13 GROUND CONDITIONS & CONTAMINATION

13.1 INTRODUCTION

Company

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Chapter Purpose

This chapter of the ES assesses the likely significant effects of the proposed development on the environment in terms of ground conditions and contamination. In particular, it considers the potential risk of contamination to human health and the environment and the impacts of existing ground conditions on new buildings, structures and surface waters. The chapter and it's supporting appendices describe the planning policy context, the assessment methodology; the baseline conditions at the application site and surroundings; the likely significant effects; the mitigation measures required to prevent, reduce or offset any significant adverse effects; the likely residual effects after these measures have been employed; and the cumulative effects. In summary, the objectives of the chapter are to:

- Present an assessment of the potential environmental impacts related to ground conditions; and
- Ensure that impacts on human health and the wider environment are comprehensively assessed and that, where necessary, any perceived adverse effects are mitigated.

Figures

All figures are contained in Appendix 13.1 & 13.2.

Appendices

- Appendix 13.1: Hydrock, August 2019, 'Desk Study, Ground Investigation and Data Assessment', Ref: 10730-HYD-XX-XX-RP-GE-1000.
- Appendix 13.2: Hydrock, September 2019, 'Outline Remediation Method Statement', Ref: 10730-HYD-XX-XX-RP-GE-1001.

13.2 METHODOLOGY

Guidance

- Model Procedures for the Management of Land Contamination, Environment Agency (2004) [1];
- Land Contamination: Risk Management, Environment Agency (05/06/2019 GOV.UK) [2];
- Planning Practice Guidance (PPG): Land Affected by Contamination, 2019 [3];
- BS10175: 2017 Investigation of Contaminated Sites: Code of Practice [4];
- BS5930: 2015 Code of Practice for Ground Investigations [5];
- CL:AIRE, Definition of Waste: Development Industry Code of Practice Version 2, 2011 [6];
- CIRIA C552 2001; Contaminated Land Risk Assessment. A guide to Good Practice [7].

Legislation and Policy

- Section 78A of Part 2A of the Environmental Protection Act of 1990 [8];
- Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance [9];
- The Water Resources Act 1991 [10];
- The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 [11];
- The Water Act 2003 [12];
- The National Planning Policy Framework (NPPF) (2019) [13].

Consultees

No consultations have been undertaken in respect of ground conditions at this stage.

Scoping

The Environment Agency scoping comments (ref: KT/2018/125012/01-L01) identified that the site overlies a chalk aquifer. Any pathways for contamination must be strictly controlled to avoid pollution of the principle aquifers from any historic contamination identified on site from previous uses. This has been considered as part of the assessment.

No other comments on the proposed scope of this chapter were provided in the Scoping Opinion.

Consideration of Climate Change

It is considered that climate change will not have an impact on ground conditions across the site. Wider consideration of climate change in the context of the proposed development may be found at Appendix 2.4, Vol III of this ES.

Consideration of Human Health

A human health risk assessment has been undertaken. This uses industry developed soil screening values for a variety of land use scenarios based on proposed end use zones across the site. Wider consideration of human health in the context of the proposed development may be found at Appendix 2.5, Vol III of this ES.

Consideration of Risk of Major Accidents and/or Disasters

The only risks of major accidents and disasters of relevance to ground conditions are associated with the functions of QinetiQ and DSTL at the application site, which relate to research and forensic analysis into explosives. In 2011, DSTL announced its intention to relocate from the site to Porton Down and Portsdown West and has since started withdrawing from the application site. Consequently, activities on the application site have been scaled down in recent years, with a number of the buildings being decommissioned and/or demolished by DSTL on vacant possession. However, QinetiQ continues to operate on the application site, with its future operations incorporated within the extant permission and also included within the proposed development. QinetiQ's future operations would continue to focus on the research, analysis and trace testing of energetic material for commercial manufacturing and the Ministry of Defence.

As discussed in Appendix 2.6, Vol II of this ES, given that all of QinetiQ's operations would be Health and Safety Executive (HSE) compliant, specific consideration of QinetiQ's activities in the EIA is not proposed.

Alternatives

None of the alternatives considered during design development are considered relevant to this assessment.

Assessment of Baseline Conditions & Receptor Sensitivity

Baseline conditions have been assessed using Phase 1 desk based research and Phase 2 ground investigation surveys undertaken in June and July 2016 and November 2018. Historic investigation works and prior assessments have also been undertaken by others and details of these works are summarised within the Desk Study, Ground Investigation and Data Assessment provided as appendix 13.1.

The desk based research included;

- an overview of historic site investigation done by both Hydrock and others to determine physical ground conditions (ground and groundwater) and develop a preliminary ground model. [12]
- Review of third party environmental and geological databases.
- Review of historical ordnance survey mapping to check for evidence of contaminative use.
- A reconnaissance site visit to determine current conditions and to check for visual or olfactory evidence of ground contamination associated with current and past uses.
- Identification of current and future potential receptors that might be harmed as a result of contamination being present.
- Formation of a Preliminary Conceptual Model identifying source-pathway-receptor linkages that may result in harm to the designated receptor.

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The 2016 and 2018 ground investigation surveys included;

- A series of 60 machine excavated trial pits, 6 hand excavated trial pits, 6 cable percussive boreholes and 63 window sample boreholes across the site targeting potential contamination identified within the desk study.
- Soil samples were collected and chemical analysis results compared to soil guideline values representative of the proposed end use in the area the sample was collected.
- A drainage inspection targeting depleted uranium was carried out around buildings Q7, Q6.3, N19 and H19. All of these buildings were identified as areas of historical uranium use and storage.

Further details are presented in Appendix 13.1.

Table 13.1 sets out the scale of sensitivity that has been applied to receptors identified and considered within this assessment.

Table 13.1

Scale of ground conditions sensitivity used in the assessment

SENSITIVITY	DESCRIPTION		
	HUMAN HEALTH	CONTROLLED WATERS	OTHER
Very High	Construction workers, Residential	Waters used for drinking water (surface or groundwater)	Assets of very high heritage or ecological value, such as scheduled monuments and ancient woodland
High	Education end-use, Neighbours, passers-by	Waters of high ecological importance; groundwaters in source protection Zones II and III	-
Medium	Business (B1a, B1b, B1c), retail (A1-5), community and leisure (D1, D2 (exc. Education)) Maintenance Users.	Natural watercourses, urban environment, low water quality; naturally low-quality aquifers	Existing buildings on site. Adverse impact to Existing flora and fauna other than ancient woodland.
Low	-	Man-made drainage systems in urban areas; naturally low-quality/low productivity aquifers	Proposed new buildings. Proposed flora and fauna.
Negligible	Industrial end-use.	Small, intermittent, accumulations of surface water, groundwater in Made Ground	-

Assessment of Magnitude

The assessment was undertaken based on the description of development contained in chapter 3 of this volume of the ES. Table 13.2 indicates the scale of impact magnitude that has been used in undertaking the assessment.

Table 13.2

Scale of magnitude for ground conditions impacts used in the assessment

MAGNITUDE	DESCRIPTION
Very large	Complete loss of an attribute (eg species die back or short term acute human health impact). Likely to failure to meet statutory objectives and result in breaches of legislation.
Large	Large scale loss of an attribute (eg long term chronic human health impact or substantial pollution of ecologically important groundwater). Possible failure to meet statutory objectives and result in breaches of legislation.
Medium	Moderate impact on attribute or less sensitive receptor (eg soil contamination exists but the concentrations would not be in high enough concentrations to cause harm or that there is a low likelihood of serious pollution).
Small	No discernible change or an impact on attribute (eg Soil contaminants present, but risk assessment suggests negligible/low risk to human health or controlled waters).

Assessment of Significance

The assessment of significance within this chapter is based on the matrix presented in Table 13.3.

Table 13.3

Significance Matrix

MAGNITUDE OF EFFECT	SENSITIVITY OF RECEPTOR				
	Very High	High	Medium	Low	Negligible
Very Large	Major Significance	Major Significance	[3]	Moderate Significance	[1]
Large	Major Significance	[3]	Moderate Significance	Minor Significance	[2]
Medium	[3]	Moderate Significant	Minor Significance	[2]	Negligible Significance
Small	Moderate Significance	Minor Significance	[2]	Negligible Significance	Negligible Significance
Negligible	[1]	[2]	Negligible Significance	Negligible Significance	Negligible Significance

[1] The choice between 'Moderate Significance', 'Minor Significance' and 'Negligible Significance' will depend on the specifics of the impact and will be down to professional judgement and reasoning.

[2] The choice between 'Minor Significance' and 'Negligible Significance' will depend on the specifics of the impact and will be down to professional judgement and reasoning.

[3] The choice between 'Major Significance' and 'Moderate Significance' will depend on the specifics of the impact and will be down to professional judgement and reasoning.

n.b. 'Negligible Significance' includes 'Neutral' and 'No Impact' assessments.

Relevant Associated Development

Associated development has not been considered at this stage in relation to this assessment. This will be considered at reserved matters stage when further details are confirmed.

Assumptions/Limitations

In undertaking the ground conditions assessment of the application site and wider surrounding area, there are a number of limitations and constraints affecting the outputs from this work. These include:

- The scheduled monument was not accessible for ground investigation.
- Areas beneath existing buildings were not accessible during ground investigation.
- Ground gas monitoring commissioned was insufficient to fully characterise the site in accordance with CIRIA Report 665. A preliminary ground gas assessment has been undertaken; however, further assessment will be required in due course to be in accordance with CIRIA C665.

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13.3 BASELINE CONDITIONS

KEY RECEPTORS	DESCRIPTION	SENSITIVITY	FURTHER INFORMATION
Human Health (Future users)	Once operational, the proposed residential units will bring new users to the site. Contaminants potentially present at the site of relevance to this receptor are as follows: ■ The Made Ground within the existing waste compound is a source of lead, copper, PAH and petroleum hydrocarbons. Asbestos fibres have also been encountered in Made Ground at various locations across the site. ■ Depleted Uranium – Historic activities associated with the Works undertaken to date have indicated the potential for elevated radionuclide concentrations. This is primarily anticipated around existing buildings Q7, Q6.3, N19 and H19. ■ Explosive residues - Historic activities associated with the Works undertaken to date have indicated the potential for elevated explosive residues. This is primarily anticipated in the R, M and X areas.	Proposed residential - Very High Proposed primary school – High Proposed business areas - Medium Proposed mixed use village centre - Medium Proposed D1 use areas - Medium	Appendix 13.1, Chapters 4, 5 and 9 & drawing 10730-HYD-XX-ZZ-DR-GE-1002.
Human Health (Neighbours and passers-by)	During construction there is a risk identified asbestos fibres in Made Ground may have a pathway via wind blown dispersion to impact upon site neighbours.	High	Appendix 13.1, Chapter 9
Human Health (Construction workers)	During construction, workers on site will be in direct contact with the ground. Contaminants potentially at site of relevance to this receptor are as follows: ■ The Made Ground within the existing waste compound is a source of lead, copper, PAH and petroleum hydrocarbons. Asbestos fibres have also been encountered in Made Ground at various locations across the site. ■ Depleted Uranium – Historic activities associated with the Works undertaken to date have indicated the potential for elevated radionuclide concentrations. This is primarily anticipated around existing buildings Q7, Q6.3, N19 and H19. ■ Explosive residues - Historic activities associated with the Works undertaken to date have indicated the potential for elevated explosive residues. This is primarily anticipated in the R, M and X areas.	Very High	Appendix 13.1, Chapters 4, 5 and 9 & drawing 10730-HYD-XX-ZZ-DR-GE-1002.
Scheduled Monument	Investigation works have been limited within the Scheduled Monument however given the known storage of potentially explosive materials there remains the potential for impact to the structure. Given its proposed community use there also remains a potential risk to future users of the site.	Low	Appendix 13.1, Section 5.9.
Ancient woodland	Elevated concentrations of lead, copper, PAH and petroleum hydrocarbons as a result of the sites historic activities have been identified within the Made Ground and have the potential to impact any future plant life or ecology.	Very High	Appendix 13.1, Section 5.3.
Flora and Fauna	Elevated concentrations of lead, copper, PAH and petroleum hydrocarbons as a result of the sites historic activities have been identified within the Made Ground and have the potential to impact any existing and proposed flora or fauna.	Existing – Medium Proposed - Low	Appendix 13.1, Chapter 5
Controlled Waters (Groundwater water)	Groundwater is understood to be at least 90m bgl and unlikely to be impacted by contamination identified at the site. Sensitivity remains high as the underlying chalk formation is a Principal Aquifer.	High	Appendix 13.1, Chapter 5
Controlled Waters (Surface water)	Elevated concentrations of lead, copper, PAH and petroleum hydrocarbons as a result of the sites historic activities have been identified within the Made Ground and consequently have the potential to impact on proposed surface water features (eg.swales). Sensitivity is medium as all surface waters are proposed and will be designed to mitigate risk of contact with existing contamination.	Medium	Appendix 13.1, Chapter 5
Buildings and infrastructure.	Elevated concentrations of lead, copper, PAH and petroleum hydrocarbons as a result of the sites historic activities have been identified within the Made Ground have the potential to impact building materials for new structures.	Existing - Medium Proposed - Low	Appendix 13.1, Chapter 5

13.4 POTENTIAL SIGNIFICANT IMPACTS

PHASE	DESCRIPTION	ADVERSE/BENEFICIAL
Construction	Asbestos containing materials within existing buildings impacting on construction workers and neighbours, during demolition.	Adverse
Construction	The construction phase may lead to effects on Site workers and neighbours, who are assigned a very high sensitivity. Baseline conditions are such that earthworks (including removal / crushing of concrete floor slabs, basement excavations, foundations and areas of external hardstanding) could disturb and expose workers to localised ground contamination through dermal contact, inhalation and/ or ingestion pathways. These pathways were previously contained and isolated by the prevailing hard ground cover.	Adverse

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PHASE	DESCRIPTION	ADVERSE/BENEFICIAL
Construction	The construction phase may lead to effects on Controlled Waters (groundwater) assigned a Medium sensitivity. Baseline conditions are such that earthworks (including removal / crushing of concrete floor slabs, basement excavations, foundations and areas of external hardstanding) could disturb and theoretically impact groundwater through the mobilisation of identified contaminants. These pathways were previously contained and isolated by the prevailing hard ground cover. Deep bore soakaways are proposed for drainage. These have the potential to create a pathway for surface/shallow contamination to the principal aquifer at depth.	Adverse
Construction	The construction phase may lead to effects on Controlled Waters (surface waters) assigned a Medium sensitivity. Baseline conditions are such that earthworks (including removal / crushing of concrete floor slabs, basement excavations, foundations and areas of external hardstanding) could disturb and theoretically impact surface waters through the mobilisation of identified contaminants to surface waters via the unsaturated zone. These pathways were previously contained and isolated by the prevailing hard ground cover.	Adverse
Construction	The presence of elevated contaminants within the site soils has the potential to adversely impact on new buildings and infrastructure where construction materials come into direct contact with the soils.	Adverse
Construction	The presence of elevated contaminants within the site soils has the potential to adversely impact plant life and ecology where contaminants come into direct contact with the flora and fauna.	Adverse
Operation	During the operational phase, ingestion, dermal contact and root uptake pathways will generally only exist in areas of soft landscaping. Elsewhere the areas of hardstanding (i.e. the building floor slabs, commercial service yards, car parks, pavements,) will break these pathways.	Adverse
Operation	During the operational phase any subsurface chemical contamination coming into contact with buried services has the potential for a major significant effect on this receptor. Potable water supply pipes are a particularly sensitive receptor in this regard.	Adverse
Operation	Where Made Ground is present at service locations, future maintenance workers may be at risk of exposure to contaminants hazardous to human health.	Adverse

13.5 DESIGN INTERVENTIONS

No design interventions have been proposed in relation to this topic.

13.6 ASSESSMENT PRE-MITIGATION (INCLUDING DESIGN INTERVENTION)

PHASE	RECEPTOR(S) AFFECTED	IMPACT	MAGNITUDE PRE-MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION PROPOSED?	FURTHER INFORMATION
Construction	Human Health (Construction Workers / future residents of proposed residential properties)	During construction the disturbance of Made Ground has the potential to create a pathway for inhalation of asbestos fibres and windblown dust, particularly by groundworkers. In addition, users and visitors to neighbouring off-site properties as well as passers-by may be at risk of exposure. Magnitude is very large due to health risks associated with inhalation of asbestos fibres.	Very Large	Major Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Construction	Human Health (users of proposed primary school, passers-by / users of off-site areas)	During construction the disturbance of Made Ground has the potential to create a pathway for inhalation of asbestos fibres and windblown dust. Should any of these receptors be operational while the construction phase is ongoing, users of these receptors could be affected. Magnitude is very large due to health risks associated with inhalation of asbestos fibres.	Very Large	Major Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Construction	Human Health (users of proposed business areas, mixed use village centre and D1 use areas)	The disturbance of Made Ground has the potential to create a pathway for inhalation of asbestos fibres and windblown dust. Should any of these receptors be operational while the construction phase is ongoing, users of these receptors could be affected. Magnitude is very large due to health risks associated with inhalation of asbestos fibres.	Very Large	Major Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Construction	Human Health (Construction Workers / future residents of proposed residential properties)	Direct contact or inhalation of elevated lead, copper, PAH, petroleum hydrocarbons during construction activities particularly by groundworkers. In addition, any new residents brought to the site while construction works are ongoing may be at risk of exposure. Magnitude is large due to health risks of exposure to metals, PAH and petroleum hydrocarbons.	Large	Major Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Construction	Human Health	Risk of exposure by direct contact or inhalation of elevated lead, copper, PAH, petroleum hydrocarbons during construction activities. Any new users of the primary school that may be brought to the site while construction works are ongoing, as well as any visitors to neighbouring off-site properties or passers-by may be at risk of exposure. Magnitude is large due to health risks of exposure to metals, PAH and petroleum hydrocarbons.	Large	Major Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2

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PHASE	RECEPTOR(S) AFFECTED	IMPACT	MAGNITUDE PRE-MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION PROPOSED?	FURTHER INFORMATION
	(users of proposed primary school, passers-by / users of off-site areas)					
Construction	Human Health (users of proposed business areas, mixed use village centre and D1 use areas)	Risk of exposure by direct contact or inhalation of elevated lead, copper, PAH, petroleum hydrocarbons during construction activities. Any new users of the proposed business areas, mixed use village centre or D1 use areas that may be brought to the site while construction works are ongoing may be at risk of exposure. Magnitude is large due to health risks of exposure to metals, PAH and petroleum hydrocarbons.	Large	Moderate Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Construction	Existing buildings and infrastructure	Existing foundations and services in direct contact with elevated contaminants are at risk of damage to building materials potentially creating structural faults in the buildings/infrastructure. Magnitude is medium due to presence of contaminants unlikely to have catastrophic impact on buildings and infrastructure.	Medium	Minor Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Construction	New buildings and infrastructure	Proposed foundations and services in direct contact with elevated contaminants are at risk of damage to building materials potentially creating structural faults in the buildings/infrastructure. Magnitude is medium due to presence of contaminants unlikely to have catastrophic impact on buildings and infrastructure.	Medium	Minor Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Construction	Ancient woodland	Direct contact with elevated contaminants may cause an adverse impact on existing ancient woodland. Magnitude is medium due to lack of evidence of distress in existing plant life.	Medium	Moderate Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Construction	Existing flora and fauna	Direct contact with elevated contaminants may cause an adverse impact to newly planted flora and any associated fauna. Magnitude is medium due to lack of evidence of distress in existing plant life.	Medium	Minor Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Construction	Proposed flora and fauna	Direct contact with elevated contaminants may cause an adverse impact to newly planted flora and any associated fauna. Magnitude is medium due to lack of evidence of distress in existing plant life.	Medium	Minor Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Construction and Operation.	Controlled Waters (groundwater)	No significant effect on controlled waters is anticipated due to the depth to groundwater (understood to be at approximately 90m bgl). Piling foundation works have the potential to impact groundwater but given depth this is not regarded as being significant. A Piling Risk Assessment is likely to be required by the regulatory authorities to support this assessment. The magnitude is considered small due to the extremely low likelihood construction works will impact groundwater. Deep bore soakaways are proposed for drainage. These have the potential to create a pathway for surface/shallow contamination to the principal aquifer at depth.	Small	Minor Adverse	No	Appendix 13.1 Chapter 7 & Appendix 13.2
Construction	Controlled Waters (Surface waters)	Surface waters (eg swales) have the potential for direct contact with elevated contaminants and through surface water runoff. Magnitude is small due to extremely low likelihood construction works will impact surface waters.	Small	Minor Adverse	No	Appendix 13.1 Chapter 7 & Appendix 13.2
Operation	Human Health (residents of proposed residential properties)	When in operation, recreational use of landscaping areas and digging in residential gardens by future users may create a pathway for inhalation of asbestos fibres, potential for generation of contaminated dust. Magnitude is very large due to health risks associated with inhalation of asbestos fibres.	Very Large	Major Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Operation	Human Health (users of proposed primary school)	When in operation recreational use of landscaping areas by future users may create a pathway for inhalation of asbestos fibres, potential for generation of contaminated dust. Magnitude is very large due to health risks associated with inhalation of asbestos fibres.	Very Large	Major Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Operation	Human Health (users of proposed business areas, mixed use village centre and D1 use areas)	When in operation, recreational use of landscaping areas by future users may create a pathway for inhalation of asbestos fibres, potential for generation of contaminated dust. Magnitude is very large due to health risks associated with inhalation of asbestos fibres.	Very Large	Major Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Operation	Human Health (residents of proposed residential properties)	When in operation, recreational use of landscaping areas or digging in residential gardens by future users may create a pathway for direct contact or inhalation of lead, copper, PAH, petroleum hydrocarbons identified during ground investigation. Magnitude is large due to health risks of exposure to metals, PAH and petroleum hydrocarbons.	Large	Major Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2

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PHASE	RECEPTOR(S) AFFECTED	IMPACT	MAGNITUDE PRE-MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION PROPOSED?	FURTHER INFORMATION
Operation	Human Health (users of proposed primary school)	When in operation, recreational use of landscaping areas by future users may create a pathway for direct contact or inhalation of lead, copper, PAH, petroleum hydrocarbons identified during ground investigation. Magnitude is large due to health risks of exposure to metals, PAH and petroleum hydrocarbons.	Large	Major Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Operation	Human Health (users of proposed business areas, mixed use village centre and D1 use areas)	When in operation, recreational use of landscaping areas by future users may create a pathway for direct contact or inhalation of lead, copper, PAH, petroleum hydrocarbons identified during ground investigation. Magnitude is large due to health risks of exposure to metals, PAH and petroleum hydrocarbons.	Large	Moderate Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Operation	Human Health (residents of proposed residential properties)	When in operation, utilities services run through Made Ground may create pathways via direct contact (eg potable water pipes) resulting in the ingestion of elevated contaminants present within the residual soils. Magnitude is large due to health risks of exposure to metals, PAH and petroleum hydrocarbons.	Large	Major Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Operation	Human Health (users of proposed primary school)	When in operation, utilities services run through Made Ground may create pathways via direct contact (eg potable water pipes) resulting in the ingestion of elevated contaminants present within the residual soils. Magnitude is large due to health risks of exposure to metals, PAH and petroleum hydrocarbons.	Large	Major Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Operation	Human Health (users of proposed business areas, mixed use village centre and D1 use areas)	When in operation, utilities services run through Made Ground may create pathways via direct contact (eg potable water pipes) resulting in the ingestion of elevated contaminants present within the residual soils. Magnitude is large due to health risks of exposure to metals, PAH and petroleum hydrocarbons.	Large	Moderate Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2
Operation	Human Health (Maintenance Users)	During operation, maintenance workers may have to raise covers or work in service ducts creating a pathway for direct contact or inhalation of lead, copper, PAH, petroleum hydrocarbons, asbestos fibres during maintenance works. Magnitude is large due to health risks of exposure to metals, PAH and petroleum hydrocarbons.	Large	Moderate Adverse	Yes	Appendix 13.1 Chapter 9 & Appendix 13.2

13.7 MITIGATION & ENHANCEMENT MEASURES

PHASE	POSSIBLE EFFECT BEING MITIGATED	MITIGATION MEASURE	HOW SECURED / TRIGGER	MAGNITUDE POST-MITIGATION	ADVERSE/BENEFICIAL	FURTHER INFORMATION
Construction	Inhalation of asbestos fibres and windblown dust during demolition and construction activities	Prior to demolition, the existing buildings will be subject to an asbestos survey to identify if asbestos is present. If so, demolition would be preceded by removal of asbestos by licensed contractors. A Construction Environmental Management Plan (CEMP) should be developed to place environmental controls on the construction activities to ensure any construction related impacts are minimised. Further ground investigation will be undertaken to investigate areas previously not accessible. This will allow further delineation of asbestos fibres.	Planning Condition	Negligible	Beneficial	Appendix 13.1, Chapter 9. Appendix 13.2.
Construction/Operation	Direct contact or inhalation of elevated lead, copper, PAH, petroleum hydrocarbons during construction activities	Following demolition of existing structures further ground investigation will be required to investigate areas previously not accessible. This will allow further delineation of metals, PAH and petroleum hydrocarbons. Further investigation should also be undertaken in the area of the Scheduled Monument Area. A Construction Environmental Management Plan (CEMP) should be developed to place environmental controls on the construction activities to ensure any construction related impacts are minimised.	Planning Condition	Negligible	Beneficial	Appendix 13.1, Chapter 9. Appendix 13.2.
Construction	Foundations in direct contact with elevated contaminants are at risk	Following demolition of existing structures further ground investigation will be required to investigate areas previously not accessible. This will provide further information on potential aggressive contaminated ground conditions.	Planning Condition	Negligible	Beneficial	Appendix 13.1, Chapter 7.

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PHASE	POSSIBLE EFFECT BEING MITIGATED	MITIGATION MEASURE	HOW SECURED / TRIGGER	MAGNITUDE POST-MITIGATION	ADVERSE/BENEFICIAL	FURTHER INFORMATION
	damage to building materials potential creating structural faults in the buildings/infrastructure.	Foundations will then be designed in accordance with the identified ground conditions.				Appendix 13.2.
Construction	Direct contact with elevated contaminants may cause an adverse impact to newly planted flora and fauna.	Within areas of landscaping, gardens or public open space a suitable capping layer should be placed over the Made Ground with a no dig marker to prevent plant life and ecology coming into contact with contaminants.	Planning Condition	Negligible	Beneficial	Appendix 13.1, Chapter 9. Appendix 13.2.
Construction	Impact to Controlled Waters (Groundwater)	Whilst no significant impact to controlled waters has been identified given the depth to the underlying groundwater, the Contractors for each stage of works must manage the construction activities to ensure no adverse impact to controlled waters or underlying soils occurs. A Construction Environmental Management Plan (CEMP) should be developed to place environmental controls on the construction activities to ensure any construction related impacts are minimised. A Piling Risk Assessment will be undertaken to demonstrate the proposed foundations do not have an adverse risk on the underlying groundwater. Deep bore soakaways are proposed for drainage. These are anticipated to discharge surface waters at depth (circa 15m bgl) and be sealed to prevent any contact with potential surface contaminants. The design of the Deep bore soakaways will be agreed with the regulatory authorities.	Planning Condition	Negligible	Beneficial	Appendix 13.1, Chapter 9. Appendix 13.2.
Construction	Impact to Controlled Waters (surface waters)	Surface waters (eg swales) have the potential for direct contact with elevated contaminants. The swales will be specifically designed to remove any potential contamination from the sites operation and be isolated from any existing contaminants within the Made Ground. The design of the surface water strategy will be agreed with the regulatory authorities.	Planning Condition	Negligible	Beneficial	Appendix 13.1, Chapter 9. Appendix 13.2.
Operation	Recreational use of landscaping activities and garden	To mitigate for the presence of asbestos a suitable capping layer will be placed over the Made Ground within areas of landscaping, gardens or public open space to prevent receptors coming into contact with asbestos.	Planning Condition	Negligible	Beneficial	Appendix 13.1, Chapter 9. Appendix 13.2.
Operation	Recreational use of landscaping activities and garden	To mitigate for the presence of metals, PAH and petroleum hydrocarbons a suitable capping layer will be placed over the Made Ground within areas of landscaping, gardens or public open space to prevent receptors coming into contact with contaminants.	Planning Condition	Negligible	Beneficial	Appendix 13.1, Chapter 9. Appendix 13.2.
Operation	Potable water supply to future users	To mitigate for the presence of metals, PAH and petroleum hydrocarbons the use of barrier pipe for potable water supplies is proposed.	Planning Condition	Negligible	Beneficial	Appendix 13.1, Chapter 9. Appendix 13.2.
Operation	Undertaking maintenance works	All services should be installed within clean service corridors to prevent direct contact with contaminants and ensure future maintenance workers do not come into contact with contaminants.	Planning Condition	Negligible	Beneficial	Appendix 13.1, Chapter 9. Appendix 13.2.

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13.8 ASSESSMENT POST-MITIGATION

PHASE	RECEPTOR	RESIDUAL IMPACT	RESIDUAL EFFECT SIGNIFICANCE	ADV/BEN	ST/MT/LT	D/IND	P/T	R/IRR
Construction	Human Health (Construction Workers / passers-by / users of off-site areas, future site users associated with any proposed uses that become operational during construction)	Following completion and removal of asbestos containing materials by a licensed contractor demolition of existing buildings will have no residual impact on inhalation of asbestos fibres.	Negligible	Beneficial	Long Term	Direct	Permanent	Irreversible
Construction	Human Health (Construction Workers)	Following completion of construction works in accordance with the CEMP no residual impact from direct contact or inhalation of elevated lead, copper, PAH, petroleum hydrocarbons is anticipated.	Negligible	Beneficial	Long Term	Direct	Permanent	Irreversible
Construction	Existing buildings and infrastructure	Existing buildings that are to be retained and currently show no sign of damage are not anticipated to experience any residual impact.	Negligible	Beneficial	Long Term	Direct	Permanent	Irreversible
Construction	New buildings and infrastructure	Foundations will be designed taking into account potential aggressive contaminated ground conditions and therefore no residual impact on building materials is anticipated.	Negligible	Beneficial	Long Term	Direct	Permanent	Irreversible
Construction	Existing flora and fauna	Existing flora and fauna that does not show any evidence of distress is not anticipated to experience any residual impact.	Negligible	Beneficial	Long Term	Direct	Permanent	Irreversible
Construction	Proposed flora and fauna	Clean capping layers for plant growth will be installed removing the pathway for direct contact with elevated contaminants that may cause an adverse impact to newly planted flora and fauna. No residual impact anticipated.	Negligible	Beneficial	Long Term	Direct	Permanent	Irreversible
Construction	Controlled Waters (Groundwater)	Following completion of construction works in accordance with the CEMP, completion of a foundation works risk assessment and approval for the deep bore soakaway design, no residual impact to controlled waters is anticipated.	Negligible	Beneficial	Long Term	Direct	Permanent	Irreversible
Construction	Controlled Waters (Surface Water)	Following completion of construction works in accordance with the CEMP and approval for the surface water strategy, no residual impact to controlled waters is anticipated.	Negligible	Beneficial	Long Term	Direct	Permanent	Irreversible
Operation	Human Health (future site users associated with all proposed uses)	Capping layers installed in gardens and landscaped areas will break the pathway to the risk of asbestos fibres leaving no residual impact	Negligible	Beneficial	Long Term	Direct	Permanent	Irreversible
Operation	Human Health ((future site users associated with all proposed uses)	Capping layers installed in gardens and landscaped areas will break the pathway to the risk of direct contact or inhalation of lead, copper, PAH, petroleum hydrocarbons leaving no residual impact.	Negligible	Beneficial	Long Term	Direct	Permanent	Irreversible
Operation	Human Health ((future site users associated with all proposed uses)	The use of barrier pipe for potable water supplies will ensure contaminants do not impact potable water supplies. No residual impact is anticipated.	Negligible	Beneficial	Long Term	Direct	Permanent	Irreversible
Operation	Human Health (Maintenance Users)	Installation of all services in clean service corridors will ensure there is no residual impact to maintenance workers from direct contact with contaminants.	Negligible	Beneficial	Long Term	Direct	Permanent	Irreversible

Key: ADV/BEN= Adverse/Beneficial; ST/MT/LT = Short-term/Medium-term/Long-term; D/IND = Direct/Indirect; P/T = Permanent/Temporary; R/IRR = Reversible/Irreversible

13.9 GROUND CONDITIONS AND CONTAMINATION INTER-CUMULATIVE SCHEME IMPACTS

No cumulative schemes have been considered in the EIA

GROUND CONDITIONS & CONTAMINATION

13.10 WORKS CITED

13.11

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