

Cottam Parkway Railway Station

Environmental Statement

Volume 2: Main Statement Chapter 10: Soils and Geology Document Reference: 07-ES-02-10-02



www.lancashire.gov.uk

ES Chapter Document Control

Project Title: Cottam Parkway Railway Station

Document Reference: 07-ES-02-10-02

Chapter Title: Soils and Geology

Version No: 2

	Created By	Checked By	LCC Checker and Date Comments Provided
Version 1	Harriet Wood	Richard Pollard	Niamh O'Sullivan
26/05/2022			Nick Benson
			31/05/2022
Version 2	Harriet Wood	Richard Pollard	Grace Wilson
13/06/2022			17/08/2022
Document Status	Final	·	

10 Soils, Geology and Hydrogeology

ES Chapter	Environmental	Relevant Appendices
Number	Торіс	
10	Soils, Geology	Appendix 10.1: Preliminary
	and	Sources Study Report and Ground
	Hydrogeology	Investigation Reports
		Appendix 10.2: Geo-environmental
		Desk Study
		Appendix 10.3 Figures

10.1 Introduction

- 10.1.1 This chapter outlines the potential effects of the construction of the Scheme on soils, geology and groundwater. The assessment scope includes the following:
 - Geological and hydrogeological characterisation;
 - Assessment of potentially contaminated land;
 - Soil types and classifications;
 - Groundwater and surface water resources;
 - Mineral resources; and
 - Geologically designated sites.
- 10.1.2 Potential effects related to materials use are presented in Chapter 16: Materials. Hydrogeological effects related to groundwater flow and potential construction dewatering are assessed in Chapter 11: Water Environment of this Environmental Statement (ES).

10.2 Relevant Legislative, Plans, Policies and Background

- 10.2.1 This assessment has taken into account relevant legislation and planning policy at national and local levels, as described below.
- 10.2.2 Legislation relevant to this topic is summarised in Table 10.1.

Policy	Relevance
Documents	
Part IIA of the	Part IIA of the Environmental Protection Act 1990
Environmental	contaminated land in the UK and requires land to be
Protection Act	determined as contaminated if it poses an
1990	unacceptable risk to human health, controlled waters (including groundwater) or the environment. This legislation defines contaminated land and the procedures to identify and initiate remediation of such land.
	It should be noted that where land is subject to a planning application or Development Consent Order as part of a major infrastructure project, Part IIA is not directly relevant. However, the National Planning Policy Framework (NPPF) (discussed in Table 10.2) requires that where land has been remediated for any reason it, should not then be capable of being determined as contaminated land under Part IIA.
Environmental	Activities, processes and land-use with the potential
Permitting	Wales under the Environmental Permitting
(England and	Regulations 2016. Under these regulations, any
Wales)	must be authorised by the Environment Agency.
Regulations 2016	This includes but is not limited to, discharges; disposal to land; abstractions and impoundments. Permits in respect of controlled waters are typically conditioned with regards to the nature of the permitted activities, the volume of water potentially affected and, where applicable, permissible contaminant concentrations. Permits in respect of disposal typically specify the types and volumes of waste that may be deposited and permitted landfills are usually categorised as being able to accept inert

 Table 10.1: Summary of relevant legislation

Policy	Relevance
Documents	
	and/or non-hazardous and/or hazardous wastes.
Water Framework	The purpose of the Water Framework Directive
Directive (Council	(WFD) is to establish a framework for the protection of inland surface waters (rivers and lakes),
Directive	transitional waters (estuaries), coastal waters and
2000/60/EC);	groundwater, which includes risks from contamination. The overarching objective of the
implemented in	WFD is for the water bodies in Europe to attain
England by the	Good or High Ecological Status.
Water	
Environment	
(Water	
Framework	
Directive)	
(England and	
Wales)	
Regulations 2017	

10.2.3 National policy documents relevant to this topic are summarised in Table 10.2.

Table 10.2: Summary of relevant national policy

Policy	Relevance
Documents	
NPPF (Ministry of	Land contamination:
Housing,	The NPPF states that <i>planning policies and</i>
Communities and	decisions should contribute to and enhance the natural and local environment by: a) protecting and
Local	enhancing valued landscapes, sites of biodiversity
Government,	or geological value and soils (in a manner commensurate with their statutory status or
2021)	identified quality in the development plan) e)
	preventing new and existing development from
	contributing to, being put at unacceptable risk from,

Policy	Relevance
Documents	
	or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.' (Paragraph 174)
	The policy also states that 'planning policies and decisions should ensure that: a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. 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); b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and c) adequate site investigation information, prepared by a competent person, is available to inform these assessment. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.' (Paragraphs 183 and 184)
	Geology:
	The NPPF also provides guidance relating to geological conservation. The guidance indicates that the assessment should ensure that the effects on internationally, nationally and locally designated sites of geological conservation are considered. This includes taking advantage of opportunities to conserve geological interests. Guidance within the Government Circular: Biodiversity and Geological Conservation – Statutory Obligations and their Impact within the Planning System (ODPM 06/2005, Defra 01/2005) is referred to.
National Policy	Land contamination and soils:
Statement for	The policy document states: <i>'applicants should also identify any effects, and seek to minimise impacts,</i>

Policy	Relevance
Documents	
National	on soil quality, taking into account any mitigation
Networks	measures proposed. Where possible, developments should be on previously developed (brownfield) sites
(Department for	provided that it is not of high environmental value.
Transport, 2014)	For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination and how this is proposed to be addressed'
	Geology:
	'Sites of regional and local geological interest (which include Local Geological Sites) have a fundamental role in contributing to the quality of life and the wellbeing of the community, and in supporting research and education. The Secretary of State should give due consideration to such regional or local designation'

10.2.4 The local development planning documents and the policies therein are of relevance to the assessment, and these are summarised in Table 10.3.

Policy	Relevance	
Documents		
Preston City	The strategy states:	
Council	'Risks therefore need to be assessed on a site-by-	
Contaminated	site basis balanced against the intended reuse or existing use of the land. This "suitable for use"	
Land Strategy	approach basically consists of Ensuring that land	
(Preston City	given for that new use –	
Council, 2012)	The assessment is performed on the potential risks from contamination on the proposed future use, avoiding any unacceptable risks to human health and the environment. This may include a scheme of remediation where necessary.'	
Preston Local	Policy EN7 – Land Quality:	
Plan 2012-26	'New development should demonstrate that:	
(Adopted 2 July	a) Any existing contamination of the land will be	

Table 10.3: Summary of relevant local policy documents

Policy	Relevance
Documents	
2015) (Preston	addressed by appropriate mitigation
City Council,	measures to ensure that the site is suitable for the proposed use and that there is no
2015)	unacceptable risk of pollution within the site or in the surrounding area; and,
	b) The proposed development will not cause the land to become contaminated, to the detriment of future use or restoration of the site or so that it would cause pollution in the surrounding area.'

10.3 Methodology

- 10.3.1 This section sets out the approach to the soils and geology assessment and methodology. This assessment has been undertaken with regard to the best practice guidance contained within the Guidelines for Environmental Impact Assessment (IEMA, 2016). Due regard is also given to other Environmental Impact Assessment (EIA) guidelines and best practice published by Government statutory agencies and professional institutions, such as the National Highways Design Manual for Roads and Bridges (DMRB), notably LA 104 Environmental assessment and monitoring (National Highways 2020a), LA 109 Geology and Soils (National Highways 2019) and LA 113 Road drainage and the water environment (National Highways 2020b).
- 10.3.2 Primary guidance for assessing and managing land contamination is presented in Land Contamination Risk Management (LCRM) (Environment Agency, 2021). LCRM provides a technical framework for identifying and remediating contamination through the application of a risk management process.

Study area

10.3.3 The study area is defined as a 250m buffer from the boundary of the Scheme. The 250m buffer has been chosen based on National House

Building Council et al. guidance (2008). The buffer is considered appropriate and proportionate in the context of the Scheme, taking into account the distance over which contamination can potentially migrate.

Baseline data collection methodology

- 10.3.4 Baseline data has been collected from the following sources:
 - Groundsure reports covering the study area (Groundsure 2020a, Groundsure 2020b);
 - Online historical maps;
 - MAGIC online map service;
 - Coal Authority Interactive Map Viewer;
 - British Geological Survey (BGS) Onshore GeoIndex; and,
 - Relevant site-specific reports:
 - Cottam Parkway Access Bridge and Road Preliminary Sources Study Report (Geotechnical Report No. CLM07), Lancashire County Council, 2021 (included as Appendix 10.1 in volume 3 of this ES)
 - Cottam Parkway: Access Bridge and Embankment Ground Investigation Report (Geotechnical Report No. CLM07b-LCC-RP-600-0001), Lancashire County Council, 2021 (included as Appendix 10.1)
 - Cottam Parkway: Access Road and Car Park Ground Investigation Report (Geotechnical Report No. CLM07b-LCC-RP-600-0001), Lancashire County Council, 2021 (included as Appendix 10.1)
 - Cottam Parkway Geo-environmental Desk Study, Jacobs, 2020 (included as Appendix 10.2 in volume 3 of this ES).

- 10.3.5 It should be noted that the Geo-environmental Desk Study was undertaken on a larger study area than that assessed within this report. Therefore, it includes baseline data and potential sources of contamination that may no longer be relevant to the Scheme. All pertinent data has been carried through to this assessment.
- 10.3.6 The site-specific ground investigation data summarised in Table 10.4 has been incorporated into this assessment. Ground investigation has also been undertaken on the railway line, though at this stage of the assessment this is not available.

GI Report / Phase	GI Report / Phase		
	2014-15, Preston Western Distributor	2021, Access Bridge and Embankment	2021, Access Road and Car Park
Boreholes	4 No.	6 No.	-
Borcholes	(BH221 to BH224)	(CP01 to CP06)	
Window	1 No.	3 No.	15 No.
Samples	(WS227)	(WS01 to WS03)	(WS04 to WS18)
Trial Pits	-	-	6 No. (TP01 to TP06)
Soil Chemical	Yes	Yes	Yes
Testing			
<u> </u>			

Table 10.4: Summary of relevant ground investigation information

Soil Chemical Testing	Yes	Yes	Yes
Soil Leachate Testing	No	No	No
Groundwater Monitoring	Yes	Yes	Yes
Groundwater	No	No	No

Environmental Statement: Chapter 10 Soils, Geology and Hydrogeology

GI Poport /	GI Report / Phase			
Phase	2014-15, Preston Western Distributor	2021, Access Bridge and Embankment	2021, Access Road and Car Park	
Sampling				
Ground Gas Monitoring	No	No	No	

Assessment methodology

- 10.3.7 The good practice guidance listed above and professional judgement have been used to develop the criteria which have been used in this assessment, detailed below.
- 10.3.8 The relative value or sensitivity of key receptors in the study area is set out in Table 10.5. It should be noted that risks to construction and maintenance workers have been excluded from this assessment as mitigation and best practice measures to prevent impacts on workers would be undertaken prior to the construction period. This is in line with current Health and Safety Executive (HSE) Construction Design and Management (CDM) regulations (HSE, CDM Regulations 2015).

Sensitivity	Receptor Type	Examples of Receptors
Very High	Human Health	Schools, playing fields, medical facilities
	Surface Water	WFD Chemical Status 'Good'
		WFD Ecological Status 'High'
	Groundwater	Principal Aquifer
		Public Water Supplies
		Source Protection Zone (SPZ) 1
	Designated Sites	Internationally important geology (Earth Heritage Sites, European GeoParks),

Table 10.5: Sensitivity of Receptors

Sensitivity	Receptor Type	Examples of Receptors			
		Special Protection Areas, Special Areas of Conservation, SSSIs and World Heritage Sites			
	Buildings and Infrastructure	Hospitals, fire stations, essential public buildings			
	Mineral Resources	Operational mineral workings			
		Mineral Reserve or Measured Mineral Resource			
	Soil Quality	Agricultural Land Classification (ALC) Grade 1 (Excellent Quality) or Grade 2 (Very Good Quality)			
		Peat soils			
High	Human Health	Future site users, residential, allotments			
	Surface Water	WFD Chemical Status 'Good'			
		WFD Ecological Status 'Good'			
	Groundwater	Secondary A Aquifer			
		Licensed abstractions			
		SPZ 2			
	Designated Sites	Limestone Pavement Orders, National Nature Reserves, Designated Heritage Coasts, Marine Conservation Zones, Marine Nature Reserves, National Parks			
	Buildings and Infrastructure	Significant utilities (eg. high pressure gas main, sewage works)			
	Mineral Resources	Mineral resource with planning permission for future working			
		Probable Mineral Reserve or Indicated Mineral Resource			
	Soil Quality	Grade 3a (Good Quality)			
Medium	Human Health	Commercial / industrial, public access land			
	Surface Water	WFD Chemical Status 'Moderate'			
		WFD Ecological Status 'Moderate'			
	Groundwater	Secondary B Aquifer			
		Unlicensed abstractions			

Sensitivity	Receptor Type	Examples of Receptors
		SPZ 3
1 	Designated Sites	Local Geological Sites, RIGS, Local Nature Reserves
	Buildings and Infrastructure	Transport links (eg. railway), residential, commercial / industrial developments
	Mineral Resources	Minerals Safeguarding Areas
		Feasibility Mineral Resource or Pre- feasibility Mineral Resource
	Soil Quality	Grade 3b (Moderate Quality)
Low	Human Health	Users of adjacent land
	Surface Water	WFD Chemical Status 'Poor'
		WFD Ecological Status 'Poor'
	Groundwater	Secondary Undifferentiated Aquifer
	Designated Sites	Locally important geology
	Buildings and Infrastructure	Local infrastructure / services
	Mineral Resources	Inferred Mineral Resource or Reconnaissance Mineral Resource
	Soil Quality	Grade 4 (Poor Quality) or Grade 5 (Very Poor Quality)
Negligible	Human Health	N/A
	Surface Water	WFD Chemical Status 'Moderate'
		WFD Ecological Status 'Bad'
	Groundwater	Unproductive Strata
	Designated Sites	No outcrop
	Buildings and Infrastructure	N/A
	Mineral Resources	No mineral occurrences / prospects
	Soil Quality	Urban

10.3.9 The magnitude of the impact will be defined by the potential degree of change from the baseline, as presented in Table 10.6.

Table 10.6: Magnitude of impact

Sensitivity	Receptor Type	Examples of Receptors
Major	Human Health	Significant harm as defined by Part 2A
	Surface Water	Permanent reduction in WFD classification
	Groundwater	Major and/or irreversible change to groundwater flow, water level, quality or available yield
	Designated Sites	Total or significant (>50%) permanent loss of the designated site
	Buildings and Infrastructure	Total permanent loss of infrastructure
	Mineral Resources	Total sterilisation of the reserve / resource
	Soil Quality	Previously reusable soils rendered totally unsuitable for reuse
Moderate	Human Health	Effects on health occur (less than significant harm under Part 2A)
	Surface Water	Temporary reduction in WFD classification
	Groundwater	Moderate long-term or temporary significant changes to groundwater flow, water level, quality or available yield
	Designated Sites	Permanent loss of part (15-50%) of the designated site, total temporary loss of the site
	Buildings and Infrastructure	Total temporary loss of infrastructure, permanent loss of part (<50%) of infrastructure
	Mineral Resources	Permanent loss of part (<50%) of the site
	Soil Quality	Previously reusable soils rendered unsuitable for reuse without remediation/treatment
Minor	Human Health	Soils unlikely to be deemed as Part 2A (Category 3)
		One or more pollutant linkage present

Sensitivity	Receptor Type	Examples of Receptors		
	Surface Water	No reduction in WFD classification		
	Groundwater	Minor changes to groundwater flow, water level, quality or available yield		
	Designated Sites	Permanent loss of minor part (<15%) of designated site, temporary loss of part (15-50%) of designated site		
	Buildings and Infrastructure	Temporary loss of part of infrastructure		
	Mineral Resources	Permanent loss of minor part (<15%) of resource, temporary loss of part (<50%) of resource		
	Soil Quality	High quality soils (suitable for use in residential/public areas) rendered suitable for use in commercial/industrial areas only		
Negligible	Human Health	Soils unlikely to be deemed as Part 2A (Category 4)		
		Pollutant linkages unlikely to be present		
	Surface Water	No reduction in WFD classification		
	Groundwater	Very slight change from groundwater baseline conditions		
	Designated Sites	Temporary loss of negligible (<15%) part of designated site		
	Buildings and Infrastructure	No changes or damage to structures or buildings		
	Mineral Resources	Temporary loss of negligible (<15%) part of resource		
	Soil Quality	No measurable change to quality of soil resources.		

10.3.10 The 'significance' of an environmental effect is a function of the 'value' or 'sensitivity' of the receptor and the 'magnitude' or 'scale' of the impact. The significance of the resulting effect will be defined as presented in Table 10.7.

Table 10.7: Significance of effect

Sensitivity	Magnitude							
	Major	Moderate	Minor	Negligible	No Change			
Very High	Very Large	Large or Very Large	Moderate or Large	Slight or Moderate	Neutral			
High	Large or Very Large	Moderate or Large	Slight or Moderate	Slight	Neutral			
Medium	Moderate or Large	Slight or Moderate	Slight	Neutral or Slight	Neutral			
Low	Slight or Moderate	Slight	Neutral or Slight	Neutral	Neutral			
Negligible	Slight	Neutral or Slight	Neutral	Neutral	Neutral			

10.3.11 Depending on the result of the assessment in Table 10.7, the residual effect following mitigation will be evaluated as 'significant' or 'not significant'. The criteria are shown in Table 10.8. Where a range of significances have been reported, such as slight/moderate, one will be chosen.

Table 10.8: Significance of effect

Reported Significance	Final Significance
Very Large, Large or Moderate	Significant
Slight or Neutral	Not Significant

Assessment assumptions and limitations

10.3.12 This assessment is based on third party data, and the geographical extents of the soils, geology and hydrogeology receptors and potential sources of contamination have been assumed to be correct.

- 10.3.13 No additional analysis of site-won data has been undertaken above that undertaken in the ground investigation reports.
- 10.3.14 This assessment is based on indicative designs and is therefore limited by the accuracy of the design information at this stage. Potential land-take areas may be subject to change.
- 10.3.15 Site-specific or post-1988 ALC data are not available for the study area and therefore, the assessment is based on provisional ALC data. As this data does not discriminate between Grade 3a and Grade 3b agricultural land, as detailed in Section 10.4, this assessment is considered to be conservative.
- 10.3.16 It should be noted that construction of the Preston Western Distributor Road (PWDR) has commenced and will be open in 2023.

10.4 Baseline Description and Evaluation

<u>Geology</u>

- 10.4.1 BGS Artificial Ground mapping does not indicate Made Ground on site. However, given the historical use of the area, Made Ground is likely to be present in the vicinity of the railway line, canal and the areas of infilled land detailed in Potentially Contaminative Land Uses.
- 10.4.2 During the ground investigation, brick inclusions were recorded within topsoil to depths of 0.20 m below ground level (bgl) in WS10. No other exploratory locations recorded anthropogenic material.
- 10.4.3 The site is shown to be underlain by Devensian Glacial Till, comprising diamicton. To the south of the site, Head, comprising clay, silt, sand and gravel is recorded in two narrow bands along the alignment of Darkinson Lane and the northwest boundary of Ashton and Lea Golf Course.

- 10.4.4 The relevant ground investigation reports (GIRs) divided the encountered superficial deposits into four units as follows: Upper Glacial Till; Upper Glaciofluvial Deposits; Lower Glacial Till and Lower Glaciofluvial Deposits.
- 10.4.5 The Upper Glacial Till was recorded across the Scheme and was described as firm to stiff slightly sandy, slightly gravelly silty clay with occasional localised lenses of sand, silt and gravel. The Upper Glacial Till was recorded at depths of 0.20 to 12.80 m bgl.
- 10.4.6 The Upper Glaciofluvial Deposits were recorded across the Scheme and were described as layers of medium-dense sandy clayey silts, soft slightly sand slightly gravelly silty clays, and medium-dense silty, clayey and occasionally gravelly sands. The Upper Glaciofluvial Deposits were encountered at depths of 11.30 to 15.00 m bgl.
- 10.4.7 The Lower Glacial Till was recorded across the Scheme and described as a very stiff slightly sandy, occasionally slightly gravelly, silty clay. The Lower Glacial Till was encountered at depths of 13.70 to 16.50 m bgl.
- 10.4.8 The Lower Glaciofluvial Deposits were encountered directly above the bedrock in CP04 and CP05 between 16.30 and 17.90 m bgl. The Lower Glaciofluvial Deposits were described as very dense, very gravelly silty clayey sand.
- 10.4.9 The site is underlain by Triassic Sherwood Sandstone. Bedrock was recorded at five exploratory locations (BH223, CP01 to CP04) at depths of 15.60 to 19.20 m bgl. It was described as weathered reddish-brown or brown sandstone.
- 10.4.10 The superficial and bedrock geology within the study area is shown on Figures 10.1 and 10.2 included as Appendix 10.3 in volume 3 of this ES.

<u>Soils</u>

- 10.4.11 The entire study area is classified as Grade 3 ALC, defined as good to moderate quality agricultural land. No detailed post-1988 survey data is available for the site, and therefore the ALC should be conservatively considered as Grade 3a (good quality) best and most versatile (BMV) land.
- 10.4.12 The Cranfield University Soilscapes Map (Cranfield University, 2022) shows the study area is underlain by Soilscape 18, defined as slowly permeable seasonally wet slightly acidic but base-rich loamy and clayey soils with impeded drainage and moderate fertility.
- 10.4.13 Where encountered during ground investigation, the topsoil is generally 0.20 to 0.60 m thick and described as grass over a soft grey slightly sandy, slightly gravelly silty organic clay with frequent rootlets.
- 10.4.14 The ALC in the study area is shown on Figure 10.3 (Appendix 10.3).

Controlled waters

- 10.4.15 The Lancaster Canal crosses the north of the site in a broadly east-west direction. Two minor watercourses are located in the western and central areas of the site; both of which flow in a broadly southerly direction and join Savick Brook to the south of the study area. Both are unnamed, and are referred to here as the Central Watercourse and the Western Ordinary Watercourse. A watercourse named as Lady Head Runnel is located in the eastern area of the site, and flows in a broadly south-southeasterly direction to join Savick Brook.
- 10.4.16 The majority of the site lies within the Savick Brook catchment under the Water Framework Directive. In 2019 (the most recent year data is available), the catchment rated Fail for chemical quality, Moderate for ecological quality and Moderate overall. The chemical Fail was due to the presence of priority

hazardous substances, namely Polybrominated diphenyl ethers and mercury and its compounds.

- 10.4.17 The Glacial Till is designated as a Secondary (Undifferentiated) aquifer, defined as where it has not been possible to attribute either a Secondary A or Secondary B category due to the variable characteristics of the strata.
- 10.4.18 The Head is designated as a Secondary A aquifer, defined as permeable layers capable of supporting water supplies at a local scale, and in some cases forming an important source of base flow to rivers.
- 10.4.19 The Sherwood Sandstone is designated as a Principal aquifer, defined as strata that have high intergranular and/or fracture permeability, and may support water supply and/or river base flow on a strategic scale.
- 10.4.20 Groundwater observations recorded during the ground investigations are summarised in Table 10.9. Groundwater levels were variable, with multiple strikes indicating perched groundwater within the superficial units.

Location	Installation Depth (m bgl)	Installation Unit	Strike(s) (m bgl)	Min Depth (m bgl)	Max Depth (m bgl)
BH221	20.00 (piezometer)	Sand	18.20	4.18	12.76
BH224	20.00 (piezometer)	Sand	3.10, 12.30, 16.80	0	12.72
CP01	1.00 – 18.00	Clay, silt, sandstone	N/A	9.03	11.51
CP03	1.00 – 16.50	Clay, silt, sandstone	12.90	13.40	13.95
CP04	1.00 – 17.00	Clay, silt, sand	2.70, 8.30, 12.90, 16.30	9.17	13.61

Table 10.9:	Summary	of	groundwater	observations	during	ground
investigation						

Location	Installation Depth (m bgl)	Installation Unit	Strike(s) (m bgl)	Min Depth (m bgl)	Max Depth (m bgl)
CP06	1.00 – 17.00	Clay, silt, sand, sandstone	1.40, 2.80	2.73	7.38
WS05	1.00 - 4.00	Clay and sand	1.00	0.27	1.74
WS09	0.50 - 3.00	Clay	N/A	0.33	1.65
WS14	1.00 - 6.00	Clay	3.50	0.46	1.47
WS18	0.50 - 3.00	Clay	N/A	0.58	2.88

- 10.4.21 It should be noted that no soil leachate or groundwater testing has been undertaken during the ground investigations, and as such the chemical quality of the groundwater or leaching potential of the soil is unknown.
- 10.4.22 There is one historical groundwater abstraction license recorded within 1,000 m of the site, as detailed in Table 10.10. There are no active groundwater abstraction licenses, surface water abstractions, groundwater or surface water safeguard zones within the study area. The entire study area is located within a Zone 3 (Total Catchment) groundwater SPZ.

Table 10.10:	Groundwater abs	tractions recorded	d within 1 km of the site
--------------	-----------------	--------------------	---------------------------

Distance / Direction	Point Name	Status	Licence No.	Use	Annual Volume (m³)	Max Daily Volume (m³)
709 m E	Well at Valentine House Cottam - Grime	Historical	2671348010	General use	N/A	N/A

10.4.23 There is one licensed discharge consent recorded within the study area, as detailed in Table 10.11.

Distance /	Effluent	Receiving	Permit	Status
Direction	Type	Water	Number	
135m NE	Sewage discharges – final / treated effluent	Lady Head Runnel	011024	Surrendered under EPR 2010

10.4.24 The site is not within a Drinking Water Safeguard Zone.

Human receptors

10.4.25 The following human receptors have been identified in the study area:

- Construction and maintenance workers
- Future site users
- Off-site residential
- Educational Facilities Lea Endowed School
- Leisure facilities Caravan/Camping park visitors, Golf course users

Potentially contaminative land uses

- 10.4.26 Following review of current and historical mapping, several potentially contaminated land uses have been identified. These are summarised below and shown on Figure 10.4 (Appendix 10.3):
 - Ponds and/or old clay pits
 - Railway line and historic station
 - Farms

- Minor industrial uses (Depot, Malt Kiln)
- Made ground associated with historical development.
- 10.4.27 No significant areas of made ground or potentially putrescible material were recorded during the ground investigation.
- 10.4.28 The soil samples collected during the ground investigation were subjected to laboratory analysis for asbestos, metals, semi-metals, inorganics, polycyclic aromatic hydrocarbons and total petroleum hydrocarbons.
- 10.4.29 Screening of the soil samples against long-term human health risk generic assessment criteria for Public Open Space (Park) (Category 4 Screening Levels (Defra, 2014) and LQM/CIEH Suitable 4 Use Levels (Nathanail *et al.*, 2015) did not result in any exceedances. In addition, no asbestos was recorded in any of the samples analysed.
- 10.4.30 It should be noted that no ground gas monitoring has been conducted during the ground investigations.

Designated Sites

10.4.31 There are no designated ecological or geological sites recorded within the study area.

Mineral Resources

10.4.32 No mineral resources have been identified within the study area

Other environmental data

- 10.4.33 There are no pollution incidents recorded in the study area.
- 10.4.34 The radon potential in the study area is recorded as <1% of homes considered above the Action Level of 200 Bq m⁻³.

10.4.35 The Zetica Unexploded Bomb Risk Map shows the study area to be Low Risk (Zerita UXO, 2022).

Summary of baseline sensitivities

10.4.36 A summary of the potential receptors to be taken forward for assessment is shown in Table 10.12 with their associated sensitivities.

Table 10.12: Summary of receptors and baseline sensitivities identified within the study area

Receptor Type	Receptor	Sensitivity
Human Health	Future site users	High
	Off-site residential	High
	Educational facilities - Lea Endowed School	Very High
	Leisure facilities - Caravan/Camping park visitors, Golf course users	Medium
	Commercial	Medium
Surface Water	Lancaster Canal	Low
	Lady Head Runnel, Western Ordinary Watercourse, Central Watercourse	Low
	Savick Brook	Scoped out due to distance from site
Groundwater	Glacial Till Secondary (Undifferentiated) Aquifer	Low
	Head Deposits Secondary A Aquifers	High
	Sherwood Sandstone Principal Aquifer	Very High
Designated Sites	None identified	N/A
Buildings and	Railway line	High
Infrastructure	Residential, Commercial developments	Medium

Receptor Type	Receptor	Sensitivity
Soil Quality	Grade 3 ALC	High

10.5 Consultation

10.5.1 This soils and geology chapter and the related appendices are to form the basis of a consultation exercise with the relevant statutory and non-statutory consultees. This chapter is to be updated to provide the details of the consultation exercise once completed.

10.6 Impacts – Construction

- 10.6.1 The construction effects on soils and geology are those arising due to the construction phase of the Scheme, as well as those arising due to longer term effects of construction. The potential adverse effects and pre-mitigation significances during construction are discussed in the following sections, with potential mitigation measures detailed in Section 10.8.
- 10.6.2 Where an environmental effect is considered to be potentially 'significant', it is marked by bold text.

Human Health

10.6.3 The disturbance of existing land contamination during construction works has the potential to result in unacceptable risks to the health of construction workers via acute exposure to land contamination. Exposure pathways may include accidental ingestion, dermal contact and the inhalation of soil vapours, ground gases and/or contaminated dust particles, or contact with contaminated groundwater. Off-site receptors have the potential to be subjected to similar exposure pathways, though exposure is likely to be chronic rather than acute.

- 10.6.4 Few potential sources of contamination have been identified within the site footprint, limited to potentially infilled ponds, the existing farmland, the Lancaster Canal and the existing railway line. Ground investigation data and analysis of soil samples has not identified pollutant linkages within the site or any exceedances of human health generic assessment criteria. Therefore, the construction effect is considered to be negligible.
- 10.6.5 As noted in Section 10.3, risks to construction and maintenance workers have been excluded from this assessment.

Receptor	Receptor Sensitivity	Construction Effect	Construction Effect Magnitude	Significance
Educational facilities	Very high	Potential health risk from	Negligible	Slight/ moderate
Off-site residential	High	contaminants	Negligible	Slight
Leisure facilities, commercial	Medium	and groundwater	Negligible	Neutral/ slight
Educational facilities	Very high	Potential health risk from short	Negligible	Slight/ moderate
Off-site residential	High	exposure to potentially asphyxiant / explosive ground gases	Negligible	Slight
Leisure facilities, commercial	Medium		Negligible	Neutral/ slight

Table 10.13: Summary of human health construction effects

Surface Water

10.6.6 Surface water impacts may occur through temporary changes to baseflow due to groundwater levels being altered because of construction activities. Contaminants may also be introduced to surface water bodies, either by mobilising contaminated soils and/or groundwater, run-off from stockpiled materials, discharge of water from dewatering or by accidents and/or spillages in or around watercourses.

- 10.6.7 The surface water course and the Lancaster Canal lie within or directly adjacent to the site footprint. Both have been assigned a sensitivity of Low in accordance with Table 10.5.
- 10.6.8 Analysis of the soil samples collected during the ground investigation has not shown contamination to be present. Therefore, the construction effect is considered to be minor, and no remedial measures are considered necessary.

Receptor	Receptor Sensitivity	Construction Effect	Construction Effect Magnitude	Significance
Lancaster Canal	Low	Contamination due to leaks /	Minor	Neutral/ slight
Lady Head Runnel, Western Ordinary Watercourse, Central Watercourse		creation of preferential pollution pathways	Minor	Neutral/ slight

Table 10.14: Summary of surface water construction effects

<u>Groundwater</u>

- 10.6.9 Direct effects to groundwater may occur where groundwater levels and flows are altered as a result of construction activities, or through the remobilisation on existing in-ground contamination or the introduction of new contamination.
- 10.6.10 The sensitivity of the groundwater receptors in the study area ranges from low to very high. Monitoring data from the ground investigation indicates that groundwater is perched and localised within the Glacial Till and Glaciofluvial deposits. The hydraulic connectivity from the surface to the bedrock aquifer is not considered to be significant. In addition, no potential sources of contamination were identified during the ground investigation and there was no recommendation for groundwater monitoring in the LCC GIR (Appendix

10.1). As such, the construction effect is considered to be no change for the bedrock aquifer and negligible for the superficial units.

Receptor	Receptor Sensitivity	Construction Effect	Construction Effect Magnitude	Significance
Sherwood Sandstone Principal Aquifer	Very high	Contamination due to leaks / spills,	No change	No change Slight/ moderate
Head Deposits Secondary A Aquifers	High	of existing contamination	Negligible	Slight/ moderate
Glacial Till Secondary (Undifferentiated) Aquifer	Low	contamination and/or creation of preferential pollution pathways	Negligible	Neutral/ slight

Table 10.15:	Summary of	[;] groundwater	construction	effects
--------------	------------	--------------------------	--------------	---------

Buildings and Infrastructure

- 10.6.11 Direct impacts to existing buildings and infrastructure may occur through damage from the ground gas regime being altered through construction activities, then accumulating in confined spaces and resulting in an explosion.
- 10.6.12 Indirect impacts to existing buildings and infrastructure may occur where construction activities cause a change in groundwater levels, leading to subsidence and/or heave. This may be through active dewatering of the construction area, impoundment of groundwater levels by temporary below ground structures, other temporary drainage or recharge of groundwater, or temporary diversion of surface water.
- 10.6.13 The ground investigation did not identify any potential sources of ground gas or putrescible Made Ground and there was no recommendation for ground gas monitoring in the LCC GIR (Appendix 10.1). In addition, no areas were found to be at significant risk of rising groundwater during construction and no significant below-ground works are proposed. Therefore, the construction effect magnitude is considered to be negligible.

Receptor	Receptor Sensitivity	Construction Effect	Construction Effect Magnitude	Significance
Railway line	High	Accumulation	Negligible	Slight
Residential, Commercial developments	Medium	of ground gases in confined spaces resulting in explosion.	Negligible	Neutral/ slight

Table 10.16: S	Summary of building	s and infrastructure	construction effects
----------------	---------------------	----------------------	----------------------

Soil Quality

- 10.6.14 Construction effects on soil quality may result in previously reusable soils being rendered unsuitable for reuse through compaction, soil erosion or a degradation in chemical quality from the stripping, storage and reinstatement of soils during construction of the scheme. This may also result in a reduction of ALC grade.
- 10.6.15 Permanent effects could occur during construction through the physical removal or permanent sealing of agricultural soils below the site footprint.
- 10.6.16 The site is underlain by Grade 3 ALC land. As discussed in Section 10.4, no site-specific ALC survey is available so it is conservatively assumed that this land can be considered to be Grade 3a BMV land. A permanent loss of agricultural land is associated with the proposed areas of hardstanding and road realignments. Temporary reduction of access or a loss of quality is associated with the areas of temporary land take, which may be used for construction compound areas or subjected to other disturbances.

Receptor	Receptor Sensitivity	Construction Effect	Construction Effect Magnitude	Significance
Grade 3 ALC	High	Permanent sealing of soils	Moderate	Moderate/ large
		Temporary loss of	Minor	Slight/

Table 10.17:	Summary	y of soil (quality	<pre>/ construction</pre>	effects
--------------	---------	-------------	---------	---------------------------	---------

Receptor	Receptor Sensitivity	Construction Effect	Construction Effect Magnitude	Significance
		resource and/or access		moderate
		Previously reusable soils rendered unsuitable for reuse through excavation, stripping, storage and/or compaction	Moderate	Moderate/ large

10.7 Impacts – Operation

- 10.7.1 The operational effects on soils and geology are those arising due to the permanent presence of the scheme, as well as those arising due to the use of the constructed infrastructure. The potential adverse effects and premitigation significances during construction are discussed in the following sections, with potential mitigation measures detailed in Section 10.8.
- 10.7.2 Where an environmental effect is considered to be potentially 'significant', it is marked by bold text.

Human Health

- 10.7.3 On completion of the construction phase, the scheme predominantly comprises hardstanding. Hardstanding would remove the pathway between any contamination which may be in the ground and the future site users and off-site receptors. As discussed in Section 10.3, maintenance workers have been excluded from this assessment. Therefore, the operational effect is considered to be no change.
- 10.7.4 The presence of the scheme has the potential to alter the ground gas regime due to sealing of surfaces that were otherwise open to the air. However, the

ground investigation identified no significant sources of ground gas and as such the operational effect is considered to be negligible.

Receptor	Receptor Sensitivity	Operational Effect	Operational Effect Magnitude	Significance
Educational facilities	Very high	Potential health risk	No change	Neutral
Future site users	High	interaction	No change	Neutral
Off-site residential		with contaminant	No change	Neutral
Leisure facilities, commercial	Medium	s present in soils and groundwater	No change	Neutral
Educational facilities	Very high	Potential health risk	Negligible	Slight/ moderate
Future site users	High	trom short	Negligible	Slight
Off-site residential		exposure to potentially	Negligible	Slight
Leisure facilities, commercial	Medium	aspnyxiant / explosive ground gases	Negligible	Neutral/ slight

Table 10.18: Summary of human health operational effects

Surface Water

- 10.7.5 Long-term surface water impacts may occur through alterations to the groundwater regime from the presence of below-ground structures resulting in changes to the baseflow. Chemical contamination may migrate into surface water as a result of the creation of preferential migration pathways associated with the presence of infrastructure. In addition, spillages during maintenance activities have the potential to introduce contaminants into surface water courses.
- 10.7.6 As no contamination has been identified during the ground investigation, it is not anticipated that the presence of the scheme would act as a preferential pathway. Therefore, the operational effect has been assessed as negligible.

Receptor	Receptor Sensitivity	Operational Effect	Operational Effect Magnitude	Significance
Lancaster Canal	Low	Contamination due to leaks /	Negligible	Neutral
Lady Head Runnel, Western Ordinary Watercourse, Central Watercourse		creation of preferential pollution pathways	Negligible	Neutral

Table 10.19: Summary of surface water operational effects

<u>Groundwater</u>

10.7.7 Long-term impacts to groundwater may occur where groundwater levels and flows are altered as a result of the presence of the Scheme, or through the scheme acting as a preferential pathway for contamination. In addition, spillages during maintenance activities have the potential to introduce contaminants into groundwater bodies. During the operational stage, potential contaminated land linkages would have been broken due to the construction of extensive hardstanding for car parking and roads. Therefore, the operational effects are considered to be negligible.

Table 10.20:	Summary o	f groundwater	operational	effects
--------------	-----------	---------------	-------------	---------

Receptor	Receptor Sensitivity	Operational Effect	Operational Effect Magnitude	Significan ce
Sherwood Sandstone Principal Aquifer	Very high	Contaminati on due to leaks / spills, creation of	Negligible	Slight/ moderate
Head Deposits Secondary A Aquifers	High	preferential pollution pathways	Negligible	Slight
Glacial Till Secondary (Undifferen tiated)	Low	1	Negligible	Neutral

Receptor	Receptor	Operational	Operational Effect	Significan
	Sensitivity	Effect	Magnitude	ce
Aquifer				

Buildings and Infrastructure

- 10.7.8 Operational effects on buildings and infrastructure may occur from the presence of the scheme altering the ground gas regime, leading to gases accumulating in confined spaces and potentially resulting in an explosion. In addition, any remaining contamination that was not remediated or removed during construction may result in aggressive ground conditions.
- 10.7.9 The ground investigation did not identify any potential sources of contamination or ground gas, and therefore the operational effect is expected to be negligible.

Receptor	Receptor Sensitivity	Operational Effect	Operational Effect Magnitude	Significance
Railway line	High	Accumulation	Negligible	Slight
Residential, Commercial developments	Medium	gases in confined spaces resulting in explosion	Negligible	Neutral/ slight
Railway line	High	Presence of	Negligible	Slight
Residential, Commercial developments	Medium	leading to aggressive ground conditions	Negligible	Neutral/ slight

Table 10.21: Summary of buildings and infrastructure operational effects

Soil Quality

10.7.10 There are not considered to be any operational effects on soil quality, as any potential loss or degradation of soil quality would occur during the construction stage.

10.8 Mitigation

Human Health

- 10.8.1 Risks to human health during construction can be mitigated by the design and implementation of a materials management plan (MMP) and designer's risk assessment to ensure any potentially contaminated material encountered during construction is reused, treated or disposed of appropriately. Potential risks to site workers from residual land contamination can be mitigated against by the adoption of a robust risk assessment and the adoption of appropriate Personal Protective Equipment and good site hygiene.
- 10.8.2 The presence of any currently unrecorded contaminated material identified during the construction phase should be recorded in the health and safety file in accordance with CDM Regulations and a contingency strategy put in place to manage such material, including reuse, treatment or disposal as appropriate. The location of any potentially contaminated material that remains on site should be recorded and passed on to the operator of the scheme.
- 10.8.3 The design of construction materials reuse should ensure that the potential risk of exposure to contaminated material during operation is reduced.

Surface Water

- 10.8.4 To protect surface water courses from leaks and spills during construction and maintenance works, measures should be put in place to prevent the release of contaminants during works, and to limit potential impacts should a release occur.
- 10.8.5 All work should be supported by site-specific method statements and operate in accordance with the relevant Guidance for Pollution Prevention (GPPs) within a construction environment management plan (CEMP). This

would include ensuring all potentially contaminated material is stored on an impermeable surface where runoff is controlled.

10.8.6 Appropriate materials management during the construction phase should ensure that no material should be left at the surface that may produce potentially contaminative runoff during the operational phase.

<u>Groundwater</u>

- 10.8.7 To prevent groundwater bodies from being contaminated by leaks and spills during construction and maintenance activities, GPPs and a CEMP should be implemented.
- 10.8.8 The remedial measures outlined for encountering potentially contaminated material during construction should ensure that no material is left in place which may migrate along a preferential pathway during the operational phase.
- 10.8.9 It should be noted that the existing ground investigation reports undertaken by Lancashire County Council (Appendix 10.1) do not include groundwater monitoring and there is no recommendation for future groundwater monitoring. Whilst groundwater sampling to establish a baseline could be undertaken prior to construction works but it should be noted that no contamination sources have been identified in the assessment of soil contamination and groundwater is perched and localised within the Glacial Till and Glaciofluvial deposits. There is not considered to be significant hydraulic connectivity from the surface to the bedrock aquifer so negative effects from construction activities and operation is assessed to be negligible.

Buildings and Infrastructure

10.8.10 The materials management procedures outlined above should ensure that no potentially aggressive ground is left in-situ which may interact with the construction materials. If construction activities are proposed which may interact with the groundwater table, a groundwater management plan should be prepared, and mitigation should be proposed to prevent substantial changes in groundwater levels during construction and operation.

- 10.8.11 It should be noted that the existing ground investigation reports undertaken by Lancashire County Council (Appendix 10.1) do not include ground gas monitoring and there is no recommendation for future ground gas monitoring. Whilst ground gas monitoring could be undertaken prior to the start of the construction works there are practical difficulties of undertaking these works given the occurrence of shallow perched groundwater and therefore the absence of appreciable unsaturated strata for ground gas migration. It should be noted that no putrescible Made Ground was identified during the ground investigation. The construction and operational effects are assessed to be negligible
- 10.8.12 Implementation of the mitigation measures outlined for the construction phase should ensure that there are no operational effects for buildings and infrastructure.

Soil Quality

- 10.8.13 The permanent sealing or wastage of topsoil would be avoided as far as practicable via stripping and sustainable reuse elsewhere. In addition, by following best practice soil management measures, degradation during stripping, handling and storage would either be avoided, or would only be temporary in nature. It should be noted that construction impacts related to the permanent sealing of soils under infrastructure can only be mitigated through design changes.
- 10.8.14 Prior to construction, a site-specific ALC survey would discriminate between the Grade 3a and Grade 3b ALC land recorded within the proposed site footprint. If a proportion of the Grade 3 land is reclassified as Grade 3b land,

then the area of high sensitivity ALC land recorded within the footprint would reduce and the area subjected to significant effects will also reduce.

- 10.8.15 During the construction period, the adoption of good soil management practices in accordance with the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra, 2018) in an appropriate MMP and soils management plan (SMP) it can be used to limit the impact to soils. These soils include those that are to be stripped and reused on or off-site, as well as those that may be temporarily sealed under temporary works such as construction compounds.
- 10.8.16 There are not considered to be any operational effects on soil quality, as any potential loss of resource or degradation of soil quality would occur during the construction stage.

10.9 Cumulative Effects

- 10.9.1 There are a number of developments in the vicinity of the scheme that have been identified as creating potential cumulative effects. These are detailed in Chapter 17: Cumulative Effects. The developments within the study area that have the potential to result in cumulative effects for soils and geology are the PWDR (LCC/2016/0046) and the Cottam Hall housing development (06/2019/0114, 06/2012/0145, 06/2015/0243, 06/2017/0324).
- 10.9.2 These developments have the consequence of adding additional receptors and also acting as potential sources of new contamination.
- 10.9.3 Following application of the mitigation measures in Section 10.8, the developments are not expected to result in cumulative effects.

10.10 Residual Impacts

- 10.10.1 Following implementation of the mitigation measures outlined above, the construction phase residual effects identified for the scheme are summarised in Table 10.22.
- 10.10.2 Following mitigation, the only remaining significant effect during the construction phase is related to Grade 3 agricultural land being subjected to permanent sealing. The application of an appropriate MMP and SMP will mitigate against the potential permanent loss of quality related to temporary excavation, stripping, storage and/or compaction, and therefore this effect on soil quality is no longer considered to be potentially significant.

Receptor	Receptor Sensitivity	Construction Effect Magnitude	Significance
Human Health	Medium to Very High	Negligible	Neutral to Slight
Surface Water	Low	Negligible	Neutral
Groundwater	Low to Very High	Negligible	Neutral to Slight
Buildings and Infrastructure	Medium to High	No change	Neutral
Soil Quality	High	Minor to Moderate	Slight to Moderate

 Table 10.22:
 Construction phase residual effects

10.10.3 The post-mitigation operational phase residual effects identified for the Scheme are summarised in Table 10.23 below. No significant effects are predicted.

Receptor	Receptor Sensitivity	Construction Effect Magnitude	Significance
Human Health	Medium to Very High	No change	Neutral
Surface Water	Low	Negligible	Neutral
Groundwater	Low to Very High	Negligible	Neutral to Slight
Buildings and Infrastructure	Medium to High	No change	Neutral
Soil Quality	Scoped out – N/A	<u>.</u>	

10.10.4 Provided the mitigation measures outlined in Section 10.8 are implemented appropriately, it is considered that the Scheme's residual impacts on human health, surface water, groundwater, buildings and infrastructure and mineral resources are unlikely to be significant. Significant effects are predicted on the Grade 3 ALC soils due to the permanent sealing.

10.11 Summary

- 10.11.1 This chapter of the ES has assessed a range of environmental receptors related to soils, geology and hydrogeology. The baseline conditions were established through a review of desk-based and ground investigation data. Assessments were undertaken to determine the environmental impact of the Scheme during construction and operation. Ground investigation data did not identify any potential sources of contamination or ground gas.
- 10.11.2 Prior to mitigation, the key receptors identified in the study area as requiring mitigation from the Scheme are human health, buildings and infrastructure,

surface water, groundwater, mineral resources and soil quality. Proposed mitigation measures to reduce the effects of the Scheme are:

- A site-specific ALC survey to discriminate between Grade 3a and Grade 3b agricultural land;
- Adoption of good soil management practices in accordance with the Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra, 2018);
- Design and implementation of an appropriate MMP; and,
- An appropriate CEMP, including site-specific method statements for construction activities in accordance with the relevant guidance for pollution prevention measures.
- 10.11.3 Following the implementation of these mitigation measures, the only remaining significant effect during the construction or operational phases is related to the permanent sealing of Grade 3 agricultural land during construction.

10.12 References

Cranfield University (2022). Cranfield Soils and Agrifood Institute Soilscapes Map. [online] Available at: http://www.landis.org.uk/soilscapes/ (Accessed 28 March 2022)

Department for Environment, Food and Rural Affairs (2014). SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination

Department for Environment, Food and Rural Affairs (2018). Construction Code of Practice for the Sustainable Use of Soils on Construction Sites. [online] Available at: https://www.gov.uk/government/publications/code-of-practice-for-the-sustainableuse-of-soils-on-construction-sites (Accessed 28 March 2022)

Department for Transport (2014). National Policy Statement for National Network. [online] Available at: https://www.gov.uk/government/publications/national-policystatement-for-national-networks (Accessed 28 March 2022) Environment Agency (2021). Land contamination risk management (LCRM). [online] Available at: https://www.gov.uk/government/publications/land-contamination-riskmanagement-lcrm#full-publication-update-history (Accessed 28 March 2022)

Environment Agency (2022). Catchment Data Explorer – Savick Brook Water Body. [online] Available at: https://environment.data.gov.uk/catchmentplanning/WaterBody/GB112071065470 (Accessed 28 March 2022)

Groundsure (2020a). Report Reference GSIP-2020-10362-1207

Groundsure (2020b). Report Reference GSIP-2020-10362-1209

IEMA (2016). Environmental Impact Assessment Guide to Delivering Quality Development

Ministry of Housing, Communities and Local Government (2021). National Planning Policy Framework. [online] Available at:

https://www.gov.uk/government/publications/national-planning-policy-framework--2 (Accessed 28 March 2022)

Nathanail, C.P., McCaffrey, C., Gillett, A.G., Ogden, R.C. and Nathanail, J.F (2015). The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham

National Highways, Transport Scotland, Welsh Government, Department for Infrastructure (2019). Design Manual for Roads and Bridges LA 109 Geology and Soils. [online] Available at:

https://www.standardsforhighways.co.uk/dmrb/search/adca4c7d-4037-4907-b633-76eaed30b9c0 (Accessed 28 March 2022)

National Highways, Transport Scotland, Welsh Government, Department for Infrastructure (2020a). Design Manual for Roads and Bridges LA 104 Environmental assessment and monitoring Revision 1. [online] Available at: https://standardsforhighways.co.uk/dmrb/search/0f6e0b6a-d08e-4673-8691cab564d4a60a (Accessed 28 March 2022) National Highways, Transport Scotland, Welsh Government, Department for Infrastructure (2020b). Design Manual for Roads and Bridges LA 113 Road drainage and the water environment Revision 1. [online] Available at: https://www.standardsforhighways.co.uk/dmrb/search/d6388f5f-2694-4986-ac46b17b62c21727 (Accessed 28 March 2022)

National House Building Council, Environment Agency and Chartered Institute on Environmental Health (2008). Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66: 2008. [online] Available at: https://www.nhbc.co.uk/binaries/content/assets/nhbc/products-and-services/techadvice-and-guidance/guidance-for-the-safe-development-of-housing-on-landaffected-by-contamination.pdf (Accessed 28 March 2022)

Office of the Deputy Prime Minister and Department for Environment, Food and Rural Affairs (2005). Government Circular: Biodiversity and Geological Conservation – Statutory Obligations and their Impact within the Planning System (ODPM 06/2005, Defra 01/2005). [online] Available at: https://www.gov.uk/government/publications/biodiversity-and-geologicalconservation-circular-06-2005 (Accessed 28 March 2022)

Preston City Council (2012). Contaminated Land Strategy. [online] Available at: https://www.preston.gov.uk/media/209/Contaminated-Land-Strategy-2012/pdf/Contaminated-Land-Strategy-2012.pdf?m=636906835179970000 (Accessed 28 March 2022)

Preston City Council (2015). Local Plan 2012-26. [online] Available at: https://www.preston.gov.uk/article/1050/Preston-s-Local-Plan (Accessed 28 March 2022)

Zetica UXO (2022). Zetica Unexploded Bomb Risk Map. [online] Available at: https://zeticauxo.com/downloads-and-resources/risk-maps/ (Accessed 28 March 2022)