioning will be decided in the future by the contractor and so is uncertain at this stage. The potential effects of decommissioning are, in the worst case, considered to be equivalent to the effects associated with construction/installation and are assessed on this basis, though they may potentially be less than those associated with construction/installation depending on the decommissioning activities undertaken, for instance where the Cable ducts are left in situ.

19.4. ASSESSMENT METHODOLOGY

19.4.1.1. The assessment methodology used in this chapter builds on and adapts the classification contained in the DMRB Volume 11, Section 3, Part 10 (HD 45/09) and the TAG Unit A3 Environmental Impact Appraisal – Impacts on the Water Environment.

19.4.1.2. The above guidance, although developed for assessing impacts that road projects may have on the water environment, provides a suitable framework to develop a consistent classification of both magnitude of effects and sensitivity of potential water receptors. This is standard practice and the TAG Unit A3 EIA methodology is considered suitable for this assessment.

19.4.1.3. The methodology of the assessment for this chapter includes:

- Establish baseline conditions within the study area through review of desk based sources of information, literature review, site walkovers and consultation with relevant authorities;
- Determine the anticipated receptors and their sensitivity;
- Assessment of predicted impact prior to mitigation measures and the residual effects once the expected mitigation measures is applied;
- Identify opportunities for enhancements within the groundwater environment; and

- Impacts during potential cable replacement/ maintenance activities during operation are considered to involve similar techniques to those during construction and therefore typical cable replacement works are assumed to be similar as construction and therefore not specifically considered further.

19.4.2. SIGNIFICANCE CRITERIA

19.4.2.1. In determining the significance of a potential effect, the magnitude of impact arising from the Proposed Development is correlated with the sensitivity of the environmental attribute or process under consideration.

Magnitude

19.4.2.2. The magnitude relates to the level at which the receptor will be impacted, using the duration of the impact, timing, scale, size and frequency to determine the magnitude of the impact to each receptor. Magnitude of impact is evaluated in accordance with the definitions set out in Table 19.2 below, as per the TAG Unit A3 guidance.

19.4.2.3. The TAG Unit A3 guidance provides classifications of magnitude of impact in' Large', 'Moderate', and 'Slight' quantities and the DMRB guidance provides classification of magnitude of impact in 'Major', 'Moderate', 'Minor' and 'Negligible'. For the purposes of this assessment, the magnitude of change/effect will be considered as 'Major', 'Moderate', 'Minor' and 'Negligible'.

Table 19.2 – Definitions of 'magnitude' of impact

Magnitude of Impact	Definition	Example
Major	Results in a major loss or gain of feature	Pollution of potable source of abstraction. Increase of a significant amount of flow entering controlled systems (Sufficient enough to cause a change in WFD classification or loss or gain of important fishery); Major reduction in flooding extension/likelihood; Removal of major existing pollutant; High risk of pollution during construction, significant or long-term change in water quality, resulting in a permanent change in WFD status or permanent loss of water supply (groundwater and surface water); Major loss of an aquifer in terms of water level or yield, with total loss of or major changes to dependent habitats/abstractions; or

Magnitude of Impact	Definition	Example
		Major groundwater flow changes with significant consequences on nearby groundwater dependent habitats/abstractions.
Moderate	Results in a medium impact of integrity (beneficial or adverse) of feature or loss or gain of part of a feature.	Flooding of the Site which could cause financial impact and disruption (but no loss of life) is statistically possible or even likely; A significant increase in the likelihood of flooding offsite is possible as a consequence of the development with potential financial effect but no loss of life; Increase of amount of flow entering controlled systems (sufficient enough to cause an increase in flooding); Moderate risk of pollution during construction, moderate temporary change in water quality, resulting in a temporary change of WFD status or preventing attainment of overall status of 'Good', or temporary loss of water supply (groundwater and surface water); Moderate groundwater flow changes with minor consequences on nearby groundwater dependent habitats/abstractions; or Partial change or loss of a Groundwater Dependent Terrestrial Ecosystem ('GWDTE') where the value of the site would be affected.
Minor	Results in a low impact of integrity of feature or minor loss of part of a feature.	Small increase/decrease in the likelihood of flooding; Increased amount of flow entering controlled systems, but would not cause flooding; Measurable changes in feature, but of limited size and/or proportion; Minor risk of pollution during construction, minor temporary changes in water quality such that ecology is temporarily affected. Equivalent to a temporary minor, but measurable, change within WFD status class;

Magnitude of Impact	Definition	Example
		Minor groundwater flow changes with minimal impact on nearby groundwater dependent habitats/abstractions; or Small changes to or loss of a GWDTE, where the value of the site would not be affected.
Negligible	Results in a change but insufficient to affect attribute.	The Proposed Development is unlikely to affect the integrity of the water environment and the impact on flooding is not relevant. For example, the quantity is immeasurable or insignificant, when compared to the baseline condition; No increased amount of flow entering controlled systems i.e. no effect when compared to baseline condition; No significant effect on the economic value of the feature; Negligible risk of pollution during construction, very slight temporary change in water quality with no discernible effect on watercourse ecology; Negligible groundwater flow changes with no discernible impact on nearby groundwater dependent habitats/abstractions; Minimal or no change to an aquifer in terms of water level or yield, with no discernible change to dependent habitats/abstractions; or Minimal or no change to or loss of a GWDTE.

Value/Sensitivity

19.4.2.4. As described within Chapter 4 (EIA Methodology) of the ES Volume 1 (document reference 6.1.4), sensitivity is a means to measure how affected receptors/processes and/or the receiving environment is to change. The sensitivity is assigned at the receptor/process level. This may be defined in terms of quality, value, rarity or importance, and be classed as low, medium, or high. For the purpose of this assessment, receptors assessed with a 'negligible' sensitivity will not be assessed as the effects on them are insignificant.

19.4.2.5. Table 19.3 below shows the general criteria used in assessing the sensitivity of water receptors as part of this assessment.

Table 19.3 – Sensitivity of Receptor Criteria

Sensitivity	Description	Example Receptors
High	Receptor with High quality and rarity, regional or national scale and limited potential for substitution.	Principal Aquifer providing a regional important resource or supporting a site protected under EC and UK habitat legislation; Located within Source Protection Zone ('SPZ') Inner Zone (Zone 1) and SPZ Outer Protection Zone (Zone 2); Waterbody with 'High' or 'Good' WFD overall status and/or water quality status for surface water or groundwater waterbody; Designated site protected under EU or UK habitat legislation, such as SSSI, SAC, and SPA, for the disciplines assessed in this chapter; and Residents.
Medium	Receptor with Medium quality and rarity, regional or national scale and limited potential for substitution.	Aquifer providing abstraction water for a small number of domestic private water supplies, agricultural or industrial use; Secondary A aquifer; Waterbody with 'Moderate' WFD overall status and/or water quality status for surface water or groundwater waterbody; Located within SPZ Total Catchment Zone 3; Surface water or groundwater waterbodies considered to be directly supporting or maintaining water conditions in non-designated wetland or peatland sites with hydrological linkage to Proposed Development; and Commercial users/construction workers.
Low	A receptor with Low quality and rarity, regional or national scale and limited potential for substitution.	Waterbody with 'Poor' or 'Bad' WFD overall status and/or water quality status for surface water or groundwater waterbody; Surface water or groundwater waterbodies are not considered to contribute or maintain water conditions in any wetland or peatland sites; Secondary undifferentiated Aquifer; and Secondary B Aquifer.

19.4.2.6. The TAG Unit A3 and DMRB guidance includes a 'very high' classification for the value/importance of receptors. For the purposes of this assessment, receptors assessed with 'very high' value/importance in accordance with TAG Unit A3 and DMRB guidance will be assessed as having a 'high' sensitivity.

Significance

19.4.2.7. The overall significance will be assessed using the matrix shown in Table 19.4. Effects deemed to be significant for the purpose of assessment are those which are described as 'major' and 'moderate/major'. In addition, 'moderate' effects can also be deemed as significant. Whether they do so shall be determined by a qualitative analysis of the specific impact to the environment and will be based on professional judgement. If/where this is the case, the basis for any judgement will be outlined.

Table 19.4 – Matrix for classifying the significance of effects

		Sensitivity of receptor/receiving environment to change			
		High	Medium	Low	Negligible
Magnitude of Change	Major	Major	Major to Moderate	Moderate	Negligible
	Moderate	Major to Moderate	Moderate	Minor to Moderate	Negligible
	Minor	Moderate	Minor to Moderate	Minor	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

19.4.2.8. The following terms have been used to define the significance of the effects identified:

- **Major effect**: where the Proposed Development could be expected to have a considerable effect (either beneficial or adverse) on groundwater flood risk, groundwater resources quality or groundwater resources quantity in the area;
- **Moderate effect**: where the Proposed Development could be expected to have a noticeable effect (either beneficial or adverse) on groundwater flood risk, groundwater resources quality or groundwater resources quantity in the area;
- **Minor effect**: where the Proposed Development could be expected to result in a small, barely noticeable effect (either beneficial or adverse) on groundwater flood risk, groundwater resources quality or groundwater resources quantity in the area; or
- **Negligible**: where no discernible effect is expected as a result of the Proposed Development on groundwater resources in the area. (i.e. the effect is insignificant).

19.4.3. ASSUMPTIONS AND LIMITATIONS

19.4.3.1. This assessment has been undertaken based on the information provided within Chapter 3 (Description of the Proposed Development) and using the worst case design parameters presented in Appendix 3.3 and 3.6 of the ES.

19.4.3.2. This chapter provides preliminary information as it relates to the Proposed Development to date and to data currently available and gathered at this point of the assessment process. For example, ground investigation data and continuous winter groundwater level monitoring is incomplete for the Onshore Cable Corridor. If available, this data would fully inform if groundwater interceptions would occur along any point of the Proposed Development and require groundwater management/dewatering. This will be confirmed in the detailed Design Stage of works. In the absence of this data, the ES will qualitatively assess 'worst-case' impacts and therefore assumes groundwater dewatering will be required where groundwater is/or may be present within the trenched Onshore Cable Route footprint. A worst-case scenario has therefore been accounted for within the assessment.

19.4.3.3. The description of the Proposed Development does not include any dewatering calculations for the proposed trenches or pits where groundwater dewatering will occur. This would inform the likely quantity of groundwater required for management and whether a groundwater abstraction license would be required. This will be confirmed in the detailed Design Stage of works.

19.4.3.4. The description of the Proposed Development also does not include for groundwater strategy and/or groundwater management strategies to inform upon the proposed dewatering management practices. This will be confirmed in the detailed Design Stage of works.

19.4.3.5. HDD-4 (Farlington Railway Crossing) will be installed using trenchless techniques. This report assumes the micro tunnel here will be constructed in such a way that groundwater does not seep into, or drilling fluids seep out of, the micro tunnel annulus.

19.4.3.6. This chapter is linked to a number of other environmental assessments being undertaken as part of this ES. It should be noted that potential impacts on these topic areas are not included within this chapter and can be found in other chapters as summarised below:

- Ground Conditions - the release of contaminants contained in the ground will be assessed in Chapter 18 (Ground Conditions) of the ES Volume 1 (document reference 6.1.18);
- Surface Water Resources and Flood Risk – impacts on sensitive and/or important surface water physical processes, flood risk and drainage will be assessed in Chapter 20 (Surface Water Resources and Flood Risk) of the ES Volume 1 (document reference 6.1.20);

- Marine - impacts on sensitive and/or important marine physical processes, marine water and sediment quality, intertidal and benthic ecology (e.g. water resources and ecology including and below intertidal zone) will be assessed in Chapters 6 to 14 of the ES Volume 1 (document reference 6.1.6 to 6.1.14); and
- Onshore Ecology - impacts on sensitive and/or important onshore aquatic species and habitats within the non-saline environment (e.g. above inter-tidal environment) will be assessed in Chapter 16 (Onshore Ecology) of the ES Volume 1 (document reference 6.1.16) which includes impacts on sensitive and/or important ecology associated to noise and vibration.

19.5. BASELINE ENVIRONMENT

19.5.1.1. The Groundwater baseline consists of information collected from the British Geological Society ('BGS'), the EA, Portsmouth Water, PCC, Ground Investigation data, Magic.gov and through a site walkover. A list of data sources is presented below;

- EA Catchment Data Explorer (WFD data);
- EA Groundwater Flood Susceptibility Map;
- Ordnance Survey Mapping and terrain data;
- DEFRA 'Magic Map' online GIS portal;
- BGS GeoIndex Database;
- BGS Geoveiwer;
- BGS Karst hydrogeology of the Bedhampton and Havant springs;
- WSP site walkover surveys completed December 2018 and July 2019;
- WSP, Initial Ground Investigation Findings, Milton Common, October 2018;
- WSP, UK Converter Station Ground Investigation – Geotechnical Interpretative Design Development Report dated May 2019;
- WSP, UK Route, HDD and Landfall Ground Investigation - Geotechnical Interpretative Design Development Report dated May 2019;
- EA data on groundwater including aquifer type, aquifer vulnerability, SPZs, and groundwater level monitoring data (long term discrete manual spot dips);
- PCC continuous groundwater level monitoring;
- WSP continuous groundwater level monitoring;
- WSP groundwater quality sampling; and
- EA data on licensed/unlicensed abstractions and consented discharges.

19.5.2. INTRODUCTION TO CONVERTER STATION AREA AND ONSHORE CABLE CORRIDOR SECTIONS

19.5.2.1. The main geology and hydrogeology characteristics of the study area are described below with the main bedrock and superficial geology presented in Figure 19.1 and Figure 19.2 of the ES Volume 2 (document reference 6.2.19.1 and 6.2.19.2). A detailed description of the geology of the study area is also available in Chapter 18 (Ground Conditions).

Section 1 – Lovedean (Converter Station Area)

Geology

19.5.2.2. Review of the BGS mapping indicates a presence of superficial Head Deposits in the Converter Station Area and Access Road comprising mostly clay, silt, sand and gravel.

19.5.2.3. The Converter Station Area and Access Road is underlain by the Tarrant Chalk Member comprising soft white chalk with relatively widely spaced but large flint seams.

Hydrogeology

19.5.2.4. The Tarrant Chalk Member is classified as a Principle Aquifer and the Head Deposits are classified as a Secondary Undifferentiated Aquifer by the EA.

19.5.2.5. Principle Aquifers are defined as geologies with high permeability, high water storage, able provide baseflow to surface water features and can be abstracted for regional supply.

19.5.2.6. Secondary Undifferentiated Aquifers are assigned where it is not possible to differentiate between a Secondary A or Secondary B Aquifer. Secondary A Aquifers are defined as permeable strata, able provide baseflow to surface water features and can be abstracted for local supply. Secondary B Aquifers are defined as lower permeability strata which may yield finite amounts of groundwater.

19.5.2.7. Section 1 is located within a Groundwater SPZ 1. SPZ's are assigned by the EA to protect public groundwater abstractions. SPZ 1's are defined as having a 50 day or less travel time to the abstraction source, SPZ 2's having a 400 day or less travel time and SPZ 3's are defined as the abstraction's entire recharge catchment. This SPZ relates to the Lovedean Pumping Station, potable water supply operated by Portsmouth Water.

19.5.2.8. Section 1 is located in a Karst Zone 2. Karsts are solution features which provide fast flowing conduits for groundwaters to travel. Karst Zone 2 is an intermediate area where the Clay with Flints superficial deposits are present. In this zone, dolines and solution pipes are likely to occur but few hydrologically active stream sinks are present, i.e. no flow of water through the system.

Section 2 – Anmore

Geology

19.5.2.9. The superficial geology is composed of Head Deposits which provide partial coverage to the Tarrant Chalk Member bedrock geology.

Hydrogeology

19.5.2.10. The Tarrant Chalk Member is classified as a Principal Aquifer and the superficial Head Deposits are classified as a Secondary Undifferentiated aquifer by the EA.

19.5.2.11. Section 2 is located within the Lovedean Pumping Station Groundwater SPZ 1.

19.5.2.12. The EA Groundwater Flood Susceptibility Map identifies that Section 2 is susceptible to superficial groundwater flooding approx. 700 m south of the proposed Converter Station Area. The BGS defines groundwater flooding as the emergence of groundwater at the ground surface away from perennial river valleys or the rising of groundwater into man-made ground under conditions where the 'normal' range of groundwater levels and groundwater flow is exceeded.

19.5.2.13. Section 2 is located in a Karst Zone 1 and 2. Karst Zone 1 is characterised by frequent stream sinks and dolines associated with the geological boundary between Tertiary (sand and clay) and Cretaceous (chalk) deposits. Stream sinks and dolines are defined as holes in the ground caused by a collapse of a surface layer, i.e. chemical dissolution of carbonate rocks has occurred. Karst Zone 2 is an intermediate area where the Clay with Flints superficial deposits are present. In this zone, dolines and solution pipes are likely to occur but few hydrologically active stream sinks are present, i.e. no flow of water through the system.

Section 3 – Denmead/Kings Pond Meadow

Geology

19.5.2.14. The superficial geology is composed of Head Deposits which provide partial coverage to the Lambeth Group bedrock geology. The Lambeth Group bedrock overlies the Chalk and this coverage thickens towards the south.

19.5.2.15. The London Clay Formation overlies the Lambeth Group to the far south of Section 3, and occurs just north of the B2150 and Soak Road junction. The London Clay Formation thickens towards the south.

Hydrogeology

19.5.2.16. The Lambeth Group is classified as a Secondary A Aquifer and the Head Deposits are classified as a Secondary Undifferentiated Aquifer by the EA.

19.5.2.17. Section 3 is located within the Lovedean Pumping Station Groundwater SPZ 1.

19.5.2.18. The EA Groundwater Flood Susceptibility identifies that Section 3 is susceptible to superficial groundwater flooding.

Section 4 – Hambledon Road to Farlington Avenue

Geology

19.5.2.19. The superficial geology is composed of Head Deposits which provide partial coverage to the London Clay Formation, Bognor Sand Member, Wittering Formation, Lambeth Group, Portsdown Chalk Formation, Spetisbury Chalk Member, Tarrant Chalk Member and the Newhaven Chalk Formation bedrock geologies.

Hydrogeology

19.5.2.20. The Portsdown Chalk Formation, Spetisbury Chalk Member, Tarrant Chalk Member and the Newhaven Chalk Formation are classified as Principal Aquifers by the EA. The Bognor Sand Member, Wittering Formation and Lambeth Group are classified as a Secondary A Aquifers by the EA. The Head Deposits are classified as a Secondary Undifferentiated Aquifer by the EA.

19.5.2.21. The EA Groundwater Flood Susceptibility Map identifies that Section 4 (up to Widley) is susceptible to superficial groundwater flooding. From Widley to the northern part of Section 4 (B2177) the alignment is susceptible to both superficial and clearwater flooding. Clearwater flooding can be caused by the water table in an unconfined aquifer rising above the land surface as a response to extreme rainfall.

19.5.2.22. Section 3 is located in a Karst Zone 1. Karst Zone 1 is characterised by frequent stream sinks and dolines associated with the geological boundary between Tertiary (sand and clay) and Cretaceous (chalk) deposits. Stream sinks and dolines are defined as holes in the ground caused by a collapse of a surface layer i.e. chemical dissolution of carbonate rocks has occurred.

Section 5 – Farlington

Geology

19.5.2.23. The superficial geology is composed of Head Deposits and River Terrace Deposits which provide partial coverage to the Newhaven Chalk Formation and Lewes Nodular Chalk Formation bedrock geologies.

Hydrogeology

19.5.2.24. The Newhaven Chalk Formation and Lewes Nodular Chalk Formation are classified as Principal Aquifers by the EA. The River Terrace Deposits are classified as a Secondary A Aquifer by the EA. The Head Deposits are classified as a Secondary Undifferentiated Aquifer by the EA.

19.5.2.25. The EA Groundwater Flood Susceptibility Map identifies Section 5 to be susceptible to clearwater groundwater flood risk. The Chalk is unconfined in Section 5.

Section 6 – Zetland Field and Sainsbury's Car Park

Geology

19.5.2.26. The superficial geology is composed of River Terrace Deposits and Raised Marine Deposits which provide full coverage to the Lewes Nodular Chalk Formation bedrock geology.

Hydrogeology

19.5.2.27. The Lewes Nodular Chalk Formation is classified as Principal Aquifer by the EA. The River Terrace Deposits are classified as a Secondary A Aquifer by the EA. The Raised Marine Deposits are classified as a Secondary Undifferentiated Aquifer by the EA.

19.5.2.28. The EA Groundwater Flood Susceptibility Map identifies Section 6 to be susceptible to clearwater groundwater flood risk.

Section 7 – Farlington Junction to Airport Service Road

Geology

19.5.2.29. The superficial geology is composed of River Terrace Deposits, Raised Marine Deposits and Beach and Tidal Flat Deposits which provide full coverage to the Lewes Nodular Chalk Formation and Lambeth Group bedrock geologies.

Hydrogeology

19.5.2.30. The Lewes Nodular Chalk Formation is classified as Principal Aquifer by the EA. The River Terrace Deposits are classified as Secondary A Aquifer by the EA. The Raised Marine Deposits and Beach and Tidal Flat Deposits are classified as Secondary Undifferentiated aquifers by the EA.

19.5.2.31. The EA Groundwater Flood Susceptibility Map identifies Section 7 to be susceptible to both clearwater and superficial groundwater flood risk.

Section 8 – Eastern Road (adjacent to Great Salterns Golf Course) to Moorings Way

Geology

19.5.2.32. The superficial geology is composed of Raised Marine Deposits, Beach and Tidal Flat Deposits and River Terrace Deposits which provide full coverage to the Lambeth Group, London Clay Formation and Bognor Sand Member bedrock geologies.

Hydrogeology

19.5.2.33. The Lambeth Group, Bognor Sand Member and River Terrace Deposits are classified as Secondary A Aquifers by the EA. The Raised Marine Deposits and Beach and Tidal Flat Deposits are classified as Secondary Undifferentiated aquifers by the EA.

19.5.2.34. The EA Groundwater Flood Susceptibility Map identifies Section 8 to be susceptible to both clearwater and superficial groundwater flood risk.

Section 9 –Moorings Way to Bransbury Road

Geology

19.5.2.35. The superficial geology is composed of River Terrace Deposits, Raised Marine Deposits and Beach and Tidal Flat Deposits which provide full coverage to the London Clay Formation, Portsmouth Sand Member and Whitecliff Sand Member (undifferentiated) and Wittering Formation bedrock geologies.

Hydrogeology

19.5.2.36. The Portsmouth Sand Member and Whitecliff Sand Member (undifferentiated), Wittering Formation and River Terrace Deposits are classified as Secondary A Aquifers by the EA. The Raised Marine Deposits and Beach and Tidal Flat Deposits are classified as Secondary Undifferentiated Aquifers by the EA

19.5.2.37. The EA Groundwater Flood Susceptibility Map identifies Section 9 to be susceptible to both clearwater and superficial groundwater flood risk.

Section 10 – Eastney (Landfall)

Geology

19.5.2.38. The superficial geology is composed of River Terrace Deposits, Tidal Flat Deposits and Storm Beach Deposits which provide full coverage to the Wittering Formation bedrock geologies.

Hydrogeology

19.5.2.39. The Wittering Formation, River Terrace Deposits and Storm Beach Deposits are classified as Secondary A Aquifers by the EA. The Tidal Flat Deposits are classified as a Secondary Undifferentiated Aquifer by the EA.

19.5.2.40. The EA Groundwater Flood Susceptibility Map identifies Section 10 to be susceptible to both clearwater and superficial groundwater flood risk.

19.5.3. LOCAL CHALK KARST SYSTEM

19.5.3.1. The Chalk of the South Downs contains features indicative of a karst landscape, which are formed through the dissolution of soluble rocks. Karst landscapes developed in the Chalk are often associated with springs that can provide large supplies of water. The Bedhampton and Havant spring complex in Hampshire, where the Proposed Development is located, is one of the best examples of Chalk karst springs in the UK.

19.5.3.2. Karst in the Chalk aquifer of the South Downs is associated with the removal of the overlying Tertiary age geology. Water running off and through the Tertiary deposits is slightly acidic. Chemical weathering of the underlying chalk leads to dissolution along groundwater flow paths. The karst system is, therefore, most 'active' close to the contact between the Chalk aquifer and the overlying Tertiary deposits. With time as the Tertiary deposits are further eroded and retreat (in this case to the south), leaving remnant (older) karst at relatively higher elevations and distant from the Tertiary. Karst becomes less 'active' in the groundwater system with increasing distance from the Tertiary deposits. The BGS (Mourice, 2012) has identified three Karst Zones that describe this process (Figure 19.1):

- Karst Zone 1 is characterised by frequent stream sinks and dolines associated with the geological boundary between Tertiary (sand and clay) and Cretaceous (chalk) deposits. Stream sinks and dolines are defined as holes in the ground caused by a collapse of a surface layer, i.e. chemical dissolution of carbonate rocks has occurred. Route Sections 2 and 3 are located within a Karst Zone 1.
- Karst Zone 2 is an intermediate area where the Clay with Flints superficial deposits are present. In this zone, dolines and solution pipes are likely to occur but few hydrologically active stream sinks are present, i.e. no flow of water through the system. Route Sections 1 and 2 are located within a Karst Zone 2.
- Karst Zone 3 is where stream sinks are absent and dolines are rare. No part of the Proposed Development falls within Karst Zone 3.

19.5.3.3. Groundwater contours, provided on BGS Hydrogeological Map of Hampshire and the Isle of White (1979) suggest that the general flow direction within the catchment of the springs is from north to south, with focused concentrations of flow down valley features. Dry valleys may develop on permeable rocks such as chalk and, do not hold surface water because it infiltrates into the underlying permeable rocks.

19.5.3.4. Tracer tests are used to determine connections between stream sinks and springs to demonstrate how fast the water moves through the subsurface. Tracer tests have been carried out at five (5 no.) stream sinks located on the White Chalk Subgroup and superficial deposits boundary (Atkinson and Smith, 1974) within Route Section 2 of the Proposed Development. Tracer from four (4 no.) of these stream sinks were detected at both the Bedhampton and Havant Springs, demonstrating rapid groundwater flow of several kilometres per day which are defined in Appendix 19.2 Table 3 (Groundwater Resources Baseline) of the ES Volume 3 (document reference 6.3.19.2).

19.5.3.5. Velocities of kilometres per day are extremely high for groundwater and suggest flow through a well-connected system of karstic conduits and fissures extending over distances of many kilometres. The highest velocities were recorded in tests undertaken at Rowlands Castle NGR SU 73317 10662 (10.5 km/day and 12.3 km/day).

19.5.3.6. The tracer tests (Appendix 19.2 (Groundwater Resources Baseline), Table 3) demonstrate the presence of karstic groundwater flow linking the stream sinks along the geological boundary between the Tertiary (sand and clay) and Cretaceous (White Chalk Subgroup) deposits to the Bedhampton and Havant Springs in Section 4 and Section 5.

19.5.4. GROUNDWATER FLOWS AND LEVELS

19.5.4.1. The BGS Hydrogeological Map of Hampshire and the Isle of White (1979), which is also available on the BGS website, provides a regional piezometric map with 50.0 m interval contours on the estimated minimum level water table for the Chalk aquifer and base of the Palaeogene deposits (see Appendix 19.3 (The Hydrogeology of Kings Pond and Denmead Meadow) of the ES Volume 3 (document reference 6.3.19.3)). The water table level for both the Chalk aquifer and base of the Palaeogene varies along the Onshore Cable Corridor from north (Section 2 at Denmead) to south (Section 9 at Portsmouth Harbour).

19.5.4.2. The minimum level water table, as record on the BGS hydrogeological map (1979), for the Palaeogene Deposits is 0.0 mOD within Section 7, Section 8, and the southern-most part of Section 4 at Widley. The latter section marks the Portsdown anticline and it is here that the Bedhampton and Havant spring complex emerges at surface to the east of Section 4 alignment (NGR SU 70454 06460). A minimum level water table at the northern most part of Section 4 (at Soake) is 0.0 mOD.

19.5.4.3. The minimum level water table for the Chalk aquifer, which is present in the southern-most part of Section 4 (at Widley) to Section 7, is 50.0 mOD. The Chalk aquifer outcrops at surface in the southern-most part of Section 4 and it is here that the Bedhampton and Havant spring complex emerges at surface.

WSP Groundwater Level Monitoring

19.5.4.4. The WSP Preliminary Ground Investigation ('GI') works were split into two phases; Phase 1 to investigate the ground conditions in and around the Converter Station Area and Phase 2 to investigate ground conditions along the Onshore Cable Corridor.

19.5.4.5. Prior to the Phase 1 preliminary GI, Portsmouth Water and the EA were consulted to agree the methodology and any mitigation required for all GI works within SPZ1. Given the sensitivity of the SPZ1 GI methods had to be agreed to limit risk of contamination to the underlying Principal Chalk aquifer. All boreholes were limited to 30.0 m depth below ground level ('BGL') and Portsmouth Water did not allow standpipe installation unless shallow ground water was encountered (i.e. less than 10.0 mBGL). Groundwater was not encountered during the Phase 1 GI and therefore no groundwater observation boreholes were installed. Portsmouth Water suggest that groundwater is anticipated to be located between 45.0 mBGL and 60.0 mBGL at the Converter Station Area.

19.5.4.6. The Phase 2 preliminary GI focused on confirming ground conditions along the Onshore Cable Corridor and was undertaken between July and November 2018. The Phase 2 preliminary GI comprised of the following:

- 24 cable percussive boreholes;
- 52 window samples;
- 4 trial pits; and
- 11 groundwater monitoring installations with 12 data loggers.

19.5.4.7. Groundwater observations from the Phase 2 GI (2018), located between Section 2 and Section 10 of the Onshore Cable Corridor, found water levels to be variable along the corridor. Shallow groundwater levels were recorded at 0.47 mOD (0.28 mBGL) in BH16 (Section 7) within the White Chalk Subgroup. The deepest groundwater level was recorded at 1.61 mOD (2.48 mBGL) in BH34 (Section 9) within Tidal Flat Deposits.

19.5.4.8. There are 11 boreholes available for groundwater level monitoring purposes and installation details are summarised in Appendix 19.2 (Groundwater Resources Baseline), Table 3. BH33 has a dual installation for shallow (BH33 s) and deep (BH33 d) strata, River Terrace Deposits and Wittering Formation, respectively. Records of groundwater monitoring to date are summarised in Appendix 19.2 (Groundwater Resources Baseline), Table 4 and 5. The location figure of these boreholes is provided in the Phase 2 GI Report Factual report (Geotechnics Ltd, 2019). The WSP groundwater level monitoring locations are shown on Figure 19.3 of the ES Volume 2 (document reference 6.2.19.3).

19.5.4.9. Continuous groundwater level monitoring commenced on the 27–28 November 2018 and continued until May 2019. The groundwater level data predominantly reflects groundwater levels for winter within the superficial deposits predominantly along Section 6 to Section 10 of the Onshore Cable Corridor. A maximum winter groundwater level of 0.72 mOD was recorded in BH15A (Section 6) and a minimum winter groundwater level of 2.59 mOD was recorded in BH33 D (Section 9).

19.5.4.10. Section 6 and Section 7 fall within the Broom Channel Estuary which is tidally influenced. Groundwater levels recorded in BH36, BH19, BH18, BH16 and BH15A are strongly influenced by the tide (see Appendix 19.2 (Groundwater Resources Baseline)) which suggests that the superficial deposits are in hydraulic continuity with the channel and the tide influences local groundwater levels.

19.5.4.11. The superficial deposits are considered highly sensitive to recharge events which may potentially affect groundwater flow dynamics. These recharge influences, mainly rainfall recharge and tidal influence, are will be reduced during the summer months and increased in the winter months. Generally ground level maximums occur in the winter period and minimums occur in the summer months. Groundwater flow directions will be dependent on recharge areas driving flow, which can be changeable and anthropogenically altered.

Environment Agency Groundwater Level Monitoring

19.5.4.12. The Environment Agency ('EA') have provided groundwater level monitoring data for seven observation boreholes located within the Study Area within Section 1 to Section 4. Six of the observation boreholes are inactive and the data provided by the EA is considered historic and for reference only. The time series for groundwater level monitoring records span between 1967 and 2018. The data records are not continuous but do provide an indication of any changes in groundwater levels within the Study Area. The EA groundwater level monitoring locations are shown on Figure 19.3.

19.5.4.13. Crossways (Section 1), Denmead Nurseries (Section 2) and Portsdown (Section 4) observation boreholes are three key locations within the Study Area that provide groundwater level monitoring data for areas where groundwater receptors are considered highly sensitive, i.e. geological boundaries, groundwater dependent ecosystems and Principal Aquifers.

19.5.4.14. Crossways EA observation borehole is located close to the Converter Station location (Section 1). Manual dips are only recorded for this site for groundwater levels within the Chalk aquifer. A minimum groundwater level of 38.58 mBGL (44.42 mOD) and maximum groundwater level of 30.12 mBGL (52.88 mOD) was recorded. These records confirm that groundwater levels for the Chalk aquifer are at depth.

19.5.4.15. Denmead Nurseries EA observation borehole is located close to Denmead Meadows and Kings Pond (Section 2) which are considered to have a proportion of groundwater dependency. Manual dips are provided for this site for discontinuous groundwater levels within the Chalk aquifer between 1967 and 2002. A maximum groundwater level of 1.03 mBGL (44.9 mOD) and a minimum groundwater level of 16.2 mBGL (29.8 mOD) was recorded.

19.5.4.16. Portsdown EA observation borehole is located in Section 4 close to the geological boundary of the Chalk and Lambeth Group. Manual dips are only recorded for this site between 1994 and 2018. The data identifies a seasonal response in recorded groundwater levels for the time series provided with a maximum groundwater level of 49.5 mBGL (49.5 mOD) and minimum groundwater level of 89.72 mBGL (9.28 mOD) was recorded.

Portsmouth City Council Groundwater Level Monitoring

19.5.4.17. Portsmouth City Council ('PCC') have provided their continuous groundwater monitoring data for five observation boreholes located along the Onshore Cable Corridor within Section 6 to Section 9, the locations of these are shown on Figure 19.3. The groundwater level data reflects groundwater levels for summer and winter months between 2015 and 2018 within the superficial deposits predominantly.

19.5.4.18. A maximum summer groundwater level of 0.50 mBGL (-0.29 mOD) and a maximum winter groundwater level of 0.17 mBGL (0.04 mOD) was recorded in Farlington Marshes observation borehole located in Section 6.

19.5.4.19. Farlington Marshes and Tudor Sailing Club observation boreholes are located close to the Broom Channel Estuary (Section 6 and Section 7 respectively) which is influenced by tide. The groundwater monitoring data provided for this location identifies that local groundwater levels within the superficial deposits are in hydraulic continuity with the channel and the tide influences local groundwater levels.

19.5.4.20. Borehole BH10C is located in the north-east corner of the playing fields just to the south of Section 6. BH10C shows groundwater reach surface and has a lowest elevation recording of 0.53 mBGL.

19.5.4.21. PCC boreholes BH4A, 3Y and 3C are all located in Section 9. BH4, BH3Y and BH3C have recorded a groundwater maximum of 1.59 mBGL, 1.04 mBGL (summer 2018 only), and 1.8 mBGL respectively with groundwater minimums of 2.19 mBGL, 1.29 mBGL and 2.92 mBGL respectively.

19.5.4.22. Borehole BH3C is located just to the north of Section 10. BH3C has recorded a groundwater maximum of 1.8 mBGL and groundwater minimum of 2.92 mBGL.

BGS Borehole Records

19.5.4.23. There are a few areas where groundwater level monitoring data is not available, namely Sections 3, 4, 5 and 8. The BGS stores a database of borehole logs of which can contain groundwater strikes. Groundwater strikes are drilling observations of where groundwater seepage into the cavity occurs. These are not to be confused with rest water levels. Rest groundwater levels are likely to rise above the observed seepage level and therefore groundwater strikes can only provide an indicative groundwater elevation.

19.5.4.24. In Section 3 no nearby BGS boreholes provide information on the Lambeth Group, the majority of boreholes target the below lying Chalk aquifer and therefore no groundwater information is available for the Lambeth Group.

19.5.4.25. There are a number of BGS boreholes located within Bognor Sand Member to the north of Section 4, which is described as a firm Silty Clay with ~7-12 mm laminations of sand (see BGS borehole logs SU61SE148, SU61SE149 and SU61SE31), described as weathered London Clay Formation. Boreholes note this Member to be approximately 1.5 m thick where encountered. Although no groundwater strikes are recorded it is anticipated groundwater flow within this unit will be highly constrained by the high proportions of Clay. Please note that there are no BGS boreholes in the Bognor Sand member to the south of Section 4.

19.5.4.26. There is one sole available borehole to review of the Wittering Formation in Section 3, BGS borehole SU60NE230. The borehole log records Stiff sandy, silty Clay for the majority of layers, with sand units observed from 15-25 mBGL. The lower 5 m of the borehole (installed 20-25 mBGL) was screened and records a rest groundwater level of 15 m BGL. Groundwater flow within the upper 15 m of this unit is anticipated to be highly constrained due to the higher proportions of Clay.

19.5.4.27. Within Section 4 of the Onshore Cable Corridor there are no BGS boreholes founded within the Whitecliff Sand Member. The nearest borehole founded within the Whitecliff Sand Member is located approximately 6.6 km west of the Onshore Cable Corridor. BGS borehole log SU60NW184 shows the Whitecliff Sand Member to be a sandy clayey Silt with occasional gravel layers and is water bearing, with groundwater noted at 1 mBGL at this location at the time of drilling (6 October 1977).

19.5.4.28. It should be noted that the Chalk to the south of Section 4 is described above in relation to the Portsdown EA monitoring borehole.

19.5.4.29. BGS borehole log SU60NE65, located ~470 m east of the alignment at the Section 5 and 6 boundary, is founded within the Chalk and contains both rest water level and pumping test data. The borehole was dipped in June 1938 and recorded a rest water level of 1.5 mBGL. Pump test data shows the borehole can yield 4000 gallons per hour, or 1.8 m^3/per hour, to meet commercial water supply demands. It should be noted that as no hydraulic barriers exist between the Superficial Deposits and the Chalk, it is assumed both the superficial aquifers and bedrock aquifers are in hydraulic continuity.

19.5.4.30. The BGS boreholes founded across the Lambeth Group in Section 8 do not contain groundwater information. The borehole logs record the Lambeth Group as soft silty Clay and therefore any groundwater flow within this unit is anticipated to be highly constrained because of the high proportions of Clay.

19.5.4.31. The BGS boreholes founded across the Bognor Sand Member in Section 8 do not contain groundwater information. The borehole logs record the Bognor Sand Member as 4-5 m thick fine-grained Sand. Ground material permeability in this unit is anticipated to be low-moderate and potentially tidally influenced. Please note as no hydraulic barriers exist between the Superficial Deposits and the Bognor Sand Member, it is assumed both the superficial aquifers and bedrock aquifers are in hydraulic continuity.

19.5.4.32. The remaining areas have groundwater level monitoring completed either via the EA, PCC, or WSP and the results of these are commented on above in Paragraphs 19.5.4.4 to 19.5.4.22.

19.5.5. GROUNDWATER QUALITY

19.5.5.1. Under the WFD, the EA has determined that Section 1 lies within the 'East Hants Chalk' Groundwater Waterbody (waterbody ID GB40701G502700). This has been assessed and assigned a 'Poor' status for both quantitative and chemical classifications based on the 2016 dataset. The main pressures that are resulting in a less than good status are from agricultural and rural land management and the water industry (groundwater abstraction). The groundwater waterbody is linked to protected areas under the Nitrates and Drinking Water Directives and the Safeguard Zone Directive for the Bedhampton and Havant spring complex. The location of the waterbody is shown on Figure 19.4 of the ES Volume 2 (document reference 6.2.19.4).

19.5.5.2. No site-specific groundwater water quality data are available for Section 1.

19.5.5.3. Under the WFD, the EA has determined that Section 2 and Section 3 of the Onshore Cable Corridor lies within the 'East Hants Lambeth Group' Groundwater Waterbody (waterbody ID GB40702G500800), classified as holding a 'Poor' quantitative status and 'Good' chemical status classifications based on the 2016 dataset. The main pressures are classified 'no sector responsible', which applies where the pressure (and reason for status) is not related to the activities of a particular sector. The groundwater waterbody is linked to protected areas under the EU Nitrates Directive (1991) and Drinking Water Directives (98/83/EC). The location of the waterbody is shown on Figure 19.4.

19.5.5.4. Under the WFD, the EA has determined that the southernmost part of Section 4 (Portsdown Hill Road) to Section 7 lies within the 'East Hants Chalk' Groundwater Waterbody (waterbody ID GB40701G502700), classified as holding a 'Poor' status for both quantitative and chemical classifications based on the 2016 dataset. The main pressures are either from agricultural and rural land management and the water industry (groundwater abstraction). The groundwater waterbody is linked to protected areas under the Nitrates and Drinking Water Directives and the Safeguard Zone Directive for the Bedhampton and Havant spring complex. The location of the waterbody is shown on Figure 19.4.

19.5.5.5. Under the WFD, the EA has determined that the southernmost part of Section 4 (at Widley), Section 8 and the southernmost part of Section 7 (Airport Service Road) lie within the 'South Hants Lambeth Group' Groundwater Waterbody (waterbody ID GB40702G503700), classified as holding both 'Good' quantitative and chemical status classifications based on the 2016 dataset. The groundwater waterbody is linked to protected areas under the Nitrates and Drinking Water Directives. The location of the waterbody is shown on Figure 19.4.

19.5.5.6. Under the WFD, the EA has determined that Section 9 lies within the 'South East Hants Bracklesham Group' Groundwater Waterbody (waterbody ID GB40702G503000), classified as having 'Good' qualitative and 'Poor' chemical status classifications based on the 2016 dataset. The main pressures are from landfill leaching. The groundwater waterbody is linked to protected areas under the Drinking Water Directive. The location of the waterbody is shown on Figure 19.4.

19.5.5.7. Under the WFD, the EA has determined that Section 10 lies within the 'South East Hants Bracklesham Group' Groundwater Waterbody (waterbody ID GB40702G503000), classified as having 'Good' qualitative and 'Poor' chemical status classifications based on the 2016 dataset. The main pressures are from landfill leaching. The groundwater waterbody is linked to protected areas under the Drinking Water Directive. The location of the waterbody is shown on Figure 19.4.

19.5.5.8. Groundwater sampling and testing was undertaken as part of the Phase 2 ground investigation and results are discussed in detail in Chapter 18 (Ground Conditions).

19.5.5.9. Appendix 19.2 (Groundwater Resources Baseline), Table 6 summarises the results of groundwater water quality along the entire Onshore Cable Corridor for 2018. The results are based on a groundwater quality campaign carried out on eleven (11 no.) boreholes in 2018 and, represent the latest data available. The monitoring campaign is ongoing along the entire Onshore Cable Corridor (Sections 2 to Section 9).

19.5.5.10. Groundwater water quality results are screened against UK Drinking Water Standards ('DWS') and exceedances are highlighted in Appendix 19.2 (Groundwater Resources Baseline) Table 6.

19.5.5.11. Exceedances in the UK DWS for chloride and sulphate (as SO4) is expected in coastal environments. High concentrations of chloride are also positively correlated to high conductivity levels within the boreholes which are located in a coastal environment.

Groundwater Dependent Terrestrial Ecosystems

19.5.5.12. Two potential Groundwater Dependent Terrestrial Ecosystems ('GDTEs') have been identified in Section 3 and are described below.

19.5.5.13. Kings Pond (NGR SU 66732 11781) is a Priority Lowlands Meadow Habitat and a Site of Importance for Nature Conservation ('SINC'). The area is known to be inundated during winter and a network of ephemeral surface water bodies are present. The hydraulic relationship between Kings Pond and groundwater in underlying aquifers and the groundwater dependency of the surrounding habitat is described in Appendix 19.3 (The Hydrogeology of Kings Pond and Denmead Meadow). Groundwater is likely providing flow to this feature during the winter months, when groundwater is at its highest, but not the summer months when groundwater recedes. During a site visit completed 9 July 2019 the Kings Pond was observed to be dry with desecration cracks on the pond base.

19.5.5.14. The hydraulic relationship between Denmead Meadow and groundwater in underlying aquifers and the groundwater dependency of the surrounding habitat is not known, however, as a precautionary measure it has been assumed that groundwater discharge provides a contributory source of water to this feature.

19.5.5.15. Following a precautionary approach, Kings Pond and Denmead Meadow have also been considered as GWDTEs and therefore, considered to have a High sensitivity. Chapter 16 (Onshore Ecology) should be referred to for site-specific details and any assessment of the potential ecological effects associated with the site.

19.5.5.16. No other groundwater Dependent Terrestrial Ecosystems are known.

Groundwater Vulnerability

19.5.5.17. Section 1 falls within Major Aquifer High and Major Aquifer Intermediate groundwater vulnerability zones, which are defined as a Principal Aquifer with no retarding overburden. Any at surface pollution will freely percolate into the aquifer. Section 1 is located within a eutrophic water and groundwater Nitrate Vulnerable Zone ('NVZ') as specified by the EA (2018). This identifies a risk from agricultural nitrate pollution.

19.5.5.18. Section 2 falls within a Major Aquifer Intermediate groundwater vulnerability zone and is located within a groundwater and eutrophic water NVZ, as specified by the EA (2018). This identifies a risk from agricultural nitrate pollution in the area. Eutrophic water NVZ are defined within the Nitrates Directive if they have elevated nitrate concentrations and are eutrophic.

19.5.5.19. The majority of Section 3 falls within a Minor Aquifer Low groundwater vulnerability zone. The northernmost section of Section 3 (at Anmore Road) falls within a Major Aquifer Intermediate groundwater vulnerability zone and is also located within a groundwater NVZ. The entire section is located within a eutrophic water NVZ and identifies a risk from agricultural nitrate pollution.

19.5.5.20. Section 4 (along the B2150 to the southernmost part of the section) falls within a Minor Aquifer High groundwater vulnerability zone and is located within a eutrophic water NVZ. The southernmost part of the section (at Widley along the B2177) is located within a groundwater and eutrophic water NVZ.

19.5.5.21. The southernmost section of Section 4 (at Widley along the B2177) to Section 8 fall within a Major Aquifer High groundwater vulnerability zone. The major aquifers include the White Chalk Subgroup, specifically the Lewes Nodular Chalk, Seaford Chalk, Newhaven Chalk, Culver Chalk and Portsdown Chalk Formations, which are highly permeable formations and able to easily transmit pollution to groundwater.

19.5.5.22. Sections 4 to Section 9 are located within a eutrophic water NVZ.

19.5.5.23. Section 9 falls within a Minor Aquifer High groundwater vulnerability zone.

19.5.5.24. Section 10 falls within a Minor Aquifer High groundwater vulnerability zone and is located within a eutrophic water NVZ, which identifies that there is a risk from agricultural nitrates pollution in the area.

Groundwater Abstractions

19.5.5.25. There are a number of private water supply and licensed groundwater abstractions within the search area. The search area for groundwater users extends 5 km to the east, south and west of the Converter Station Area and 1 km to the north of the Converter Station. For the Onshore Cable Corridor, a 1 km search radius has been used.

19.5.5.26. Private water supply groundwater abstractions are presented in Table 19.5 and licenced abstraction are presented in Table 19.6 below. These tables present the approximate distance and orientation of the abstractions in relation to the Onshore Cable Corridor.

Table 19.5 – Private Water Supplies

Supply	Reference Number	Source	Approx. Distance (km)	Orientation from Proposed Development
Stoneacre	33.2/P1	GW	0.32	West of Section 2
Sheepwash Farm	33.3/P1	Unknown	1.67	South West of Section 4
Purbrook Heath House	33.4/P1	GW	0.95	West of Section 4
Russels Farm	33.6/P3	Unknown	4.46	West Northwest of Section 1
Spitbank Fort	35/P1	GW	3.4	South West of Section 3

Table 19.6 – Licensed Groundwater Abstractions

Licence Number	Licence Holder Name	USE	Approx. Distance (km)	Orientation from Proposed Development
11/42/33.1/1	Portsmouth Water Ltd	Potable Water Supply - Direct	0.24	East of Section 1
11/42/33.1/1	Portsmouth Water Ltd	Potable Water Supply - Direct	0.24	East of Section 1
11/42/33.2/3	Not provided (deregulated i.e. abstracts less than 20m^3 per day)	General Farming & Domestic	0.12	West of Section 2
11/42/33.6/10	Portsmouth Water Ltd	Potable Water Supply - Direct	4.7	West of Section 3
11/42/33.6/10	Portsmouth Water Ltd	Potable Water Supply - Direct	4.7	West of Section 3
11/42/33.6/10	Portsmouth Water Ltd	Potable Water Supply - Direct	4.7	West of Section 3
28/032	Sale	Golf Course Spray Irrigation - Direct	0.7	South West of Section 3
11/42/36.1/3 CA	Borrow Investments Ltd	Agriculture Spray Irrigation - Direct	3.4	North East of Section 4
11/42/33.5/23	Southwick Park Naval Recreational Centre Management Committe	Golf Course Spray Irrigation - Direct	4	West of Section 4

19.5.5.27. Table 19.5 summarises the private abstraction (private water supplies) located within the 5 km buffer zone. The majority of the private licenced supplies are located to the west of the Onshore Cable Corridor. Two private abstraction wells are located within 1 km of the Onshore Cable Corridor. Three out of the five licenced abstractions in the area have been confirmed to be supplied by groundwater sources, the closest of which is Private Water Supply 33.2/P1 which is located on Head deposit overlaying the Chalk 0.32 km to the west of the Onshore Cable Corridor, Section 2. Private water supply 33.6/P3 is located on unconfined Chalk and the remaining private water supplies have been drilled through alternative bedrock geologies before reaching the below lying Chalk.

19.5.5.28. Five licenced abstraction located within a 5 km buffer zone of the Proposed Development are operated by Portsmouth Water Limited, as shown in Table 19.6. Two groundwater abstractions are located within 0.5 km to the east of the Proposed Development. The remaining three abstractions are located to the 3-4 km west of the Onshore Cable Corridor. The public water supply for Portsmouth Water Ltd. has a maximum daily abstraction above 2,500 m^3. Licenced groundwater abstractions 11/42/33.1/1 and 11/42/33.2/3 are located in Sections 1 and 2 respectively and are founded on unconfined Chalk. The remaining licensed groundwater abstractions have been drilled through alternative bedrock geologies before reaching the below lying Chalk.

19.5.5.29. Abstraction rates and quantities have not yet been made available by the EA. It is assumed all abstractions are founded in and abstract groundwater from the Chalk aquifer.

19.5.6. REGIONAL CONCEPTUAL MODEL

19.5.6.1. The WSP conceptual site model of the Order Limits is based on the geological, hydrogeological and topographical reviewed from onsite and third party listed information. The conceptual site model focuses on the ground conditions, groundwater conditions and groundwater resources located along the Onshore Cable Corridor. This conceptual model provides a generic regional understanding of the hydrogeology of the area.

19.5.6.2. The site topography is dipping to the south towards Portsmouth, from approximately 90m AOD towards the north to approximately 0 m AOD at the coast to the south. The Order Limit area is divided in to valleys which contains multiple interconnected, natural drainage channels which flow approximately north to south.

19.5.6.3. The Proposed Development is located in the Chichester Synform, which folds the Chalk below the Lambeth Group Secondary A aquifers and London Clay Formation aquitard before re-emerging to the south. Chalk groundwater recharge occurring to north will flow below the Lambeth Group and London Clay Formation and re-emerge at the south outcrop. The confined/pressurised groundwater table is referred to as the piezometric surface; the theoretical unconfined water table of the Chalk aquifer. Where overlaying superficial deposits are present, these will transmit groundwaters north to south and towards the Coast.

19.5.6.4. Where the Chalk tucks below the Lambeth Group (near Anmore Road), groundwater emergence has the potential to occur. When the regional Chalk groundwater body recharge is larger than removal groundwater, groundwater rise will occur. In times of high rainfall recharge the groundwater table could be raised above the lowest northern outcrop which can lead to groundwater flooding. Kings Pond, which is considered to have a proportion of groundwater dependency, is located near the Chalk and Lambeth Group contact. During the winter the pond is wet and in the summer the pond is dry, meaning groundwater reaches near surface in this area during the winter months.

19.5.6.5. The Secondary A bedrock aquifers to the centre of the Proposed Development, to the south of the Chalk in the north and north of the Chalk in the south, will be aquifers of finite quantities, as the water bodies are discrete in lateral and vertical extent. Groundwater maybe near surface in the winter, with groundwater drying in the summer months.

19.5.6.6. Permeable superficial deposits are predominantly present in the coastal area and in the wet and dry valleys of the region. Groundwater will be present near surface water features, as these features will either receive water from groundwater or provide water to groundwater (defined as gaining and losing surface water bodies respectively). Where superficial aquifers overlap aquitards, overspill of bedrock groundwater could be received by the superficial aquifers. This may occur between the Chalk units separated by the Lambeth Group, as well as, the Bracklesham Group near the coastal area.

19.5.6.7. Where groundwater is tidally influenced, back-up and emergence could occur as these deposits have finite and limited storage capacity.

19.5.6.8. Where no coastal defences exist at depth, coastal waters and fresh groundwater could mix, creating a mixing zone. Extents of mixing zones are dependent on water densities, hydraulic gradients and structural controls. The extent of the groundwater mixing area is unknown. The combination of groundwater and coastal waters are likely to reduce vadose zone thicknesses and make these areas more prone to combined surface water, coastal water and groundwater flood type events.

19.5.7. FUTURE BASELINE

19.5.7.1. For the future baseline, the WFD groundwater body objectives are assumed to be met.

19.5.7.2. Section 1, and Section 4 to Section 7 are located in the 'East Hants Chalk' (GB40701G502700) groundwater body. The 'East Hants Chalk' (GB40701G502700), which is currently designated a 'Poor' WFD status will be assessed according to future 'Good' WFD status. The EA expect the groundwater waterbody to achieve 'Good' status of all assessment parameters by 2027. Any potential change in status would not affect the sensitivity of the receptor, which will remain a regionally important aquifer irrespective of designation. Based on the current available information no other changes are expected in baseline conditions.

19.5.7.3. Section 2 and Section 3 are located within the 'East Hants Lambeth Group' (GB40702G500800) groundwater waterbody. The waterbody is currently designated a 'Poor' WFD status and will be assessed according to future 'Good' WFD status. The EA expect the groundwater waterbody to achieve 'Good' status of all assessment parameters by 2021 and maintain 'Good' chemical status. Any potential change in status would not affect the sensitivity of the receptor.

19.5.7.4. Section 4 to Section 7 and all of Section 8 are located within the 'South Hants Lambeth Group' (GB40702G503700) groundwater waterbody. The waterbody is currently designated as having a 'Good' WFD status. The EA expect the groundwater waterbody to maintain a 'Good' status for both quantitative and chemical classifications.

19.5.7.5. Sections 9 and 10 are located within in the 'South East Hants Bracklesham Group' (GB40702G503000) groundwater waterbody. The waterbody is currently designated as 'Poor' WFD status and will be assessed according to future 'Good' status. The EA expect the groundwater waterbody to achieve 'Good' status of all assessment parameters by 2027 and maintain 'Good' quantitative status.

19.5.7.6. Based on the current available information for the entire Onshore Cable Corridor, no other changes are expected in baseline conditions.

19.6. PREDICTED IMPACTS

19.6.1. EMBEDDED MITIGATION MEASURES

19.6.1.1. Embedded mitigation measures include those measures that have already been incorporated into the Proposed Development design to avoid or reduce any likely significant effects. The embedded mitigation measures included in the assessment are summarised below.

Converter Station Construction Embedded Mitigation Measures

19.6.1.2. The construction design includes grouting of the surface karst at the Converter Station site prior to any earthwork movements, removing the primary pathway to underlying Chalk aquifer. The mitigation measures to complete this are outlined in Appendix 3.6 Surface Water Drainage and Aquifer Contamination Mitigation Strategy. This applies to Section 1.

Trenching Embedded Mitigation Measures

19.6.1.3. It is expected that the installation rate for cable ducts for one circuit will be approximately 18 m – 30 m per day and typically in 100 m sections, within urban areas and approximately 50 m per day in open countryside. Any groundwater or rainwater that collects in a trench will be pumped into locations agreed with the landowners, local authorities, EA or drain operators (Portsmouth Water and Highways Authorities). The method of water discharge has yet to be determined.

19.6.1.4. The water management permitting, licenses and agreements will be completed by the appointed contractor, with the quantities of groundwater management determined at the detailed design stage. This applies to all sections. The groundwater collected will either be discharged to surface water, sewer, disposed of off-site or a combination of these three methods. This applies to all sections.

19.6.1.5. If the water is to be discharged to sewer or a surface waterbody then a discharge consent(s) may be required. The permitting process will be completed by the contractor, after detailed design, once a dewatering and discharge management methodology has been agreed upon. This applies to all sections.

19.6.1.6. Should groundwater dewatering be substantial (greater than or equal to 20m^3/day) an abstraction licence and discharge consent will be required from the EA. At present the requirement for a groundwater abstraction for trench installation is unknown, the quantities of groundwater removal will be determined at detailed design stage. The contractor will be responsible for acquiring the relevant consents and adhering to the conditions of said consents. All groundwater abstraction licensing and discharge permits will not be disapplied but obtained during the detailed Design Stage, as agreed upon with the EA during the consultation meeting held on 23 July 2019. This applies to all sections.

19.6.1.7. Trenching in Section 2 and Section 3, in the vicinity of the Kings Pond and Denmead Meadows, will avoid the wet winter season. The trenches will be installed at end of the summer to ensure groundwater is at its lowest elevation. If the trenches were to be installed during the peak winter months, groundwater dewatering would likely be required, and this could potentially impact upon Kings Pond which is considered to have a proportion of groundwater dependency. This applies to Sections 2 and 3.

19.6.1.8. The required groundwater dewatering quantities for trench construction will be determined at detailed design. The designer must ensure the discharge quantities are accurate or conservative to ensure no flood risk should be increased due to surplus groundwater encountered during construction. This applies to all sections.

HDD Groundwater Level and Flow Embedded Mitigation Measures

19.6.1.9. To ensure drilling fluids do not break out into the groundwater environment nor groundwater seeps into the bore, a mud engineer will be present at all times during the HDD drilling process to monitor drilling fluid viscosity, density, annual pressure, solids contents, filter cake quality and total mud volume and thereby ensuring the filter cake remains intact and that drilling fluid is not lost to the ground and that groundwater does not seep into the bore annulus.

19.6.1.10. Drilling fluid losses to groundwater can occur in high permeability ground materials. Where these conditions are to be encountered the drilling contractors will need to monitor the fluid pressures and observe for pressure drops. When a significant pressure drop occurs, losses maybe occurring. To stop drilling fluid loss a number of actions can be taken to seal the area of loss, for example increasing the drilling fluid viscosity or introducing a cement grout. Real time downhole annular pressure monitoring should be completed to allow for these observations. No HDD works are proposed in karstic chalk to the north of the Proposed Development.

19.6.1.11. If any fluid loss occurs works will halt immediately to allow drilling fluid reconfiguration.

19.6.1.12. HDD-5 (near Kings Pond) will be installed within the Lambeth Group geology to avoid the Chalk. This will therefore ensure the HDD alignment avoids the Chalk karst features. Karst features can be present in ground materials overlying the Chalk and if any voided overburden is encountered, drilling fluid control measures will be implemented to prevent drilling fluid losses. The contractor will ensure that when drilling HDD-5 there will be at least a 5m standoff between the proposed HDD alignment and the Chalk at all times.

19.6.1.13. The launch and receptor pits for the HDD-4 (Farlington Railway Crossing (Trenchless)) will include perimeter sheet piled walls toed into the Chalk to reduce groundwater ingress from the superficial River Terrace Deposits. Groundwater seepage at the base of the pits could occur and this will be sump pumped during operation. The potential consents and permits required to manage this water will be completed by the contractor. The method of discharge has yet to be determined. The groundwater collected will either be discharged to surface water, sewer, disposed off site or a combination of these three methods. If the water is to be discharged to sewer or a surface waterbody then a discharge consent(s) may be required. The permitting process will be completed by the contractor, after detailed design, once a dewatering and discharge management methodology has been agreed upon. The contractor will be responsible for acquiring the relevant consents and adhering to the conditions of said consents. Any contaminated water would require off-site disposal.

19.6.1.14. The required groundwater dewatering quantities for HDD-4 pits will be determined at detailed design. The designer must ensure the discharge quantities are accurate or conservative to ensure no flood risk should be increased due to surplus groundwater encountered during construction.

HDD Groundwater Quality Mitigation Measures

19.6.1.15. All drilling equipment will be checked and cleaned before use. This will prevent cross contamination. A review of the drilling fluid and inert polymers will also be completed before ground is broken. All drilling fluids, including polymers, will be Cefas rated.

19.6.1.16. Drilling through alternative geologies can transfer existing contamination from one source to another. Drilling can also generate fines which can increase sediment in the water column, creating turbidity contamination. The Filter Cake (see Paragraph 19.6.6.1) will prevent the mobilisation of contaminants from one groundwater body to another, as the cake 'self-seals' as the drilling progresses. Therefore, no cross contamination is anticipated. Following the embedded mitigation measures the drilling fines and fluids will be contained in the drilling cake, preventing contamination from spreading between sources and drilling fines entering the local groundwater receptors.

19.6.1.17. As HDD-6 penetrates the Milton Common (Section 8), landfill and associated leachates will be 'locked in place' by the drilling mud, as outlined in paragraph 19.6.7.4 and therefore no leachate disturbance is anticipated. Chapter 18 – Ground Conditions also describes impacts related to workings in Milton Common and should be read in conjunction with this Chapter.

19.6.1.18. To ensure surface breakout is not lost to the environment a flexible hose pump will be contained at the exit compound site so breakout fluid can be retained on site. A sufficiently sized Intermediate Bulk Container or similar will be stored on site to store such a breakout.

19.6.2. CONVERTER STATION GROUNDWATER QUANTITY IMPACTS

19.6.2.1. The Proposed Development directly overlays and will directly interact with the Tarrant Chalk Member bedrock aquifer, which is designated a Principal Aquifer and is therefore assessed to have a **High** sensitivity. Groundwater users/abstractors of the Chalk aquifer are also assessed to have a **High** sensitivity.

19.6.2.2. The superficial head deposit aquifer is also present in this Section and is designated as a Secondary undifferentiated aquifer by the EA. Secondary undifferentiated aquifers are composed of low permeability material and any potential effect is likely to be highly constrained both spatially and vertically (with depth). Therefore, the Head deposit aquifer is assessed to have a **Low** sensitivity.

Construction (and Decommissioning) Stage

19.6.2.3. Based on the initial water strikes recorded (during drilling) in Phase 1 of the ground investigation (2018), it is assumed that no groundwater control measures (i.e. dewatering the Chalk aquifer) will be required at the Converter Station Area. A **no change** magnitude of impact is therefore assigned to the Head (**Low** sensitivity), chalk (**High** sensitivity) and groundwater users/abstractors (**High** sensitivity). A **Negligible** significance of effect is assigned. This is not considered a significant environmental impact.

Operational Stage (including repair and maintenance)

19.6.2.4. As per Section 19.3.3 Converter Station operational impacts have been scoped out of this assessment.

19.6.3. CONVERTER STATION GROUNDWATER QUALITY IMPACTS

Construction (and Decommissioning) Stage

19.6.3.1. During the site preparation, earthworks and construction works, it will be necessary to store construction materials at the Converter Station site along with other materials such as oils and fuels, and potential limited quantities of other chemicals. It may also be necessary to store some limited quantities of other chemicals. When unmanaged, there is a risk to groundwater posed by leakage or spillage of such chemicals.

19.6.3.2. During the construction of the Converter Station, contamination from mobilised suspended solids (turbidity) through site runoff is generally the prime concern, but spillage of fuels from machinery, lubricants, hydraulic fluids and cement from construction plant may lead to a potential contamination risk to groundwater and associated groundwater abstractions.

19.6.3.3. Contaminated surface water run off or accidental fuel or chemical spills on the Proposed Development during site preparation, earthworks and construction works has the potential to impact groundwater via infiltration migration to the underlying groundwater aquifers.

19.6.3.4. The movement of plant and machinery has the potential to damage soil stability, e.g. creating waterlogged conditions during wet weather and generating dust during dry periods. This, as well as, the stockpiling of spoil and other construction materials, has the potential to increase sediment in surface water runoff on-site which will infiltrate to ground and potentially impact groundwater receptors. Such plant movements can be expected across the site but can be controlled using designated haulage routes and tracks by construction vehicles.

19.6.3.5. Two surface karst features are located within the Converter Station Area; one in an area of cutting and the second in an area of embankment. Karst conduits can transmit groundwater rapidly meaning that any pollution incident at the Converter Station Area could be far reaching. The embedded construction design includes for grouting of the Karst features prior to any earthwork movements, blocking the primary pathway for contamination release to the Chalk aquifer. Please see Appendix 3.6 Aquifer Contamination Mitigation Strategy for further detail on karst grouting.

19.6.3.6. Following this construction design mitigation measures, it is anticipated that there will be a **Negligible** magnitude impact to the Chalk, Water Users (**High** sensitivities) and Head Deposit (**Low** sensitivity) aquifers, resulting in a **Negligible** significance of effect for the aquifers. This is not considered an environmental significant impact.

Operational Stage (including repair and maintenance)

19.6.3.7. As per Section 19.3.3 Converter Station operational impacts have been scoped out of this assessment.

19.6.4. TRENCHED ONSHORE CABLE CORRIDOR GROUNDWATER QUANTITY IMPACTS

19.6.4.1. The Onshore Cable Route will be constructed in part via trenching. This will require excavating approximately 1.1 m - 1.3 m below the ground surface. The construction process will require mechanical excavation of ground materials. The cable ducts will be installed in a 400 mm deep cement bound sand at the bottom of the trench, the excavation will then be back filled with native ground materials/soil backfill.

Construction (and Decommissioning) Stage

Section 1 – Lovedean (Converter Station Area)

19.6.4.2. The Proposed Development in Section 1 directly overlays and will directly interact with the Tarrant Chalk Member bedrock aquifer, which is designated a Principal Aquifer and is therefore assessed to have a **High** sensitivity. Groundwater users/abstractors of the Chalk aquifer are also assessed to have a **High** sensitivity.

19.6.4.3. Additionally, interactions with the superficial aquifers that are designated Secondary undifferentiated aquifers, are composed of low permeability material and any potential effect is likely to be highly constrained both spatially and vertically (with depth). The superficial Head Deposits are deemed to have a **Low** sensitivity.

19.6.4.4. The trenches could intercept perched groundwater in the superficial Head Deposits aquifer, which would require sump pump dewatering to mitigate trench flooding, however, this is not anticipated based on local topography and local groundwater conditions (see groundwater baseline section above). Where groundwater interceptions occur, seepages will likely be in small finite quantities and a **negligible** magnitude of change is expected. The excavations proposed in the Chalk bedrock aquifer are not anticipated to intercept groundwater and **Negligible** is expected to the Chalk aquifer and associated water users.

19.6.4.5. It is anticipated that there will be a no quantity impact to either the superficial Head Deposit aquifer (**Low** sensitivity), Chalk aquifer and water users (**High** sensitivities) for the cable installations and a **Negligible** significance of effect is assigned on this basis. This is not considered a significant environmental impact.

Section 2 - Anmore

19.6.4.6. The Proposed Development directly overlays and will directly interact with the bedrock Tarrant Chalk Member aquifer, which is designated a Principal Aquifer and is therefore assessed to have a **High** sensitivity. Groundwater users/abstractors of the Chalk aquifer are also assessed to have a **High** sensitivity. The head deposits are designated as a Secondary undifferentiated aquifer which has been assessed to have a **Low** sensitivity.

19.6.4.7. The Proposed Development in Section 2 is located in an area designated by the EA as susceptible to superficial groundwater flooding (Section 19.5.2.21).

19.6.4.8. The trenches could intercept groundwater in the superficial Head Deposits (**Low** sensitivity) aquifer, which would require sump pump dewatering to mitigate trench flooding, however, this is not anticipated. Where groundwater interceptions occur, seepages will likely be in small finite quantities and only a **negligible** magnitude of change is expected. The excavations proposed in the Chalk bedrock are not anticipated to intercept groundwater and **Negligible** to the Chalk aquifer or local water users (**High** sensitivities) is expected. On this basis, a **Negligible** significance of effect is assigned. This is not considered to be significant.

Section 3 – Denmead/Kings Pond Meadow

19.6.4.9. The Proposed Development directly overlays and will directly interact with the bedrock Lambeth Group aquifer, which is designated a Secondary A Aquifer and is therefore assessed to have a **Medium** sensitivity. There are no known groundwater users/abstractors of the Lambeth Group.

19.6.4.10. Towards the South the London Clay Formation is present, this is an aquitard (unproductive aquifer) and does not transmit groundwater.

19.6.4.11. Additionally, interactions with the superficial aquifers, designated Secondary (undifferentiated), are composed of low permeability material and any potential effect is likely to be highly constrained both spatially and vertically (with depth). The superficial Head Deposits are deemed to have a **Low** sensitivity.

19.6.4.12. The trenches could intercept groundwater in the Lambeth Group and superficial Head Deposits aquifers, which would require sump pump dewatering to mitigate trench flooding, however, this is not anticipated. Where groundwater interceptions occur, seepages will likely be in small finite quantities and only a **Negligible** magnitude of change is expected.

19.6.4.13. It is anticipated that there will be a no quantity impact to either the Lambeth Group (Medium sensitivity) and superficial Head Deposit (Low sensitivity) aquifers for the cable installations and a **Negligible** significance of effect is assigned on this basis. This is not considered to be significant.

Section 4 – Hambledon Road to Farlington Avenue

19.6.4.14. The Portsdown Chalk Formation, Spetisbury Chalk Member, Tarrant Chalk Member and the Newhaven Chalk Formation are classified as Principal Aquifers by the EA and considered to have a **High** sensitivity. The Bognor Sand Member, Wittering Formation and Lambeth Group are classified as a Secondary A Aquifers by the EA and are considered to have a **Medium** sensitivity. The superficial Head Deposits are classified as a Secondary Undifferentiated aquifer by the EA and considered to have a **Low** sensitivity.

19.6.4.15. The London Clay Formation is also present in this section and is classified as an aquitard (unproductive aquifer) and does not transmit groundwater.

19.6.4.16. The Proposed Development in Section 4 is located in an area designated by the EA as susceptible to superficial and clearwater groundwater flooding (see Paragraph 19.5.2.21).

19.6.4.17. The trenches are likely to intercept groundwater in the Bognor Sand Member, Wittering Formation, and Lambeth Group aquifers (**Medium** sensitivities) during the winter or following periods of rainfall, which would require sump pump dewatering to mitigate trench flooding. Where groundwater interceptions occur, seepages will likely be in small finite quantities and create a **Minor** magnitude of change is expected. It is anticipated that there will be a **Minor Adverse** quantity impact to the Bognor Sand Member, Wittering Formation, and Lambeth Group aquifers for the cable installations. This is not considered to be significant.

19.6.4.18. The excavations proposed in the Portsdown Chalk Formation, Spetisbury Chalk Member, Tarrant Chalk Member and Newhaven Chalk Formations bedrock are located in areas susceptible to groundwater flooding, as defined by the EA.

19.6.4.19. No site-specific groundwater level monitoring data is available.

19.6.4.20. Third party ground investigation and groundwater level monitoring data is not available or relevant for this assessment.

19.6.4.21. Excavations proposed in the Portsdown Chalk Formation, Spetisbury Chalk Member, Tarrant Chalk Member and Newhaven Chalk Formations (**High** sensitivities) may require sump pump dewatering should groundwater be proven within 1.3 m of surface, it is assumed groundwater dewatering will be required as worst-case scenario. It is therefore assessed that the dewatering impact to the Principal Chalk aquifers would be **Minor**, resulting in a **Moderate Adverse** significance of effect for the aquifers. This is considered to be significant.

19.6.4.22. The trenches could intercept groundwater in the superficial Head Deposits aquifer (**Low** sensitivity), which would require sump pump dewatering to mitigate trench flooding however, this is not anticipated. Where groundwater interceptions occur, seepages will likely be in small finite quantities and only a **Negligible** magnitude of change is expected, resulting In a **Negligible** significance of effect for the superficial Head Deposits aquifer for the cable installations at this location. This is not considered to be significant.

Section 5 - Farlington

19.6.4.23. The Newhaven Chalk Formation and the Undifferentiated Chalk to the south are classified as Principal Aquifers by the EA and considered to have a **High** sensitivity. The superficial River Terrace Deposits are classified as Secondary A aquifers by the EA and considered to have a **Medium** sensitivity. The superficial Head Deposits are classified as Secondary Undifferentiated aquifer by the EA and considered to have a **Low** sensitivity.

19.6.4.24. The Proposed Development in Section 5 is located in an area designated by the EA as susceptible to clearwater groundwater flooding (Section 19.5.2.32).

19.6.4.25. The trenches could intercept groundwater in the superficial Head Deposits aquifer (**Low** sensitivity), which would require sump pump dewatering to mitigate trench flooding however, this is not anticipated. Where groundwater interceptions occur, seepages will likely be in small finite quantities and only a **Negligible** magnitude of change is expected, resulting In a **Negligible** significance of effect for the superficial Head Deposits aquifer for the cable installations at this location. This is not considered to be significant.

19.6.4.26. The excavations proposed in the superficial River Terrace Deposits, Newhaven Chalk Formation and the Undifferentiated Chalk are located in areas susceptible to groundwater flooding, as defined by the EA (Paragraph 19.5.2.22). Third party ground investigation and groundwater level monitoring data is sparse, however, BGS borehole log SU60NE65 located in the same topographic and geographic area as the excavation areas records Chalk rest groundwater levels at 1.5 m. The borehole was drilled in February 1941 however, this is the most recent dataset available.

19.6.4.27. Due to the size of the trenching, trenching construction timeframes, and included embedded mitigation measures, it is anticipated that there will be a **Minor** magnitude impact to superficial River Terrace Deposits aquifer for the trench construction, resulting in a **Minor Adverse** significance of effect. This is not considered a significant environmental impact.

19.6.4.28. Excavations proposed in the superficial Newhaven Chalk Formation and the Undifferentiated Chalk aquifers may require sump pump dewatering should groundwater be proven within 1.3 m of surface. There is potential to intercept groundwater at this location, which will require groundwater dewatering and a **Minor** magnitude of change is expected, resulting in a **Moderate Adverse** significance of effect for the Chalk Aquifers. This is considered to be significant.

Section 6 – Zetland Field and Sainsbury's Car Park

19.6.4.29. The Undifferentiated Chalk is designated a Principal Aquifer by the EA and considered to have a **High** sensitivity. The superficial River Terrace Deposits are classified as Secondary A aquifers by the EA and considered to have a **Medium** sensitivity. The Raised Marine Deposits are classified as Secondary Undifferentiated aquifers by the EA and considered to have a **Low** sensitivity.

19.6.4.30. The Proposed Development in Section 6 is located in an area designated by the EA as susceptible to clearwater groundwater flooding (Section 19.5.2.21).

19.6.4.31. The trenches could intercept groundwater in the Raised Marine Deposits aquifer, which would require sump pump dewatering to mitigate trench flooding, however, this is not anticipated. Where groundwater interceptions occur, seepages will likely be in small finite quantities and a **Negligible** magnitude of change is expected. It is anticipated that there will be a **Negligible** quantity impact to the Raised Marine Deposits aquifer for the cable installations. This is not considered to be significant.

19.6.4.32. Portsmouth City Council provided their continuous groundwater monitoring data for review. BH10C is located in the north east corner of the playing fields, to the south of Section 6. BH10C shows groundwater reach surface and has a lowest elevation recording of 0.53 mBGL. Groundwater will therefore be intercepted by the proposed trenches.

19.6.4.33. Groundwater dewatering will be required for a short period, given the length of time the proposed trenches are to remain open, and therefore the quantity of groundwater dewatering is not anticipated to be significant.

19.6.4.34. It is anticipated that there will be a **Minor** magnitude impact to superficial River Terrace Deposits aquifer for the trench construction, resulting in a **Minor Adverse** significance of effect. This is not considered a significant environmental impact.

19.6.4.35. Excavations proposed in the superficial Newhaven Chalk Formation and the Undifferentiated Chalk will require groundwater dewatering and a **Minor** magnitude of change is expected, resulting in a **Moderate Adverse** significance of effect for the Chalk Aquifers. This is considered to be significant.

Section 7 – Farlington Junction to Airport Service Road

19.6.4.36. The Undifferentiated Chalk is classified as Principal Aquifer by the EA and considered to have a **High** sensitivity. The superficial River Terrace Deposits are classified as Secondary A aquifers by the EA and considered to have a **Medium** sensitivity. The Raised Marine Deposits and Beach and Tidal Flats Deposits are classified as a Secondary Undifferentiated aquifer by the EA and considered to have a **Low** sensitivity.

19.6.4.37. The Proposed Development may increase groundwater flooding risk where the EA has identified that Section 7 is susceptible to superficial and clearwater groundwater flooding (Section 19.5.2.38).

19.6.4.38. The trenches could intercept groundwater in the Raised Marine Deposits and Beach and Tidal Flats Deposits aquifers, which would require sump pump dewatering to mitigate trench flooding. Where groundwater interceptions occur, seepages will likely be in small finite quantities because of the likely low-moderate permeabilities of the geologies and relatively shallow depth of trench installation. A **Negligible** magnitude of change is expected from sump-pump dewatering. It is anticipated that there will be a **Negligible** quantity impact to the Raised Marine Deposits and Beach and Tidal Flats Deposits aquifers for the cable installations.

19.6.4.39. Portsmouth City Council provided their continuous groundwater monitoring data for review and BH10C is located in the north-east corner of the St Johns Playing Fields just to the south of Section 6. BH10C shows groundwater reach surface and has a lowest elevation recording of 0.53 mBGL. Groundwater will therefore be intercepted by the proposed trenches. The excavations proposed in the superficial River Terrace Deposits and the below lying Undifferentiated Chalk will therefore likely intercept groundwater meaning trench construction will require groundwater dewatering.

19.6.4.40. Excavations proposed in the superficial River Terrace Deposits aquifers will require sump pump dewatering as groundwater is located within the proposed trench footprint and a **Minor** magnitude of change is expected, resulting in a **Minor Adverse** effect for the aquifers. This is not considered to be significant.

19.6.4.41. Excavations proposed in the Undifferentiated Chalk aquifers will require sump pump dewatering as groundwater is located within the proposed trench footprint and a **Minor** magnitude of change is expected, resulting in a **Moderate Adverse** significance of effect for the aquifers. This is considered to be significant.

Section 8 – Eastern Road (adjacent to Great Salterns Golf Course) to Moorings Way

19.6.4.42. The Bognor Sand Member and River Terrace Deposits are classified as a Secondary A aquifer by the EA and considered to have a **Medium** sensitivity. The Raised Marine Deposits are classified as a Secondary Undifferentiated aquifer by the EA and considered to have a **Low** sensitivity.

19.6.4.43. The London Clay Formation is also present in this section and is classified as an aquitard (unproductive aquifer) and does not transmit groundwater.

19.6.4.44. The Proposed Development may increase groundwater flooding risk where the EA has identified that Section 8 is susceptible to superficial and clearwater groundwater flooding (Section 19.5.2.41).

19.6.4.45. The trenches could intercept groundwater in the Raised Marine Deposits aquifers, which would require sump pump dewatering to mitigate trench flooding. Where groundwater interceptions occur, seepages will likely be in small finite quantities because of the likely low-moderate permeabilities of the geology and relatively shallow depth of trench installation. A **Negligible** magnitude of change is expected from sump-pump dewatering. It is anticipated that there will be a **Negligible** quantity impact to the Raised Marine Deposits aquifers for the cable installations. This is not considered to be significant.

19.6.4.46. Excavations proposed in the Bognor Sand Member and River Terrace Deposits aquifer will require sump pump dewatering as groundwater will likely be located within the proposed trench footprint and a **Minor** magnitude of change is expected, resulting in a **Minor Adverse** effect for the aquifers. This is not considered to be significant.

Section 9 – Moorings Way to Bransbury Road

19.6.4.47. The Proposed Development directly overlays and will directly interact with the superficial River Terrace Deposits, Portsmouth Sand Member and Wittering Formation aquifers, which are designated as Secondary A aquifers and considered to have a **Medium** sensitivity. The Tidal Flat Deposits aquifer is designated as a Secondary undifferentiated aquifer, composed of low permeability material and any potential effect is likely to be highly constrained both spatially and vertically (with depth). The Tidal Flat Deposit aquifer is deemed to have a **Low** sensitivity. There are no known groundwater users/abstractors of these geologies.

19.6.4.48. To the north the London Clay Formation is present, this is an aquitard (unproductive aquifer) and does not transmit groundwater.

19.6.4.49. The Proposed Development may increase groundwater flooding risk where the EA has identified that Section 9 is susceptible to superficial and clearwater groundwater flooding (Section 19.5.2.37).

19.6.4.50. The trenches could intercept groundwater in the Tidal Flats Deposits aquifer, which would require sump pump dewatering to mitigate trench flooding. Where groundwater interceptions occur, seepages will likely be in small finite quantities because of the likely low-moderate permeabilities of the geology and relatively shallow depth of trench installation. A **Negligible** magnitude of change is expected for sump-pump dewatering of the Tidal Flat Deposits. It is anticipated that there will be a **Negligible** quantity impact to the Tidal Flats Deposits aquifer for the cable installations. This is not considered to be significant.

19.6.4.51. PCC provided their continuous groundwater monitoring data for review and BH4A, 3Y and 3C, all located in Section 9. BH4, BH3Y and BH3C have recorded a groundwater maximum of 1.59 mBGL, 1.04 mBGL (summer 2018 only), and 1.8 mBGL respectively with groundwater minimums of 2.19 mBGL, 1.29 mBGL and 2.92 mBGL respectively. Groundwater will therefore be intercepted in areas in close proximity to BH3Y and potentially in areas around BH3C in the southern half of Section 9.

19.6.4.52. Excavations proposed in the superficial River Terrace Deposits, Portsmouth Sand Member and Wittering Formation aquifers will likely require sump pump dewatering as groundwater has been proven 1.3 m of surface. Groundwater dewatering quantities will be confirmed at detailed design stage.

19.6.4.53. The proposed sump pump dewatering for the superficial River Terrace Deposits, Portsmouth Sand Member and Wittering Formation aquifers has been assessed to have a **Minor** magnitude impact, resulting in a **Minor Adverse** significance of effect for the aquifers. This is not considered to be significant.

Section 10 – Eastney (Landfall)

19.6.4.54. The Proposed Development directly overlays and will directly interact with the superficial River Terrace Deposits, Storm Beach Deposits and Wittering Formation aquifers, which are designated as Secondary A aquifers and considered to have a **Medium** sensitivity.

19.6.4.55. The Proposed Development may increase groundwater flooding risk where the EA has identified that Section 10 is susceptible to superficial and clearwater groundwater flooding (Section 19.5.2.40).

19.6.4.56. Portsmouth City Council provided their continuous groundwater monitoring data for review and BH3C, all located just to the north of Section 10. BH3C has recorded a groundwater maximum of 1.8 mBGL and groundwater minimum of 2.92 mBGL. It is anticipated that groundwater will therefore be intercepted towards the south of Section 10.

19.6.4.57. The trenches could intercept groundwater in the Tidal Flats Deposits aquifer, which would require sump pump dewatering to mitigate trench flooding. Where groundwater interceptions occur, seepages will likely be in small finite quantities because of the likely low-moderate permeabilities of the geology and relatively shallow depth of trench installation. A **Negligible** magnitude of change is expected for sump-pump dewatering of the Tidal Flat Deposits. It is anticipated that there will be a **Negligible** quantity impact to the Tidal Flats Deposits aquifer for the cable installations. This is not considered to be significant.

19.6.4.58. The excavations proposed in the superficial River Terrace Deposits, Storm Beach Deposits and Wittering Formation will likely intercept groundwater meaning trench construction will require groundwater dewatering. The detailed Design Stage will consider groundwater seepage rates into the proposed trenches and inform upon whether an abstraction licence and/or a discharge consent will be required.

19.6.4.59. The proposed sump pump dewatering for the River Terrace Deposits, Storm Beach Deposits and Wittering Formation aquifers has been assessed to have a **Minor** magnitude impact, resulting in a **Minor Adverse** significance of effect for the aquifers. This is not considered to be significant.

Operational Stage (including repair and maintenance)

All Sections

19.6.4.60. As per Section 19.3.3 trenched Onshore Cable Corridor quantity operational impacts have been scoped out of this assessment.

19.6.5. TRENCHED ONSHORE CABLE CORRIDOR GROUNDWATER QUALITY IMPACTS

19.6.5.1. The trench construction process will require mechanical excavation of ground materials. This process will loosen sediment which will collect in the bottom of the trench. When the trench is open and rainfall occurs, water will collect in the base of the trench any loose sediment will become entrained in the water, which will percolate through the unsaturated zone to the aquifer. Therefore, there is potential for groundwater turbidity contamination when open trenching. This issue is more prevalent in the wet season, when more frequent rainfall is expected.

19.6.5.2. Contamination could arise from the spillage of fuels from machinery, lubricants, hydraulic fluids and cement from construction plant. As the open trenches provide a direct pathway to groundwater, pollution incidents to groundwater should be considered.

Construction (and Decommissioning) Stage

All Sections

19.6.5.3. Due to the inert ground materials proposed for trench construction and the included embedded mitigation measures, it is anticipated that there will be a **Negligible** magnitude impact for the following aquifers during the trench construction: Chalk (Portsdown Chalk Formation, Spetisbury Chalk Member, Tarrant Chalk Member, Newhaven Chalk Formations, Undifferentiated Chalk) and associated Water Users (**High** sensitivity), Lambeth Group, Bognor Sand Member, Portsmouth Sand Member, Wittering Formation, River Terrace Deposit, Storm Beach Deposits (**Medium** sensitivity), Head Deposit, Raised Marine Deposits and Tidal Flat Deposit (**Low** sensitivity). This is predicated to result in a **Negligible** significance effect for these aquifers which is not considered a significant environmental impact.

Operational Stage (including repair and maintenance)

19.6.5.4. As per Section 19.3.3 trenched Onshore Cable Corridor quality operational impacts have been scoped out of this assessment.

19.6.6. HDD ONSHORE CABLE CORRIDOR GROUNDWATER QUANTITY IMPACTS

19.6.6.1. HDD is a guided borehole drilling technique used to guide drill bits to a desired non-linearly placed destination, often used for the installation of cable and pipeline services. The drilling process includes a drill pit penetrating the ground with drilling fluid circulating around the drill bit to provide lubrication. The drilling fluid is designed to be of a consistency to form an outer solid layer, referred to as a filter cake, whereby the outer surface quickly forms a solid film, trapping the drilling fines within and preventing groundwater ingress or drilling fluid egress.

19.6.6.2. The Onshore Cable Route will be partially constructed via HDD in Sections 3, 6, 7, 8, 9 and 10. The depths and details of these installations are described below.

19.6.6.3. Please note that there are no HDD installations proposed in Sections 1, 2, 4, and 5. Therefore no assessment has been included for these sections

Construction (and Decommissioning) Stage

19.6.6.4. The HDD installations will introduce four <36-inch diameter bentonite based clay tubes into the ground, preventing groundwater ingress or egress. This introduce a small hydraulic barrier to local aquifers.

Section 3 – Denmead/Kings Pond Meadow

19.6.6.5. The Onshore Cable Route will be partially constructed via HDD and this is known as HDD-5 (Kings Pond). To install the HDD an entry compound will be used to launch the drill bit and an exit compound will be used to receive the drill bit. The drilling process will install a bore approximately 12 m below ground surface, founded within the Lambeth Group (**Medium** sensitivity). Below the Lambeth Group is the Chalk aquifer and ground investigation boreholes have been installed which indicate that there is at least a 5 m standoff between the proposed HDD alignment and the Chalk. All works are therefore expected to be confined within the superficial Head Deposits and Lambeth Group.

19.6.6.6. The HDD alignment could intercept groundwater; however, the HDD includes groundwater seepage mitigation measures. Therefore, it is anticipated that there will be a **negligible impact** to either the Lambeth Group or superficial Head Deposit aquifers for the cable installations. This is not considered to be significant.

Section 6 – Zetland Field and Sainsbury’s Car Park

19.6.6.7. The Onshore Cable Route will be partially constructed via micro-tunnel and this is known as HDD-4 (Farlington Railway Crossing (Trenchless), required to cross the railway line. To install the micro-tunnel (approximately 4 m deep) an entry pit will be used to launch the drill bit and an exit pit (approximately 4 m deep) will be used to receive the drill bit. Both pits will be founded in superficial River Terrace Deposits and Chalk. To restrict groundwater ingress to the pits, sheet pile walls will be used to prevent lateral groundwater seepage.

19.6.6.8. Presently the requirement for an abstraction license and discharge license is unknown and this will be determined at detailed design (as agreed with the EA during consultation on the 23 July 2019). This assessment assumes less than 20 m^3 of dewatering per day will be required during pit construction. It is assumed that the discharged water will be to the land drain to the east of St John’s College Farlington Pitches, however, this will be confirmed during the detailed Design Stage of works.

19.6.6.9. Taking into consideration the embedded mitigation measures it is anticipated that there will be a **Negligible** impact magnitude to the superficial River Terrace Deposit (**Medium** sensitivity) and Chalk (**High** sensitivity) aquifers through pit dewatering, resulting in a **Negligible** significance of effect for the aquifers. This is not considered a significant environmental effect.

19.6.6.10. The HDD alignment will likely intercept groundwater however, the HDD includes for groundwater seepage mitigation measures. It is anticipated that there will be a **negligible impact** to the superficial River Terrace Deposits and Chalk aquifers as a result of the cable installations. This is not considered to be significant.

Section 7 – Farlington Junction to Airport Service Road

19.6.6.11. Section 7 includes for two HDD locations: HDD-4 (Farlington Railway Crossing Trenchless)) and HDD-3 (Langstone Harbour (HDD)). HDD-4 is assessed in Paragraph 19.6.6.7 above. HDD-3 is assessed below.

19.6.6.12. The Onshore Cable Route will be partially constructed via HDD in this Section, known as HDD-3 (Langstone Harbour (HDD)), required to cross the Langstone Harbour. To install the HDD an entry compound will be used to launch the drill bit and an exit compound will be used to receive the drill bit. The entry compound is founded on superficial River Terrace Deposits (**Medium** sensitivity) and Beach and Tidal Flat Deposit (**Low** sensitivity) aquifers which overlay the Undifferentiated Chalk (**High** sensitivity) aquifer and the exit pit will be founded on Beach and Tidal Flat Deposit which are underlain by the Undifferentiated Chalk aquifer.

19.6.6.13. The HDD alignment will likely intercept groundwater; however, the HDD includes for groundwater seepage mitigation measures. Therefore, it is anticipated that there will be a **no quantity impact** to the River Terrace Deposit, Beach and Tidal Flat Deposit and Undifferentiated Chalk aquifers for the HDD installation. This is not considered to be significant.

Section 8 – Eastern Road (adjacent to Great Salterns Golf Course) to Moorings Way

19.6.6.14. Please note Chapter 18 – Ground Conditions also describes impacts related to workings in Milton Common and should be read in conjunction with this assessment.

19.6.6.15. Due to the Milton Common landfill in Section 8, the Onshore Cable Route will be partially constructed via HDD in this section (known as HDD-6). To install the HDD an entry compound will be used to launch the drill bit and an exit compound will be used to receive the drill bit. The drilling process will install a bore approximately 6 m below surface, founded within the superficial Raised Marine Deposits and London Clay Formation (aquitard).

19.6.6.16. Following the embedded mitigation measures it is anticipated that there will be a **Negligible** impact magnitude to the Raised Marine Deposits (**Low** sensitivity) superficial aquifer, resulting in a **Negligible** effect for the aquifers. This is not considered to be significant.

Section 9 – Moorings Way to Bransbury Road

19.6.6.17. The Onshore Cable Route will be partially constructed via HDD and this is known as HDD-2. To install the HDD an entry compound will be used to launch the drill bit and an exit compound will be used to receive the drill bit. The drilling process will install a bore approximately 15 m below surface, founded within the superficial River Terrace Deposits, Portsmouth Sand Member and Wittering Formation.

19.6.6.18. The HDD alignment could intercept groundwater however, the HDD includes for groundwater seepage mitigation measures. Therefore, it is anticipated that there will be a no quantity impact to the superficial River Terrace Deposits, Portsmouth Sand Member and Wittering Formation (**Medium** sensitivities) for the cable installations. This is not considered to be significant.

Section 10 – Eastney (Landfall)

19.6.6.19. The Onshore Cable R will be partially constructed via HDD and this is known as HDD-1. To install the HDD an entry compound will be used to launch the drill bit and the drill bit will exit in the ocean. The drilling process will install four bores approximately 7 m below ground surface, founded within the Storm Beach Deposits and Bracklesham Group.

19.6.6.20. The HDD alignment could intercept groundwater however, the HDD includes for groundwater seepage mitigation measures . Therefore, it is anticipated that there will be a **no quantity impact** to the Storm Beach Deposits or Wittering Formation (**Medium** sensitivity) aquifers for the cable installations.

Operational Stage (including repair and maintenance)

19.6.6.21. As per Section 19.3.3 trenched HDD quantity operational impacts have been scoped out of this assessment.

19.6.7. HDD ONSHORE CABLE CORRIDOR GROUNDWATER QUALITY IMPACTS

19.6.7.1. There are no HDD installations proposed in Sections 1, 2, 4, and 5. Therefore, no assessment has been included for these sections.

Construction (and Decommissioning) Stage

19.6.7.2. Drilling through alternative geologies can transfer existing contamination from one source to another. Drilling can also generate fines which can increase sediment in the water column, creating turbidity contamination. Following the embedded mitigation measures (as outlined in the embedded mitigation measures above in Paragraphs 19.6.7.2 to 19.6.7.4), the drilling fines and fluids will be contained in the drilling cake, preventing contamination from spreading between sources and drilling fines entering local groundwater receptors.

Section 3 – Denmead/Kings Pond Meadow

19.6.7.3. It is anticipated that there will be a **Negligible** groundwater quality impact to the Lambeth Group (**Medium** sensitivity) and superficial Head Deposit (**Low** sensitivity) aquifers from HDD-5 installation, resulting in a **Negligible** effect on the aquifers. This is not considered a significant environmental impact.

Section 6 – Zetland Field and Sainsbury's Car Park

19.6.7.4. It is anticipated that there will be a **Negligible** groundwater quality impact to the superficial River Terrace Deposits (**Medium** sensitivity) and Chalk (**High** sensitivity) aquifers from HDD-4 installation, resulting in a **Negligible** effect on the aquifers. This is not considered a significant environmental impact.

Section 7 – Farlington Junction to Airport Service Road

19.6.7.5. Section 7 includes for two HDD locations: HDD-4 and HDD-3. HDD-4 is assessed above. HDD-3 is assessed below.

19.6.7.6. It is anticipated that there will be a **Negligible** groundwater quality impact to the superficial River Terrace Deposits (**Medium** sensitivity) and Chalk (**High** sensitivity) aquifers from HDD-3 installation, resulting in a **Negligible** effect on the aquifers. This is not considered a significant environmental impact.

Section 8 - Eastern Road (adjacent to Great Salterns Golf Course) to Moorings Way

19.6.7.7. It is anticipated that there will be a **Negligible** groundwater quality impact to the Raised Marine Deposit (**Low** sensitivity) superficial aquifer from HDD-6 installation, resulting in a **Negligible** effect on the aquifers. This is not considered a significant environmental impact.

Section 9 – Moorings Way to Bransbury Road

19.6.7.8. It is anticipated that there will be a **Negligible** groundwater quality impact to the superficial River Terrace Deposits, Portsmouth Sand Member and Wittering Formation aquifers (**Medium** sensitivities) from HDD-2 installation, resulting in a **Negligible** effect on the aquifers. This is not considered a significant environmental impact.

Section 10 – Eastney (Landfall)

19.6.7.9. It is anticipated that there will be a negligible groundwater quality impact to the superficial Storm Beach Deposits and Wittering Formation (**Medium** sensitivities) aquifers from HDD-1 installation, resulting in a **Negligible** effect on the aquifers. This is not considered a significant environmental impact.

Operational Stage (including repair and maintenance)

19.6.7.10. As per Section 19.3.3 HDD quality operational impacts have been scoped out of this assessment.

19.6.8. INTER-PROJECT EFFECTS

Construction (and Decommissioning) Stage

19.6.8.1. A list of projects within the vicinity of the Proposed Development that have the potential to give rise to a cumulative effect on groundwater receptors have been considered (and are presented in Appendix 19.4 (Cumulative Effect Assessment Matrix (Stage 1 and 2)) (document reference 6.3.19.4).

19.6.8.2. Proposed mitigation measures will restrict the ZoI of cumulative groundwater impacts to areas directly above the Onshore Cable Corridor.

In addition, grouting the Karst features at the Converter Station will prevent the transportation of contamination to distant receptors. Below is an overview of the applications within the ZoI.

19.6.8.3. Applications 40, 25, and 19 fall within the Onshore Cable Corridor and are property developments, however, no basement structures are proposed in the planning application outlines and therefore will not interact with the groundwater regime. No groundwater impacts due to the proposed development will impact upon these applications.

19.6.8.4. Application 32 is to construct a wall and widen a footpath along the seafront to the south of site. Again, no flow or quality impact from the Proposed Development to the groundwater environment is anticipated.

19.6.8.5. Application 62 is the Phase 4 of the Coastal Flood Defence includes for a 150 m sheet piled wall. The installation depths are unknown, however, it is assumed that these will be toed above the currently proposed HDD-1 alignment so no groundwater interaction between the proposed development or the proposed Coastal Flood Defence is anticipated.

Operational Stage (including repair and maintenance)

19.6.8.6. Once the Onshore Cable Route is installed there are not anticipated to be any inter-project groundwater effects between the Proposed Development and other currently proposed planning applications.

19.6.9. INTRA PROJECT EFFECTS

19.6.9.1. As detailed in Chapter 4 (EIA Methodology), Chapter 29 (Cumulative Effects) presents consideration of potential intra-project effects for groundwater.

19.7. PROPOSED MITIGATION AND ENHANCEMENT

19.7.1.1. It is assumed that standard mitigation measures, including a variety of good environmental site practices, will be undertaken at the Proposed Development during the site preparation, earthworks and Construction (and Decommissioning) Stage to minimise the risk of site runoff transmitting contaminants and sediment into surface waterbodies via the surface water drainage system.

19.7.1.2. A variety of good environmental site practices will be implemented to avoid or minimise impacts at the source. Such measures include, but are not limited to, the following:

- Working areas shall be clearly defined to ensure the disturbance of soils is minimised, where practicable;
- Haul routes and accesses shall be clearly defined to minimise the risk of accidents. Construction vehicles will be regularly inspected and maintained to reduce the risk of hydrocarbon contamination associated with leaks and spillage and will only be active when required;
- The cleaning of vehicle wheels prior to leaving site;
- Dust suppression (i.e. damping down);
- Installation of systems such as silt traps and swales designed to trap silty water including adequate maintenance and monitoring of these to ensure effectiveness, particularly after adverse weather conditions;
- Designated areas for the storage of hazardous materials, fuels and chemicals. All designated areas will be appropriately bunded to at least 110% capacity and all filler points/valves will be located within the extent of bund or appropriate drip trays provided;
- On-site availability of oil spill clean-up equipment including absorbent material and inflatable booms for use in the event of an oil spill or leak;
- Use of drip trays under mobile plant;
- Provision of environmental awareness training for site workers; and
- Use of inert, uncontaminated material during construction.

19.7.1.3. The risk of pollution to surface and groundwater can be significantly reduced by the adoption of good working practices and strict adherence to guidance provided by the EA on Gov.uk. The current guidance on gov.uk explains how to:

- Report an environmental incident;
- Get permission to discharge to surface water and groundwater;
- Manage business and commercial waste;
- Store oil and any oil storage regulations;
- Discharge sewage with no mains drainage; and
- Work on or near water and manage water on land.

19.7.1.4. Guidance is also available in the following CIRIA publications;

- C532 - Control of Water Pollution from Construction Sites;
- C698 - Site handbook for the construction of SUDs; and
- C648 - Control of Water Pollution from Linear Construction Projects.

19.7.1.5. Best practice recommendations for the prevention of contamination will be outlined in more detail in an Onshore Outline Construction Environmental Management Plan ('CEMP') and agreed with relevant statutory consultees prior to commencement of construction works. This will include measures to comply with relevant legislation and guidance (including the EA's Guidance online) and best practice measures in line with the Considerate Contractors Scheme and 'Site handbook for the construction of SUDS' (CIRIA C698). It will include an erosion prevention and sediment control plan to reduce the quantity of sediment entrained in runoff.

19.7.1.6. It is recommended that surface runoff from the various construction areas within the site is managed by the use of temporary bunding and settlement ponds to protect the receiving water environment. Settlement ponds are beneficial in that they allow for isolation and on-site treatment of sediment laden or chemically contaminated surface water runoff prior to discharge, following agreement with the appropriate authority, or use of other appropriate means of disposal.

19.7.1.7. Movement of materials around the site will be managed under an appropriate Materials Management Plan ('MMP').

19.8. RESIDUAL EFFECTS

19.8.1.1. Significant trench dewatering impacts to the Chalk aquifers in Section 4 – 7 during the Construction Stage have been identified.

19.8.1.2. Trenched excavations required for construction proposed in the Portsdown Chalk Formation, Spetisbury Chalk Member, Tarrant Chalk Member and Newhaven Chalk Formations may require sump pump dewatering should groundwater be proven within 1.3 m of surface, it is assumed groundwater dewatering will be required (as a worst-case scenario). It is therefore assessed that the dewatering impact to the Principal Chalk aquifers would result in a Moderate Adverse effect for the aquifers during construction, and is therefore considered to be significant.

19.8.1.3. There are no other significant quantity or quality groundwater effects related to the Converter Station, trenched alignment or HDD alignment for either Construction or Operation Phase of the Proposed Development.

19.8.1.4. The following table provides a summary of the findings of the groundwater assessment.

Table 19.7 – Summary of Effects Table for Groundwater

Description of Effects	Receptor	Significance and Nature of Effects Prior to mitigation	Summary of Mitigation/Enhancement	Significance and Nature of Residual Effects following Mitigation / Enhancement
CONVERTER STATION IMPACTS				
Construction and Decommissioning				
Construction Quantity Impacts	Head Aquifer Chalk Aquifer Water Users	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
Construction Quality Impacts	Head Aquifer Chalk Aquifer Water Users	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST

TRENCHED ONSHORE CABLE CORRIDOR QUANTITY IMPACTS				
Construction and Decommissioning				
Construction Quantity Impacts in Section 1	Head Deposits Chalk Water Users	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
Construction Quantity Impacts in Section 2	Head Deposits Chalk Water Users	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
Construction Quantity Impacts in Section 3	Head Deposits Lambeth Group	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
Construction Quantity Impacts in Section 4	Portsdown Chalk Formation Spetisbury Chalk Member Tarrant Chalk Member Newhaven Chalk Formation	**Moderate Adverse** (Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Moderate Adverse** (Significant) - / T / D / ST

	Bognor Sand Member Wittering Formation Lambeth Group	**Minor Adverse** (Not Significant) - / T / D / ST		**Minor Adverse** (Not Significant) - / T / D / ST
	Head Deposits	**Negligible** (Not Significant) - / T / D / ST		**Negligible** (Not Significant) - / T / D / ST
Construction Quantity Impacts in Section 5	Newhaven Chalk Formation Undifferentiated Chalk	Significant - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	Significant - / T / D / ST
	River Terrace Deposits	**Minor Adverse** (Not Significant) - / T / D / ST		**Minor Adverse** (Not Significant) - / T / D / ST
	Head Deposits	**Negligible** (Not Significant) - / T / D / ST		**Negligible** (Not Significant) - / T / D / ST
Construction Quantity Impacts in Section 6	Undifferentiated Chalk	**Moderate Adverse** (Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Moderate Adverse** (Significant) - / T / D / ST

	River Terrace Deposits	**Minor Adverse** (Not Significant) - / T / D / ST		**Minor Adverse** (Not Significant) - / T / D / ST
	Raised Marine Deposits	**Negligible** (Not Significant) - / T / D / ST		**Negligible** (Not Significant) - / T / D / ST
Construction Quantity Impacts in Section 7	Undifferentiated Chalk	**Moderate Adverse** (Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Moderate Adverse** (Significant) - / T / D / ST
	River Terrace Deposits	**Minor Adverse** (Not Significant) - / T / D / ST		**Minor Adverse** (Not Significant) - / T / D / ST
	Raised Marine Deposits Beach and Tidal Flats Deposits	**Negligible** (Not Significant) - / T / D / ST		**Negligible** (Not Significant) - / T / D / ST
Construction Quantity	Bognor Sand Member River Terrace Deposits	**Minor Adverse** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Minor Adverse** (Not Significant) - / T / D / ST

Impacts in Section 8	Raised Marine Deposits	**Negligible** (Not Significant) - / T / D / ST		**Negligible** (Not Significant) - / T / D / ST
Construction Quantity Impacts in Section 9	River Terrace Deposits Portsmouth Sand Member Wittering Formation	**Minor Adverse** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Minor Adverse** (Not Significant) - / T / D / ST
	Tidal Flat Deposits	**Negligible** (Not Significant) - / T / D / ST		**Negligible** (Not Significant) - / T / D / ST
Construction Quantity Impacts in Section 10	River Terrace Deposits Storm Beach Deposits Wittering Formation	**Minor Adverse** (Not Significant - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Minor Adverse** (Not Significant - / T / D / ST
	Tidal Flat Deposits	**Negligible** (Not Significant) - / T / D / ST		**Negligible** (Not Significant) - / T / D / ST
TRENCHED ONSHORE CABLE CORRIDOR QUALITY IMPACTS				

Construction and Decommissioning				
All sections	Portsdown Chalk Formation Spetisbury Chalk Member Tarrant Chalk Member Newhaven Chalk Formation Undifferentiated Chalk Water Users	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
	Lambeth Group Bognor Sand Member, Portsmouth Sand Member Wittering Formation River Terrace Deposit Storm Beach Deposits			
	Head Deposit Raised Marine Deposits Tidal Flat Deposit			
HDD ONSHORE CABLE CORRIDOR QUANTITY IMPACTS				
Construction and Decommissioning				

Section 3: Quantity impacts: HDD5A Construction	Head Deposits Lambeth Group	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant - / T / D / ST
Section 6: Quantity impacts: HDD4 Construction	Undifferentiated Chalk River Terrace Deposits	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
Section 7: Quantity impacts: HDD3 Construction	Undifferentiated Chalk River Terrace Deposits Beach and Tidal Flat Deposits	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
Section 8 Quantity impacts: HDD6 Construction	Raised Marine Deposits	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
Section 9 Quantity impacts: HDD2 Construction	Portsmouth Sand Member Wittering Formation River Terrace Deposits	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST

Section 10 Quantity impacts: HDD1 Construction	Storm Beach deposits Wittering Formation	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
HDD ONSHORE CABLE CORRIDOR QUALITY IMPACTS				
Construction and Decommissioning				
Section 3: Quality Impacts: HDD5A Construction	Head Deposits Lambeth Group	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
Section 6: Quality Impacts: HDD4 Construction	Undifferentiated Chalk River Terrace Deposits	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
Section 7: Quality Impacts: HDD3 Construction	Undifferentiated Chalk Raised Marine Deposits River Terrace Deposits	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
Section 8: Quality Impacts:	Raised Marine Deposits	**Negligible** (Not Significant)	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant)

HDD6 Construction		- / T / D / ST		- / T / D / ST
Section 9: Quality Impacts: HDD2 Construction	Portsmouth Sand Member Wittering Formation River Terrace Deposits	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST
Section 10: Quality Impacts: HDD1 Construction	Storm Beach Deposits Wittering Formation	**Negligible** (Not Significant) - / T / D / ST	Mitigation measures outlined in 19.6.1 & 19.8	**Negligible** (Not Significant) - / T / D / ST

Key to table:

+ / - = Beneficial or Adverse P / T = Permanent or Temporary, D / I = Direct or Indirect, ST / MT / LT = Short Term, Medium Term or Long Term, N/A = Not Applicable

REFERENCES

Allen, et al, (1997). The physical properties of major aquifers in England and Wales. British Geological Survey Technical Report WD/97/34. Environment Agency R&D Publication 8

Department for Transport, (2019). Transport Analysis Guidance (TAG) UNIT A3: Environmental Impact Appraisal. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/825064/tag-unit-a3-environmental-impact-appraisal.pdf [Accessed August 2019]

Gridreferencefinder.com, (2019). Grid Reference Finder. [online] Available at: https://gridreferencefinder.com/ [Accessed August 2019].

Highways England, (2009). Design Manual for Roads and Bridges ('DMRB') Volume 11, Section 3, Part 10 (HD 45/09)

Jones et al., (2000) The physical properties of minor aquifers in England and Wales. Hydrogeology Group Technical Report WSD/00/04. Environment Agency R&D Publication 68.

Mapapps2.bgs.ac.uk, (2019). GeoIndex - British Geological Survey. [online] Available at: http://mapapps2.bgs.ac.uk/geoindex/home.html [Accessed August 2019].

Magic.defra.gov.uk.co.uk, (2019). Department of the Environment, Fisheries and Rural Affairs [online] Available at: https://magic.defra.gov.uk/MagicMap.aspx [Accessed August 2019].

Ordnancesurvey.co.uk, (2019). OS Maps. [online] Available at: https://osmaps.ordnancesurvey.co.uk/osmaps/51.1919670056,-0.8912733673,7/pin [Accessed August 2019].

Bgs.ac.uk/lexicon, (2018) - British Geological Survey. [online] Available at: http://www.bgs.ac.uk/lexicon/ [Accessed August 2019]

Mapapps2.bgs.ac.uk, (2018). GeoIndex - British Geological Survey. [online] Available at: http://mapapps2.bgs.ac.uk/geoindex/home.html [Accessed August 2019]

Magic.defra.gov.uk/MagicMap, (2018). Department of Environment, Food and Rural Affairs [Online] available at: https://magic.defra.gov.uk/MagicMap.aspx [Accessed August 2019]

Maurice, L. A. (2012), *Karst hydrogeology of the Bedhampton and Havant springs*. Retrieved from British Geological Survey: https://www.bgs.ac.uk/research/groundwater/about/karstAquifers/bedhamptonHavantSprings.html

Nowak and Gilbert (2015) Earthworks: A Guide, second edition. ICE

Planning Inspectorate. (2016). Advice note six: Preparation and submission of application documents.