

Growing Baldock

Environmental Statement Volume 1: Text
Chapter 12: Ground Conditions



October 2025

Urban&Civic



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12.1 INTRODUCTION

12.1.1 This chapter of the Environmental Statement (ES) has been prepared by Mike Taylor, a Chartered Engineer (CEng), Chartered Environmentalist with over 28 years of construction industry experience and Director/Owner of Shadbolt Group and addresses the impact of the Proposed Development on the existing ground conditions, geology and hydrogeology of the Site. Consideration has been given to impacts during both the construction and operational phases of the Proposed Development.

12.1.2 The description of development comprises:

Outline planning application with all matters reserved except for means of highway access into the development from the A505/Royston Road, North Road and Clothall Road for: up to 3,200 homes, up to 16ha of employment, waste and leisure infrastructure, a mixed use local centre, up to 1 secondary school, up to 2 x primary schools, up to 1 SEND school, health hub, green infrastructure (including parks, formal sports provision, play, habitat areas, informal open space and structural planting), internal street network, access junctions and railway crossing, public transport infrastructure, pedestrian/cycle network (including PRow diversions, active travel routes, mobility hubs and crossing of the railway), utilities and drainage infrastructure (including diversions of existing and provision of new infrastructure, pumping stations, sustainable drainage, primary substations, rising main/strategic sewer and renewable energy infrastructure), ground remodelling/earthworks and any necessary demolitions.

12.2 RELEVANT POLICY**National Policy*****National Planning Policy Framework***

- 12.2.1 The National Planning Policy Framework (NPPF) (February 2025) [1] is a key part of the reforms to make the planning system more accessible, to protect the environment and to promote sustainable growth.
- 12.2.2 Chapter 2 ('Achieving Sustainable Development') of the NPPF, paragraph 8 states that:
- "an environmental objective – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimizing waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy".
- 12.2.3 Chapter 15, 'Conserving and enhancing the natural environment,' paragraph 187 states that:
- "Planning policies and decisions should contribute to and enhance the natural and local environment by
 - e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. 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.
- 12.2.4 In terms of ground conditions and pollution, paragraph 196 sets out 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 assessments.

Planning Practice Guidance

- 12.2.5 Ministry of Housing, Communities and Local Government, Ministry of Housing, Communities & Local Government (2018 to 2021) and Department for Levelling Up, Housing and Communities [2].
- 12.2.6 Failing to deal adequately with contamination can cause harm to human health, property and the wider environment. It can also limit or preclude new development; and undermine compliance with the Water Environment Regulations 2017 [3]
- 12.2.7 To ensure a site is suitable for its new use and to prevent unacceptable risk from pollution, the implications of contamination for development should be considered through the planning process to the extent that it is not addressed by other regimes. The latter include:
- The system for identifying and remediating statutorily defined contaminated land under Part 2A of the Environmental Protection Act 1990 [4], which provides a risk based approach to the identification and remediation of land where contamination poses an unacceptable risk to human health or the environment. The government has published statutory guidance on Part 2A, which focuses on addressing contaminated land that meets the legal definition and cannot be dealt with via any other means, including planning.
- 12.2.8 Building Regulations, which require that reasonable precautions are taken to avoid risks to health and safety caused by contaminants in ground to be covered by buildings and associated ground.
- 12.2.9 Environmental Permitting Regulations, under which an Environmental Permit from the Environment Agency is normally required to cover the treatment and/or redeposit of contaminated soils if the soils are 'waste'.

Local Policy**North Hertfordshire Local Plan (2022)[5]***Policy NE10: Water conservation and wastewater infrastructure*

- 12.2.10 Planning permission for new development will be granted provided that;
- a) It does not result in the deterioration of any watercourse in accordance with the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, WFD [3];
 - b) It helps contribute towards the WFD actions and objectives;

- c) It helps achieve the objectives set out in the Anglian and Thames River Basin Management Plans;
- d) Mechanisms for delivering any necessary new or improved water and/ or wastewater infrastructure are secured under the requirements of Policy SP7; and
- e) Adequate foul water treatment and disposal already exists or can be provided in time to serve the development.

Policy NE11: Contaminated land

12.2.11 Planning permission for development affecting or affected by contaminated land will be granted provided that:

- a) A contaminated land study / contaminated land risk assessment is submitted as part of the application;
- b) Appropriate mechanisms are in place to investigate, characterise the risks and remediate the contamination to remove the risks, or reduce the risk to an acceptable level; and
- c) The Site is suitable for use taking into account of ground conditions, groundwater vulnerability and pollution arising from previous land use and land remediation in reference to relevant guidance.

Hertfordshire Minerals and Waste Local Plan 2040 Draft Plan Hertfordshire County Council [6]

12.2.12 Chalk extraction in Hertfordshire has historically been undertaken on a small scale and is currently only worked at one site in the county. Chalk can be used as an industrial mineral in the production of cement, however in Hertfordshire it has predominantly been used as an agricultural lime on farmland.

12.2.13 There are no national policy requirements to maintain a supply of permitted reserves because chalk previously extracted in Hertfordshire was not used as an industrial mineral. Owing to the low use and unlikely requirement for further chalk supply in the county, no additional sites are identified in this Plan for the extraction.

Other Guidance and Best Practice

Environmental Protection Act 1990

12.2.14 Part IIA of the Environmental Protection Act describes a regulatory role for Local Authorities in dealing with contaminated land.

Environmental Act 1995 [7]

12.2.15 The Environment Act creates a system whereby Local Authorities must identify and if necessary, arrange for the remediation of contaminated sites. The provisions are set out in Section 57, which inserts Part IIA into the Environmental Protection Act, 1990. In

addition to these requirements, the operation of the regime is subject to regulation and statutory guidance.

12.2.16 Part IIA of the Environmental Protection Act provides a definition of what constitutes 'contaminated land' and sets out the responsibilities of the Local Authority (LA) and the Environment Agency (EA) in the identification and management of contaminated land. Under section 78A(2), contaminated land is defined as:

- 'any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that -:
- significant harm is being caused or there is a significant possibility of such harm being caused; or significant pollution of controlled waters is being caused or there is a significant possibility of such pollution being caused;
- and, in determining whether any land appears to be such land, a local authority shall, subject to subsection (5) below, act in accordance with guidance issued by the Secretary of State in accordance with section 78YA below with respect to the manner in which that determination is to be made.
- (a) what harm or pollution of controlled waters is to be regarded as "significant",
- (b) whether the possibility of significant harm or of significant pollution of controlled waters being caused is "significant".

Land Contamination Risk Management (LCRM), 2020 [8]

12.2.17 Land Contamination Risk Management is the guidance that the EA expect to be followed in managing risks on sites affected by contamination. The guidance sets out a staged approach to assess risks from contamination, develop a remediation strategy and implement and verify remediation works.

12.2.18 In addition to the legislation listed above, there is a range of non-statutory guidance material and British Standards which, where relevant, have been considered in this assessment, and are included in the reference section.

12.3 ASSESSMENT METHODOLOGY

Scope

12.3.1 The environmental effects relating to the ground conditions have been assessed in accordance with the methodology set out below. Potential environmental effects on land or ground conditions may arise as a result of:

- General site preparation works including minor excavation and re-compaction of site soils to form an appropriate development platform at the appropriate level for each development parcel.
- The presence and activities associated with construction of building on individual parcels within the Site and associated infrastructure (services and pavements etc).
- The creation of landscape areas.

12.3.2 Consideration is given to potential ground instability and land contamination related effects, and the potential for mineral sterilisation arising from the Proposed Development.

Data Sources

12.3.3 The assessment has involved the review of the following data sources:

- Baldock, North Hertfordshire, Project No.2899, Preliminary Risk Assessment, Urban & Civic. Issue V1, July 2022: Author Shadbolt Group [9]
- Baldock, North Hertfordshire, Project No. 2899, Ground Investigation Interpretive Report BA1 Area, Urban and Civic, Issue V2, February 2025: Author Shadbolt Group [10]
- Baldock, North Hertfordshire, Project No. 2899, Ground Investigation Interpretive Report BA2 Area, Urban and Civic, Issue V2, February 2025: Author Shadbolt Group [11]
- Baldock, North Hertfordshire, Project No. 2899, Ground Investigation Interpretive Report BA3 Area, Urban and Civic, Issue V2, February 2022: Author Shadbolt Group [12]
- Baldock, North Hertfordshire, Project No. 2899, Ground Investigation Interpretive Report BA10 Area, Urban and Civic, Issue V2, February 2025: Author Shadbolt Group [13]
- Baldock, North Hertfordshire, Project No. 2899, CD 622 Technical Documentation Road and Bridge – Option 1, Urban & Civic, Issue V1, February 2025: Author Shadbolt Group [14]
- Baldock, North Hertfordshire, Project No. 2899, CD 622 Technical Documentation Multi Modal Bridge, Urban & Civic, Issue V1, December 2024: Author Shadbolt Group [15]

Assessment Approach

- 12.3.4 Environmental effects relating to the ground conditions arising from the above have been assessed in accordance with the guidelines and methodology set out in:
- National Planning Policy Framework, Department for Communities and Local Government, February 2019 [1]
 - Department for Communities and Local Government Consultation Paper - Environmental Impact Assessment: a guide to good practice and procedures [16]
 - Contaminated land risk assessment – a guide to good practice, CIRIA Report C552 [17]; and
 - Chartered Institute of Environmental Health, 2000 Environmental Impact Assessment in the UK [18]
 - Environment Agency 2020 (update June 25) Land contamination risk management (LCRM) [8]
- 12.3.5 There are three broad categories of potential ground (or land) instability, namely:
- the effects of underground cavities which can be from both natural and human activities;
 - the presence of unstable slopes; and
 - ground compression / consolidation or movements arising from natural process, the presence of compressible strata of natural origin, human activities (e.g. made ground, quarrying activities and landfill) and ground subject to movement due to shrinking and swelling clays.
- 12.3.6 An assessment of the potential risk of ground instability across the Site and surrounding area has been carried out by via an initial desk study and detailed ground investigations. The documents provide a detailed review of available published geological sources together with data acquired from public databases, site reconnaissance and information obtained during the ground investigations undertaken and subsequent laboratory analysis.
- 12.3.7 The objective of the ground investigations was to recognise the risk of occurrence and potential for subsidence and/or slope instability, assesses potential contaminated land and groundwater issues, at the earliest possible stage in the development process, so that:
- appropriate action can be taken in accordance with current knowledge and good practice to assess the risks of subsidence and, where practicable, to deal with them by ground treatment or by designing new buildings and structures to withstand the subsidence expected (foundation design);

- due account can be taken of the constraints imposed by elevated concentrations of soils and groundwater of the development process; and
- due account can be taken of the constraints imposed by subsidence at all stages of the development process; and
- that it can be ensured that new development is suitable for the ground conditions at its location and will not be adversely affected by subsidence / elevated concentration of contaminants in the future.

Development on Potentially Contaminated Land

- 12.3.8 The Environment Agency provides guidance on how to conduct an Environmental Impact Assessment with regard to residential developments and contamination issues (Scoping the Environmental Impacts of Residential Developments and Redevelopment and Clean-up of Contaminated Land [19]). There is also a considerable body of guidance that has been prepared in order to assist both local authorities and practitioners in assessing the degree to which land is contaminated and deciding whether such land is contaminated, within the meaning of Part 2A of the Environmental Protection Act 1990 (as amended: [4]).
- 12.3.9 Part 2A of the Environmental Protection Act provides a statutory definition of contaminated land:
- "Contaminated land is any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that:
 - Significant harm is being caused or there is a significant possibility of such harm being caused.
 - Pollution of controlled waters is being or is likely to be caused."
- 12.3.10 In guidance that originally accompanied the Act [7], advice is outlined on what constitutes significant harm and what constitutes a significant possibility.
- 12.3.11 The Environment Agency has released an updated review of technical guidance [8], with respect to Section 57 of the Environmental Protection Act (EPA). This updated guidance was issued on 6 April 2012 and reviews the way contaminated land is assessed under the EPA. While this guidance primarily deals with defining what constitutes contaminated land in the statutory sense requiring intervention to protect human health and the environment (a Part 2A determination), this will also influence levels acceptable for planning.
- 12.3.12 The technical guidance confirms that the existing assessment criteria published by the Environment Agency and other bodies are cautious estimates of levels of contamination and do not represent the level suitable for either Part 2A determination or for planning.

In general, future assessment criteria are likely to be generated that increase the level of the contaminant concentrations that remain acceptable from that used in the current assessment.

- 12.3.13 Land contamination risk management (LCRM). Environment Agency (2020, updated 2025) [8] provides guidance on the risk assessment process and references the Contaminated Land Exposure Assessment (CLEA) model. The CLEA model was intended to be used as the common basis for contamination assessments in the UK, which derives both Soil Guideline Values (SGVs) and can also calculate Site Specific Guideline values (SSGs) using software-based models, the latest release being the CLEA UK model (Version 1.071 2015) and has been utilised to derive Shadbolt Group SSVs (Site Specific Values).
- 12.3.14 Underpinning the guidance is a source-pathway-receptor methodology, with the underlying principle of identification of pollutant linkages in order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences.
- 12.3.15 A pollutant linkage consists of the following three elements:
- A source/hazard (a substance or situation which has the potential to cause harm or pollution)
 - A pathway (a means by which the hazard moves along / generates exposure); and
 - A receptor/target (an entity which is vulnerable to the potential adverse effects of the hazard).
- 12.3.16 Without a significant pollutant linkage the contamination may be a hazard but does not constitute a risk to human health or the environment. Therefore, in assessing the potential for contamination to cause a significant effect, the extent and nature of the potential source of contamination must be assessed, pathways identified, and sensitive receptors or resources identified and appraised, to determine their value and sensitivity to contamination related impacts.
- 12.3.17 LCRM promotes a staged approach to the assessment of ground quality/conditions and details three tiers of risk assessment:
- (i) Tier 1 - preliminary – a qualitative assessment forming part of a Phase 1 report (commonly referred to as a Desk Study or Preliminary Risk Assessment);
 - (ii) Tier 2 - generic - a quantitative assessment using published criteria to screen site specific ground condition data forming part of a Phase 2 report; and
 - (iii) Tier 3 - detailed – a quantitative assessment involving the generation of site-specific assessment criteria.
- 12.3.18 Each tier of risk assessment comprises the four stages as set out in **Table 12.1**.

Table 12.1 - Risk Assessment Stages

Assessment Process	Scope
Stage 1 Hazard identification	Identifying potential contaminant sources on and off site
Stage 2 Hazard Assessment	Assessing the potential for unacceptable risks by identifying what pathways and receptors could be present and what pollutant linkages could result (forming the Conceptual Site Model (CSM))
Stage 3 Risk Estimation	Estimating the magnitude and probability of the possible consequences (what degree of harm might result to a defined receptor and how likely)
Stage 4 Risk Evaluation	Evaluating whether the risk needs to be, and can be, managed

12.3.19 The approach to risk estimation adopted for this Site involves identification of the magnitude of the potential consequence (taking into account both the potential severity of the hazard and the sensitivity of the receptor) and the magnitude of the likelihood, i.e. the probability (taking into account the presence of the hazard and the receptor and the integrity of the pathway). This approach is referred to in current guidance such as the Environment Agency / National House Building Council R&D Publication 66 Guidance for the Safe Development of Housing on Land Affected by Contamination [20].

12.3.20 Potential pollutant linkages have been considered assuming change in land use from the former quarry and agricultural farmland to proposed land uses that would be more vulnerable to the presence of contamination. This would include any residential development, schools, commercial development, allotment gardens, parks or similar uses. If a pollution linkage is identified, then it represents a potential risk which requires further consideration and either:

- remediation / direct risk management; or
- further tiers of assessment.

12.3.21 Subsequent tiers require additional information and the refinement of the Conceptual Site Model (CSM). Within the context of this Environmental Statement, this methodology is used to identify any risks that could potentially be considered “significant” in the decision-making process.

Mineral Assessment

12.3.22 The British Geological Survey provides guidance to planning practitioners on how to implement national policy with respect to the safeguarding and as appropriate prior extraction of minerals [21].

Significance Criteria

- 12.3.23 There are no 'standard' significance criteria for 'ground conditions'. Evaluation of the ground conditions within the Site is based on the geoenvironmental and geotechnical properties of the ground for the intended end use, and the process and treatment of the ground that will be required to achieve that end use.

Table 12.2 - Magnitude of Impacts

Impacts	Large	Moderate	Small	Negligible
Land Stability	Substantial constraint on land use	Mitigation measures likely to be required	Minimal changes to slope stability or subsidence problems, which are not likely to require mitigation, although consideration of potential problems should be given.	No change to land stability or probability of.
Land Contamination	Soil contamination is considered to pose a high risk to potential receptors with one or more pollutant linkages certain to be present.	Soil contamination is considered to pose a moderate risk to potential receptors with one or more pollutant linkages likely to be present.	Soil contamination is considered to pose a low risk to potential receptors with one or more pollutant linkages possibly present.	No pollutant linkages present.

Table 12.3 – Sensitivity of Receptors

Receptor	High	Medium	Low	Negligible
Land Stability	Slope stability or subsidence problems almost certainly present or have occurred in the past. Major constraint on land use.	Slope stability or subsidence problems are possibly present or anticipated.	Slope stability or subsidence problems are not likely to occur but consideration to potential problems should be given.	Slope stability or subsidence problems are not thought to occur but consideration should be given to potential problems on adjacent areas.
Human Health	Residential end use, open spaces and other sensitive developments where children are present (i.e. Schools)	Construction workers.	Workers in commercial premises/ Visitors to residential properties.	Unoccupied/ visitors to commercial premises.
Environmental	Ecology: Special Protection Area, Special Area of Conservation or Ramsar (protected wetland) site, or ecological SSSI. Groundwater: Principal aquifer providing regionally important potable water supply; SPZ1 – Inner Source Protection Zone. Private water supplies for potable use (boreholes, springs or wells). Surface water: Primary water body on site or immediately adjacent Buildings and services: World heritage site and Scheduled Ancient Monuments.	Ecology: National Nature Reserve (NNR) Groundwater: Principal aquifer supplying locally important water supply. SPZ2 – Outer Source Protection Zone Surface water: Secondary waterbody immediately adjacent	Ecology: County wildlife site Groundwater : Secondary Aquifer. SPZ3 – Source Protection Zone total catchment. Surface water: Tertiary water body immediately adjacent. Buildings and property: Local value/ historical character. Agricultural land in arable production or set to pasture.	Ecology: Local habitat resource/ no local designation. Groundwater Unproductive non-aquifer Surface water: Water body within 25m. Buildings and property: Replaceable buildings.

Table 12.4 - Significance of Effects

Magnitude	Sensitivity			
	High	Medium	Low	Negligible
Large	Major	Major	Moderate	Minor
Moderate	Major	Moderate	Minor	Negligible
Small	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

Uncertainties and Limitations

- 12.3.24 It is assumed that the environmental, geological and historical data used to compile the baseline reports reflect the true nature of ground conditions and previous land use history across the Application Site and surrounding area.
- 12.3.25 Given the Outline stage of the planning process, it has not been possible to fully quantify all the effects of the Proposed Development; however, an assessment has been made of the magnitude and significance of the predicted effects based on a worst-case scenario in terms of ground conditions.
- 12.3.26 The parameters set out within the Parameter Plan (**Appendix 2.1**) and Development Specification (**Appendix 2.2**). This includes a flexible land use parcel on BA3, with three potential development options:
- **Option 1** – Knights Templar expansion and relocation to BA3 – Relocation and expansion (up to 12FE) of Knights Templar school to BA3. BA3 to accommodate SEND school and secondary school.
 - **Option 2** – Knights Templar expansion – Expansion of Knights Templar on existing site (up to 10FE). BA3 to accommodate SEND school and residential (c. 250 units).
 - **Option 3** – Additional secondary school on BA3 – Provision of additional secondary school (up to 5FE) on BA3. BA3 to accommodate SEND school, secondary school and residential (c.90 units).
- 12.3.27 The Assessment Methodology for the development of the school options and the risks posed by the ground conditions are the same for all three options.

12.4 BASELINE CONDITIONS

- 12.4.1 The Site has been subject to desk study review and physical ground investigations by Shadbolt Group. The description of the baseline conditions within the Site has been prepared with reference to these technical reports, which form **Appendices 12.1 to 12.7**. Establishment of baseline conditions involves a description of the environment as it is currently and how it is expected to change. Specifically, for development including a residential end use, the potential impact on local soils, geology and water quality with respect to both ground stability and ground and water contamination issues has been considered.
- 12.4.2 The scope of work for the initial desk study comprised an initial data collection exercise. The following primary sources of data were used in the compilation of the report:
- 12.4.3 Geological information was obtained from various reference materials published by the British Geological Survey (BGS) and from previous ground investigation reports relating to the Baldock site [10, 11, 12, 13, 14, 15].
- 12.4.4 Acquisition and inspection of historical and current Ordnance Survey map records;
- 12.4.5 Detailed historical information on the Site was obtained from previous geoenvironmental reports and factual ground investigation reports made available by the Applicant.
- 12.4.6 Ground stability information was obtained from a GroundSureGeoInsight report obtained for inclusion [9] and ground investigations undertaken by Shadbolt Group
- 12.4.7 Environmental information was obtained from a GroundSureEnviroInsight report obtained within [9] and ground investigation undertaken by Shadbolt Group.

The Current Baseline

Geology

- 12.4.8 There are 16 No. records of artificial deposits (Made Ground) indicated within 500m of the Site boundary. 7 No. are recorded within the Site. This refers to the B656 road running central through the Site.
- 12.4.9 British Geological Survey (BGS) mapping records 39 No. different superficial geology across the whole site. Northwest of the Site is made up of Lowestoft Formation – Diamicton and localise Glaciofluvial Deposits, Mid Pleistocene. Throughout the Site, evidence of Dry Valley Deposits – Clay, Silt, Sand and Gravel are found. Towards the south end of the Site, Alluvial Fan Deposits – Sand and Silt are identified.
- 12.4.10 The solid geology beneath the Site is indicated to comprise of the Holywell Nodular Chalk Formation and New Pit Chalk formation across the whole site. Northwest also has areas of Melbourne Rock Member – Chalk identified.

12.4.11 There are 107 No. borehole records within 250m of the Site. 48 No. records are within the Site boundary and all shallow depths ranging from 2m to 13m. The propose of these were for the A505 Baldock Bypass and the records indicate that the strata mainly comprise of topsoil overlying hard fissure chalk at approximately 3m. There are 2 No. of bedrock faults indicated to be present on site. This refers to an inferred fault.

12.4.12 The development area is predominantly in agricultural use, with Agricultural Land Classification Grade 2 (very good) and Grade 3 (good to moderate) soils.

Ground Investigations

12.4.13 Ground investigations have been undertaken by Shadbolt Group across the Site

The Site works comprised the following (across all areas):

- 58 No. rotary cored boreholes;
- 234 No. machine excavated trial pits;
- 96 No. window sample boreholes;
- 91 No. Groundwater / gas monitoring installations;
- Soakaway testing;
- Laboratory and Insitu geotechnical testing and analysis;
- Chemical laboratory analysis; and
- 6 No. ground gas monitoring visits.

Topsoil

12.4.14 Topsoil was encountered in the majority of exploratory holes across the Site. The topsoil encountered from ground level to between 0.10m and 0.40m bgl, more typically in the range of 0.30m bgl. The topsoil was generally described as Brown friable slightly sandy slightly gravelly clayey TOPSOIL. Gravel includes angular to sub angular fine to coarse chalk, flint and chert.

Made Ground

12.4.15 No significant Made Ground was encountered in the exploratory holes across the Site. When isolated Made Ground was encountered it comprised reworked clay / chalk.

Superficial Deposits

12.4.16 Superficial Deposits were recorded in isolated locations, the majority of which were located in the northern regions of the Site. The superficial deposits comprised cohesive material of firm to stiff friable grey mottled brown slightly sandy slightly gravelly CLAY and were encountered between typically between 0.30m bgl and 2.50m bgl. Clays generally increased in stiffness with depth and became more grey as strata became less weathered losing the brown mottling characteristic of weathered clay. Gravel fractions predominately comprising fine to coarse chalk, chert, flint and limestone with a generally low cobble content.

Solid Deposits

- 12.4.17 Bedrock deposits of Chalk were encountered in all of exploratory holes across the Site from depths of 0.3m bgl –immediately beneath Topsoil.
- 12.4.18 The Chalk strata initially comprised Structureless Chalk of white mottled orange brown silty GRAVEL/gravelly SILT.
- 12.4.19 Localised loose orange brown mottled white SAND and GRAVEL of chalk and flint was also encountered directly below the Topsoil. Given the general lack of other superficial deposits across the Site and the predominance of chalk as the gravel fraction these soils are considered to be heavily weathered chalk as opposed to superficial deposits.
- 12.4.20 Structured Chalk was encountered from depth of between 0.30m and 2.50m depth bgl (more typically 1.00m to 2.00m bgl) and comprised extremely weak to weak low locally medium density Chalk. The Chalk strata was generally excavated to a depth of 3.00m without significant obstruction and recovered as angular fine to coarse gravel with light orange brown silty matrix typically becoming coarser with cobbles and lower matrix content at depth. The shallow structured chalk was typically considered to be of Grade B/C.
- 12.4.21 At depth the chalk typically comprised white, off white and cream locally mottled orange brown and speckled black extremely weak to very weak low to medium, locally high-density CHALK with very closely to medium spaced horizontal (bedding) and steeply inclined / vertical fractures. The fractures were typically undulating rough to smooth, planar and stepped tight clean with grey, brown and orange brown staining and black speckling but were locally up to moderately open with silty fine gravel infill.
- 12.4.22 The potential hazard presented by ground dissolution, which occurs when water passing through soluble rocks produces underground cavities and cave systems. These cavities reduce support to the ground above and can cause localised collapse of the overlying rocks and deposits.
- 12.4.23 The groundsure report states that;
- Soluble rocks are either not thought to be present within the ground, or not prone to dissolution (negligible risk), and
 - Soluble rocks are present within the ground. Few dissolution features are likely to be present. Potential for difficult ground conditions or localised subsidence are at a level where they need not be considered (Very Low risk).
- 12.4.24 The Shadbolt Group ground investigations did not encounter any obvious visual dissolution features within the exploratory holes.

Hydrogeology

- 12.4.25 The superficial geology located beneath the Site is designated as both Secondary A and Secondary Undifferentiated. Secondary Undifferentiated; Assigned where it is not possible to attribute either category A or B to a rock type. In general, these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type. Secondary A; Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
- 12.4.26 The solid geology located beneath the Site is designated a Principal Aquifer; Geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale. Generally principal aquifers were previously major aquifers.

Hydrology

- 12.4.27 Information on flood risk is contained with Chapter 10 of this document.
- 12.4.28 Information from the Environment Agency (EA) indicates that the Site does lie within 50m of an indicated Environment Agency Zone 2 or Zone 3 flood plain.
- 12.4.29 Information from the Environment Agency RoFRaS (Risk of Flooding from Rivers and Sea) database indicates 4 No. are records within 50m of the Site. However, there is no record of flood risk within the Site boundary.
- 12.4.30 Ambiantal Risk Analytics surface water (pluvial) FloodMap identifies the Site to be within an area likely to flood as a result of extreme rainfall events, i.e., land naturally vulnerable to surface water ponding or flooding. Maximum modelled depth for return periods are greater than 1.0m.
- 12.4.31 The BGS indicate that the Site lies within 50m of groundwater flooding susceptible areas, the highest risk of groundwater flooding within this distance (including the Site) is deemed to be High. Northwest of the Site is considered to be the highest risk.
- 12.4.32 There are no Flood Defences or areas benefitting from Flood Defences or Flood Storage within 250m of the Site. There are no records of historical flood events within 250m of the Site.

Historical Setting

- 12.4.33 The earliest attainable records show the Site has remained as predominantly agricultural land, with associating farming building throughout its mapped history. The Site has a history of allowing sections of the land to be accessible to the public with several public footpaths established. Local roads have been developed within the Site, for example

Bygrave Road, for farming relating access. However, some main roads have been marked on the map, for example southeast of the Site is the Roman Road (Clothall Road) and Warren Lane leading east. Roman Road also intersects the Site boundary in the northwest of the Site. Ashwell Road and Royston Road cuts through the northeast areas of the Site. In addition, the national railway line passes through the central part of the Site.

- 12.4.34 The earliest available OS maps show the surrounding land is recorded as agricultural land, with smaller villages around the areas, including the town of Baldock. However, throughout the mapped history, the surrounding areas have gradually developed from both residential and industrial development. From Late 1800s to early 1900s the land relied on chalk related industries with several chalk pits marked around the surrounding areas of the Site. From, 1920s onwards, the town of Baldock has expanded steadily with factories and warehouse development in the Letchworth area with the chalk pits closing.

Contamination Assessment

- 12.4.35 In total 182 No. soil samples have been submitted for testing for a suite of common contaminants during the Shadbolt Group ground investigations within the Site. The laboratory chemical results have reported concentrations of potential contaminants to be within SE TSVs (Shadbolt Environmental Tier 1 Screening Values – typical industry wide screening values, incorporating S5UL / C4SL) for a Residential end use except for 1 No. sample of marginally elevated concentration of lead and 1 No. sample of marginally elevated concentrations of Benzo(a)pyrene. Statistical analysis has shown that the isolated marginally elevated concentrations of contaminants are not significant. PFAS / VOCs were not scheduled for chemical analyses as no potential source was identified.
- 12.4.36 It should be noted that no obvious visual or olfactory evidence was noted during the ground investigations and the samples which have reported slightly elevated lead or benzo(a)pyrene ground conditions were no different on composition and appearance than soil samples which reported low concentrations of lead and Benzo(a)pyrene.
- 12.4.37 No asbestos fibres or asbestos containing materials were detected.
- 12.4.38 Significant groundwater was not typically encountered during the fieldworks in the shallow machine excavated trial pits and windowless sampler boreholes or the deeper rotary core boreholes. However, groundwater was recorded in 4 No. exploratory holes, TP-096 (3.00m bgl), TP-097 (2.00m bgl), TP-098 (2.70m bgl) and WS-37 (2.00M bgl), all of which were located in the northwest area of the Site adjacent to North Road. Groundwater was recorded during return monitoring visits in WS-37 ranging from 1.20m to 2.35m during subsequent monitoring (6No visits between May and August). It should be noted that although every effort has been made to ensure the accuracy of the data obtained from the investigations, the possibility exists of variations in ground and groundwater conditions between and around the exploratory hole locations; additionally, groundwater levels will vary seasonally and with changes in weather conditions.

- 12.4.39 In should be noted that although the cored rotary boreholes did not record significant water strikes during the drilling, however water flush was used which can mask minor seepages. Subsequent monitoring of the installations on the centre of site (in the vicinity of the existing railway line) within the deeper boreholes recorded groundwater levels of between 5.0m and 8.92m below ground level during the subsequent monitoring visits. The likelihood of encountering elevated concentrations of contaminants is considered to be low.

Ground Gas

- 12.4.40 Radon is a naturally occurring radioactive gas that emanates from geological formations to varying degrees, depending on their type, porosity and permeability. The guidance notes on protective measures for new buildings published by the Building Research Establishment [22] presents a series of maps that determine the level of protection that new dwellings are required to have for protection from radon. The associated updated map for the Site area confirms that the Site is not in an area where Radon Protection Measures are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment.
- 12.4.41 BS8485:2015, "Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings" [23] sets out a methodology for determining an appropriate level of protection against ground gases in respect of the Characteristic Situation classification and the proposed building type.
- 12.4.42 Ground gas monitoring of the Site has reported low concentration of methane and carbon dioxide with corresponding low flows. The Site as a whole is classified as Characteristic Situation 1 (CS1) under the BS 8485 system for Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings.
- 12.4.43 For a site classified as CS1, no ground gas protection measures are required when the development is assessed under BS8485.

The Projected Future Baseline

- 12.4.44 Earthworks are anticipated generally comprise cut and fill earthworks to provide the required drainage falls for the Site.
- 12.4.45 No significant contamination has been reported at the Site which would warrant remediation. On consideration of the lack of contamination reported at the Site and the geotechnical suitability of the Site soils for Proposed Development no significant changes in baseline conditions are anticipated and it is anticipated this would be the case if the Site continued in agricultural use, as at present.

12.5 POTENTIAL EFFECTS

- 12.5.1 This section considers the potential effects of the Proposed Development on ground conditions. Consideration is given to both the construction and operational stages of the Proposed Development to determine potential effects and to highlight areas where measures to mitigate potential adverse effects will be required.

Construction Stage

- 12.5.2 This section considers the potential effects on ground conditions arising from the Proposed Development as described in Chapter 2 and as shown on the Parameter Plan (**Appendix 2.1**).
- 12.5.3 The construction phase includes groundworks, investigations and general construction activities. The operational phase includes occupation of the proposed buildings and ongoing maintenance of the buildings, public highways and areas of public open space. Because of the large scale of the Proposed Development and its lengthy delivery timeframe, there will likely be a period when there is overlap between the construction and operational phases.
- 12.5.4 The Site will be phased, with development commencing in site BA2 (Phase 1) and thereafter progressing in BA1 from a west to easterly direction (from North Road) alongside the build out of BA10. The final phase will comprise BA3 (dependent on the decision regarding secondary school provision). Infrastructure will be delivered at appropriate triggers throughout the development, to be agreed as part of the S106 agreement. Construction is anticipated to commence in 2027 with the first completions (in BA2) in 2028. The Proposed Development completion date is envisaged to be approximately 2043 with an average annual housing completion rate of 200 dwellings per annum.
- 12.5.5 It has been assumed that the following sequence of events will take place during all phases, not dependent on their location:
- enabling groundworks (construction of access roads and key highway infrastructure, installation of underground services, including water supply, sewerage, gas supply, electricity and telecommunication services);
 - supplementary ground investigation works to confirm ground conditions post consent.
 - groundworks related to the construction of residential and other buildings; and
 - general pavement construction and landscaping works to private gardens and areas of public open space.
- 12.5.6 Limited supplementary ground investigations may be undertaken to confirm the ground conditions at the Site. The investigation works carry inherent risk of minor leakage and spillage etc producing a minor adverse effect.

- 12.5.7 New landforms for individual developments across the Site will be engineered appropriately [24] to create a safe, stable environment thereby producing a likely minor beneficial effect.
- 12.5.8 For general design purposes, the Site is classified as a 'CHALK'. General foundation design and construction for all new building forms will therefore need to take account of the potential for erosion and the presence of potential karst features (voids and cavities caused by dissolved bedrock) [25]. Thus, the general chalk nature of the Site gives rise to potential localised moderate adverse effects, which may lead to local cracking of foundations if not addressed by design.
- 12.5.9 The construction of road/hardstanding pavement construction would produce a minor to locally **Major Adverse** effect if not constructed correctly.

Duration of effects

- 12.5.10 The duration of the various construction effects will generally all be long-term, irrespective of the date of commencement or actual completion of the Development (TBA). The exceptions to this will be:
- minor adverse potential effects relating to the Site management and control during the construction process, which should be temporary; and
 - ground movement-related effects associated with the 'chalk-soil' nature of the Site. The potential adverse effects associated with soft weathered chalk will be on a local scale (i.e. affecting an individual building) and may be minor in the short term but potentially become locally moderate or major in the medium or longer term.

Post-Completion Stage

- 12.5.11 The Parameter Plan for the Proposed Development has been provided (**Appendix 2.1**) although detailed plans for individual units and landscaping proposals are not known at this stage. It has again been assumed that the following activities will impact on ground conditions as a result of the normal occupation and ongoing maintenance of public facilities provided:
- residential gardening activities;
 - additions to the existing buildings by means of the addition of conservatories and/or extensions; and
 - landscape maintenance of public open space.
- 12.5.12 In the context of the Proposed Development of 2-4 storey residential units, primary schools and local centre units, there is no plausible potential for the completed development to significantly impact ground conditions. The effects of the above activities on ground conditions should be **Negligible**.

- 12.5.13 In terms of any identified local soil contamination, the effect of the Proposed Development on ground conditions during the operational phase through controlled management or removal of such contamination will be locally **Minor Beneficial**.
- 12.5.14 In the context of the Proposed Development there is no plausible potential for the completed roads and hardstanding's to impact on ground conditions. The effects of the above activities on ground conditions would be **Negligible**.
- 12.5.15 Although no significant contamination is anticipated at the Site, as part of the works, any soils which exhibit elevated concentrations of contaminants above the criteria for residential gardens will be placed at depth (below 600mm bgl) or used within public open spaces are commercial end-use areas.

Embedded Mitigation

- 12.5.16 Where low-rise buildings or residential development is proposed, the guidance and recommendations in BS 8103-1:2011 Structural design of low-rise buildings [29] will control and mitigate ground-related risks, together with guidelines published by the EA and NHBC.
- 12.5.17 Where the use of piled foundations is required to safely sustain and support new buildings, additional mitigation measures will comprise selection of the most appropriate form, type and construction method in agreement with the EA, LPA and NHBC (as appropriate). Design will also comply with current best practice guidelines detailed in the NHBC standards (and BRE (Building Research Establishment) publications [30].
- 12.5.18 Where risks posed by hazardous ground gases are identified, assessment and design of required gas protection measures will be in accordance with BS 8485:2015 [31] and best practice guidelines outlined in CIRIA Report C665 [32]
- 12.5.19 Other guidelines published by the BRE with respect to ground-related risks for buildings on brownfield sites will also be followed [33] to control and mitigate any potential local risk from remnant structures or contaminants from the Site's previous land use history.
- 12.5.20 With respect to the development road infrastructure, design guidance as detailed in the Department for Transport – Highways Agency Design Manual for Roads and Bridges, Interim Advice Note 73/06 [34], together with Hertfordshire County Council estate roads construction specification requirements [TBA], will be followed.
- 12.5.21 With respect to the development of landscape areas and specifically the potential impact of shrinkage by tree root action and thus possible subsidence to buildings / structures BS 8103-1:2011 and BRE guidance will be followed.

- 12.5.22 **Minor to Locally Major Adverse** (Permanent) Residual low risk of short, medium- and long-term ground movements and effect on existing building foundations due to highly weathered chalk.

12.6 MITIGATION MEASURES

- 12.6.1 This section sets out the mitigation measures that will be implemented to remedy or reduce the potential adverse effects.
- 12.6.2 Where there is any ancillary requirement to alter local ground levels or create development platforms, this will be carried out in a controlled manner in accordance with current knowledge, good practice and statutory controls. Any earthworks will be minor, relating to potential slight changes to levels to facilitate appropriate drainage falls.
- 12.6.3 While it is anticipated that all fill materials required for earthworks within the Site will be generated from within it, where any import of fill is required, it is reasonable to assume the material will comply with current good practice and statutory controls for the classification of 'acceptable fill' for acceptability for use in any Permanent Works.
- 12.6.4 All construction activity in respect of ground conditions will be carried out with due regard to the consented earthworks undertaken at the Site, which have comprised, full ground investigation, geoenvironmental risk assessment, geotechnical analysis and remedial works and that design will take place in accordance with current knowledge, good practice, statutory controls and in order to meet the intended end uses of the individual site/development parcel by the onward developer via an appropriate planning consent..

Construction Stage

- 12.6.5 An Outline Construction Management Plan (OCEMP) is submitted with the outline planning application which will outline the mitigation, control and monitoring measures to be put in place to minimise the effect of the development works on ground conditions and land quality. Subsequent phased CEMPs will be prepared.
- 12.6.6 Site management and control during the construction process will include material operational management plans to eliminate the risk of pollution from spills or leaks of fuel and oil used in the construction process, or from site investigation causing new pathways for contaminant migration. Operational plans will also include collection, settlement and treatment as required of surface water run-off and the use of vehicle wheel washing if there is any risk of contamination to the surrounding area. These activities all have potential for minor adverse effect.
- 12.6.7 Foundation construction for new development may on individual parcels require the use of specialist foundation techniques such as raft or piled foundations. Some methods of piling can create additional pathways for the migration of potential contaminants in soil or groundwater. Where contamination is present, the selection of the piling technique will be made in conjunction with the EA to ensure that any risk to the environment is reduced to an acceptable level.

Land Contamination Related Effects

- 12.6.8 Intrusive ground investigation works have been carried out in accordance with BS5930:1990 Code of practice for site investigations [26] as amended by BS EN 14688 and BS EN 14689, and BS10175:2011 Investigation of potentially contaminated sites [27]
- 12.6.9 Should unexpected contamination be identified at the site, the works should cease and the advice of a suitably qualified and experienced geoenvironmental professional be sought. The works in the vicinity of the unidentified / unexpected contamination should cease and the Environmental Health / Contaminated Land officer be contacted.

Geotechnical and Structural Effects

- 12.6.10 Placement and compaction of fill material to form new landforms (minor earthworks) by the onward developer will be carried out in accordance with current best accepted engineering practice such as outlined in BS 6031:2009 Code of practice for earthworks [24] and Ciria C574 (2002) Engineering in Chalk [25]
- 12.6.11 For all permanent building forms, current Building Regulations [28] will establish general functional requirements for buildings when constructed. The Building Regulations are supported by a series of approved documents, including Approved Document C (C1 Site preparation and resistance to contaminants and C2 Resistance to moisture).

Post-Completion Stage

- 12.6.12 The LPA-controlled planning process will control any substantial modifications to the existing building forms which may potentially arise in the future, and which may have local impact on ground conditions.
- 12.6.13 No other mitigation measures are considered necessary with respect to the ground or groundwater environment during the post-completion phase.

12.7 RESIDUAL EFFECTS

12.7.1 This section outlines the effects of the Proposed Development taking into account of the mitigation measures outlined above.

Construction and Post-Completion Stage

12.7.2 It is anticipated that all construction activity will be carried out in accordance with current good practice, statutory controls and in order to meet the requirements of the intended end uses of the Site. Consequently, with the mitigation measures in place, the residual effects during the construction phase (as well as the operational phase) will be either Beneficial or Negligible.

12.7.3 It is acknowledged, however, that even with the use of mitigation measures such as the selection of the most appropriate technology, risk assessments and EA guidance/approval, there are possible minor adverse effects associated with the risk that the development process on any individual parcel may create additional pathways for the migration of potential contaminants, but only if such contaminants are present. Where there is a risk that the development process on any individual parcel could create pathways for potential contaminants that may be present, further mitigation measures will comprise selection of the most appropriate foundation technology, further risk assessment and consultation/approval by the EA. This will ensure any residual effects are reduced to a **Negligible** level.

12.7.4 It should be noted that the residual effects will be the same during both construction phase and post-completion phase and would only likely be relevant if additional construction works are undertaken beyond the build-out of this development – for example householder extension.

Summary of Effects

12.7.5 The effects identified are summarised in **Table 12.5** below:

Table 12.5 - Summary of Effects

Potential effect	Significance (pre-mitigation)	Mitigation measure	Significance of residual effect
Construction Stage			
Creation of new landforms / construction plateaus by placement and compaction of site generated or imported fill	Minor Beneficial (Permanent)	Earthworks to be carried out in accordance with BS6031:2009 Ciria C574 Engineering in Chalk	Minor Beneficial

Potential effect	Significance (pre-mitigation)	Mitigation measure	Significance of residual effect
Some inherent risk of minor spillage / leakage / spread of contaminated materials or risk of creating potential contaminant pathways	Minor Adverse (Temporary)	Storing fuels in accordance with EA PPG2: Above Ground Oil Storage Tanks should mitigate the effect of spillages impacting upon	Negligible (Permanent)
Short, medium and long term serviceability on this 'chalk-soil' dependent on foundation scheme proposed/ adopted.	Moderate Adverse (Permanent)	Design in accordance with BS8103-1:2011, BS 8485:2007, NHBC Standards, BRE best accepted practice guidance and Building Regulations requirements	Negligible (Permanent)
Short, medium and long term serviceability dependent on pavement construction scheme proposed / adopted.	Minor to Locally Major Adverse (Permanent)	Design in accordance with Highways Agency IAN 73/06 and LPA estate road construction specification.	Negligible (Permanent)
New landscape plantings associated with the development causing local shrinkage by tree root action and thus possible subsidence to existing buildings / structures, dependent on the foundation schemes to the existing building / structure and the proposed position and species of the new planting(s).	Minor to Locally Major Adverse (Permanent)	Residual low risk of short, medium and long term ground movements and effect on existing building foundations due to the presence of chalk soils.	Negligible (Permanent)
Construction workers - Exposure to previously unforeseen contaminants	Minor Adverse	Construction workers should be briefed on potential for encountering previously unforeseen contamination.	Negligible
Future residents - Exposure to previously unforeseen contaminants during the construction / build out process.	Minor Adverse	Ground investigation to confirm presence of any significant contaminant linkages. Widespread hardstanding at the surface and clean cover system in garden areas	Minor Beneficial

Potential effect	Significance (pre-mitigation)	Mitigation measure	Significance of residual effect
		and soft landscaping which will break direct contact pathways between any contamination and future site users.	
Post-Completion Stage			
Construction workers - Exposure to previously unforeseen contaminants	Minor Adverse	Construction workers should be briefed on potential for encountering previously unforeseen contamination.	Negligible
Future residents - Exposure to previously unforeseen contaminants	Minor Adverse	Ground investigation to confirm presence of any significant contaminant linkages. Widespread hardstanding at the surface and clean cover system in garden areas and soft landscaping which will break direct contact pathways between any contamination and future site users.	Minor Beneficial (Permanent)
Post construction modification/ extension to individual building forms.	Negligible (Permanent)	The Local Planning Authority planning process will control any substantial modifications.	Negligible (Permanent)
Road/hardstanding pavement construction	Negligible (Permanent)	In the context of the Proposed Development there is a no plausible potential for the completed roads and hardstanding's to impact on ground conditions. The effects of the above activities on ground conditions would be negligible	Negligible (Permanent)

12.8 CUMULATIVE EFFECTS

- 12.8.1 This section considers the cumulative effects of the Proposed Development with the other proposed developments as outlined in Chapter 2.
- 12.8.2 The cumulative effects on the Proposed Development are those that result from additional impacts caused by other existing and/or approved projects, together with the project itself.
- 12.8.3 During both the construction and post-completion phases of development, all sites surrounding the development are expected to adhere to the same local and national guidance for Water Resources as the Proposed Development.
- 12.8.4 Therefore, no cumulative effects are expected during both the construction and post-completion phases of development.

12.9 REFERENCE LIST

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