

Havant Thicket Reservoir Project

Environmental Statement Volume 2 - Main Report Chapter 10 Ground Conditions

Portsmouth Water Ltd.

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10. Ground Conditions

Competent expert evidence

- 10.1. This chapter of the ES Volume 2, Chapter 10 Ground Conditions, has been prepared by the following individuals who have used their knowledge and professional judgement to undertake this assessment:
- An Associate Director (BSc (Hons), MSc, CGeol, CSci) with 19 years' experience in contaminated land and groundwater risk assessment.
 - A Senior Environmental Consultant (BSc (Hons), MSc, CEnv) with 15 years of experience in contaminated land risk assessment and environmental assessment and management.
 - An Environmental Consultant (BSc (Hons), MSc) with 8 years of experience in contaminated land and environmental risk assessment.

Legislative and policy framework

- 10.2. This section identifies and describes legislation and policy framework guidance of relevance to the assessment of the likely ground condition impacts associated with the Scheme. The relevant documents have been summarised in Table 10-1.
- 10.3. Legislative and policy framework guidance has been considered on an international, national, regional and local level. The following sections are considered to be relevant to the ground conditions assessment because they have influenced the identification and categorisation of sensitive resources and receptors, requirements for mitigation or the scope and/or method of assessment.

Table 10-1 - Legislation, regulatory, and policy framework for ground conditions

Legislation/ Regulation/ Policy	Summary of requirements
International	
Water Framework Directive (WFD) 2000/60/EC	The WFD 2000¹ establishes a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. It requires: • Environmental objectives be set to ensure that good status of groundwater is achieved and that its deterioration is avoided. This includes that any sustained upward trend in the concentration of a pollutant must be identified and reversed; • Good status of groundwater requires early action and stable long-term planning of protective measures, owing to the natural time lag in its formation and renewal; and • Monitoring programmes should cover monitoring of the chemical and quantitative status of groundwater. The WFD is transposed into the UK law by Water Environment (Water Framework Directive) (England and Wales) Regulations 2017².
Waste Framework Directive 2008	Waste Framework Directive 2008³ is a European Union (EU) Directive, which sets the foundations for waste management across the EU and aims to promote the minimising or recycling of waste. The directive establishes the preferred hierarchy of waste management options, which are in order of preference: prevention, re-use, recycle, recovery and disposal.

¹ European Parliament, Water Framework Directive (Directive 2000/60/EC), 2000.

² United Kingdom Parliament, Water Environment (Water Framework Directive) (England and Wales) Regulations, 2017.

³ European Parliament, Waste Framework Directive (2008/98/EC), 2008.

Legislation/ Regulation/ Policy	Summary of requirements
National	
Part IIA of the Environmental Protection Act (EPA) 1990	Part IIA of the EPA⁴ introduced a statutory regime for the identification and remediation of 'Contaminated Land'. It introduced, for the first time in the UK, a statutory definition of 'Contaminated Land' based on significant harm or the likelihood of significant harm (including risks to human health) or the pollution or likely pollution of controlled waters (all groundwater, inland waters and estuaries, excluding water perched above the zone of saturation). Local authorities are the primary regulators under the Part IIA regime, with a duty to identify whether the land in their area is 'Contaminated Land', although provision is made for consultation and co-ordination with the Environment Agency in situations when pollution of controlled waters is an issue. The principal objectives of the legislation are described in the Department for Environment, Food and Rural Affairs (Defra) Contaminated Land Statutory Guidance 2012⁵ as follows: • To identify and remove unacceptable risks to human health and the environment; • To seek to ensure that contaminated land is made suitable for its current use; and • To ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development. These three objectives underpin the suitable for use approach to the assessment and remediation of land contamination. This approach recognises that the risks presented by any given level of land contamination can vary greatly according to the use of the land and a wide range of other factors, such as the sensitivity of the underlying ground conditions and the receptors which may be affected. The suitable for use approach consists of three elements: • Ensuring that land is suitable for its current use; • Ensuring that land is made suitable for any new use; and • Limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land. This approach has been followed within the ground conditions assessment presented within this Environmental Statement (ES).
Water Resources Act (WRA) 1991 (as amended)	The WRA ⁶ as amended, regulates discharges to controlled waters, namely rivers, estuaries, coastal waters, lakes and groundwaters.
Reservoirs Act 1975 (as amended)	Reservoirs that are capable of holding 25,000m ³ or more of water are regulated under the Reservoirs Act ⁷ . Reservoirs that fall within the scope of the Act must be designed, constructed and inspected in accordance requirements set out in the Act.

⁴ United Kingdom Parliament, Environmental Protection Act, 1990.

⁵ Department for Environment Food and Rural Affairs, Environmental Protection Act 1990: Part 2A. Contaminated Land Statutory Guidance, April 2012.

⁶ United Kingdom Parliament, The Water Resources Act, 1991 (as amended).

⁷ United Kingdom Parliament, Reservoirs Act, 1975 (as amended).

Legislation/ Regulation/ Policy	Summary of requirements
The Control of Substances Hazardous to Human Health (COSHH) Regulations 2002 (as amended)	Under the COSHH Regulations ⁸ employers are required to protect employees and other persons (such as site visitors) from potential exposure to hazardous substances used at work. This is to be achieved by undertaking a risk assessment to identify potential risks and then to prevent those risks, or, if this is not reasonably practicable, to adequately control such exposures.
Construction (Design and Management) Regulations (CDM Regulations) 2015	The CDM Regulations ⁹ define specific legal duties with the aim of protecting the health, safety and welfare of all persons involved with construction works. The regulations provide a broad definition of construction works which includes earthworks, groundworks and other enabling works.
Waste Management Regulations 2016 (as amended)	Waste Management Regulations ¹⁰ establish the legislative framework for the management, recovery, transport and disposal of waste and state that excavated material generated by the development of land may be subject to waste regulatory controls to ensure that waste does not harm human health or the environment.
Landfill (England and Wales) Regulations 2005	The Landfill Regulations ¹¹ establish procedures and criteria for the classification and acceptance of waste at landfills.
Hazardous Waste (England and Wales) Regulations 2005	The Hazardous Waste Regulations ¹² provide a regime for the control, transport and tracking of hazardous wastes in accordance with waste Duty of Care requirements.
The Environmental Permitting (England and Wales) Regulations 2016	The Environmental Permitting Regulations ¹³ provide procedures for regulation and permitting of a wide range of activities which have the potential to impact upon the environment. With regard to land quality issues the regulations allow for the re-use of soils and aggregates within a development provided that this can be achieved in a manner protective of the wider environment.
National Planning Policy Framework (NPPF) 2019	The NPPF¹⁴ states that local planning policies and decisions should contribute to and enhance the natural and local environment by: • Protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils; • Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability; and • Remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate. With specific regard to ground conditions and pollution, paragraph 178 of the NPPF states that planning policies and decisions should ensure that:

⁸ United Kingdom Parliament, The Control of Substances Hazardous to Human Health Regulations (SI 2002/2677), 2002 (as amended).

⁹ United Kingdom Parliament, Construction (Design & Management) Regulations (SI 2015/51), 2015.

¹⁰ UK Government, Waste Management Regulations (SI 2016/24), 2016.

¹¹ UK Government, The Landfill (England and Wales) Regulations (SI 2002/1559), 2002.

¹² United Kingdom Parliament, The Hazardous Waste (England and Wales) Regulations (SI 2005/894), 2005 (as amended).

¹³ United Kingdom Parliament, The Environmental Permitting (England and Wales) Regulations (SI 2010/675), 2016 (as amended).

¹⁴ Department for Communities and Local Government, National Planning Policy Framework, 2018.

Legislation/ Regulation/ Policy	Summary of requirements
	- A site is suitable for its proposed use, taking account of ground conditions and any risks arising from land instability. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation); - After remediation, as a minimum, land should not be capable of being determined as Contaminated Land as defined under Part IIA of the Environmental Protection Act (as amended); and - Adequate site investigation information, prepared by a competent person is available to inform these assessments. The NPPF also sets out an objective to contribute to protecting and enhancing the natural environment including the minimisation of waste and pollution. It also encourages sustainable use of minerals through use of secondary and recycled materials and minerals waste in preference to primary materials, and requires the planning authority to protect mineral resources by defining Mineral Safeguarding Areas (MSAs).
Draft National Policy Statement for Water Resources Infrastructure 2018	A draft National Policy Statement (NPS) for Water Resources Infrastructure¹⁵ has been published. This draft document sets out policy for the development of nationally significant infrastructure projects (NSIPs) for water resources in England. The draft NPS is currently under parliamentary scrutiny following consultation. Whilst the Scheme is not currently deemed to be a NSIP, the final NPS will be a material consideration
Planning Practice Guidance (PPG) 2019	The PPG¹⁶ issued by the Ministry of Housing, Communities and Local Government sits alongside the NPPF. With regard to land stability, PPG identified that the planning system has an important role in; minimising the risk and effects of land stability, ensuring that specific types of development are not placed in unstable locations without suitable precautions being implemented and should wherever possible bring unstable land back into productive use. The PPG states that with regard to contamination the planning system provides a risk based approach, which works alongside various other regulatory regimes (which are discussed in turn in the sections below). The implications of contamination for a new development should be considered by the local planning authority to the extent that is not addressed by other regimes. Whilst responsibility for securing a safe development rests with the developer and/or landowner, the PPG states that local planning authorities should be satisfied that a proposed development, along with any necessary remediation works or proposed mitigation measures, will be appropriate for its location and not pose an unacceptable risk.
Government's 25 Year Environment Plan	A Green Future: Our 25 Year Plan to Improve the Environment¹⁷ lays out the Governments ambition to protect and enhance the

¹⁵ Department for Environment, Food and Rural Affairs, Draft National Policy Statement for Water Resources Infrastructure, November 2018.

¹⁶ MHCLG , Planning Practice Guidance, 2019. [Online]. Available: <https://www.gov.uk/government/collections/planning-practice-guidance>.

¹⁷ DEFRA Government's 25 Year Environment Plan, 2018. [Online]. Available: <https://www.gov.uk/government/publications/25-year-environment-plan>.

Legislation/ Regulation/ Policy	Summary of requirements
	environment. This includes aims to embed an 'environmental net gain' principle for all forms of development, minimise waste and reduce its environmental impacts by promoting re-use and to reduce pollution (to land, water and air).
Local	
Havant Borough Council Core Strategy (2011)	The Havant Borough Council Core Strategy¹⁸ is the current planning policy for Havant along with the Local Plan (Allocations). The Core Strategy was adopted in 2011 and sets out the planning framework until 2026. The Local Plan 2036 (currently in draft format) will replace the Core Strategy and is hoped to be adopted in 2020 (see below). Policies within the Local Plan (Core Strategy) that are relevant to the ground conditions assessment are: • Policy CS14 Efficient Use of Resources; and • Policy CS18 Strategic Site Delivery (Strategic Site 2 Havant Thicket Reservoir).
Havant Borough Council Local Plan (Allocations) (2014)	The Havant Borough Local Plan (Allocations)¹⁹ follows on from the Havant Borough Local Plan (Core Strategy); together these documents provide up to date policies for the borough. The Allocations Plan was adopted in 2014. Policies within the Allocation Plan that are relevant to the ground conditions assessment are: • Policy AL6 Havant Thicket Reservoir Pipeline; • Policy DM17 Contaminated Land; and • Policy DM18 Protecting New Development from Pollution.
East Hampshire District Council Local Plan: Joint Core Strategy 2014	The Joint Core Strategy²⁰ is the current Local Plan for East Hampshire, created as a joint effort between East Hampshire District Council and the South Downs National Park Authority. It was adopted in 2014 and replaced the previous 2006 Local Plan. A new draft Local Plan is due to be adopted by the end of 2020. The South Downs National Park have subsequently adopted a separate local plan in 2019 (as discussed below). Policies within the Joint Core Strategy that are relevant to the ground conditions assessment are: • Policy CP26 – Water resources/water quality; and • Policy CP27 – Pollution.
Hampshire Minerals and Waste Plan 2013	The Hampshire Minerals and Waste Plan²¹ establishes Hampshire's strategy for managing minerals and waste. It sets out 34 policies relating to minerals and waste, including the safeguarding of mineral resources and the sustainable management of waste. The Plan defines the MSAs in Hampshire. In addition, the Plan states that a key objective is to maximise the re-use, recycling and recovery of construction, demolition and excavation wastes. For non-hazardous waste, it sets targets for 60% to be recycled and 95% to be diverted from landfill by 2020.

¹⁸ Havant Borough Council, Havant Borough Core Strategy, Local Development Framework, March 2011.

¹⁹ Havant Borough Council, Havant Borough Local Plan (Allocation), Adopted Version, 2014.

²⁰ East Hampshire District Council, East Hampshire District Local Plan: Joint Core Strategy, June 2014.

²¹ Hampshire County Council, Hampshire: Portsmouth, Southampton, New Forest National Park and South Downs National Park, Mineral and Waste Plan, October 2013.

Legislation/ Regulation/ Policy	Summary of requirements
South Downs Local Plan 2014 – 2033 adopted by the South Downs National Park Authority in July 2019	The South Downs National Park Local Plan²² was adopted in 2019. The Scheme does not fall within the boundary of the National Park, but the park is located within close proximity to the north and west of the Site. Policies within the South Downs National Park Local Plan that are relevant to the ground conditions assessment are: • Strategic Policy SD17: Protection of the Water Environment; • Strategic Policy SD48: Climate Change and Sustainable Use of Resources; • Development Management Policy SD54: Pollution and Air Quality; and • Development Management Policy SD55: Contaminated Land.
Local – Draft to be adopted	
Havant Borough Council Local Plan 2036 – Pre-submission Draft (2019)	The Havant Borough Council's Local Plan 2036 is currently in draft form and will replace the Core Strategy (see above) Policies within the Draft Local Plan that are relevant to the ground conditions assessment are: • KP9 Havant Thicket Reservoir; • E21 Aquifer Source Protection Zones; • E22 Amenity and Pollution; and • E24 Contamination.
East Hampshire District Council Draft Local Plan 2017-2036 (2019)	East Hampshire District Council have produced a new draft Local Plan which is due to be adopted by the end of 2020. The Plan sets out the Council's strategic development vision up to 2036. Policies within the Draft Local Plan that are relevant to the ground conditions assessment are: • Policy DM28: Resource Efficient Design; • Policy S26: Protection of Natural Resources; and • Policy S31: Havant Thicket Reservoir.

Study area

- 10.4. For the purposes of the assessment, the Site has been divided into two areas comprising:
- The reservoir site including access roads; and
 - The pipeline corridor.
- 10.5. To consider the physical effects of the Scheme (reservoir site and pipeline corridor) on geology (e.g. changes in soil erosion, soil compaction and ground stability), effects on mineral resources (e.g. loss, damage or sterilisation of important mineral resources) and the effects associated with the re-use of soils and generation of waste soils (as part of the proposals for soil re-use within the Scheme), the study area will be the area within the red line boundary (the Site).
- 10.6. To consider the effects associated with ground contamination on human receptors, controlled waters, ecological receptors and property receptors; the study area includes the Site area within the red line boundary and land immediately beyond it to a distance of 500 m. This takes into account the transport and final destination of potential contaminants of concern in the environment and the connectivity of these contaminants via migration pathways, or exposure to the receptors identified. A 500 m zone is considered appropriate for the consideration of potential land contamination for

²² South Downs National Park Authority, South Downs Local Plan (2014-33), Adopted July 2019.

sites such as the Scheme, where the land has undergone limited development and as such contamination is likely to be limited or have a limited lateral mobility if present.

Assessment methodology

Scope of the assessment

- 10.7. This chapter of the ES comprises an assessment of the impacts of the Scheme on physical geology, mineral resources, generation of waste soils, soil re-use and land contamination during construction and operational phases. The assessment methodology is based on the Government's Good Practice Guide for EIA²³.
- 10.8. The scope of this assessment has been established through a formal EIA scoping process undertaken with the Planning Authorities. A request for an EIA Scoping Opinion was initially issued to the Local Planning Authorities in 2009²⁴, with an updated Scoping addendum issued in 2019²⁵.
- 10.9. The Government's Good Practice Guide for EIA²³ outlines the potential environmental effects that should be considered for ground conditions including:
 - Physical effects of the Scheme: e.g. changes in soil compaction, soil erosion, ground stability etc;
 - Effects on mineral resources: e.g. mineral resource sterilisation, loss or damage to Local Geological Sites (formerly known as Regionally Important Geological Sites (RIGS)), geological Sites of Special Scientific Interest (SSSIs) etc;
 - Effects on soil as a valuable resource: e.g. loss or damage to soil of good agricultural quality;
 - Effects associated with ground contamination that may already exist on site: e.g. introducing/changing pathways and receptors;
 - Effects associated with the potential for polluting substances used (during construction/operation) to cause new ground contamination issues on site: e.g. introducing/changing the source of contamination and/or pathways; and
 - Effects associated with re-use of soils and generation of waste soils: e.g. re-use of site-sourced materials on- or off-site, disposal of site-sourced materials off-site, importation of materials to the Site etc.
- 10.10. Physical effects and the effects associated with the re-use of soils and generation of waste soils were scoped into the ground conditions assessment as part of the Scoping addendum²⁵ due to the potential physical effects of the Scheme on geology and the proposals for soil re-use on site. Physical effects in relation to changes in topography are discussed in Chapter 11 Landscape and Visual of the ES Volume 2. Management of site-sourced waste materials, other than site soils (i.e. general waste materials from construction and operational phases), is summarised in Chapter 14 Material Resources and Waste of the ES Volume 2.
- 10.11. Effects on geology as a valuable resource were also included within the scope as part of the Scoping addendum²⁵. A review of the Minerals and Waste Policy Map for Hampshire²¹ indicates the presence of a brick clay resource within the footprint of the Site. According to the Hampshire Minerals and Waste Plan Policies Map, this area is a Minerals and Waste Consultation Area (MWCA).
- 10.12. Effects on soil as a valuable resource were scoped out of the assessment as part of the Scoping addendum²⁵, as the Scheme is unlikely to cause loss or damage to soil of good agricultural quality. Reference to Agricultural Land Classification maps²⁶ indicates that the Site is classified as 'other land primarily in non-agricultural use'.
- 10.13. Potential impacts from contamination sources on controlled waters (groundwater and surface water) are considered as part of this chapter to determine and classify potential effects. Further

²³ Department for Communities and Local Government, Environmental Impact Assessment: A Guide to Good Practice and Procedures. A Consultation Paper (DCLG), 2006. It should be noted that this document has been withdrawn; however, it still constitutes good advice and should be referred to in the absence of alternative guidance documents

²⁴ Arup, Havant Thicket Storage Reservoir. Environmental Impact Assessment Scoping Report, February 2009.

²⁵ Atkins, Havant Thicket Reservoir Project. EIA Scoping Report - Addendum, November 2019.

²⁶ Natural England, 1: 250,000 Series Agricultural Land Classification Maps, London and South East Region, 2010.

consideration of impacts to water resources is undertaken within Chapter 15 Water (including flows, quality and groundwater) of the ES Volume 2.

10.14. Therefore, the following environmental effects have been considered and form part of the assessment:

- Physical effects including soil erosion, soil compaction and ground stability;
- Mineral resource loss, damage or sterilisation;
- Effects associated with existing ground contamination and potential new ground contamination issues; and
- Effects associated with the re-use or disposal of site sourced soils and waste soils.

Assessment scenarios

10.15. The assessment of effects on geology and land quality includes the assessment of the construction and operational phases of the development, rather than specific assessment years.

Guidance

10.16. This assessment has been undertaken in accordance with the following guidance documents:

- Primary guidance for assessing and managing land contamination is presented in Contaminated Land Report (CLR) 11²⁷, the Guiding Principles for Land Contamination (GPLC)²⁸ and the Environment Agency (2019) Draft Land contamination: risk management (LCRM)²⁹. These documents provide a technical framework for the identification and remediation of contamination through the application of a risk management process;
- The Definition of Waste: Development Industry Code of Practice (DoWCoP)³⁰ constitutes a voluntary Code of Practice containing procedures for the sustainable re-use of soils as a resource for the development industry;
- Department of the Environment (1995) Industry Profiles for previously developed land, Environment Agency³¹;
- Construction Industry Research and Information Association (CIRIA) C552 (2001) Contaminated Land Risk Assessment – A Guide to Good Practice³²;
- National House-Building Council (NHBC) and Environment Agency (2008) Guidance on the Safe Development of Housing on Land Affected by Contamination (R&D66)³³;
- British Standards (2015) BS 5930: Code of practice for ground investigations³⁴;
- British Standards (2017) BS 10175:2011+A2:2017: Code of Practice for Investigation of Potentially Contaminated Sites³⁵; and
- British Standard (2019) BS 8485:2015+A1:2019: Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings³⁶.

²⁷ Department for Environment, Food and Rural Affairs and Environment Agency, Contaminated Land Report (CLR) 11: Model Procedures for the Management of Land Contamination, 2012. It is noted that CLR11 is due to be withdrawn in 2020 and replaced by updated online guidance: Environment Agency (June 2019) Land contamination: Risk Management (Draft).

²⁸ Environment Agency, GPLC1 – Guiding Principles for Land Contamination, March 2010.

²⁹ Environment Agency, Land contamination: Risk Management, 2019. [Online]. Available: <https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks>.

³⁰ CL:AIRE, The Definition of Waste: Development Industry Code of Practice, March 2011.

³¹ Environment Agency, Department of the Environment – Industry Profiles for previously developed land, 1995.

³² Construction Industry Research and Information Association, C552 – Contaminated Land Risk Assessment – A Guide to Good Practice, 2001.

³³ National House-Building Council & Environment Agency, Guidance on the Safe Development of Housing on Land Affected by Contamination (R&D66), 2008.

³⁴ British Standards, BS 5930 – Code of practice for ground investigations, 2015.

³⁵ British Standards, BS10175 – Code of Practice for Investigation of Potentially Contaminated Sites, 2013.

³⁶ British Standards, BS 8485 - Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings, 2019.

Assessment criteria

- 10.17. EIA methodology²³ considers whether impacts of the Scheme would have an effect on any identified resources or receptors. For physical effects and effects associated with mineral resources, waste soils and soil re-use, the assessments broadly consider the magnitude of impacts and value/sensitivity of resources/receptors that could be affected in order to classify effects. For land contamination the assessment considers the change in the level of contaminative risks to the relevant receptors in order to classify effects.
- 10.18. A summary of the two assessment methods and assessment criteria used in the geology and land quality assessment is presented in the following sub-sections.

Physical effects and effects associated with mineral resources, waste soils and soil re-use

- 10.19. An impact assessment of the potential physical effects of the Scheme on geology and the effects associated with mineral resources, soils re-use and waste soils has been undertaken using a qualitative approach, which considers the effects of the construction and operational phases of the Scheme on soil compaction, soil erosion, ground stability, mineral resources, potential for soil re-use and waste soil generation.

Value / Sensitivity

- 10.20. The value or sensitivity of a receptor is considered when determining the consequence of an effect in the impact assessment. Where the attribute falls within two value/sensitivity criteria, the worst case value/sensitivity is selected. The criteria used in the assessment for determining the value/sensitivity of soil and geological receptors has been determined using the classifications given in Table 10-2.

Table 10-2 - Criteria for classifying the value and/or sensitivity of environmental resources/receptors²³

Value / Sensitivity	Criteria	Description
High	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the Site/receptor. Attribute has a very low capacity to accommodate the proposed change.	Regionally important mineral resource. Within a MSA. Major ground stability, soil compaction or erosion hazards currently present at the Site. High potential for soils re-use.
Medium	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the Site/receptor. Attribute has a low capacity to accommodate the proposed change.	Moderately economically viable mineral resource. Adjacent to a MSA or within a MWCA. Moderate ground stability, soil compaction or erosion hazards currently present at the Site. Moderate potential for soils re-use.
Low	Attribute only possesses characteristics which are locally significant. Attribute has some tolerance to accommodate the proposed change.	Low economically viable minerals. Low ground stability, soil compaction or erosion hazards currently present at the Site. Limited opportunity for soils re-use.
Very low	Attribute characteristics do not make a significant contribution to local character or distinctiveness. Attribute is generally tolerant and can accommodate the proposed change.	No economically viable minerals. No ground stability, soil compaction or erosion hazards currently present at the Site. No opportunity for soils re-use.

Magnitude

- 10.21. Following determination of the value/sensitivity of the receptors, the magnitude of potential impacts are determined. The criteria for the assessment of impact magnitude for physical effects and effects associated with mineral resources, waste soils and soil re-use are shown in Table 10-3.

Table 10-3 - Assessment of magnitude of impact for physical effects and effects associated with mineral resources, waste soils and soil re-use²³

Magnitude	Criteria
High	Total loss or major alterations to one of more of the key elements, features or characteristics of the baseline. The situation will be fundamentally different.
Medium	Partial loss or alteration to one of more of the key elements or characteristics of the baseline. The situation will be partially changed.
Low	Minor loss or alteration to one or more of the key elements, features or characteristics of the baseline. The change will be discernible, but the underlying situation will remain similar to the baseline.
Very low	Very minor loss or alteration to one or more of the key elements, features or characteristics of the baseline, such that the change will be barely discernible, approximating to the 'no change' situation.

Effect Definitions

- 10.22. The overall significance of physical effects and effects associated with mineral resources, waste soils and soil re-use is defined using the matrix presented below in Table 10-4 which describes the relationship between the value/sensitivity of the receptor and the magnitude (change) of the impact.
- 10.23. Following the classification of an effect as presented in Table 10-5, a clear statement is made as to whether the effect is 'significant' or 'not significant'. As a general rule, major and moderate effects are considered to be significant and minor and negligible effects are considered to be not significant. However, professional judgement is also applied where appropriate.

Table 10-4 - Criteria for determining the significance of physical effects and effects associated with mineral resources, waste soils and soil re-use²³

		Value / Sensitivity of receptor			
		Very low	Low	Medium	High
Magnitude	Very low	Negligible	Negligible	Minor	Minor
	Low	Negligible	Minor	Minor	Moderate
	Medium	Minor	Minor	Moderate	Major
	High	Minor	Moderate	Major	Major

- 10.24. Physical effects and effects associated with mineral resources, waste soils and soil re-use are described as adverse/negative or beneficial/positive considering the value of the receptor, the area over which the effect may occur, whether the effect is direct or indirect, the duration of the effect (short term: <3 years, medium term: 3-10 years or long term: >10 years), and whether the effect is permanent or temporary.
- 10.25. The classifications of physical effects and effects associated with mineral resources, waste soils and soil re-use are described in Table 10-5.

Table 10-5 - Classification of effects (mineral resources, waste soils and soil re-use)²³

Classification	Effect
Major adverse	Major sterilisation of mineral resources from either an active mining /quarrying site or MSA. Significant soil erosion, soil compaction or ground instability that is permanent in nature. The generation of significant volumes of soils classified as hazardous waste requiring off-site disposal.
Moderate adverse	Moderate sterilisation of a mineral resource or MSA. Moderate soil erosion, soil compaction, or ground instability that is either permanent or long term in nature. The generation of moderate volume of waste requiring off-site disposal.
Minor adverse	Minor sterilisation of a mineral resource or MSA. Limited medium-term soil erosion, soil compaction, or ground instability. The generation of a minor amount of waste soil requiring off-site disposal.
Neutral	No change to a mineral resource or MSA. No measurable impact on soil erosion, soil compaction, waste volumes, or ground instability or impacts that are only temporary in nature (less than five years).
Minor beneficial	Minor improvement in access to a mineral resource potentially facilitating future mineral extraction. Limited medium-term reduction in existing soil erosion, soil compaction, or ground instability issues. A minor amount of soil re-use on site, thereby reducing off-site disposal volumes.
Moderate beneficial	Moderate improvement in access to a mineral resource facilitating future mineral extraction. Moderate permanent or long-term reduction in existing soil erosion, soil compaction, or ground instability issues. A moderate amount of soil re-use as part of the development, thereby reducing off-site disposal volumes by a significant extent.
Major beneficial	Major improvement in access to a mineral resource facilitating future mineral extraction. Significant permanent reduction in existing soil erosion, soil compaction or ground instability issues. Sustainable re-use of materials on site with no, or only minimal, offsite disposal of waste soils.

Land Contamination

- 10.26. The generic EIA methodology is not used to consider the effects on land contamination from the Scheme. Instead, the assessment considers the risks to various receptors from land contamination and the change in this risk profile during construction and operation. As such, the magnitude of the impact is not determined, being replaced by the change in risk level to the various receptors, which is subsequently used to define the effect.
- 10.27. The assessment of the potential impacts of the Scheme on land contamination is undertaken over two stages including:
- Stage 1 – a land contamination risk assessment; and
 - Stage 2 – a land contamination impact assessment.

Stage 1 - Risk Assessment

- 10.28. The approach for the ground conditions risk assessment is based on the guidance documents CLR11²⁷, LCRM²⁹ and the Good Practice Guide to EIA. These documents provide a technical framework for the application of a risk management process through the following steps:
- **Develop a preliminary conceptual site model (PCSM)** – a desk study review of available documentary information has been undertaken to develop the PCSM, which describes the linkage between potential contamination hazards/sources, pathways and receptors relevant to the Site and where all three are present or considered likely to be present, described as potential contaminant linkages (PCLs) that can then be subject to the risk assessment process; and
 - **Risk assessment** – based on the desk study information a PCSM has been developed and a qualitative risk assessment has been undertaken in accordance with relevant guidance, considering the potential sources, pathways and receptors present during the baseline, construction and operational phases. Where available, ground investigation data has been used to undertake a generic quantitative risk assessment (GQRA) for human and controlled waters receptors.
- 10.29. To assist in the risk assessment process and to help determine the consequence of contamination being present, a value/sensitivity has been assigned to each of the contaminated land receptors. The definition of each of these is given in Table 10-6.

Table 10-6 - Assessment of the value or sensitivity of receptors associated with land contamination^{23, 27, 29}

Value / Sensitivity	Criteria	Description
High	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the Site/receptor. Attribute has a very low capacity to accommodate the proposed change.	Principal aquifer providing potable water to a large population, within an inner or outer groundwater source protection zone (SPZ) (SPZ 1 or SPZ 2). WFD high status water body (surface water) providing potable water to a small population. Sensitive human health receptors, e.g. children / other users of residential areas, schools and parks. Buildings, including services and foundations of high historic value or other sensitivity e.g. statutory historic designations, schools, residential dwellings. Ecological statutory designations with high sensitivity or international designations e.g. SSSI, Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar sites etc. Crops and livestock with a high commercial / economic value.
Medium	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the Site/receptor. Attribute has a low capacity to accommodate the proposed change.	Principal aquifer beyond a SPZ 1 or 2. Secondary A aquifers and other secondary aquifers providing abstraction water for single private potable water supplies, agricultural or industrial use. WFD good status water body (surface water). Moderate sensitivity human health receptors, e.g. commercial / industrial users.

Value / Sensitivity	Criteria	Description
		Buildings and infrastructure of high regional value or high sensitivity e.g. schools, hospitals, residential dwellings and listed buildings. Ecological statutory designations with medium sensitivity or national designations e.g. National Nature Reserve (NNR), Area of Outstanding Natural Beauty (AONB), Marine Conservation Zone (MCZ), Ancient Woodland etc. Crops and livestock with a medium commercial / economic value. Local Geological Site (LGS) or Regionally Important Geological Sites etc.
Low	Attribute only possesses characteristics which are locally significant. Attribute has some tolerance to accommodate the proposed change.	Secondary undifferentiated or Secondary B aquifer not currently used for groundwater abstraction. WFD moderate status (surface water). Less sensitive human health receptors, e.g. construction workers using mitigation measures. Buildings and infrastructure of local importance or low sensitivity (commercial / industrial buildings, main roads, railways). Ecological statutory designations with low sensitivity or sites with local designations e.g. Local Nature Reserve (LNR). Crops and livestock with a low commercial / economic value.
Very low	Attribute characteristics do not make a significant contribution to local character or distinctiveness. Attribute is generally tolerant and can accommodate the proposed change.	Non-productive strata (groundwater). WFD poor status (surface water). No sensitive human receptors. Locally important infrastructure (local roads, bridges, footpaths). Land with very low sensitivity and/or non-statutory designations. No crop or livestock receptors.

- 10.30. The risk assessment then applies the principles given in R&D6633 and CIRIA C55232, which provide guidance on the preparation and application of the consequence and probability matrix (as presented in) Table 10-7 for contaminated land risk assessment.
- 10.31. The potential risk to a receptor is a function of the probability and the consequence of a PCL being realised. Probability (likelihood of an event occurring) takes into account both the presence of the hazard and the receptor and the integrity of the exposure pathway. Consequence takes into account both the potential impact of the hazard and the value/sensitivity of the receptor. Definitions of probability and consequence (as given in R&D66) adopted for this assessment are provided in Appendix A10.1 in ES Volume 4.

Table 10-7 - Ground conditions estimation of the level of risk by comparison of consequence and probability^{23, 33}

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High likelihood	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/ Low Risk	Low Risk
	Low likelihood	Moderate Risk	Moderate/ Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/ Low Risk	Low Risk	Very Low Risk	Very Low Risk

10.32. The descriptions of the classified risks and likely action required as given in R&D66³³, are defined in Table 10-8 below.

Table 10-8 - Description of classified risks for contamination^{23, 33}

Risk	Description
Very high risk	There is a high probability that severe harm could arise to a receptor from an identified hazard at the Site without remediation action, or there is evidence that severe harm to a designated receptor is already occurring. Realisation of that risk is likely to present a substantial liability to the Site owner/or occupier. Investigation is required as a matter of urgency and remediation works likely to follow in the short-term.
High risk	Harm is likely to arise to a receptor from an identified hazard at the Site without remediation action. Realisation of the risk is likely to present a substantial liability to the Site owner/or occupier. Investigation is required as a matter of urgency to clarify the risk. Remediation works may be necessary in the short-term and are likely over the longer term.
Moderate risk	It is possible that harm could arise to a receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Further investigative work is normally required to clarify the risk and to determine the potential liability to site owner/occupier. Some remediation works may be required in the longer term.
Low risk	It is possible that harm could arise to a receptor from identified hazard, but it is likely at worst, that this harm if realised would normally be mild. It is unlikely that the Site owner/or occupier would face substantial liabilities from such a risk. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.
Very low risk	It is a low possibility that harm could arise to a receptor, but it is likely at worst, that this harm if realised would normally be mild or minor.
No potential risk	There is no potential risk if no pollution linkage has been established.

10.33. A PCSM has been produced based on the information available at the time of writing and taking into consideration the potential sources, pathways and receptors present during the baseline, construction and operational phases. The PCSM has been characterised using the method outlined in paragraphs 10.26 to 10.37 and taking into account probability, consequence and levels of risk.

The PCSM has been used to inform the baseline, construction phase and operation phase PCSMs, which consider the current site conditions and predictions relating to the various future phases.

Stage 2 – Impact assessment

- 10.34. The impact assessment has been undertaken by comparing the baseline risk assessments with the construction and operational phase risk assessments. This approach enables changes in the contaminated land status during the various phases to be identified and recorded.

Contaminated land effect definitions

- 10.35. The effects of the Scheme site on land contamination are described as adverse/negative or beneficial/positive, major, moderate, minor or negligible on the basis of the impact assessment completed. The classifications of these effects for land contamination follows the guidance detailed in Table 10-9.

Table 10-9 - Classification of effects (contaminated land) ^{22 26 31 32}

Classification	Effect
Major adverse	An increase in contamination risk from the existing baseline conditions of four or five risk levels in the risk matrix, e.g. land that has a very low contamination risk in the baseline becomes a high or very high risk. Land that does not meet the statutory definition of Contaminated Land in the existing baseline becomes capable of being determined under Part IIA.
Moderate adverse	An increase in contamination risk from the existing baseline conditions of two or three risk levels in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate or high risk. Land that does not meet the statutory definition of Contaminated Land in the existing baseline becomes capable of being determined under Part IIA.
Minor adverse	An increase in contamination risk from the existing baseline conditions of one risk level in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate to low risk.
Negligible	No change in contamination risks.
Minor beneficial	A reduction in contamination risk from the existing baseline conditions of one risk level in the risk matrix, e.g. land that has a moderate to low contamination risk in the baseline becomes a low risk.
Moderate beneficial	A reduction in contamination risk from the existing baseline conditions of two or three risk levels in the risk matrix, e.g. land that has a high contamination risk in the baseline becomes a moderate to low or low risk. Land that meets the statutory definition of Contaminated Land in the existing baseline is no longer capable of being determined under Part IIA.
Major beneficial	A reduction in contamination risk from the existing baseline conditions of four or five risk levels in the risk matrix, e.g. land that has a very high contamination risk in the baseline becomes a low or very low risk. Land that meets the statutory definition of Contaminated Land in the existing baseline is no longer capable of being determined under Part IIA.

- 10.36. Following the classification of an effect, as presented in Table 10-9, a clear statement is made as to whether the effect is 'significant' or 'not significant'. As a general rule, major and moderate effects are considered to be significant and minor and negligible effects are considered to be not significant.

- 10.37. It should be noted that, given the information known at the time of writing, professional judgement has been applied in certain circumstances where the introduction or removal of a receptor has automatically triggered a minor adverse or minor beneficial effect.

Assessment methodology – General approach

- 10.38. The approach to the ground conditions assessment comprises:
- Establishing the baseline conditions for the study area with respect to geology, ground stability, hydrology, hydrogeology, contaminated land (including the potential for unexploded ordnance and ground gases) and historical uses;
 - Identification of potential impacts on identified resources and receptors from the construction and operation phases of the Scheme;
 - Assessment of the significance of likely effects from the Scheme including the consideration of mitigation measures; and
 - Identification of any residual effects.

Establishing the baseline – Existing baseline

- 10.39. The baseline assessment has relied on existing data, previous desk study and ground investigation reports, groundwater monitoring data, and historical records. A summary of the sources of baseline information is provided in the individual chapters. The following general sources have been reviewed:
- Historical mapping and additional environmental information including historical landfill information and contemporary trade directories provided in Envirocheck reports^{37, 38} included in Appendix A10.2 and A10.3 in ES Volume 4;
 - Historical aerial photographs included as part of an Aerial Photograph Interpretation prepared by Arup in 2008³⁹;
 - Site history information document prepared by Portsmouth Water in 2012⁴⁰;
 - Historical and current aerial photographs provided by Historic England^{41, 42};
 - British Geological Survey (BGS) GeoIndex online mapping resource⁴³;
 - BGS Maps Portal, Geological Survey of England and Wales, 1:50,000 Geological Map Series, Sheet 316 Fareham. Solid and Draft, Published 1998⁴⁴;
 - BGS review of the hydrogeology of the Bedhampton and Havant springs source protection zones⁴⁵;
 - Geological Society assessment of the nature, formation and engineering significance of sinkholes related to dissolution of chalk in SE Hampshire⁴⁶;
 - Landmark Information Group and Alpha Associates, Preliminary Unexploded Ordnance (UXO) Threat Assessment for the reservoir, 2019⁴⁷;

³⁷ Envirocheck Landmark Group Ltd, Havant Thicket Winter Storage Envirocheck Report. Ref. 202069335_1_1, 2019.

³⁸ Envirocheck Landmark Group Ltd, Reservoir to Bedhampton Pipeline Envirocheck Report. Ref. 242175263_1_1, 2020.

³⁹ Ove Arup & Partners Ltd, Havant Thicket Winter Storage Reservoir: Havant Reservoir - Aerial Photograph Interpretation, London, 2009.

⁴⁰ Portsmouth Water, Havant Thicket Winter Storage Reservoir Site. Site History Information, Portsmouth Water, 2012.

⁴¹ Historic England, Historic England Image Order 109503, Historic England, 2019.

⁴² Atkins, Aerial photography and LiDAR interpretation Technical Note. Report no. HTR-ATK-ZZ-ZZ-RP-C-0010, 2020.

⁴³ British Geological Survey, GeoIndex - British Geological Survey, 2020. [Online]. Available: <http://mapapps2.bgs.ac.uk/geoindex/home.html>.

⁴⁴ British Geological Survey (BGS), BGS Maps Portal, Geological Survey of England and Wales, 1:50,000 Geological Map Series, Sheet 316 Fareham, Solid and Draft, [Online]. Available: <https://www.bgs.ac.uk/data/maps/Maps.cfc?method=listResults&series=E50k&scale=&origID=&getLatest=Y&pageSize=100&MapName=316>.

⁴⁵ British Geological Survey, A Review of the Hydrogeology of the Bedhampton and Havant Spring Source Protection Zones. CR/19/046, 2019.

⁴⁶ J. C. C. E. & A. P. P.W. McDowell, The nature, formation and engineering significance of sinkholes related to dissolution of chalk in SE Hampshire, England, Geological Society of London, 2008.

⁴⁷ Landmark Information Group and Alpha Associates, Preliminary Unexploded Ordnance (UXO) Threat Assessment, 2019.

- Zetica online UXO risk maps for the pipeline⁴⁸ included in Appendix A10.4 in ES Volume 4;
- Existing geo-environmental reports prepared for the reservoir site including a Desk Study Report⁴⁹ and a Ground Investigation Report⁵⁰ including aerial photography interpretation, included in Appendix A10.2 and Appendix A10.5 in ES Volume 4;
- Hampshire: Portsmouth, Southampton, New Forest National Park and South Downs National Park, Mineral and Waste Plan, Adopted October 2013²¹;
- Department of Environment, Food and Rural Affairs (Defra) Multi-Agency Geographic Information for the Countryside (MAGIC) Map application⁵¹; and
- Environment Agency, Flood Map for Planning, 2020⁵².

Assessment assumptions and limitations

10.40. The following assumptions have been made for the assessment:

- Development is undertaken within the parameters set out in Chapter 2 Description of the Development in the ES Volume 2;
- Members of the public will have transient, if any, access to the study area during construction of the Scheme;
- Construction best practice will be adhered to at all times during the works;
- This chapter does not address risks to construction or maintenance workers, as the assessment presented herein relates to the long-term (chronic) risk posed by contamination, not short-term exposure (acute risk), which is applicable to construction workers and will be managed through the application of suitable health and safety assessments and working methods;
- The assessments presented within this chapter provide supplementary information that may be used by the appointed contractors for the development of the construction workers' risk assessments and method statements to mitigate potential risks;
- Control measures to mitigate the risk of adverse health impacts to construction workers will be identified by risk assessments as required in the as set out in the Record of Environmental Actions and Commitments (REAC) as part of the Outline Environmental Management Plan (OEMP) in Appendix A2.1 in ES Volume 4; and
- For the construction and operational phase assessments, it has been assumed that all mitigation measures proposed for construction and operation have been adopted / implemented.

10.41. The following limitations were encountered during the process of collating baseline information and undertaking the subsequent assessment:

- Ground investigation data is not available for the northern section of the reservoir site, the access roads or pipeline corridor and the baseline for these areas has therefore been prepared using BGS mapping; and
- The preliminary moderate UXO risk at the Site indicates that further assessment should be undertaken to determine the UXO risk.

Baseline conditions including value/sensitivity of resources and receptors

10.42. This section presents a description of the baseline environmental characteristics within the study area.

⁴⁸ Zetica, Zetica Unexploded Ordnance Risk Maps, 2020. [Online]. Available: <https://zeticauxo.com/downloads-and-resources/risk-maps/>.

⁴⁹ Atkins, Havant Thicket Winter Storage Reservoir, Geology and Hydrogeology Desk Study Report. Ref. HTWSR-ATK-ZZ-ZZ-RP-C-0001, November 2019.

⁵⁰ Atkins, Havant Thicket Winter Storage Reservoir, Ground Investigation Report. Ref. HTR-ATK-RZ-RE-RP-C-0001, March 2020.

⁵¹ DEFRA MAGIC, Magic Map Application, 2020. [Online]. Available: <https://magic.defra.gov.uk/MagicMap.aspx>.

⁵² Environment Agency, Flood Map for Planning, 2020. [Online]. Available: <https://flood-map-for-planning.service.gov.uk/>.

- 10.43. Distances and direction for features along the corridor will have been provided with reference to Ordnance Survey grid references (OSGR).

Current site use

Site history

- 10.44. A review of the historical and current land use of the study area has been undertaken using historical maps included within the Envirocheck report^{37, 38} and available aerial photography^{42, 49}. The following section summarises the key historical land use information for the study area.

Reservoir site

Table 10-10 - Summary of historical development of the reservoir site

Date and scale	On-site development	Development in the study area
1870 (1:10,560) 1878 (1:2,500)	The site largely comprises woodland named as Havant Thicket. To the north east of the Havant Thicket woodlands is Long Wood, with the Forest of Bere located beyond to the north. Adjacent to the east is Bells Copse woodland. Open glades are also located within the wood. Three unnamed watercourses are present in the north of the Site and converge into one unnamed watercourse in the south east of the Site. An unnamed watercourse flows southwards within Bells Copse. Areas within the Site are labelled as Thicket Bottom, Deerslaughter Plain, Gammons Hill and Bondfields Plain in the south east and Parish Piece and Gypsies Plain in the east of the Site. Horsefoot Hill is labelled within the north of the Site. A number of tracks are present throughout the Site in various orientations. There were no common rights to the Site in 1870 as it became part of the private Leigh Park Estate⁵³.	The site is bordered by open agricultural fields to the north, with Blendworth Common adjacent to the north west and the Holt woodland adjacent to the north east. The watercourse in the south of the Site extends off-site beyond the study area. The unnamed watercourse within Bells Copse flows south running parallel to, and approximately 400 m away from, the south western site boundary. The watercourse flows past Middle Park Farm, located approximately 400 m south west of the Site. The settlement of Red Hill is present approximately 50 m east of the Site and comprises woodland, Red Hill Farm and a brick and tile works clay pit. St Johns Church, National School and Staunton Arms Public House are located approximately 40 m east of the Site, south of Red Hill. An area of woodland is present 140 m east of the Site boundary. A brick yard and clay pit are located approximately 100 m to 200 m south east of the Site with an additional clay pit 350 m further south east. This area is named The Durrants. A brick kiln, clay pit and drinking well are located approximately 100 m west of the Site, north of the area of Dunsbury Hill. The study area to the south of the Site contains a number of coppices including Billys Coppice, Bondfields

⁵³ Portsmouth Water, Havant Thicket Winter Storage Reservoir Site. Site History Information, Portsmouth Water , 2012.

Date and scale	On-site development	Development in the study area
		Coppice and Hammonds Land Copse. 'The Lake' associated with Leigh Park Estate is located approximately 60 m south of the Site boundary and extends 200 m further to the south. It is approximately 100 m in width. A battery is labelled within the boundary of The Lake. A group of cottages are also present approximately 200 m south of the south west corner of the Site. A possible clay pit/cutting is present approximately 300 m south of the Site.
1897 – 1898 (1:10,560) 1897 (1:2,500)	A de-vegetated strip labelled 'The Avenue' is present running through the centre of the Site, orientated from north west to south east. The Upper Lake and a Bathing House are now situated in the centre of The Avenue. A monument is also present on The Avenue within the south of the Site. A sluice gate is present on the southern border of the Upper Lake. A further de-vegetated rectangular area is located in the southwest of the Site within Deerslaughter Plain. Two old clay pits are shown within the north east and north of the Site. An old chalk pit is present within the north west of the Site. Brick works with associated clay pits are also shown within the north east of the Site.	The brick yard located approximately 100 m south east of the Site is shown as disused. A smithy is also located approximately 260 m south east of the Site. The claypit/cutting south of the Site has possibly been infilled. A drain extends west from the north east of the Site towards to the unnamed watercourse to the west of the Site.
1899 (1:10,560) (Eastern half of the Site available)	No substantial changes.	No substantial changes.
1909 – 1910 (1:10,560) 1909 (1:2,500)	The clearing in the southwest of the Site, now named 'Middle Clearing' has been replanted in the northern section. The monument is now labelled as the 'George Canning Monument'. Gipsies Plain, located in the east of the Site shows a square pattern, possibly being managed and is shown as heathland.	Residential development has taken place along Castle Road, east Red Hill, approximately 250 m to 500 m northeast of the Site. The woodland running parallel to the unnamed watercourse to the west of the Site is named The Warren.

Date and scale	On-site development	Development in the study area
	The brick works and clay pit located in the north east of the Site are labelled 'old brick works' and 'old clay pit'.	
1914 (1:10,560) (Eastern half of the Site available)	No substantial changes.	No substantial changes.
1931 – 1933 (1:10,560)	No substantial changes.	The smithy is no longer shown to be present 260 m south east of the Site.
1938-1942 (1:10,560) (North-western and southern half of the Site available)	No substantial changes.	Allotment gardens are present approximately 250 m south east of the Site.
1946 Aerial Photography	The aerial photograph shows woodland present across the majority of the Site apart from the Gipsies Plain area in the east and a cleared square in the north west of the Site. The two sections of the Middle Clearing are shown, the southern section more sparsely planted with oak trees than the northern.	Previous reports referenced within the Portsmouth Water Site History Information report [1] suggest that a military establishment was present approximately 350 m south of the Site including a number of huts and football pitches.
1954 Aerial Photography	The photograph shows that the majority of woodland within both sides of The Avenue has been cleared, leaving two small very young oak plantations (Middle Clearing and Round Wood) to the west of The Avenue. A thin row of trees bordering the Upper Lake and running south along The Avenue also remained. Tracks are present across the Site.	Residential development named Leigh Park has taken place adjacent to the south western edge of the Site.

Date and scale	On-site development	Development in the study area
1953 – 1972 (1:2,500)	No substantial changes.	The residential development to the south west of the Site extends a further 500 m southwest. A cutting is visible 50 m north of Middle Park Farm to the west of the Site and of the unnamed watercourse. A pond is marked at Middle Park Farm and approximately 100 m east of the farm. A pond is present approximately 150 m southwest of the Site. A youth hostel and Boys' Club has been constructed south of the cottages bordering the south of the Site. A series of drains are present approximately 60 m south of the Site, possibly running either to or around The Lake.
1960 Aerial Photography	The watercourses within the site appear to have been straightened and the central area of the Site remains mostly cleared of trees with the exception of Middle Clearing and The Avenue. Scattered trees are visible across the Site.	No substantial changes.
1962 (1:10,000)	No substantial changes.	No substantial changes.
1966 (1:10,000)	No substantial changes	No substantial changes.
1970 (1:2,500)	Several ponds are present on the Site of the old brick works located within the northeast of the Site.	Further residential development has taken place to the south west of the Site. Middle Park Farm is no longer present. A weir exists in the place of the cutting, intercepting the unnamed watercourse approximately 400 m west of the Site. The old chalk pit approximately 200 m north west of the Site is no longer shown and potentially infilled.
1975 (1:10,000) (Southern half of the Site available)	The woodland to the east of The Avenue has been de-vegetated and regenerating scrub cleared. West of The Avenue the woodland key indicates 'Non-coniferous Trees-Scattered'. The George Canning Monument no longer shown to be present. A weir is present on the southern boundary of the Upper Lake.	No substantial changes.

Date and scale	On-site development	Development in the study area
1980- 1982 (1:10,000) (Northern half of the Site available) 1981 (1:2,500) Aerial Photography	The central area of the Site is largely de-vegetated excluding coniferous trees on the northern boundary of the Upper Lake. Woodland is still shown within the north of the Site.	Blendworth Common located adjacent to the north west of the Site has been de-vegetated. The A3(M) has been constructed approximately 330 m west of the Site.
1992 – 1996 (1:10,000) Aerial Photography	The central area of the Site is named the Sir George Staunton Country Park. The maps show all areas of the Sir George Staunton Country Park have been de-vegetated apart from the Middle Clearing in the south west of the Site and the area within The Avenue. A section across the southern boundary of the Site also remains vegetated and is still named as Havant Thicket. The northern area of the side remains as woodland. The watercourses in the central and north of the Site have been straightened.	Further residential development has taken place approximately 150 m to 500 m north east of the Site.
2000 (1:10,000)	The central area of the Site is now named Staunton Country Park.	No substantial changes.
2003 Aerial Photography	No substantial changes.	No substantial changes.
2006 – 2007 (1:10,000) Aerial Photography	No substantial changes.	A motor racing circuit has been constructed approximately 400 m north west of the Site.
2019 (1:10,000) Site Photography	No substantial changes.	No substantial changes.

- 10.45. The access roads generally comprised undeveloped land, which was predominantly woodland. Swanmore Road and Calshot Road, which form part of the southern access road, are shown on historical maps from 1972 and 2019 respectively. The B2149 road, which forms part of the northern access road, is shown on historical maps from 1870. The historical land uses within the access road study area are as the same as those for the reservoir site and are summarised in Table 10-10.

Pipeline corridor

Table 10-11 - Summary of historical development along the pipeline corridor

Date and scale	On-site development	Development in the study area
1870 1:10,560 1867-1878 1:2,500	The site generally comprises undeveloped land. The northern extent of the Site is located within Thicket Lawn, High Lawn and Front Lawn. The southern extent of the Site is located within the town of Bedhampton with residential properties and a road located on-site at OSGR 470664, 106596. The Brighton and South Coast railway crosses the Site at approximate OSGR 470623, 106464, located within the south of the Site. An unnamed road is also shown to cross the Site at approximate OSGR 470657, 106594. The Hermitage stream crosses the Site at approximate OSGR 470764, 107806.	The study area generally comprises undeveloped land with areas of woodland including the Great Coppice, Gammons Hill, Billys Coppice and Bondfields Coppice. Bondfields Plain is located approximately 30 m from the northern most extent of the Site around OSGR 471467, 109190 . The Lake is located approximately 260 m north east of the Site around OSGR 471760, 108968. West Garden is located approximately 220 m east of the Site around OSGR 471906, 108584. Several farms are also located within the study area. An old clay pit is located approximately 300 m east of the Site around OSGR 471906, 108584. A sand pit is located approximately 380 m north west of the Site around OSGR 470910, 107878 in Billys Coppice. A brick and tile works and associated kiln are located approximately 50 m west of the Site around OSGR 470804, 107754. The village of Stockheath is located approximately 200 m east of the Site around OSGR 470908, 107588. The town of Bedhampton is located at the southern extent of the study area. Portsmouth Water Works is located in Bedhampton approximately 420 m southeast of the Site around OSGR 470652, 106559. Several wells and springs including Bedhampton Springs and Bidbury Springs are present 200 m to the south east and west of Bedhampton around OSGR 470625, 106463. Several mills are located in Bedhampton including Upper Mill and Bedhampton Mill located 250 m and 500 m south of the Site around OSGR 470625, 106463.

Date and scale	On-site development	Development in the study area
		A tannery is located approximately 500 m southeast of the Site in Bedhampton around OSGR 470625, 106463.
1898 1:10,560 1897 1:2,500	No substantial changes.	The brick and tile works located 50 m west of the Site around OSGR 470804, 107754 are now shown as ponds. The town of Bedhampton to the south of the Site has expanded. An old brick field is shown 250 m to the east of the Site around OSGR 470713, 106785. Havant Joint Hospital (Infectious Diseases) is shown 500 m to the south east of the Site around OSGR 470664, 106619. The Borough Portsmouth Water Works is now located approximately 10 m south of the Site around OSGR 470628, 106462.
1909 -1910 1:10,560 1909 1:2,500	No substantial changes.	Bedhampton Mill and Upper Mill are marked as disused.
1931-1933 1:10,560 1932 1:2,500 1938-1942 1:10,560	A Memorial Hut is located partly on-site at approximate OSGR 470646, 106561 in Bedhampton. The Brighton and South Coast railway is now labelled as the Southern Railway.	Allotment gardens are present approximately 100 m east and south of the Site in Stockheath and Bedhampton around OSGR 471108, 106894 and OSGR 470843, 106810. A pumping station is located approximately 160 m southwest of the Site in Bedhampton. Further residential development has taken place in Bedhampton.
1952-1954 1:2,500	Several roads passing through residential areas are now located within the Site around OSGR 471047, 106831 including Botley Drive, Highclere Avenue, Dunsbury Way and Ellisfield Road. Ponds are partly located on site at approximate OSGR 470680, 106669 in Bedhampton. The roads located on-site around OSGR 470662, 106611 in the south of the Site are now labelled as Bedhampton Road and North Street. The Memorial Hut is now labelled as a Library.	Extensive residential development has taken place in Bedhampton and Stockheath. The residential development of Leigh Park has been constructed located approximately 140 m north of the Site around OSGR 471787, 108658. A Sewage Disposal Works is located approximately 70 m north of the Site (located off Dunsbury Way) around OSGR 471452, 108169. A reservoir is present within the Water Works located approximately 10 m south of the Site around OSGR 470628, 106462.

Date and scale	On-site development	Development in the study area
1956-1960 1:2,500	High Lawn Way is located in the north of the Site between OSGR 471908, 108570 and OSGR 470757, 107811. Purbrook Way road is located on-site at approximate OSGR 470866, 107666. Further residential development has taken place to the north and south of Purbrook Way. The Memorial Hut is now labelled as the Bedhampton Social Hall.	Further residential development has taken place along High Way Lawn between OSGR 471899, 108610 and OSGR 470763, 107805 and to the west of the Site within the vicinity of Middle Park Way between OSGR 471146, 107977 and OSGR 470757, 107811. Further residential development has taken place to the north and south of Purbrook Way around OSGR 470863, 107666. A builders yard is located approximately 80 m east of the Site in Bedhampton around OSGR 470653, 106633. Two garages are present in Bedhampton, located approximately 40 m west of the Site off Bedhampton Road and approximately 220 m east of the Site off West Street around OSGR 470650, 106560.
1961-1973 1:2,500 1963-1966 1:10,000	No substantial changes.	Further residential development has taken place adjacent to the east of the Site (to the north of New Road) between OSGR 470659, 106596 to OSGR 471079, 106831. A water works is located 180 m southwest of the Site in Bedhampton around OSGR 470622, 106458. The A27 carriageway has been constructed approximately 380 m south of the Site around OSGR 470622, 106458. A depot and works is located approximately 400 m south of the Site (to the south of the A27). Works/factory buildings and small depots are located approximately 80 m north and 180 m north of the Site (off Fulflood Road) around OSGR 471534, 108190. A garage is located approximately 100 m north west of the Site (on Dunsbury Way) around OSGR 471337, 108102.
1975 1:10,000	No substantial changes.	Further residential development has taken place within the northwest of the Site (to the west of Gammon's Hill) around OSGR 471463, 109199.
1978-1987 1:2,500	No substantial changes.	No substantial changes.

Date and scale	On-site development	Development in the study area
1991-1992 1:10,000 1991-1993 1:2,500	Brunswick Gardens road crosses the Site at approximate OSGR 470639, 106522.	Further residential development has taken place to the south of Bedhampton Road around OSGR 470658, 106607. An industrial estate is located approximately 250 m south of the Site (north of the A27) around OSGR 470628, 106462.
1999 Historical aerial photography	No substantial changes.	No substantial changes.
2000 1:10,000	No substantial changes.	No substantial changes.
2006 1:10,000	No substantial changes.	No substantial changes.
2020 1:10,000	No substantial changes.	No substantial changes.

Mapped geology

Reservoir site

- 10.46. According to the BGS GeoIndex⁴³ Made Ground is not indicated present beneath the reservoir site. Superficial deposits underlying the central, western and southern areas of the reservoir site comprise Head. Superficial deposits are indicated to be absent within the northern and eastern areas of the Site.
- 10.47. The bedrock geology underlying the northern half of the reservoir site generally comprises the London Clay Formation – clay, sand and silt, the Harwich Formation (London Clay Formation) – sand, and the Lambeth Group (Reading Formation) – clay, sand and silt. The bedrock geology directly underlying the southern half of the reservoir site generally comprises the London Clay Formation (Bognor Sand Member) – fine and medium grained sand and the London Clay Formation – clay, sand and silt. The White Chalk Sub-Group is expected to underlie the Bognor Sand Member, London Clay Formation, Harwich Formation, and Lambeth Group at depth⁴⁴.
- 10.48. According to the BGS GeoIndex⁴³ Made Ground is not indicated present beneath the access roads. However, Made Ground is anticipated to be present on site within both the southern and northern access roads associated with the construction of Swanmore Road in the south and the B2149 in the north.
- 10.49. Superficial deposits are indicated to be largely absent within the access roads. Head is present to the west of the southern access road associated with watercourses within The Warren and within the vicinity of Hermitage Stream.
- 10.50. The bedrock geology underlying the southern access road comprises the London Clay Formation (Bognor Sand Member) – fine and medium grained sand and London Clay Formation – clay, sand and silt. Bedrock geology underlying the northern access road comprises the Harwich Formation (London Clay Formation) – sand, and the Lambeth Group (Reading Formation) – clay, sand and silt. The White Chalk Sub-Group is expected to underlie the Bognor Sand Member, London Clay Formation, Harwich Formation and Lambeth Group at depth⁴⁴.

Pipeline corridor

- 10.51. According to the BGS GeoIndex⁴³ Made Ground is not indicated to be present beneath the Site. However, Made Ground is anticipated to present on-site associated with the roads located on-site and the historic development of Bedhampton, Stockheath and Havant. The Envirocheck report³⁸

also indicates that there is potentially infilled land located on-site between OSGR 470837, 107709 and OSGR 470774, 107822 associated with the former Havant Brick and Tile Works mineral site.

- 10.52. Superficial deposits are indicated to be present underlying the southern extent of the corridor, comprising River Terrace Deposits between OSGR 470625, 106454 to OSGR 470627, 106473. Head is present between OSGR 470627, 106473 to OSGR 471329, 108077 and OSGR 471776, 108837 to OSGR 471466, 109260. Superficial deposits are indicated to be absent between OSGR 471336, 108104 to OSGR 471776, 108837.
- 10.53. The bedrock geology underlying the Site predominantly comprises the London Clay Formation – clay, sand and silt, and is present between OSGR 470650, 106565 to OSGR 470706, 106767, OSGR 470710, 106784 to OSGR 471335, 108082 and OSGR 471830, 108660 to OSGR 471466, 109260. The London Clay Formation (Bognor Sand Member) is indicated to be present in the south and centre of the Site between approximate OSGR 470708, 106783 to OSGR 470710, 106784 and OSGR 471335, 108082 to OSGR 471830, 108660. The bedrock geology within the southern extent of the Site comprises the Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (Undifferentiated) between OSGR 470625, 106454 to 50. The Lambeth Group (Reading Formation) – clay, sand and silt is present in the south of the Site between OSGR 470630, 106482 to OSGR 470633, 106492.

Natural cavities

Reservoir site

- 10.54. There is the potential for natural cavities such as swallow holes and sinkholes to be present within the study area associated with karst dissolution features within the underlying White Chalk Sub-Group.
- 10.55. There are recorded swallow holes and sink holes approximately 200 m to the north east of the reservoir site, where the Reading Formation outcrops around Rowlands Castle^{45, 46}. The presence of sinkholes was not identified within aerial photography reviewed as part of previous studies⁴⁹ or geomorphological field mapping undertaken as part of the 2019 ground investigation for the reservoir site⁵⁰.

Pipeline corridor

- 10.56. No sinkholes are recorded along the length of the pipeline^{45, 46}.

Ground stability hazards

Reservoir site

- 10.57. The Envirocheck report³⁷ indicates that the potential for collapsible ground, landslide, running sand and shrinking and swelling clay stability hazards within the reservoir site is very low to low. However, the presence of relict shear surfaces and the potential for instability hazards were noted to be present within the Head deposits during the 2019 ground investigation⁵⁰. The central area of the reservoir site is indicated by the Envirocheck report³⁷ to have a moderate risk of shrinking and swelling clay stability hazards. The presence of highly cohesive clay and potential for compaction and shrinking and swelling issues were confirmed by the 2019 ground investigation⁵⁰. No hazards are identified for compressible ground or ground dissolution stability hazards.
- 10.58. The Envirocheck report³⁷ indicates that the potential for collapsible ground and landslide stability hazards within the access road sites is very low. The potential for running sand stability hazards within the Sites is very low to low and the potential for shrinking and swelling clay stability hazards is very low to moderate. No hazards are identified for compressible stability hazards. A low risk of potential ground dissolution stability hazards has been identified within the northern access road at the northern extent of the B2149.

Pipeline corridor

- 10.59. For the pipeline corridor, the Envirocheck report³⁸ indicates that the potential for collapsible ground and running sand stability hazards within the Site are very low to low. The potential for landslide stability hazards on-site is very low. The potential for shrinking and swelling clay and ground dissolution stability hazards within the Site is indicated to vary between no hazard in the north of the

Site and moderate risk in the south of the Site. No hazards are identified for compressible ground within the Site.

Radon

- 10.60. According to the Envirocheck reports^{37, 38} the reservoir site, access roads and pipeline corridor are located within a lower probability radon area (less than 1% of homes in the area are estimated to be at or above the Action Level). No measures to mitigate the potential effects of radon are necessary in the construction of new dwellings or extensions.

Important geological sites

- 10.61. The MAGIC map application⁵¹ indicates that there are no geological SSSIs or Local Geological Sites located within the reservoir site and access roads, and pipeline corridor study area.

Mineral resources

Reservoir site

- 10.62. For the reservoir site, the Envirocheck report³⁷ indicates that there are two BGS recorded mineral sites located on site and a further six BGS recorded mineral sites located within the study area. A summary is provided within Table 10-12 below.

Table 10-12 - Summary of BGS recorded mineral sites (reservoir site)

Distance and orientation from the Site	Site name	Type / commodity	Geology	Status
0 m – located within the north of the Site	Horsefoot Clay Pit	Opencast / Common Clay and Shale	London Clay Formation	Ceased
0 m – located within the north east of the Site	Long Wood Brick Works	Opencast / Common Clay and Shale	Lambeth Group	Ceased
67 m south east	Durrants Brick Field	Opencast / Common Clay and Shale	London Clay Formation	Ceased
100 m west	Dunsbury Hill Brick Yard	Opencast / Common Clay and Shale	London Clay Formation	Ceased
205 m east	Red Hill Brick and Tile Works	Opencast / Common Clay and Shale	Lambeth Group	Ceased
296 m east	Castle Road Clay Pit	Opencast / Common Clay and Shale	Lambeth Group	Ceased
394 m south east	North Lodge Clay Pit	Opencast / Common Clay and Shale	Bognor Sand Member	Ceased
480 m north east	The Holt Gravel Pits	Opencast / sand and gravel	Head	Ceased

- 10.63. Two MWCA are located within the central and eastern areas of the reservoir site⁵⁴, both for clay resources. MWCAs are also located adjacent to the north of the reservoir site and approximately

⁵⁴ Hampshire County Council, Hantsweb, Minerals Consultation Area Search Map, 2019. [Online]. Available: <https://maps.hants.gov.uk/mineralsconsultationareas/>.

250 m east, again for clay resources. A MSA for oil and gas is located adjacent to the north of the reservoir site.

- 10.64. For the access roads, the Envirocheck report³⁷ indicates that there is one BGS recorded mineral site located within the study area as summarised in Table 10-13 below.

Table 10-13 - Summary of BGS recorded mineral sites (access roads)

Distance and orientation from the Site	Site Name	Type / Commodity	Geology	Status
100 m west	Dunsbury Hill Brick Yard	Opencast / Common Clay and Shale	London Clay Formation	Ceased

- 10.65. The northern access road is located within a MWCA for clay resources⁵⁴. The MWCA extends off-site to the north, northwest and southeast of the Site beyond the study area. A MSA for oil and gas is also present in the northern extent of the Site, along the existing B2419.

Pipeline corridor

- 10.66. The Envirocheck report³⁸ indicates that there are two BGS recorded mineral site located within the study area for the pipeline corridor as summarised in Table 10-14 below.

Table 10-14 - Summary of BGS recorded mineral sites (pipeline)

Distance and orientation from the Site	Site name	Type / commodity	Geology	Status
22 m west	Havant Brick and Tile Works	Opencast / Common Clay and Shale	London Clay Formation	Ceased
269 m east	Havant Park Brick Field	Opencast / Common Clay and Shale	River Terrace Deposits	Ceased

- 10.67. A MWCA for sharp sand and gravel resources is located approximately 120 m south of the Site. A MSA (Harts Farm Way) is located approximately 380 m south of the Site⁵⁴.

Mining cavities

- 10.68. The Envirocheck report³⁷ indicates that the Site is not located within a coal mining area. However, there is a man-made mining cavity located within the reservoir site study area as summarised in Table 10-15 below.

Table 10-15 - Summary of man-made mining cavities

Distance and orientation from the Site	Cavity type	Commodity	Geology
269 m east of the reservoir site	Historical Brick and Tile Works/Extensive Clay Pits – Potential Chalk Mining	Chalk	Lambeth Group, Culver Chalk Formation

Hydrogeology

Aquifer classifications

- 10.69. The Environment Agency's aquifer classifications for the geology underlying the study areas for the reservoir site and pipeline corridor are summarised in Table 10-16 below.

Table 10-16 - Aquifer designations

Geology	Stratum	Aquifer classification
Superficial	Head	Secondary Undifferentiated aquifer ⁵⁵
	River Terrace Deposits	Secondary A aquifer ⁵⁶
Bedrock	Reading Formation	Secondary A aquifer
	Bognor Sand Member	Secondary A aquifer
	Harwich Formation	Secondary A aquifer
	London Clay Formation	Unproductive strata ⁵⁷
	White Chalk Sub-Group	Principal aquifer ⁵⁸
	The Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation	Principal aquifer

Groundwater vulnerability

Reservoir site

- 10.70. According to the Envirocheck report³⁷ the superficial Head aquifer is indicated to have a medium vulnerability and the Reading Formation and Bognor Sand Member bedrock aquifers are indicated to have a medium to high vulnerability. The London Clay Formation is classified as an unproductive aquifer.
- 10.71. The MAGIC map application⁵¹ indicates that the north and northeast of the Site is located within a groundwater drinking safeguard zone. The zone extends beyond the study area to the north and east of the Site.

Pipeline corridor

- 10.72. According to the MAGIC map application⁵¹ and the Envirocheck report³⁸ the superficial and bedrock aquifers underlying the Site have a medium to high vulnerability.
- 10.73. The MAGIC map application⁵¹ indicates that the southern extent of the Site is located within a groundwater drinking safeguard zone.

Source Protection Zones

Reservoir site

- 10.74. The MAGIC map application⁵¹ and Envirocheck report³⁷ indicate that the reservoir site and access roads are located within an Inner Zone (Zone 1c)⁵⁹ Subsurface Activity only Source Protection Zone (SPZ). An Outer Zone (Zone 2)⁶⁰ is also present underlying the north of the reservoir site and part of

⁵⁵ The Environment Agency defines Secondary Undifferentiated aquifers as those that have been assigned where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

⁵⁶ The Environment Agency defines Secondary A Aquifers as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

⁵⁷ The Environment Agency defines Unproductive Strata as rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

⁵⁸ The Environment Agency defines a Principal aquifer as layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

⁵⁹ The Environment Agency defines an inner zone - subsurface activity only (Zone 1c) - as extending Zone 1 where the aquifer is confined and may be impacted by deep drilling activities.

⁶⁰ The Environment Agency defines an Outer zone (Zone 2) as a 400-day travel time from a point below the water table.

the northern access road. An Inner Zone (Zone 1)⁶¹ SPZ is present underlying the northern access road along the B2419. The SPZs are associated with the underlying Chalk Principal aquifer.

Pipeline corridor

- 10.75. The MAGIC map application⁵¹ and Envirocheck report³⁸ indicate that the southern extent of the Site is located within an Inner Zone (Zone 1) SPZ. The remainder of the Site is located within an Inner Zone (Zone 1c) Subsurface Activity only SPZ.

Groundwater abstractions

Reservoir site

- 10.76. The Envirocheck report³⁷ indicates that there are no groundwater abstraction licences located within the study area. It is noted that the Havant and Bedhampton Springs located approximately 3km to the south of the reservoir site will be the abstraction source for the reservoir.

Pipeline corridor

- 10.77. The Envirocheck report³⁸ indicates that there are three groundwater abstractions located within the study area. Groundwater abstraction details are summarised in Table 10-17 below.

Table 10-17 - Summary of groundwater abstractions (pipeline corridor)

Distance and orientation from the Site	Operator and location	Abstraction type	Details
22 m south	Portsmouth Water Ltd, Bedhampton Ps Spring No. 1	Public Water Supply: Potable water supply.	Permit start: 26/09/1977 Permit end: Not supplied
151 m south	Portsmouth Water Ltd, Havant Ps	Public Water Supply: Potable water supply.	Permit start: 26/09/1977 Permit end: Not supplied
411 m south east	Portsmouth Water Ltd, Bedhampton Ps Spring No. 2	Public Water Supply: Potable water supply.	Permit start: 26/09/1977 Permit end: Not supplied

Discharge consents to groundwater

- 10.78. No discharges to groundwater are recorded within the Envirocheck reports^{37, 38} within the study area.

Hydrology

Reservoir site

- 10.79. OS mapping within the Envirocheck report³⁷ indicates that there are a number of hydrological features present within the study area. Three unnamed watercourses flow from north to south and converge into one stream to the west of The Avenue in Deerslaughter Plain. The alignment of the channels has been altered over time, probably to improve the land for agricultural use⁴⁰.
- 10.80. The western-most watercourse originates in Havant Thicket within the north of the Site, before flowing south through Middle Clearing and joining the main stream in Deerslaughter Plain. The central watercourse flows south into the Upper Lake, which is located within the central area of the Site.
- 10.81. The Upper Lake covers an area of approximately 6,400 m². A weir is located on the southern edge of the lake. The damming of the central watercourse to form the lake was recorded to have been completed in 1869⁴⁰.
- 10.82. A drain exits the lake flowing south along The Avenue for approximately 200 m to a confluence. At this point the third watercourse, which flows from the north eastern area of the Site (Long Wood),

⁶¹ The Environment Agency defines an Inner zone (Zone 1) as the 50-day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres.

also joins the central watercourse. There is a drain present in the east of the Site that connects to a series of drains that flow east from Gipsies Plain, west of The Durrants [2] that also joins at this point. An additional drain flows from east to west across The Avenue approximately 290 m north of the southern boundary of the Site, towards the main confluence in Deerslaughter Plain. The combined watercourses and drains continue to flow south across the southwestern boundary of the Site, flowing parallel to the residential development west of Thicket Lawn to a culvert below Middle Park Way Road approximately 500 m south of the Site.

- 10.83. A spring, well, and two additional drains are located within Hammonds Lands Copse and Hommick Copse. The drains are located approximately 70 m and 170 m south of the Site and flow west for approximately 220 m and 500 m towards The Lake. The Lake covers an area of approximately 16,700 m² and is located 60 m south of the Site.
- 10.84. A further unnamed channel flows from north to south through Bells Copse and then off-site through The Warren and under Swanmore Road (which will form part of the southern access road) before being intercepted by a culvert located approximately 250 m west of Warren Park Primary School in the north of Leigh Park.
- 10.85. There is a collection of small ponds located within the north east of the Site near Long Wood and Furzy Plain, as well as to the south east of the Site in the woodland. Historical maps show these areas as the Sites of former brick works and clay pits.
- 10.86. The Environment Agency catchment data explorer⁶² website indicates that the Site falls within the Hermitage Stream WFD catchment. The stream is located approximately 1.32 km west of the reservoir site and flows beneath Calshot Road (which will form part of the southern access road). In 2016 the ecological classification for the stream was 'Moderate' and the chemical classification 'Good'.

Pipeline corridor

- 10.87. OS mapping within the Envirocheck report³⁸ indicates that there are a number of hydrological features present within the study area. Riders Lane Stream crosses the Site at approximate OSGR 471151, 107975 (located east of Riders Lane). The Riders Lane Stream originates to the north of the Site within the Staunton Country Park and flows in a southerly direction until it joins the Hermitage Stream. The Lake is located approximately 238 m north east of the Site. A drain connects the Lake to the Riders Lane stream.
- 10.88. The Hermitage Stream crosses the Site at approximate OSGR 470770, 107819 (east of Finchdean Road). The Hermitage Stream generally flows parallel to the Site in a southerly direction from approximate OSGR 470770, 107819 to OSGR 471082, 106835. The Hermitage Stream continues to flow south until it joins the Langstone Harbour located 1km to the south of the Site.
- 10.89. Two unnamed streams are located approximately 292 m north west and 330 m north west of the Site. The unnamed streams both flow north west into the Hermitage Stream.
- 10.90. The Environment Agency catchment data explorer⁶² website indicates that the Site falls within the Hermitage Stream WFD catchment. In 2016 the ecological classification for the stream was 'Moderate' and the chemical classification 'Good'.

Discharge consents to surface water

Reservoir site

- 10.91. The Envirocheck report³⁷ indicates there are two discharge consents located within the reservoir site study area:
 - 180 m east, related to the discharge of 'Other Matter-Surface Water' to a freshwater stream/river from domestic properties. The consent is dated March 1982, but is listed as lapsed; and
 - 235 m east, related to the discharge of 'Other Matter-Surface Water' to a freshwater stream/river from undefined property types. The consent is dated February 1988 but is listed as lapsed.
- 10.92. According to the Envirocheck report³⁷ there are no discharge consents to surface water located within the access roads study area.

⁶² Environment Agency, Catchment Data Explorer, 2019. [Online]. Available: <https://environment.data.gov.uk/catchment-planning/>.

Pipeline corridor

- 10.93. According to the Envirocheck report³⁸ there are eleven discharge consents to surface water located within the study area between 7 m east and 399 m south west of the Site. The consents are for the discharge of public sewage: storm sewage overflow, trade effluent discharge, sewage effluent, sewage discharges (final/treated effluent) and discharge of other matter into Hermitage stream, other freshwater streams/ivers and a saline estuary.

Surface water abstractions

Reservoir site

- 10.94. According to the Envirocheck Report³⁷ there is one surface water abstraction located approximately 200 m north west of the Site for general agriculture, spray irrigation at Padnell Farm.

Pipeline corridor

- 10.95. The Envirocheck report³⁸ indicates that there are no surface water abstractions located within the study area.

Pollution Incidents to controlled waters

Reservoir site

- 10.96. For the reservoir site, the Envirocheck report³⁷ indicates that four pollution incidents to controlled waters have occurred within the study area between 100 m east and 454 m south west of the Site. The incidents occurred between 1992 and 1998 and were classed as Category 3 – Minor Incidents and involved chemicals (paints / dyes), oils (diesel including agricultural pesticide/fertilizer and petrol) and agricultural pesticide/fertilizer. Details of the receiving water for the pollution incidents is not provided.
- 10.97. For the access roads, the Envirocheck report [3] indicates that there are no recorded pollution incidents to controlled waters located within the study area.

Pipeline corridor

- 10.98. For the pipeline corridor, the Envirocheck report³⁸ indicates that 21No. pollution incidents to controlled waters have occurred within the study area. The incidents occurred between 1992 and 1999 and were classed as Category 2 – Significant Incidents and Category 3 – Minor Incidents and involved oils (gas oil, diesel, petrol and other oils), sewerage, unknown chemicals, organic chemicals (mixed, unknown, waste mineral and synthetic oil), inert suspended solids (white effluent and foam). The receiving water for the pollution incidents is listed as Hermitage Stream and an unnamed watercourse.

Flood Risk

Reservoir site

- 10.99. The Environment Agency flood map for planning website⁵² shows that the majority of the reservoir site is located within a Flood Zone 1: low probability area of flooding from rivers and sea⁶³.
- 10.100. The land adjacent to the central watercourse flowing south from Deerslaughter Plain to Gammon's Hill and Thicket Lawn and the unnamed watercourse within Bells Copse are classified as Flood Zone 2: medium probability⁶⁴ and Flood Zone 3: high probability of flooding from rivers and sea⁶⁵.
- 10.101. Rowlands Golf Course located approximately 30 m north east of the Site is classified as a Flood Zone 3: high probability area.
- 10.102. For the access roads, the Environment Agency flood map for planning website [4] shows that the majority of the Site is located within a Flood Zone 1. A section of the Swanmore Road is located within a Flood Zone 1, with the flood risk associated with a watercourse flowing through The Warren.

⁶³ Defined as land having a less than 1 in 1,000 annual probability of river or sea flooding.

⁶⁴ Defined as and having between a 1 in 100 and 1 in 1,000 annual probability of river flooding.

⁶⁵ Defined as and having a 1 in 100 or greater annual probability of river flooding.

Pipeline corridor

- 10.103. The Environment Agency flood map for planning website⁵² shows that areas of the Site that are located within close proximity to the Hermitage Stream and where the Riders Lane Stream crosses the Site are located within a Flood Zone 3. The remainder of the Site is located within a Flood Zone 1.
- 10.104. Further details are provided in Chapter 15 Water (including flows, quality and groundwater) in the ES Volume 2 and in the Flood Risk Assessment included in Appendix A15.2 in ES Volume 4.

Historic and Environmentally Sensitive Sites

Reservoir site

- 10.105. According to the MAGIC map application⁵¹ the reservoir site is located within a Nitrate Vulnerable Zone (NVZ).
- 10.106. Staunton Country Park is located to the west of The Avenue. The Country Park continues south of the Site and includes the areas of Thicket Lawn, Leigh Park, The Lake, Hommick Copse and Hammonds Land Copse. The South Downs National Park is located adjacent to the north east of the Site.
- 10.107. There are also several Ancient Woodland designations located on-site and within the study area, which include Ancient and Semi-Natural Ancient Woodland and Plantation on Ancient Woodland. Areas located on-site include the Forest of Bere, Hammonds Lands Copse, The Avenue, Middle Clearings, Thicket Bottom and Long Wood and other unnamed areas.
- 10.108. Six Sites of Importance for Nature Conservation (SINC) are located within the reservoir site including Havant Thicket, Middle Clearing, Thicket Bottom, Bells Copse, Thicket Bottom Woods and Lake and the Idsworth Common SINC. Cabbage Field Row, Dunsbury Hill Grassland, The Holt, and Blendworth Common SINC are located immediately adjacent to the Site.
- 10.109. There are no scheduled monuments⁵¹ located within the study area. There are seven Grade II and one Grade II* listed buildings located within the study area. Staunton Country Park is designated as a Grade II* Historic Park, Garden or Designated Landscape.
- 10.110. For the access roads, according to the MAGIC map application⁵¹ the Site is located within a NVZ and the B2149 is located within the South Downs National Park. The Envirocheck report³⁸ indicates that the northern access road is located within the Forest of Bere Ancient Woodland and the Havant Thicket and Idsworth SINC. The access roads are located immediately adjacent to Cabbage Field Row, Dunsbury Hill Grassland 2, Bells Copse, The Warren Havant, The Holt, Pyle Farm Meadow South and Blendworth Common SINC.
- 10.111. There are no scheduled monuments⁵¹ or listed buildings within the study area.

Pipeline corridor

- 10.112. According to the MAGIC map application⁵¹ the Site is located within a NVZ. There are no ecological statutory designated sites located within the study area.
- 10.113. There are no scheduled monuments within the study area. There are 20 No. Grade II listed buildings and two Grade II* listed buildings located within the study area⁵¹.
- 10.114. Further details are provided in Chapter 8 Historic Environment and Chapter 9 Biodiversity in the ES Volume 2.

Land contamination

Historical landfill sites

Reservoir site

- 10.115. The Envirocheck report³⁷ indicates that there are two historical landfills located within the study area. Dunsbury Hill Farm landfill is located adjacent to the north west of the reservoir site and the northern access road. Deposited waste included inert waste with the first input date detailed as the 1 September 1977. No further information relating to the operation of the Site is available.

- 10.116. Padnell Farm landfill is located on Calshot Road adjacent to the north of the southern access road and approximately 180 m west of the reservoir site. Specified waste included Inert Waste. No further information relating to the operation of the Site is available.

Pipeline corridor

- 10.117. The Envirocheck report³⁸ indicates that there are no historical landfills located within the study area.

Contemporary potentially contaminative land uses

Reservoir site

- 10.118. The Envirocheck report³⁷ indicates that there are six active contemporary trade directories located within the study area including printers, petrol filling stations, commercial cleaning services, car breakdown and recovery services and manufactures and suppliers.

Pipeline corridor

- 10.119. According to the Envirocheck Report³⁸ there 39No. active contemporary trade directories located within the study area including domestic cleaning services, car dealers, domestic appliance servicing and repairs, tyre dealers, waste disposal service, car manufactures, MOT testing centre and garage service, painting and decorating supplies, road haulage services and electrical goods sales, manufacturers and wholesalers.

Fuel stations

Reservoir site

- 10.120. For the reservoir site, according to the Envirocheck Report³⁷ there is one fuel station located within the study area. A Shell petrol station (Shell Whichers Gate) is located approximately 84m east of the Site at Durrants Road and Emsworth Road. The petrol station is listed as open.

- 10.121. For the access roads, according to the Envirocheck Report³⁷ there are no fuel stations located within the study area.

Pipeline corridor

- 10.122. According to the Envirocheck Report³⁸ there are five fuel station entries located within the study area as summarised in Table 10-18 below.

Table 10-18 - Summary of fuel stations (pipeline corridor)

Distance and orientation from the Site	Name and location	Premise type	Status
68 m west	Cambridge Garage, 23 Bedhampton Road, Havant	Not applicable – no further details provided	Obsolete
132 m east	Hendy Lennox, New Road, Havant	Not applicable – no further details provided	Obsolete
276 m west	Park Lane Service Station, Park Lane Purbrook Way	Petrol station	Open
310 m east	Leigh Park Service Station, Stock Heath Road, Sombourne Road, Havant	Not applicable – no further details provided	Obsolete
474 m east	Westleigh Service Station, Petersfield Road, Havant	Not applicable – no further details provided	Obsolete

Authorised landfill and waste management facilities

Reservoir site

- 10.123. The Envirocheck Report³⁷ indicates that there are no authorised landfill sites or waste management facilities within the study area.

Pipeline corridor

- 10.124. The Envirocheck Report³⁸ indicates that there are two licenced waste management facilities located on-site and a further three licenced waste management facilities located within the study area. A summary is provided in Table 10-19.

Table 10-19 - Summary of licenced waste management facilities (pipeline corridor)

Distance and orientation from the Site	Operator and location	Site category	License status
0 m - on-site	Portsmouth Water Ltd, Bedhampton Landfill, Bedhampton Waterworks, Meyrick Road	Inert landfill, no further details provided	Issued: 21/04/2005
0 m - on-site	Portsmouth Water Company Ltd, Bedhampton Waterworks, Meyrick Road	Landfill taking non-biodegradable wastes (not construction)	Issued: 18/02/1992. Inactive
105 m east	Portsmouth Water Limited, Bedhampton Waterworks, Meyrick Road	Transfer stations taking non-biodegradable wastes	Issued: 29/06/2007. Modified
474 m south	Associated Environmental Ltd Projects, Havant Incinerator, Harts Farm Way, Havant	Household, commercial and industrial transfer stations	Issued: 21/06/1993. Surrendered
496 m south	Hampshire County Council, Harts Farm Way Depot, Harts Farm Way, Havant	Metal recycling sites (mixed)	Issued: 19/12/2002. Surrendered

Pollution controls

Reservoir site

- 10.125. For the reservoir site, the Envirocheck report³⁷ indicates there is one Local Authority Pollution Prevention Control (LAPPC) for PG1/14 petrol filling station registered to Shell UK Ltd located approximately 82 m east of the Site. The LAPPC is dated 31 December 1998 and is listed as permitted.
- 10.126. For the access roads, the Envirocheck report³⁷ indicates that there are no pollution controls located within the study area.

Pipeline corridor

- 10.127. The Envirocheck report³⁸ indicates that there are four pollution controls located within the study area as summarised below in Table 10-20.

Table 10-20 - Summary of local authority pollution prevention controls (pipeline corridor)

Distance and orientation from the Site	Name and location	Description	Permit status
132 m east	Kwik-Fit, New Road, Havant	PG1/14 Petrol filling station	Permit dated: 12/12/2005. Revoked

Distance and orientation from the Site	Name and location	Description	Permit status
275 m west	BP Park Lane Service Station, 97 Park Lane, Bedhampton	PG1/14 Petrol filling station	Permit dated: 22/12/1998. Permitted
461 m east	West Leigh Service Station (Motorwork), Petersfield Road, Havant	PG1/1 Waste oil burners, less than 0.4MW net rated thermal input	Permit dated: 22/03/2006. Transferred to IPPC
474 m east	West Leigh Service Station, Petersfield Road, Havant	PG1/14 Petrol filling station	Permit dated: 09/12/1998. Revoked

Potential for unexploded ordnance

Reservoir site

- 10.128. A UXO risk map obtained from Zetica⁴⁸ indicates that there is a low risk of encountering UXO within the Site. However, a preliminary UXO threat assessment report, provided by Landmark [5] indicates that the potential of a UXO hazard to occur within the southern and central areas of the Site has been assessed as 'Likely'.
- 10.129. This is due to the Site being located in the Petersfield Rural District, which recorded two High Explosive bomb strikes per 100 hectares and is classified as a low level of bombing. A military camp and battery were also located to the south of the Site from 1870 and 1946 respectively.

Pipeline corridor

- 10.130. A UXO risk map obtained from Zetica⁴⁸ indicates that within the northern area of the Site there is a low risk of encountering UXO and within the southern area of the Site there is a moderate risk⁶⁶ of encountering UXO.

Previous ground investigations

- 10.131. A total of four ground investigations has been undertaken within the footprint of the reservoir between 1962 and 2019 to inform the design of the Scheme. The ground investigations comprised the drilling of 58No. cable percussive and rotary boreholes, excavation of 75No. trial pits, geotechnical laboratory testing, geo-environmental testing and groundwater monitoring.
- 10.132. A summary of the reservoir footprint ground investigations is provided in the following sections. Further details are provided in the Desk Study Report⁴⁹ and Ground Investigation Report⁵⁰ included in Appendix A10.2 and Appendix A10.5 in ES Volume 4. No previous ground investigation information is available for the wider reservoir site, or pipeline corridor. A ground investigation is currently being scoped for the pipeline corridor.
- 10.133. Ground conditions encountered within the ground investigations are summarised in Table 10-21 below.

Table 10-21 - Summary of encountered geology within the reservoir footprint

Stratum	Depth Top (m bgl)	Elevation Top (m OD)	Thickness Range (m)	Typical Thickness (m)	Distribution
Topsoil	0.0	22.2 – 40.5	0.1 – 1.0	0.3	Whole of reservoir footprint
Head	0.0 – 0.5	19.6 – 40.1	0.1 – 2.9	1.0	Whole of reservoir footprint

⁶⁶ Areas indicated as having a bombing density of 15 to 49 bombs per 1000 acre.

Stratum	Depth Top (m bgl)	Elevation Top (m OD)	Thickness Range (m)	Typical Thickness (m)	Distribution
Bognor Sand Member	0.0 – 0.8	34.5 – 39.1	1.8 – 5.5	-	South-western section of reservoir footprint
Weathered London Clay Formation	0.0 – 2.7	17.9 – 35.1	0.4 – 10.9	1.1	Whole of reservoir footprint except where Harwich or Reading Formation are at surface.
London Clay Formation	1.0 – 14.0	28.2 – 33.6	0.2 – 30.6	-	Whole of reservoir footprint except where Harwich or Reading Formation are at surface.
Harwich Formation	0.1 – 36.6	5.46 – 39.8	0.3 – 5.6	2.0	Whole of reservoir footprint except where Reading Formation are at surface.
Reading Formation	0.0 – 39.6	5.3 – 38.0	29.5 – 32.5	30.7	Whole of reservoir footprint.
White Chalk Sub-Group	35.0 – 68.7	-4.5 – 5.5	>12	>12	Whole of reservoir footprint.

Notes m – metres, bgl – below ground level, OD – ordnance datum

- 10.134. No Made Ground was encountered at the Site and no visual or olfactory signs of contamination were recorded in any exploratory holes.
- 10.135. Groundwater strikes were encountered in topsoil (0 m to 0.1 m bgl), Head deposits (0.4 m to 1.6 m bgl), Bognor Sand Member (0.9 m bgl), London Clay Formation (0.5 m to 2.5 m bgl), Harwich Formation (1.0 m to 34 m bgl) and Reading Formation (12.25 m to 32.99 m bgl).
- 10.136. As part of the 2019 ground investigation⁵⁰ a total of 20No. soil samples were collected for environmental testing. Samples were obtained from the topsoil, Head deposits, London Clay Formation, Harwich Formation and Reading Formation, at depths between 0.1 m and 4.0 m. A total of 12No. groundwater samples were also collected over three monitoring rounds from four monitoring wells installed within the London Clay Formation, Head and Harwich Formation; these were analysed for potential contaminants.
- 10.137. The soil results were screened against Generic Assessment Criteria (GAC) for an open space (parkland) end use. No exceedances of the GAC were identified in the samples analysed. Six topsoil samples collected between the depths of 0.1 m and 0.3 m bgl were analysed for asbestos fibres. No asbestos fibres or Asbestos Containing Material was identified within any of the samples analysed. Based on the available data, contaminants in site soils at the concentrations recorded were considered unlikely to present unacceptable risks to identified human receptors⁵⁰.
- 10.138. Groundwater monitoring data was screened against Environmental Quality Standards for inland freshwater (EQS), protective of aquatic life in surface water and Drinking Water Standards (DWS)⁶⁷. Groundwater EQS exceedances were identified for ammoniacal nitrogen, metals and total petroleum hydrocarbon (TPH) fractions. Groundwater DWS exceedances were identified for ammoniacal nitrogen and metals. However, these are considered to be marginal exceedances and, based on the available data, potential contaminants in site groundwater samples at the

⁶⁷ HMSO, The Water Framework Directive (Standards and Classification) Direction (England and Wales), 2015.

concentrations recorded are considered unlikely to present potentially unacceptable risks to identified controlled water receptors⁵⁰.

Preliminary Conceptual Site Model

- 10.139. A PCSM identifies the potential or known sources of contamination, receptors and pathways. Where all three are present or are considered likely to be present they are defined as a PCL.
- 10.140. Three PCSMs (baseline, construction and operation) have been produced for the Scheme using the information summarised in paragraphs **Error! Reference source not found.** to 10.140. A summary of potential contamination sources for each phase (baseline, construction and operation) is provided in Table 10-22 and Table 10-23. Potential pathways and receptors identified for each phase are provided in Table 10-24 and Table 10-25.

Sources – Reservoir site (including access roads)

Table 10-22 - Potential sources of contamination (reservoir site including access roads)

Location	Potential Source of Contamination	Potential Contaminants
On-site	Re-worked site-won material used during the construction of the Upper Lake, Upper Lake Weir, Boat House and the George Canning Monument.	A range of inorganic and organic contaminants including metals and hydrocarbons.
	Re-worked site material used during the channelization of unnamed watercourses.	A range of inorganic and organic contaminants including metals and hydrocarbons.
	Potentially contaminated natural superficial strata from localised spills / leaks during past mechanical de-vegetation.	A range of inorganic and organic contaminants including heavy metals, hydrocarbons and Polyaromatic Hydrocarbons (PAHs).
	Potentially contaminated natural superficial strata from localised spills / leaks from previously observed dumped and burnt out cars or motorbike use.	A range of inorganic and organic contaminants including heavy metals, hydrocarbons and PAHs including the potential for asbestos.
	Made Ground associated with the construction and operation of the B2149, Swanmore Road and Calshot Road.	A range of inorganic and organic contaminants including heavy metals, hydrocarbons and PAHs and the potential for asbestos. Fuels and oils attributed to spills from vehicles on the roads, plus exhaust particulates.
	Infilled ground associated with two former clay pits located within the north west and north of the Site and a former chalk pit located within the north west of the Site.	A range of inorganic and organic contaminants including metals and hydrocarbons and the potential for asbestos. Potential for ground gas.
	Infilled ground associated with a former brickworks and clay pits located within the north east of the Site.	A range of inorganic and organic contaminants including metals and hydrocarbons and the potential for asbestos. Potential for ground gas.
	Potential spills / leaks during construction and operation of the reservoir and access roads.	A range of organic contaminants including hydrocarbons.
Off-site	Potentially contaminated ground and groundwater associated with the fuel station located approximately 84 m east of the Site.	A range of contaminants including heavy metals, hydrocarbons and PAHs.

Location	Potential Source of Contamination	Potential Contaminants
	Made Ground of unknown provenance used for the infilling of surrounding brick and clay pits located between 50 m and 400 m to the south east of the Site as well as potentially contaminated ground associated with the operation of the pits, brickfields and associated brickworks.	A range of inorganic and organic contaminants including metals and hydrocarbons and the potential for asbestos. Potential for ground gas.
	Made Ground and potentially contaminated groundwater associated with Dunsbury Hill Farm historical landfill located adjacent to the north west of the Site and Padnell historical landfill located 327 m west of the Site.	A range of inorganic and organic contaminants including heavy metals, hydrocarbons, PAHs, Polychlorinated Biphenyls (PCBs) including the potential for asbestos, leachate and ground gas.
	Made Ground of unknown provenance used in construction of housing estates to the east, south and south west of the Site.	A range of inorganic and organic contaminants including metals and hydrocarbons and the potential for asbestos.
	Made Ground and potentially contaminated ground associated with the former Leigh Park Estate battery located approximately 60 m south of the Site and military base located approximately 350 m south of the Site.	A range of inorganic and organic contaminants including metals and hydrocarbons.
	Former allotments located approximately 250 m south east of the Site.	A range of inorganic and organic contaminants including heavy metals, hydrocarbons, herbicides and pesticides.
	Former smithy located approximately 260 m south east of the Site.	A range of inorganic and organic contaminants including metals and hydrocarbons.
	Made Ground and localised vehicle spills/leaks associated with a motor racing circuit located approximately 400 m north.	A range of inorganic and organic contaminants including petroleum hydrocarbons, diesel and other organic compounds.

Sources – Pipeline corridor

Table 10-23 - Potential sources of contamination (pipeline corridor)

Location	Potential Source of Contamination	Potential Contaminants
On-site	Made Ground associated with the construction and operation of roads including Botley Drive, Highclere Avenue, Dunsbury Way, Ellisfield Road, Purbrook Way, High Lawn Way, Brunswick Gardens, Bedhampton Road and North Street.	A range of inorganic and organic contaminants including the potential for asbestos. Fuels and oils attributed to spills from vehicles on the roads, plus exhaust particulates.
	Made Ground associated with the construction of residential properties within Bedhampton and Havant.	A range of inorganic and organic contaminants including metals and hydrocarbons.
	Made Ground associated with the Southern Railway crossing the Site.	A range of inorganic and organic contaminants including hydrocarbons, diesel, lubricating oils,

Location	Potential Source of Contamination	Potential Contaminants
		PAHs, solvents, herbicides, metals, asbestos and ash used as fill material.
	Infilled ground associated with a former pond located partly on-site.	A range of inorganic and organic contaminants including metals and hydrocarbons and asbestos, etc.
	Portsmouth Water Works licenced waste management facilities – Bedhampton landfill.	A range of inorganic and organic contaminants including metals, leachate, nitrates, and the potential for ground gas generation.
	Potential spills / leaks during construction and operation of the pipeline.	A range of organic contaminants including hydrocarbons.
Off-site	Made Ground of unknown provenance used in construction of housing estates and commercial properties associated with the development of Bedhampton and Havant.	A range of inorganic and organic contaminants including metals and hydrocarbons.
	Made Ground associated with the construction and operation of adjacent roads.	A range of inorganic and organic contaminants including the potential for asbestos. Fuels and oils attributed to spills from vehicles on the roads, plus exhaust particulates.
	Made Ground of unknown provenance used for the infilling of surrounding sand and clay pits located between 50 m west and 380 m to the north west of the Site as well as potentially contaminated ground associated with the operation of the pits, brickfields and associated brickworks and tile works.	A range of inorganic and organic contaminants including metals and hydrocarbons and the potential for asbestos. Potential for ground gas.
	Former mills (including Bedhampton Mill and Upper Mill) within study area.	A range of inorganic and organic contaminants including metals and hydrocarbons and the potential for asbestos.
	Former tannery located approximately 500 m south east.	A range of inorganic and organic contaminants including metals, hydrocarbons and tannins.
	Portsmouth water works located approximately 10 m south and 420 m south east, former pumping station located 160 m south west and former water works located 180 m south west	A range of inorganic and organic contaminants including metals and hydrocarbons.
	Former sewage disposal works located 70 m north.	A range of inorganic and organic contaminants including metals, hydrocarbons and biological contaminants.
	Former works/factory buildings located 80 m and 180 m north.	A range of inorganic and organic contaminants including metals, solvents, PCBs and hydrocarbons and the potential for asbestos.

Location	Potential Source of Contamination	Potential Contaminants
	Former and active garages and petrol stations between 40 m west and 474 m east of the Site.	A range of contaminants including petroleum hydrocarbons, petrol additives, diesel and other organic compounds.
	Industrial estate located approximately 250 m south	A range of inorganic and organic contaminants including metals solvents, PCBs and hydrocarbons and the potential for asbestos.
	Former allotments gardens	A range of inorganic and organic contaminants including herbicides, pesticides and fuel oils.

Receptors – Reservoir site (including access roads)

Table 10-24 - Potential receptors and contaminant exposure and migration at baseline – (reservoir site including access roads)

Receptor Group	Receptor	Principal Contaminant Migration Pathways
Human health (on-site)	Current members of the public using footpaths and public rights of way.	Dermal contact with and ingestion of contaminants in soils, soil-derived dusts and water.
	Current road users.	Inhalation of contaminants in soil, soil-derived dust, fibres, gas and vapours.
	Future on-site users including reservoir operatives and members of the public visiting the reservoir.	
Human health (off-site)	Workers and residents in surrounding commercial and residential areas.	Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water which may have migrated off-site.
	Visitors using the surrounding footpaths and parks.	Inhalation of contaminants in soil, soil-derived dust, fibres and gas/vapours which may have migrated off-site.
Controlled Waters: Groundwater (on-site and off-site)	Groundwater in the Superficial Undifferentiated aquifer and bedrock Secondary A aquifers.	Leaching/migration of contaminants in soil to groundwater in underlying aquifers.
	Groundwater in the Chalk Principal aquifer.	Migration of contaminated water through preferential pathways such as underground services, pipes and granular material to groundwater in underlying aquifers.
Controlled Waters: Surface water (on-site)	The reservoir, Hermitage Stream, unnamed watercourses, drains and the Upper Lake.	Migration of contaminated groundwater, ground gas and/or vapours along strata and preferential pathways such as service routes or differentially permeable strata.
Controlled Waters: Surface water (off-site)	Drains, ponds and the lake within the study area.	Discharge of contaminants entrained in groundwater and, or surface water run-off followed by overland flow and discharge.
Property (on-site)	Future services and structures on-site.	

Receptor Group	Receptor	Principal Contaminant Migration Pathways
Property (off-site)	Existing services and structures within the study area including listed buildings.	Direct contact of contaminants in soil and/or groundwater with existing and proposed structures and buried services. Migration of contaminated groundwater, ground gas and/or vapours along strata and preferential pathways such as service routes or differentially permeable strata.
Ecological (on-site and off-site)	South Downs National Park, Ancient Woodland and SINCs.	Migration of contaminated waters/dust/fibres and subsequent uptake by flora or ingestion/ inhalation/dermal contact by fauna.

Receptors – Pipeline corridor

Table 10-25 - Potential receptors and contaminant exposure and migration at baseline (pipeline corridor)

Receptor Group	Receptor	Principal Contaminant Migration Pathways
Human health (on-site)	Current road users.	Dermal contact with and ingestion of contaminants in soils, soil-derived dusts and water. Inhalation of contaminants in soil, soil-derived dust, fibres, gas and vapours.
	Pedestrians accessing existing roads, footpaths and public rights of way.	
	Workers and residents in on-site commercial and residential areas.	
	Future on-site users including road users, pedestrians, workers and residents	
Human health (off-site)	Workers and residents in surrounding commercial and residential areas.	Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water which may have migrated off-site.
	Pedestrians using the surrounding footpaths, roads and parks.	Inhalation of contaminants in soil, soil-derived dust, fibres and gas/vapours which may have migrated off-site.
Controlled Waters: Groundwater (on-site and off-site)	Groundwater in the Superficial Undifferentiated aquifer, Superficial Secondary A aquifers and the bedrock Secondary A aquifers.	Leaching/migration of contaminants in soil to groundwater in underlying aquifers. Migration of contaminated water through preferential pathways such as underground services, pipes and granular material to groundwater in underlying aquifers.
	Groundwater in the Chalk Principal aquifer.	
Controlled Waters: Surface water (on-site)	Hermitage Stream and Riders Lane Stream.	Migration of contaminated groundwater, ground gas and/or vapours along strata and preferential pathways such as service routes or differentially permeable strata.
Controlled Waters: Surface water (off-site)	Hermitage Stream, Riders Lane Stream, two unnamed streams (approximately 292 m and 330 m north west), drains and the Lake	Discharge of contaminants entrained in groundwater and, or surface water run-off followed by overland flow and discharge.

Receptor Group	Receptor	Principal Contaminant Migration Pathways
	(approximately 238 m north east).	
Property (on-site)	Existing services and structures on-site.	Direct contact of contaminants in soil and/or groundwater with existing and proposed structures and buried services.
	Future on-site services and structures.	Migration of contaminated groundwater, ground gas and/or vapours along strata and preferential pathways such as service routes or differentially permeable strata.
Property (off-site)	Existing services and structures within the study area including listed buildings.	

Potential impacts

Impact types

- 10.141. Potential impacts of the Scheme will be considered separately for the reservoir site from the pipeline corridor, but are expected to include the following types of impacts:
- Physical effects including soil erosion, soil compaction and ground stability;
 - Mineral resource loss, damage or sterilisation;
 - Effects associated with existing ground contamination and potential new ground contamination issues; and
 - Effects associated with the re-use or disposal of site sourced soils and waste soils.

Physical effects including soil erosion, soil compaction and ground stability

- 10.142. The construction of the Scheme may result in physical effects to soils and geological receptors, arising from changes in soil erosion, soil compaction and ground stability associated with stripping of topsoil, vegetation clearance, stockpiling, earthworks, trenching, piling, tunnelling, installation of foundations and construction of the reservoir, pipeline, access roads, buildings, landscaping and other infrastructure.
- 10.143. Physical effects are considered to be mainly related to the construction phase. During operation, there would be limited effects on soil erosion, ground stability and soil compaction through maintenance operations, which may include excavations for landscaping and for repairs, upgrades or installation of services and infrastructure. Once operational there is also the potential for leakage from the reservoir and retaining structure both through the embankment and the underlying geological strata.

Mineral resource loss, damage or sterilisation

- 10.144. There is the potential for the construction and operation of the Scheme to impact upon mineral resources and associated MSA including the loss, damage or sterilisation of important mineral resources.

Effects associated with existing ground contamination and potential new ground contamination issues

- 10.145. The construction phase could potentially introduce new sources of contamination and disturb and mobilise existing sources of contamination. Construction activities, such as excavation, trenching, tunnelling and piling may introduce new pathways for migration of existing contamination and exposure of contaminated soil, remobilisation of contaminants through soil disturbance and the creation of preferential pathways for surface water run-off and ground gas migration.
- 10.146. Potential changes to the baseline situation which could create PCLs for the construction phase include:
- The potential for mobilising contaminants by excavation and stockpiling of material, increasing the risk to controlled water receptors through leaching and run-off. Earthworks could provide opportunities for run-off to contain suspended solids, if not carried out in line with required management procedure;

- The potential for introducing new sources of contamination i.e. from spillages and leaks;
- The potential for exposure of human receptors by generation of potentially contaminated dust and vapours released by the construction works; and
- The potential for creation of new pathways to groundwater during groundworks, through opening up ground temporarily and construction activities, such as earthworks, piling, installation of drainage and other below-ground services.

10.147. The operation of the Scheme would potentially introduce new sources of contamination. Spillages and leaks may occur from machinery and below ground services and leakage from the pipeline and retaining structure could create additional pathways for the migration of potential contamination that were not present at baseline.

Effects associated with the re-use or disposal of site sourced soils and waste soils

- 10.148. Waste soils would be generated during construction through excavation works. There is the potential that waste soil generated during construction would be classified as unsuitable for re-use on-site or hazardous, therefore requiring removal from site.
- 10.149. The Scheme may also generate limited waste soils during operation due to maintenance requirements which may include excavations for landscaping, repairs and maintenance of services.

Design, mitigation and enhancement measures

10.150. The following mitigation measures will be incorporated into the design, construction and operation of the Scheme to reduce impacts of physical effects, effects on valuable mineral resources and effects associated with land contamination, soil waste and soil re-use.

Design

- 10.151. Embedded mitigation measures to be incorporated into the design of the Scheme are likely to include:
- Design of the Scheme in accordance with statutory guidance and best practice;
 - Further assessment of the ground conditions underlying areas of the Scheme which have not been previously investigated through ground investigation, as required (i.e. the pipeline corridor);
 - Remediation of soil/groundwater contamination (e.g. source removal, treatment or capping) if further investigation and risk assessments deem necessary;
 - Further assessment and incorporation of mitigation/remedial measures in the design to reduce impacts from ground instability, soil compaction/settlement, leakage and contamination as required; and
 - Additional assessment of the potential risks posed by UXO across the Site and implementation of mitigation measures as appropriate.

Construction

- 10.152. Mitigation measures to be incorporated into the construction process, (as set out in the REAC as part of the OEMP in Appendix A2.1 in ES Volume 4) will include (but not be limited to):
- Undertaking health and safety risk assessments, method statements and appropriate Personal Protective Equipment (PPE) for the protection of construction workers in accordance with the CDM Regulations⁹ and COSHH Regulations⁸;
 - Minimising the area and duration of soil exposure and timely reinstatement of vegetation or hardstanding to prevent soil erosion and reduce temporary effects on topography and soil compaction;
 - Stockpile management (such as water spraying and avoiding over stockpiling to reduce compaction of soil and loss of integrity) to reduce soil erosion, windblown dust and surface water run-off;
 - Clear segregation between stockpiled material including imported material, excavated material stockpiled for re-use and excavated waste material stockpiled for treatment and / or off-site disposal;
 - Implementation of appropriate dust suppression measures to prevent migration of contaminated dust as required. Further details are provided in Chapter 7 Air Quality in the ES Volume 2;

- Implementation of working methods during earthworks to manage groundwater and surface water appropriately and ensure that there is no uncontrolled run-off from the works, any material / waste stockpiles, and storage containers into adjacent surface watercourses. Further details are provided in Chapter 15 Water (including flows, quality and groundwater) in the ES Volume 2;
- Implementation of appropriate and safe storage of fuel, oils and equipment during construction in accordance with the COSHH Regulations⁸;
- Implementation of appropriate pollution incident control e.g. plant drip trays and spill kits;
- Preparation of piling risk assessments as required in accordance with Environment Agency guidance to assess and manage potential risks to controlled waters;
- Implementation of an appropriate Materials Management Plan (MMP) or permit/exemption in accordance with the CL:AIRE DoWCoP³⁰ to document how excavated materials will be managed as outlined in Appendix A14.1 Materials Management Strategy in ES Volume 4;
- Prioritising the re-use of mineral resources (topsoil and clay) within the Scheme;
- Where waste soil is generated, it will be dealt with in line with the Government's waste hierarchy which is a guide to sustainable waste and material resource management and in accordance with CL:AIRE DoWCoP; and
- Implementation of a contamination watching brief by suitably qualified and experienced personnel would be completed for the Scheme when excavating areas of potential contamination risk. If unidentified contamination is encountered, works will be temporarily suspended in the area and appropriate investigations and remediation will be discussed and agreed with stakeholders and completed in accordance with current best practice.

Operation

- 10.153. It is assumed for the purposes of this assessment that those mitigation measures identified for the construction will be undertaken and will improve the condition of the Scheme (for contamination and physical effects) and will mitigate the risks during operation.
- 10.154. It is assumed that the Scheme will be operated in accordance with the relevant regulations, best practice guidance and pollution prevention.

Assessment of effects

- 10.155. Potential effects have been assessed for both the construction and operational phases of the Scheme, based on the information available at this time. The assessment has taken into account the embedded mitigation measures that will be implemented as part of the design of the Scheme and these are discussed further in the following sections in relation to the assessment of potential effects.

Reservoir site

Construction

Physical effects: soil erosion and soil compaction

- 10.156. Construction of the reservoir will require excavation and the creation of a retaining structure, as well as raising land levels to achieve the permanent embankment height (approximately 20m high). Excavations for the reservoir would generate substantial quantities of excavated material (approximately 2.5 million m³) and would require substantial quantities material for use as backfill within the embankment. Topsoil and clay would be excavated from borrow pits located within the reservoir footprint for re-use within the embankment, supplemented by imported material including sand, gravel and limestone.
- 10.157. Earthworks including topsoil stripping, vegetation clearance, excavations and installation of foundations would also be required for the construction of the embankment culvert, control house, visitor centre, bird hide, access roads, walking and cycling tracks, viewing areas, car parks, landscaping and other infrastructure including temporary haul roads and construction compounds.
- 10.158. Excavated material that is suitable for re-use will be stored in temporary stockpiles around the Site at various periods over the construction phase prior to re-use on-site. Movement of material around the Site would be undertaken by either conveyors or large earth moving vehicles.

- 10.159. The construction of the Scheme may result in physical effects to soils and geological receptors, arising from changes in soil erosion, soil compaction and ground stability associated with the earthworks, stockpiling of material, movement of heavy plant and construction of the proposed retaining structure.
- 10.160. There is the potential for the reactivation of shear surfaces within the Head deposits underlying the proposed retaining structure to causing ground instability hazards. However, incorporation of mitigation/remedial measures in the design will reduce impacts from ground instability and soil compaction/settlement as required.
- 10.161. There is the potential for increased soil erosion and runoff with a high sediment load to impact the surface waters within the Site. Earthworks will be planned to minimise soil exposure as far as practicable and areas required for temporary works will be reinstated as soon as possible when they are no longer required. Stockpiles will be managed to reduce soil erosion and increased dust by applying preventative techniques which may include water spraying and hydroseeding. The impacts on soil erosion and soil compaction are therefore considered to be temporary, medium term, and direct.
- 10.162. Given that there are moderate soil compaction and ground stability hazards at the Site associated with shrinking and swelling clay and relict shear surfaces, the value/sensitivity of the receptor is classed as medium. With the proposed mitigation measures, the magnitude of the impact is considered to be low. The overall effect is therefore considered to be minor adverse and classed as not significant.

Physical effects: ground stability

- 10.163. No sinkholes were identified within the reservoir site during previous studies or the 2019 ground investigation^{49, 50}. However, historical extraction of clay and shale has been undertaken within the study area. The potential for a UXO hazard to occur within the southern and central areas of the Site has been assessed as likely. Potential ground stability hazards have also been identified at the site and some elements of the proposed works the Site including deep excavations for the reservoir and retaining structure and the construction of the embankment may affect ground stability.
- 10.164. the Site. The impacts on ground stability during the construction phase are considered to be temporary, medium term, and direct. The value/sensitivity of the receptor (ground stability) is therefore classed as medium. With proposed mitigation including the incorporation of mitigation/remedial measures in the design to reduce impacts from ground instability, the magnitude of the impact is considered to be low. The overall effect is therefore considered to be minor adverse and classed as not significant.

Mineral resources

- 10.165. Clay is proposed to be excavated from borrow pits located within the footprint of the reservoir for re-use within the reservoir embankment. The baseline assessment indicates the presence of historical mineral extraction sites within the study area. Two MWCA for clay resources are located within the central and eastern areas of the reservoir site and within the northern access road. A MSA for oil and gas is located within the northern extent of the northern access road along the existing B2419, adjacent to the northern end of the reservoir site.
- 10.166. The pits identified within the baseline assessment were generally no longer recorded on ordnance survey maps published in the 1970s. The area of the northern access road located within the MSA also forms part of an existing road. Therefore, there would be a limited impact on the current regional mineral resources.
- 10.167. The impacts on mineral resources during the construction phase are therefore considered to be permanent, long term and direct. Given that the Site lies within a MWCA and MSA, the value/sensitivity of the receptor is classed as medium. The magnitude of the impact is considered to be very low as the clay would be re-used as part of the Scheme, which would mitigate the loss of the resource. The overall effect is therefore considered to be negligible and classed as not significant.

Effects associated with ground contamination

- 10.168. The construction PCSM and risk assessments are presented in Appendix A10.6 and the impact assessments in Appendix A10.7 in ES Volume 4. The construction impact assessment was undertaken by comparing the baseline land contamination risks to those predicted during

construction, while considering any new sources and pollution pathways introduced by construction activities.

- 10.169. Construction activities, such as excavation, topsoil stripping, vegetation clearance and installation of foundations may introduce new pathways for migration of existing contamination and exposure of contaminated soil, remobilisation of contaminants through soil disturbance and the creation of preferential pathways for surface water run-off and ground gas migration. There is also the potential for introducing new sources of contamination i.e. from spillages and leaks and imported materials during construction works.
- 10.170. The impacts on land contamination are considered to be permanent, and direct. Mitigation measures will be incorporated into the construction process as outlined in paragraph 10.169. These will include the adoption of good practice working methods during construction to manage groundwater appropriately, implementation of appropriate pollution prevention and incident control measures and implementation of appropriate and safe storage of fuel, oils and equipment.
- 10.171. A summary of the construction phase PCSM and impact assessment is provided in Table 10-26 and includes the risks identified to the receptors. A more detailed assessment of construction risk and impact assessment is provided in Appendix A10.6 and Appendix A10.7 in ES Volume 4.
- 10.172. It is considered that with the mitigation measures adopted, the risks identified to human health, controlled waters, ecological and property receptors during construction would be very low. Compared to the existing baseline, the level of risk to receptors during construction would generally remain the same or be slightly reduced due to the implementation of mitigation measures which would reduce potential contamination risks during construction. An overall negligible to minor beneficial effect is therefore predicted which is classed as not significant.

Table 10-26 - Construction phase effects for the Scheme (reservoir site including access roads)

Receptor	Value/ Sensitivity	Baseline Risk	Construction Risk	Classification of Effect
Human (on-site)	High	Receptor not present to very low	Receptor not present to very low	Negligible
Human (off-site)	High	Very low	Very low	Negligible
Controlled waters: groundwater (on-site and off-site)	High	Low	Very low	Minor beneficial
Controlled waters: surface water (on-site and off-site)	Medium	Low	Very low	Minor beneficial
Property: existing and future structures and services (on-site and off-site)	Medium	Receptor not present to very low	Very low	Negligible ⁶⁸

⁶⁸ Introduction of this receptor at construction automatically triggers a minor adverse effect. However, professional judgement has been exercised and this effect has been reduced to neutral.

Receptor	Value/ Sensitivity	Baseline Risk	Construction Risk	Classification of Effect
Ecological (on-site and off-site)	Medium	Very low	Very low	Negligible

Effects associated with waste soils and soil re-use

- 10.173. Waste soils would be generated during construction through excavation works. There is the potential that waste soil generated during construction would be classified as unsuitable for re-use on-site or hazardous, therefore requiring removal from site.
- 10.174. As outlined in Chapter 14 Material Resources and Waste in ES Volume 2 and Appendix A14.1 Materials Management Strategy in ES Volume 4, a MMP or permit/exemption will set out how material (including site won and imported) would be managed on-site during construction in accordance with appropriate guidance such as the CL: AIRE Development Industry Code of Practice, to allow the re-use of suitable soils during the construction works.
- 10.175. In line with the waste hierarchy, further iterations of the design would seek as far as reasonably practicable, to reduce the amount of soil/materials excavated and/or of a hazardous nature, to re-use and recycle waste soils/materials on-site, where possible and to manage soils/materials suitably; this would include off-site disposal of waste if required, in accordance with relevant legislation. Therefore, the impacts on waste soils and soil re-use are considered to be temporary, medium term and direct.
- 10.176. Given the proposals to re-use site won material as part of the Scheme, the value/sensitivity of the receptor is classed as medium. The magnitude of the impact is considered to be low. The overall effect is therefore considered to be minor adverse and not significant.

Operation

Physical effects: Soil erosion, soil compaction, and ground stability

- 10.177. Physical effects are considered to be mainly related to the construction phase. During operation, there would be limited effects on soil erosion, ground stability and soil compaction resulting from maintenance operations which might include excavations for landscaping and for repairs, upgrades or installation of services and infrastructure. Once operational, there is also the potential for leakage from the reservoir and retaining structure, both through the embankment and the underlying geological strata. However, the Scheme would be designed and constructed to take the ground conditions into account and to minimise potential physical effects during operation including ground movement, compaction, leakage and ground aggressivity hazards. The Scheme would be operated in accordance with the relevant regulations and good practice measures.
- 10.178. There is considered to be less potential for ground hazards at the Site during the operational phase and the value/sensitivity of the receptor is classed as low. It is assumed that any UXO risks associated with the Site would have been addressed at the construction stage. The impacts on soil erosion, soil compaction and ground instability during the operational phase from maintenance operations are considered to be temporary, short-term, and direct.
- 10.179. With mitigation measures undertaken during construction including the incorporation of mitigation/remedial measures in the design to reduce impacts from ground instability, the value/sensitivity of the receptors are classed as low and the magnitude of the impacts are considered to be very low. The overall effects on soil erosion, soil compaction and ground stability are therefore considered to be negligible and classed as not significant.

Mineral resources

- 10.180. Effects in relation to mineral resources during the operation phase relate to the permanent sterilisation/loss of minerals, preventing future extraction. Impacts on mineral resources during the operational phase are considered to be permanent and direct. Effects in relation to loss, damage or sterilisation of mineral resources would be the same as the construction phase effects and remain as negligible and classed as not significant.

Effects associated with ground contamination

- 10.181. The operational PCSM and risk assessment are presented in Appendix A10.6 and the impact assessment in Appendix A10.7 in ES Volume 4. The operational impact assessment has been undertaken by comparing the baseline land contamination risks to those predicted during operation, while considering any new sources and pollution pathways introduced by operational activities.
- 10.182. The operation of the Scheme would potentially introduce new sources of contamination. Spillages and leaks may occur and below ground services and leakage from the reservoir and retaining structure could create additional pathways for the migration of potential contamination that were not present at baseline. The impacts on land contamination during the operational phase are considered to be permanent and direct.
- 10.183. A summary of the potential operational phase contamination effects is provided in Table 10-27. A more detailed assessment of operational risk and impact assessment is provided in Appendix A10.6 and Appendix A10.7 in ES Volume 4. The Scheme would be operated in accordance with the relevant regulations and best practice pollution prevention guidance, therefore risks identified to human health, controlled waters, ecological and property receptors during operation are assessed very low. Compared to the existing baseline, the level of risk to receptors has generally remained the same or slightly reduced due to the implementation of mitigation measures which would reduce potential contamination risks during operation. An overall negligible to minor beneficial effect is therefore concluded which is classed as not significant.

Table 10-27 - Operational phase effects for the Scheme (reservoir site and access roads)

Receptor	Value/ Sensitivity	Baseline Risk	Operational Risk	Classification of Effect
Human (on-site)	High	Receptor not present to very low	Very low to low	Negligible ⁶⁹
Human (off-site)	High	Very low	Very low	Negligible
Controlled waters: groundwater (on-site and off-site)	High	Low	Very low	Minor beneficial
Controlled waters: surface water (on-site and off-site)	Medium	Low	Very low	Minor beneficial
Property: existing and future structures and services (on-site and off-site)	Medium	Receptor not present to very low	Very low	Negligible ⁷⁰
Ecological (on-site and off-site)	Medium	Very low	Very low	Negligible

⁶⁹ Introduction of this receptor at operation automatically triggers a minor adverse effect. However, professional judgement has been exercised and this effect has been reduced to neutral.

⁷⁰ Introduction of this receptor at operation automatically triggers a minor adverse effect. However, professional judgement has been exercised and this effect has been reduced to neutral.

Effects associated with waste soils and soil re-use

- 10.184. The Scheme may also generate limited waste soils during operation due to maintenance requirements which may include excavations for landscaping, repairs and maintenance of services. Further details are provided in Chapter 14 Material Resources and Waste in the ES Volume 2. The Scheme would be operated in accordance with the relevant regulations and best practice pollution prevention guidance. Therefore, the impacts associated with waste soils are assessed to be temporary, short-term and indirect.
- 10.185. Given that there is less potential for soil re-use during the operational phase, the value/sensitivity of the receptor is classed as low. The magnitude of the impact is considered to be very low. The overall effect is therefore assessed to be negligible and classed as not significant.

Pipeline corridor

Construction

Physical effects: soil erosion and soil compaction

- 10.186. Construction would require excavation of trenches or tunnelling (pipe jacking) for the installation of the pipeline including the use of sheet piles to support trenches where required. Earthworks would also be required for the upgrades of existing culverts and construction of new culverts and other infrastructure.
- 10.187. Excavated material including asphalt, road-base, subbase and natural material would be transported to the reservoir site for processing. Material that is suitable for re-use would be returned to the pipeline site for re-use as backfill, supplemented by imported material. Material may be stored in temporary stockpiles around the Site at various periods over the construction phase prior to use on-site.
- 10.188. The construction of the Scheme may result in physical effects to soils and geological receptors, arising from changes in soil erosion, soil compaction and ground stability associated with the earthworks, stockpiling of material and movement of heavy plant. There is the potential for increased soil erosion and runoff with a high sediment load to impact the surface waters crossing the Site.
- 10.189. Earthworks would be planned to minimise soil exposure as far as practicable and areas required for temporary works would be reinstated as soon as possible when they are no longer required. Stockpiles would be managed to reduce soil erosion and increased dust by applying preventative techniques which may include water spraying and hydroseeding. The impacts on soil erosion and soil compaction are therefore considered to be temporary, medium term, and direct.
- 10.190. Given that there are moderate soil compaction hazards at the Site associated with shrinking and swelling clay in the southern section of the Site, the value/sensitivity of the receptor is classed as medium. With the proposed mitigation measures outlined in paragraph 10.189, the magnitude of the impact is considered to be low. The overall effect is therefore considered to be minor adverse and classed as not significant.

Physical effects: ground stability

- 10.191. No sinkholes are recorded along the length of the pipeline corridor. However, historical extraction of shale and clay has been undertaken within the study area. There are potential ground stability hazards at the Site associated with moderate ground dissolution stability hazards in the southern section of the Site. The southern section of the Site is also identified as having a moderate UXO risk. Several elements of the proposed works may affect the stability of the ground at the Site including trenching and tunnelling.
- 10.192. The impacts on ground stability during the construction phase are considered to be temporary, medium term, and direct. The value/sensitivity of the receptor is classed as medium. With proposed mitigation, the magnitude of the impact is considered to be low. The overall effect is therefore considered to be minor adverse and classed as not significant.

Mineral resources

- 10.193. The baseline assessment indicates that the study area is not located within an area of historical mineral extraction or a MSA. Therefore, there would be no impacts to regional mineral resources.

- 10.194. Given that there are no valuable/viable mineral resources located on the Site, the value/sensitivity of the receptor is classed as very low. The magnitude of the impact is considered to be very low as there would be limited loss of regional mineral resources. The overall effect is therefore considered to be negligible and classed as not significant.

Effects associated with ground contamination

- 10.195. The construction PCSM and risk assessments are presented in Appendix A10.6 and the impact assessments in Appendix A10.7 in ES Volume 4. The construction impact assessment is undertaken by comparing the baseline land contamination risks to those predicted during construction, while considering any new sources and pollution pathways introduced by construction activities.
- 10.196. Construction activities, such as excavation, tunnelling and installation of the pipeline may introduce new pathways for migration of existing contamination and exposure of contaminated soil, remobilisation of contaminants through soil disturbance and the creation of preferential pathways for surface water run-off and ground gas migration. There is also the potential for introducing new sources of contamination i.e. from spillages and leaks and imported material during construction works.
- 10.197. The impacts on land contamination are considered to be permanent, and direct. Mitigation measures will be incorporated into the construction process. These will include the adoption of good practice working methods during construction to manage groundwater appropriately, implementation of appropriate pollution incident prevention and control and implementation of appropriate and safe storage of fuel, oils and equipment.
- 10.198. A summary of the construction phase PCSM and impact assessment is provided in Table 10-28 and includes the risks identified to the receptors. A more detailed assessment of construction risk and impact assessment is provided in Appendix A10.6 and Appendix A10.7 in ES Volume 4.
- 10.199. It is considered that with the proposed mitigation adopted, the risks identified to human health, controlled waters and property receptors during construction would range from very low to low risk. Compared to the existing baseline, the level of risk to receptors would generally remained the same or slightly decrease during the construction phase due to the implementation of migration measures which would reduce potential contamination risks during construction. An overall negligible to minor beneficial effect is therefore predicted which is classed as not significant.

Table 10-28 - Construction phase effects for the Scheme (pipeline corridor)

Receptor	Value/ Sensitivity	Baseline Risk	Construction Risk	Classification of Effect
Human (on-site)	High	Receptor not present to low	Receptor not present	Negligible ⁷¹
Human (off-site)	High	Low to very low	Very low	Negligible to minor beneficial
Controlled waters: groundwater (on-site and off-site)	High	Moderate/low	Low	Minor beneficial
Controlled waters: surface water (on-site and off-site)	Medium	Moderate/low	Low	Minor beneficial
Property: existing and future	Medium	Receptor not present to low	Very low	Negligible to minor beneficial

⁷¹ Removal of this receptor at construction automatically triggers a minor beneficial effect. However, professional judgement has been exercised and this effect has been reduced to neutral.

Receptor	Value/ Sensitivity	Baseline Risk	Construction Risk	Classification of Effect
structures and services (on-site and off-site)				

Effects associated with waste soils and soil re-use

- 10.200. Waste soils will be generated during construction through excavation works. There is the potential that waste soil generated during construction would be classified as unsuitable for re-use on-site or hazardous, therefore requiring removal from site.
- 10.201. As outlined in Chapter 14 Material Resources and Waste in the ES Volume 2 and Appendix A14.1 Materials Management Strategy in ES Volume 4, a MMP or permit/exemption will set out how material (including site won and imported) is managed on-site during construction in accordance with appropriate guidance such as the CL: AIRE Development Industry Code of Practice, to allow the re-use of suitable soils during the construction works.
- 10.202. In line with the waste hierarchy, the design will seek as far as reasonably practicable, to reduce the amount of soil/materials excavated and/or of a hazardous nature, to re-use and recycle waste soils/materials on-site, where possible and to manage soils/materials suitably including off-site disposal of waste if required, in accordance with relevant legislation. Therefore, the impacts on waste soils and soil re-use are considered to be temporary, medium term and direct.
- 10.203. Given the proposals to re-use site won material as part of the Scheme, the value/sensitivity of the receptor is classed as medium. The magnitude of the impact is considered to be low. The overall effect is therefore considered to be minor adverse and not significant.

Operation

Physical effects: Soil erosion, soil compaction, and ground stability

- 10.204. Physical effects are considered to be mainly related to the construction phase. During operation, there would be limited effects on soil erosion, ground stability and soil compaction through maintenance operations which could include excavations for landscaping and for repairs, upgrades or installation of services and infrastructure. The development will be designed and constructed to take into account the ground conditions to minimise potential physical effects during operation including ground movement, compaction and ground aggressivity hazards. The Scheme will be operated in accordance with the relevant regulations and best practice measures.
- 10.205. Given soil erosion, soil compaction and ground stability hazards at the Site will be mitigated during the construction phase through the incorporation of mitigation/remedial measures in the design to reduce impacts from ground instability and soil compaction/settlement, there is considered to be less potential for ground hazards the Site during operation and the value/sensitivity of the receptor is classed as low. This also assumes that any UXO risks associated with the Site would have been addressed at construction stage. The impacts on soil erosion, soil compaction and ground instability during the operational phase from maintenance operations are therefore considered to be temporary, short-term, and direct.
- 10.206. With mitigation measures undertaken during construction, the value/sensitivity of the receptors are classed as low and the magnitude of the impacts are considered to be very low. The overall effects on soil erosion, soil compaction and ground stability are therefore considered to be negligible and classed as not significant.

Mineral resources

- 10.207. Effects in relation to mineral resources during the operation phase relate to the permanent sterilisation/loss of minerals, preventing future extraction. The impacts on mineral resources during the operational phase are therefore considered to be permanent and direct.
- 10.208. Given that there are no valuable mineral resources located within the study area, the value/sensitivity of the receptor is classed as very low. The magnitude of the impact is considered to be very low as there would be limited loss of regional mineral resources. Effects in relation to

loss, damage or sterilisation of mineral resources would remain as negligible and classed as not significant.

Effects associated with ground contamination

- 10.209. The operational PCSM and risk assessment are presented in Appendix A10.6 and the impact assessment in Appendix A10.7 in ES Volume 4. The operational impact assessment has been undertaken by comparing the baseline land contamination risks to those predicted during operation, while considering any new sources and pollution pathways introduced by operational activities.
- 10.210. The operation of the Scheme would potentially introduce new sources of contamination. Spillages and leaks may occur and below ground services could create additional potential pathways for the migration of potential contamination that were not present at baseline. The impacts on land contamination during the operational phase are considered to be permanent and direct.
- 10.211. A summary of the operational phase contamination effects is provided in Table 10-29. A more detailed assessment of operational risk and impact assessment is provided in Appendix A10.6 and Appendix A10.7 in ES Volume 4. The Scheme would be operated in accordance with the relevant regulations and best practice pollution prevention guidance and it is considered that risks identified to human health, controlled waters, ecological and property receptors during operation are assessed as very low to low. Compared to the existing baseline, the level of risk to receptors would generally remain the same or slightly decrease, which will reduce potential contamination risks during operation. An overall negligible to minor beneficial effect is therefore concluded, which is classed as not significant.

Table 10-29 - Operational phase effects for the Scheme (pipeline corridor)

Receptor	Value/ Sensitivity	Baseline Risk	Operational Risk	Classification of Effect
Human (on-site)	High	Receptor not present to low	Very low	Negligible to minor beneficial
Human (off-site)	High	Low to very low	Very low	Minor beneficial
Controlled waters: groundwater (on-site and off-site)	High	Moderate/low	Low	Minor beneficial
Controlled waters: surface water (on-site and off-site)	Medium	Moderate/low	Low	Minor beneficial
Property: existing and future structures and services (on-site and off-site)	Medium	Receptor not present to low	Very low	Negligible to minor beneficial

Effects associated with waste soils and soil re-use

- 10.212. The Scheme may also generate limited waste soils during operation due to maintenance requirements which could include excavations for landscaping, repairs and maintenance of services. Further details are provided in Chapter 14 Material Resources and Waste in ES Volume 2. The Scheme would also be operated in accordance with the relevant regulations and best practice pollution prevention guidance. Therefore, the impacts associated with waste soils are assessed to be temporary, short-term and indirect.

- 10.213. Given that there is less potential for soil re-use during the operational phase, the value/sensitivity of the receptor is classed as low. The magnitude of the impact is considered to be very low. The overall effect is therefore assessed to be negligible and classed as not significant.

Monitoring

- 10.214. Mitigation measures which have been accounted for as part of the assessment. With the proposed mitigation, additional monitoring is not considered to be required for ground conditions.

Overall Assessment Findings

- 10.215. The following tables (Table 10-30 and Table 10-31) present a summary of the ground conditions assessment for the Scheme. With proposed mitigation, minor adverse to minor beneficial effects are generally predicted during the construction and operational phase of the Scheme. These are classed as not significant. Therefore, the Scheme will not result in any significant effects to ground conditions.

Table 10-30 - Ground conditions assessment summary (reservoir site including access roads)

Receptor	Impact	Mitigation	Residual effect
Construction			
Geology	Soil erosion and compaction	Design and selection of construction materials in accordance with best practice.	Minor adverse (not significant)
Geology	Ground stability	Undertake ground improvement works to reduce impacts from ground instability and soil compaction / erosion if required.	Minor adverse (not significant)
Mineral resources	Loss, damage or sterilisation	Incorporate mitigation measures into the construction process, as set out in the REAC as part of the OEMP in Appendix A2.1 in ES Volume 4, including the adoption of working methods to appropriately manage soil erosion and compaction, surface water runoff and groundwater during construction.	Negligible (not significant)
Human Health	Contamination from on-site and off-site sources	Design and selection of construction materials in accordance with best practice.	Negligible (not significant)
Controlled waters (groundwater)	Contamination from on-site and off-site sources	Incorporate mitigation measures into the construction process, as set out in the REAC as part of the OEMP in Appendix A2.1 in ES Volume 4, including the adoption of working methods to appropriately manage dust generation, pollution incidents, surface water runoff and groundwater during construction.	Minor beneficial (not significant)
Controlled waters (surface water)	Contamination from on-site and off-site sources		Minor beneficial (not significant)
Property (existing and future structures and services)	Contamination from on-site and off-site sources		Negligible (not significant)
Ecological	Contamination from on-site and off-site sources		Negligible (not significant)

Receptor	Impact	Mitigation	Residual effect
Soils	Impacts from waste soils generated during construction works	Minimise off-site disposal.	Minor adverse (not significant)
Operation			
Geology	Soil erosion and compaction	Mitigation undertaken during construction would improve ground conditions for the operational phase.	Negligible (not significant)
Geology	Ground stability	The Scheme will be operated in accordance with the relevant regulations and best practice guidance.	Negligible (not significant)
Mineral resources	Loss, damage or sterilisation		Minor adverse (significant)
Human Health	Contamination from on-site and off-site sources		Negligible (not significant)
Controlled waters (groundwater)	Contamination from on-site and off-site sources		Minor beneficial (not significant)
Controlled waters (surface water)	Contamination from on-site and off-site sources		Minor beneficial (not significant)
Property (existing and future structures and services)	Contamination from on-site and off-site sources		Negligible (not significant)
Ecological	Contamination from on-site and off-site sources		Negligible (not significant)
Soils	Impacts from waste soils generated during construction works		Negligible (not significant)

Table 10-31 - Ground conditions assessment summary (pipeline corridor)

Receptor	Impact	Mitigation	Residual effect
Construction			
Geology	Soil erosion and compaction	Design and selection of construction materials in accordance with best practice.	Minor adverse (not significant)
Geology	Ground stability	Undertake ground investigation to define risks and undertake ground improvement works to reduce impacts from ground instability and soil compaction / erosion if required.	Minor adverse (not significant)
Mineral resources	Loss, damage or sterilisation	Incorporate mitigation measures into the construction process, as set out in the REAC as part of the OEMP in Appendix A2.1 in ES Volume 4, including the adoption of working methods to appropriately manage soil erosion and compaction, surface water runoff and groundwater during construction.	Negligible (not significant)
Human Health	Contamination from on-site and off-site sources	Undertake ground investigation and risk assessment to define risks and undertake remediation if required.	Negligible to minor beneficial (not significant)
Controlled waters (groundwater)	Contamination from on-site and off-site sources	Incorporate mitigation measures into the construction process, as set out in the REAC as part of the OEMP in Appendix A2.1 in ES Volume 4, including the adoption of working methods to appropriately manage dust generation, pollution incidents, surface water runoff and groundwater during construction.	Minor beneficial (not significant)
Controlled waters (surface water)	Contamination from on-site and off-site sources	Design and selection of construction materials in accordance with best practice.	Minor beneficial (not significant)
Property (existing and future structures and services)	Contamination from on-site and off-site sources		Negligible to minor beneficial (not significant)
Soils	Impacts from waste soils generated during construction works	Undertake ground investigation to define risks and identify soils that can be re-used on-site. Minimise off-site disposal.	Minor adverse (not significant)
Operation			
Geology	Soil erosion and compaction	Mitigation measures implemented during construction would improve ground conditions for the operational phase.	Negligible (not significant)
Geology	Ground stability	The Scheme will be operated in accordance with the relevant regulations and best practice guidance.	Negligible (not significant)
Mineral resources	Loss, damage or sterilisation		Negligible (not significant)
Human Health	Contamination from on-site and off-site sources		Negligible to minor beneficial (not significant)

Receptor	Impact	Mitigation	Residual effect
Controlled waters (groundwater)	Contamination from on-site and off-site sources		Minor beneficial (not significant)
Controlled waters (surface water)	Contamination from on-site and off-site sources		Minor beneficial (not significant)
Property (existing and future structures and services)	Contamination from on-site and off-site sources		Negligible to minor beneficial (not significant)
Soils	Impacts from waste soils generated during construction works		Negligible (not significant)

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