

Ground Investigation Report [intrusive]

St Andrew's Church, Keighley



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Appendices Drawings > Exploratory Hole Logs > In-Situ Testing Results

Annexes Guidance Notes on: Unexpected material encounters; and, material suitability.

Appointment

Soil and Structures Ltd were instructed by Church on the Green Neighbourhood Foundation (the Client) in October 2024 to prepare a Ground Investigation Report (*this Report*) in support of planned development works at St Andrew’s Church, Keighley (the Site).

Development proposals include for extension of the existing church building, including a connection into the main church structure, as well as the expansion of car parking facilities.

Reliance on the advice presented herein rests solely with the Client and the *Parochial Church Council of the Ecclesiastical Parish of Keighley*.

Ground Investigation Reports

In the ground everything is inter-related: from strength to pollution potential; through to, stability and drainage characteristics. Any groundworks completed as part of a development project will therefore influence, and be influenced, by all these inter-related elements.

This Report presents: an overview of the Site setting, the anticipated ground conditions and, where structures are present, the anticipated foundations. The Report also offers more specific advice as discussed below.

Scope and Context

The Ground Investigation Report offers ground engineering advice with respect to the proposed development of the Site.

This intrusive ground investigation offers a snapshot of ground conditions at discrete locations across the Site and seeks to reconcile these findings with the Site setting to offer as complete a picture of the ground as possible. An assessment of the likely consistency of ground conditions is offered however, variations between exploratory hole positions cannot be ruled out.

The legal context of this advice relates to an assessment of:

- i) Potential ground-related hazards that may affect the development that is governed by health and safety law (various acts and regulations).

Fieldwork

This Report references intrusive investigation fieldworks that were scoped and supervised by the author of the Report.

Background to this Report

This Report is preceded by various, non-intrusive archaeological investigations completed across the Site but no other ground-related reporting.

References

The Ground Investigation Report has been written with reference to various sources of information. These are either appended or included as footnotes at the base of each respective page.

Guidance notes for: i) unexpected material encounters; and, ii) material suitability are included as annexes. These are intended to offer further context and advice on these different aspects of site investigation and groundworks.

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1.0 The Site and Proposed Development

1.1 The Site

Location and size: The Site comprises an existing church (St Andrew's Church, Keighley), adjacent church hall building and associated hardstanding and soft landscaping.

Access: At the point of the fieldworks, the Site was accessed on foot and vehicle via a gated entrance on the eastern boundary of the Site off Church Street / Market Street. The gate has height and width restrictions.

Topography: The surface topography of the Site is generally flat but, along the midline of the church hall building, falls steeply towards the south.

Utilities: Below ground utilities are understood to be present beneath the Site.

Existing structures: At the point of the fieldworks, the Site was occupied by the existing church structure and church hall building. No obvious signs of structural distress that might be associated with ground movement were observed on the latter with localised, minor signs of structural distress noted on the south-eastern corner of the church¹.

1.2 Proposed Development

Development proposals: include for extension of the existing church building, including a connection into the main church structure, as well as the expansion of car parking facilities as illustrated in Figure 1.

① **Development works and risk:** An appreciation of the construction processes is essential for development-related risk assessments given the groundworks stand to meaningfully alter the level of risk, e.g. unstable slopes being removed by earthworks, or unsuitable material being exposed as part of the works.

To enable this development, the following groundworks are likely to be required, N.B. listing is outline only.

- > **Preparation:** Site strip of surface materials and vegetation over the proposed development footprints.
- > **Earthworks:** Given the relatively flat topography across the proposed extension, no cut and fill operations are anticipated to be required with any level changes likely accommodated as part of the structure, mimicking the existing church hall building.
- > **Utility Excavations:** Excavation of drainage and other utility alignments.
- > **Foundations:** Construction of new sub-structures (foundations and floor slabs) followed by construction of the structures.
- > **Surfacing:** Formation of hardstanding and soft landscaping areas.

① **Risk profile of the proposed development for human health:** The proposed development would see an existing place of worship extended. The sensitivity of the development therefore remains unchanged. Given its age (c. 1800s) the use of coal fires to heat the church stand to have degraded soil quality across the Site however, these are general hazards that relate to all buildings of this age.

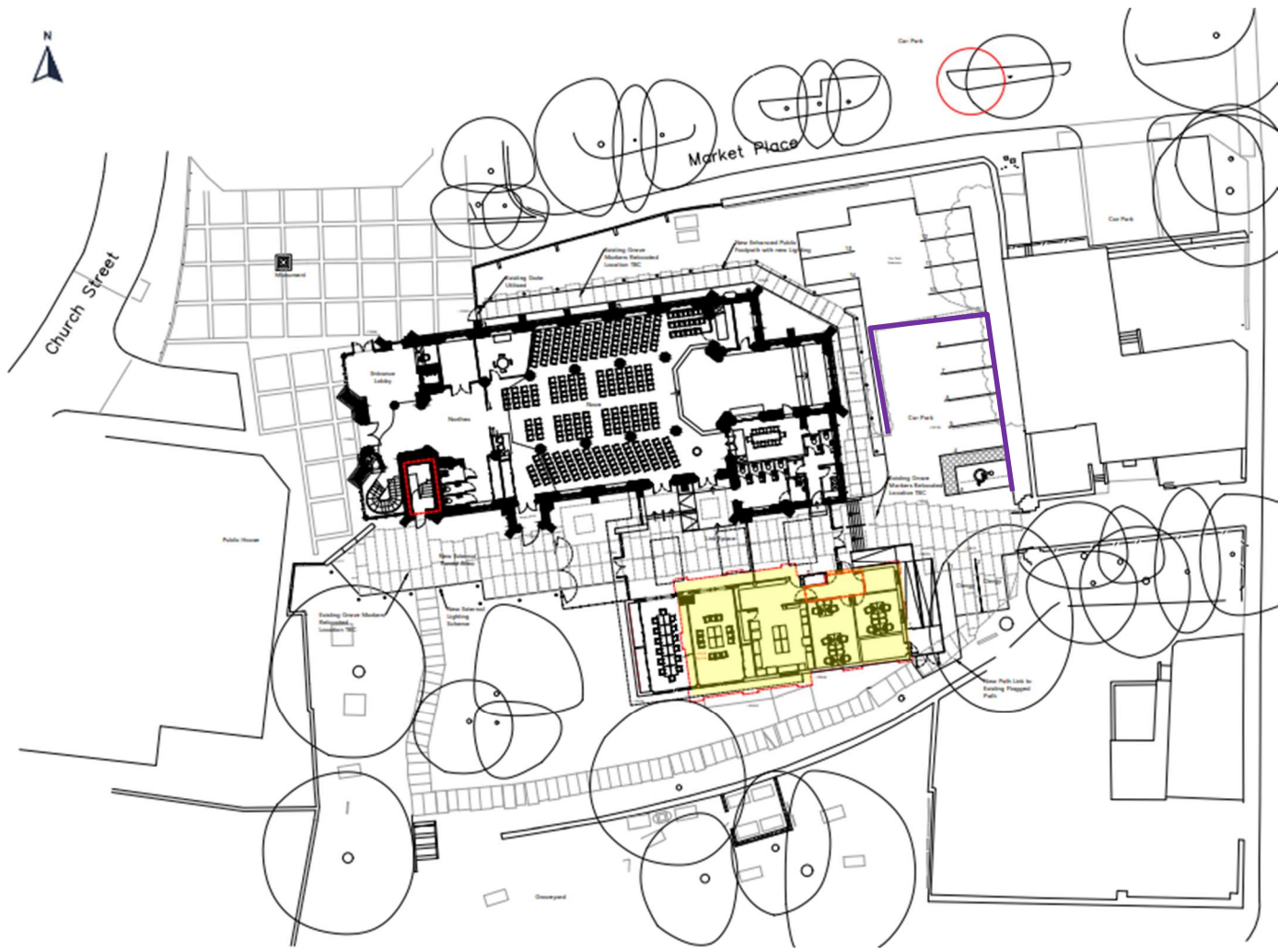


Figure 1: Location Plan

- > Extract from appended drawing
- > Approximate footprint of existing structure highlighted yellow and outlined in red
- > Northern edge of existing car parking provision illustrated by purple line
- > Site approximately centred on NGR 406084, 440988

¹ This commentary does not represent a structural condition survey with the advice of a structural engineer recommended to accurately assess the performance of the existing structures



Photograph 1: Stitched panorama from the western portion of the Site looking east towards the existing church hall



Photograph 2: View from the eastern portion of the Site looking west towards the existing church hall

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2.0 Site Setting

2.1 History

The Site has been subject to one phase of use since the 1850s (the earliest ordnance survey mapping):

> **The first phase – 1850s to present day:** St Andrew’s Church

Evidence of potentially harmful material and evidence of potentially gas generating material: Through this phase of use there is a low likelihood that potentially harmful material would have been introduced into the Site’s soils.

Given it age the use of coal fires to heat the church stand to have degraded soil quality across the Site (spreading around the structure is common) however, this is a general hazard that relates to all buildings of this age.

The adjacent church hall building (former methodist church) appears to have been constructed at some point after the 1950s.

Evidence of mining activities: No evidence of coal or non-coal mining features, e.g. old shafts or soughs, is recorded on the Site over this period.

Evidence of unexploded ordnance: **Military land use:** There is no evidence of the Site having been put to military uses on historical mapping or on internet searches. **History of bombing:** local features, e.g. industrial centre of Keighley, would have been strategic targets during both the First and Second World Wars however, none are recorded locally to the Site with bombing density expected to have been low in this area based on National Archive data.

The surrounding area is currently characterised by land uses consistent with a predominantly commercial economy being located within the centre of Keighley. Former and current works buildings are noted to the south-west and south-east of the Site.

2.2 Geology

Recorded geology: The Site is recorded being underlain by:

- > Superficial soils comprising: the Alluvial Fan Deposits (sand and gravel)
- > Bedrock comprising; the Doubler Stone Formation (Sandstone)²

Given the marked change of ground levels towards the south of the Site, it is likely that ground levels were historically lifted to form the more level plateau onto which the existing church hall building is constructed. On this basis Made Ground deposits were anticipated with depths of up to circa 3.00 m predicted based on a comparison of ground levels on adjacent sites.

Exploratory holes: Exploratory hole records are not available for the Site itself but are present locally within the same geological unit (close enough to be representative).

A brief synopsis of these borehole logs is presented on Figure 2 noting that the relative elevations compared to the Site are estimated based on satellite imagery.

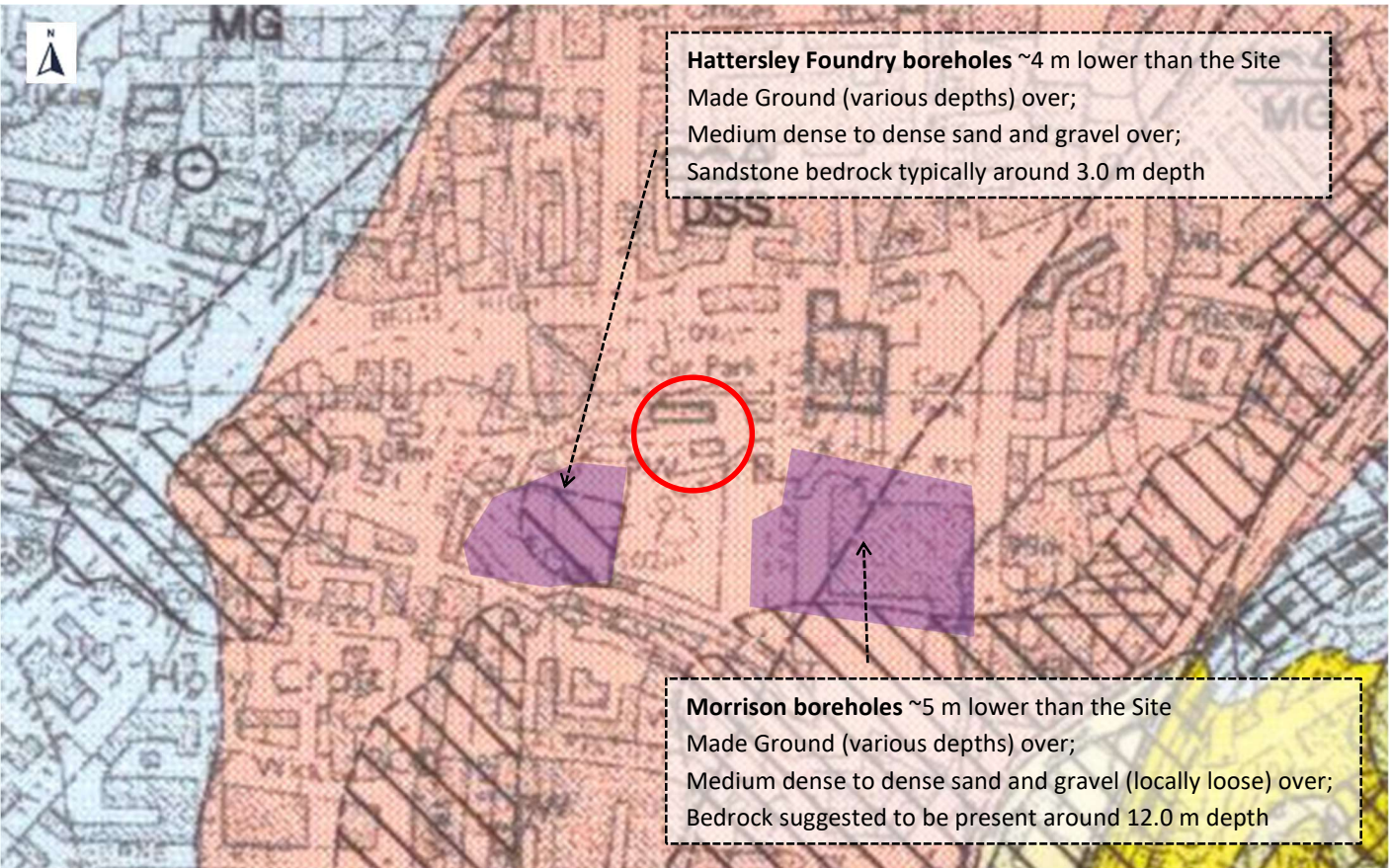


Figure 2: Geological Mapping

- > Extract from the BGS 1:10,000 map solid and drift edition, reproduced under Open Government Licence (v3.0).
- > Location of the Site identified by red circle.

Geological hazards: Based on this recorded geology, it is generally unlikely that most geological hazards will impact the Site (running sand, collapsible soils, landslips) with the typically moderate strength characteristics of the Alluvial Fan deposits resulting in more favourable ground conditions. The possible exception to this is the possible Made Ground deposits that would be anticipated to be more variable in composition and strength characteristics.

Coal and non-coal mining: No coal or non-coal mine workings are recorded beneath the Site³ nor are they anticipated.

² [BGS Lexicon of Named Rock Units - Result Details](#)

³ [Interactive Map Viewer | Coal Authority \(bgs.ac.uk\)](#)

2.3 Recorded Hydrogeology & Hydrology

A water catchment is divided into two main elements; groundwater (hydrogeology) and surface water (hydrology). The groundwater regime is primarily governed by the geology and the surface water regime by the topography and surface cover. For any given site, these regimes are likely to influence each other and be influenced by off-site factors, e.g. groundwater levels being ‘recharged’ higher up a catchment.

The Site’s drainage regime is influenced by:

- i) Its location at the watershed of two, heavily modified, urban catchments of; North Beck from Source to River Worth⁴ and, Worth from Brighouse Beck to River Aire⁵;
- ii) The Site’s predominance of ‘hard’ cover (structures and hardstanding) and varied topography, resulting in a tendency for surface water to likely; drain to the existing piped networks for the structure (outfall unknown) or, across areas of soft cover, drain to ground.

It is understood from discussions with the caretaker of the church that localised flooding previously occurred to the east of the existing car park (likely due to inadequate/blocked drainage) that has since been resolved though an upgrade to the pre-existing, dilapidated drain;
- iii) The anticipated ground conditions are expected to exhibit variably rates of infiltration with ‘f’ provisionally estimated to be between 10⁻³ to 10⁻⁸ m/s within what is anticipated to be Made Ground deposits;
- iv) The Site being classified at very low risk with respect to river, reservoir and surface water flooding⁶.
- v) The Site being located on a Secondary A Superficial and Bedrock Aquifers and outside of Source Protection Zones (SPZs)⁷; and,
- vi) Historical borehole records locally indicating groundwater is likely deeper than 5 m below ground level across the Site.

The nearest surface water feature is an open watercourse (North Beck) located around 90 m south of the Site at its nearest point.

2.4 Environmental Setting

The environmental setting relates to land designations either on-site or within the surrounding area that have the potential to influence or present a risk to the proposed development.

Landfills (historic and active) are not recorded within 250 m of the Site^{8,9}, the distance across which viable pathways for gas migration are more likely.

Historic infilled land, e.g. ponds and quarries (excluding landfill above) are not evidenced within 100 m of the Site noting that historic filling operations are suggested to have occurred across the Site to create the more level plateau across which the existing church hall building is present.

Historic and current industrial sites are not recorded on the Site with a former warehouse structure previously present immediately south-east of the Site.

Statutory protected areas, e.g. SSSI are not recorded on the Site¹³ noting that the ground is likely partially or fully consecrated.

Radon is emitted from naturally sources within a range of geologies. The United Kingdom Health Security Agency (UKHSA) data¹⁰ indicates between 3 to 5 % of dwellings are expected to be above the Action Level (200 Bq m⁻³).

This wouldn’t necessarily guide the requirement for basic radon protection to be included as part of the proposed extension given the higher workplace limits however, given the low cost of protection measures, they are recommended.

⁴ [North Beck from Source to River Worth | Catchment Data Explorer | Catchment Data Explorer](#)

⁵ [Worth from Bridgehouse Beck to R Aire | Catchment Data Explorer | Catchment Data Explorer](#)

⁶ [Your long term flood risk assessment - GOV.UK \(check-long-term-flood-risk.service.gov.uk\)](#)

⁷ [Magic Map Application \(defra.gov.uk\)](#)

⁸ [Historic Landfill Sites - data.gov.uk](#)

⁹ [Permitted Waste Sites - Authorised Landfill Site Boundaries - data.gov.uk](#)

¹⁰ [UKradon - UK maps of radon](#)

3.0 Intrusive Investigation and Laboratory Testing

The intrusive investigation (Table 1) was designed in general accordance with guidance for site investigation¹¹, with reference to the Site setting, the anticipated ground conditions, access arrangements and responding to the revealed ground conditions.

① **Comments on the scope of works:** *The presence of an existing structure, the stability/condition of which was considered generally ‘good’, guided foundation investigations to establish a viable solution for the proposed extension.*

Investigation of the existing church’s foundations was not scoped by the Structural Engineer but commentary on their anticipated nature and depth is included within Section 4.0.

The access arrangements and local experience of the Author also guided the use of easily deployable, portable investigation techniques to obtain deeper data from the ground.

Unexpected or unforeseen ground conditions may be encountered even when extensive investigation is completed.

In this scenario, further investigation may be warranted to refine the recommended piled foundation solution.

Exploratory hole locations are illustrated on the Ground Model in Section 5.0 with descriptions of the materials encountered detailed within the following section, Section 4.0.

The exploratory hole logs are appended.

Permits: No specific permissions were required for the intrusive investigation fieldworks.

Table 1: Scope and Rationale of the Intrusive Investigation

Activity	Ref.	Rationale
Exploratory Holes		
3 hand excavated trial pits	HP101 to HP103	To investigate the existing foundations and ground conditions locally to the existing church hall building (HP101 and HP102) and ground conditions across the proposed car park extension (HP103).
In-Situ Testing		
3 dynamic cone penetration tests (TRL Probing)	DCP101 to DCP103	To investigate the density profile of the ground conditions locally to the proposed car park extension.
Logging of soil arisings from exploratory holes.	All holes	To characterise: ground conditions; existing foundations; and support classification of materials present in the ground. Material descriptions are detailed in the notes on the Ground Model in Section 5.0, the accompanying exploratory hole logs and strata depths on the plan itself.

Geotechnical samples were not obtained given the nature of the materials encountered within the exploratory holes (construction materials, e.g. pea-gravel and, debris from the original construction of the church hall) and the Author’s experience of testing the Alluvial Fan Deposits within the Keighley area (within which sulphate concentrations and pH levels remain with DS-1 AC-1 classifications).

¹¹ Code of practice for site investigations. BS 5930 (2015)

Environmental samples were not obtained given the absence of potentially harmful or polluting material.

Ground gas monitoring was not undertaken given the lack of landfills or other sources of potential ground gas identified within 250 m of the Site or within the Site’s soils (no evidence of potential ground gas ‘hazards’).

4.0 Ground Conditions & Existing Foundations – Anticipated and Revealed

Anticipated ground conditions: Based on the Site setting the presence of three main materials were anticipated across the Site: (1) **surface coverings**, e.g. Topsoil or hardstanding over; (2) **Made Ground** deposits likely recovered as reworked natural soils and construction materials from either the church’s original construction or the subsequent development of the church hall building); over, (3) **Alluvial Fan Deposits** that locally are recorded as sand and gravel with localise cobble beds and cohesive lenses (silt/clay).

Revealed ground conditions: The intrusive investigation undertaken on Site confirmed the anticipated conditions with one variation and two observations:

- > *Variation 1:* The presence of Alluvial Fan Deposits was inferred by a marked increase in density within the dynamic probing with these soils typically having ‘good’ strength characteristics (well graded granular material);
- > *Observation 1:* Groundwater was not encountered within 4.0 m of the ground surface (deepest depth exploratory holes were taken) with the groundwater table anticipated to be at least 5.0 m below ground level locally; and,
- > *Observation 2:* No evidence of potentially harmful or polluting material was encountered within the exploratory holes.

The Ground Model for the Site is presented in Section 5.0 and includes further commentary on the ground conditions.

Anticipated foundations: Based on the above ground conditions but with specific reference to the local ground levels, the existing church hall structure was anticipated to be ‘deeply’ founded on spread footings.

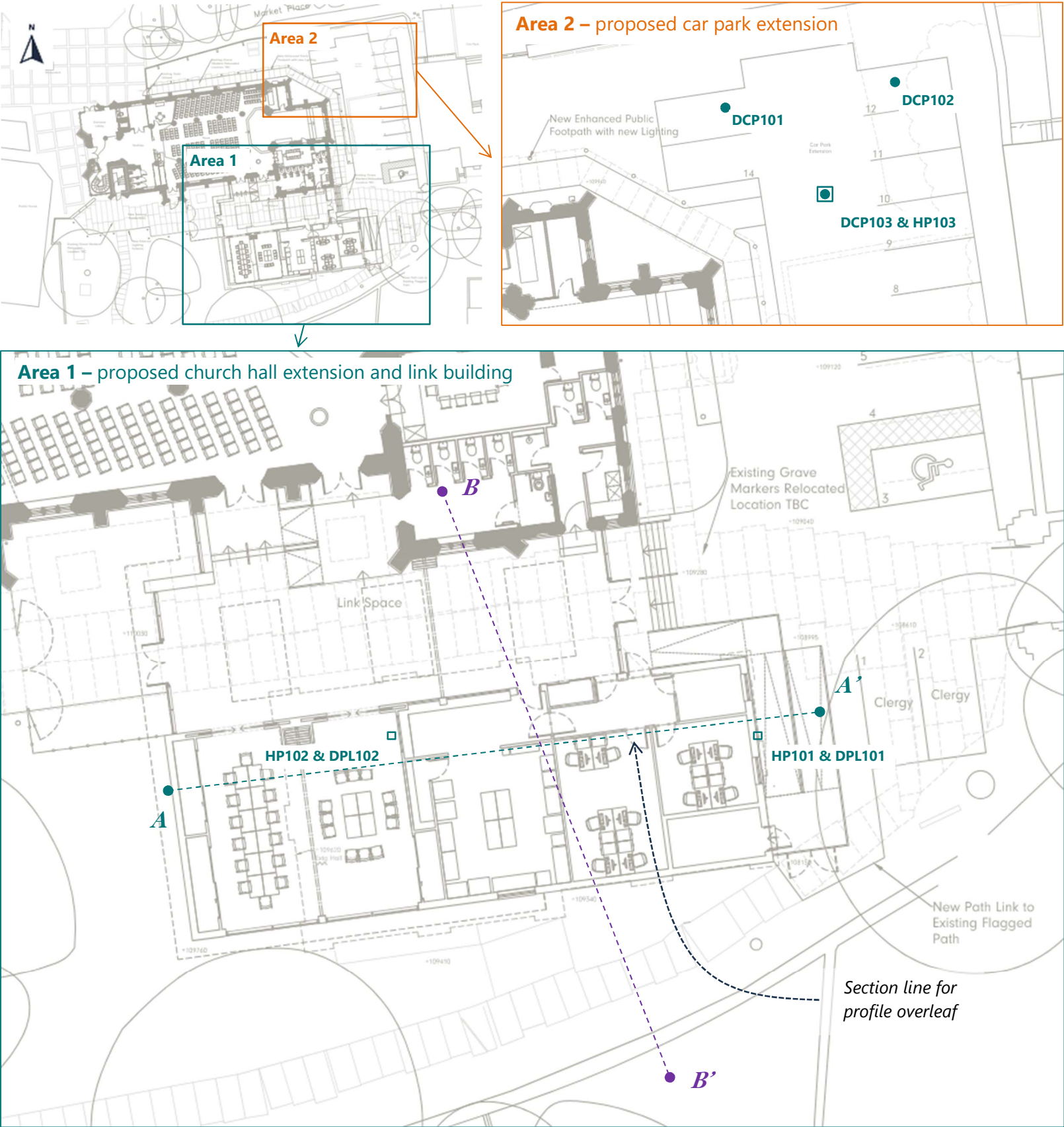
The depth of the church hall foundations was anticipated to be primarily guided by the proximity of this structure’s south-eastern corner to the adjacent retaining wall (former warehouse wall) as well as the proximity of the retaining wall south of the church structure.

The depth of the church’s foundations was anticipated to be ‘shallow’ (within 2.00 m of the ground surface) and comprised of ‘spread’, likely corbelled or flagstone supported footings.

Revealed foundations: Foundation investigations (HP101 and HP102) across the church hall confirmed ‘deep’, spread footings (at least 1.85 m below ground level; HP101, but likely deeper than 2.50 m below ground level).

Evidence of the former church hall having been constructed within temporary formwork was noted, i.e. the breezeblock wall on the outer face of the mass concrete footing, suggesting that ‘deep’ temporary works were employed when the church hall was constructed.

5.0 Ground Model – Plan



Key

Soil and Structures – October 2024 investigation

- Hand excavated trial pit (HP) with follow-on dynamic probe light (DPL) in HP101 and HP102
- Dynamic cone penetration test location (DCP)

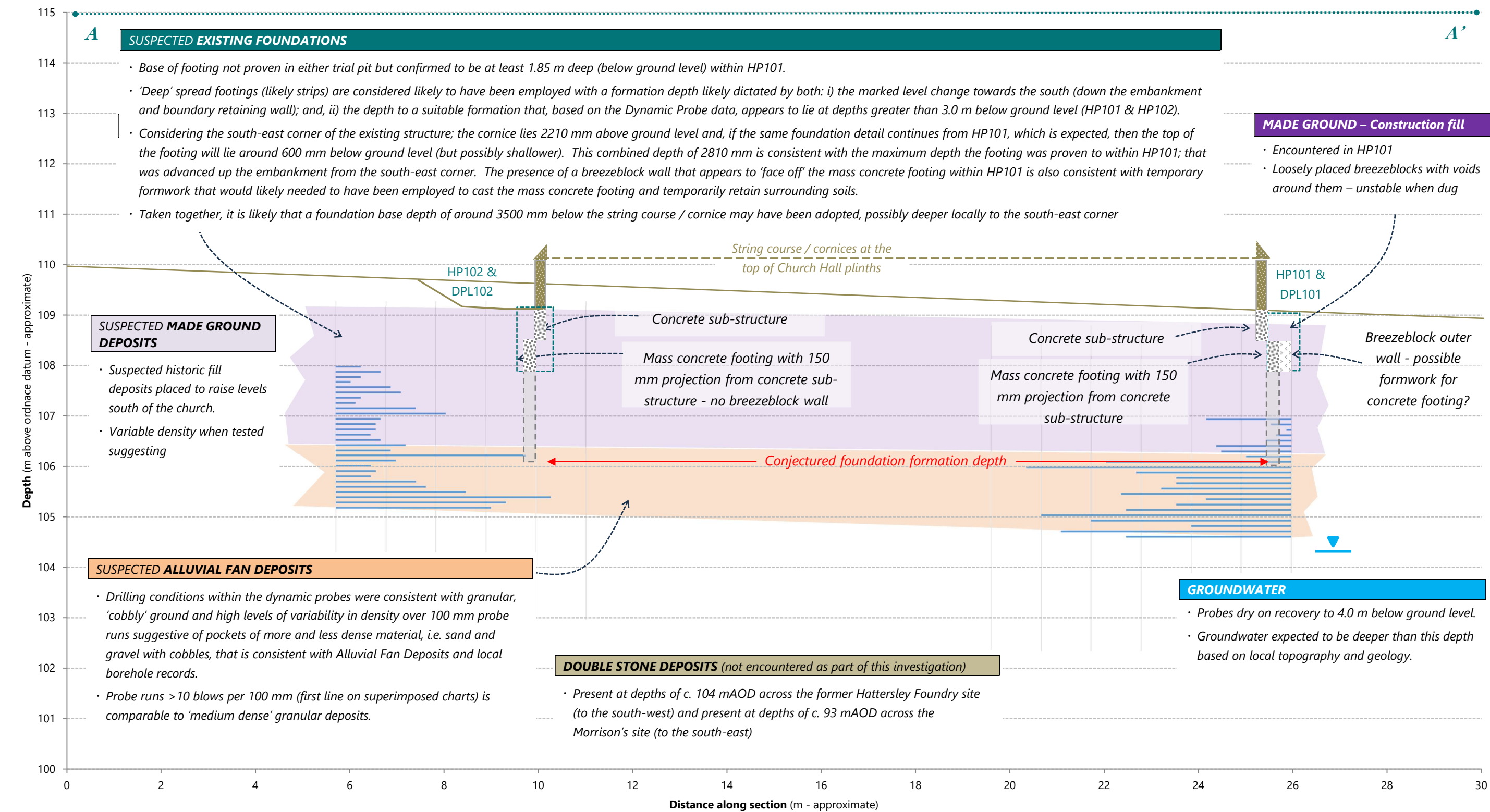
Ground Conditions

- > **Surface cover** across both areas comprised a thin Topsoil cover (with paving slabs noted in HP102)
- > **Made Ground** deposits were encountered within all exploratory hole locations.
Across Area 1 (proposed church hall extension and link building) these deposits comprised construction materials associated with the church hall’s original construction and were proven to a depth of 1.20 m below ground level.
Across Area 2 (proposed car park extension) these deposits comprised ‘ash fill’ over ‘sandstone fil’ that likely relates to the original church’s construction.
- > **The suspected Alluvial Fan Deposits** were inferred to be present within DPL101 and DPL102 based on the marked increase in density at depths that are consistent with the anticipate depth of Made Ground deposits.
Geotechnical characteristics:
 - ‘Medium dense’ to ‘dense’ consistency with an angle of internal friction (ϕ) indicated to be upwards of 33 degrees based on the dynamic probe results;
 - Low sulphate content ($<500\text{ mg/l}$); and
 - Near neutral pH ($\text{pH } 6\text{ to } 8$).Based on exploratory hole logs and Author’s experience of testing this geology locally.
- > **Groundwater** was not encountered within 4.00 m of the ground surface locally to the church hall.
- > Apart from the ash content within HP103, no visual or olfactory evidence **potentially harmful** or **polluting material** was encountered on the Site or within any of the exploratory holes.
- > Apart from roots relating to former trees within HP103, no evidence of **degradable material** was encountered within the exploratory holes.

Screening of Ground Related Hazards

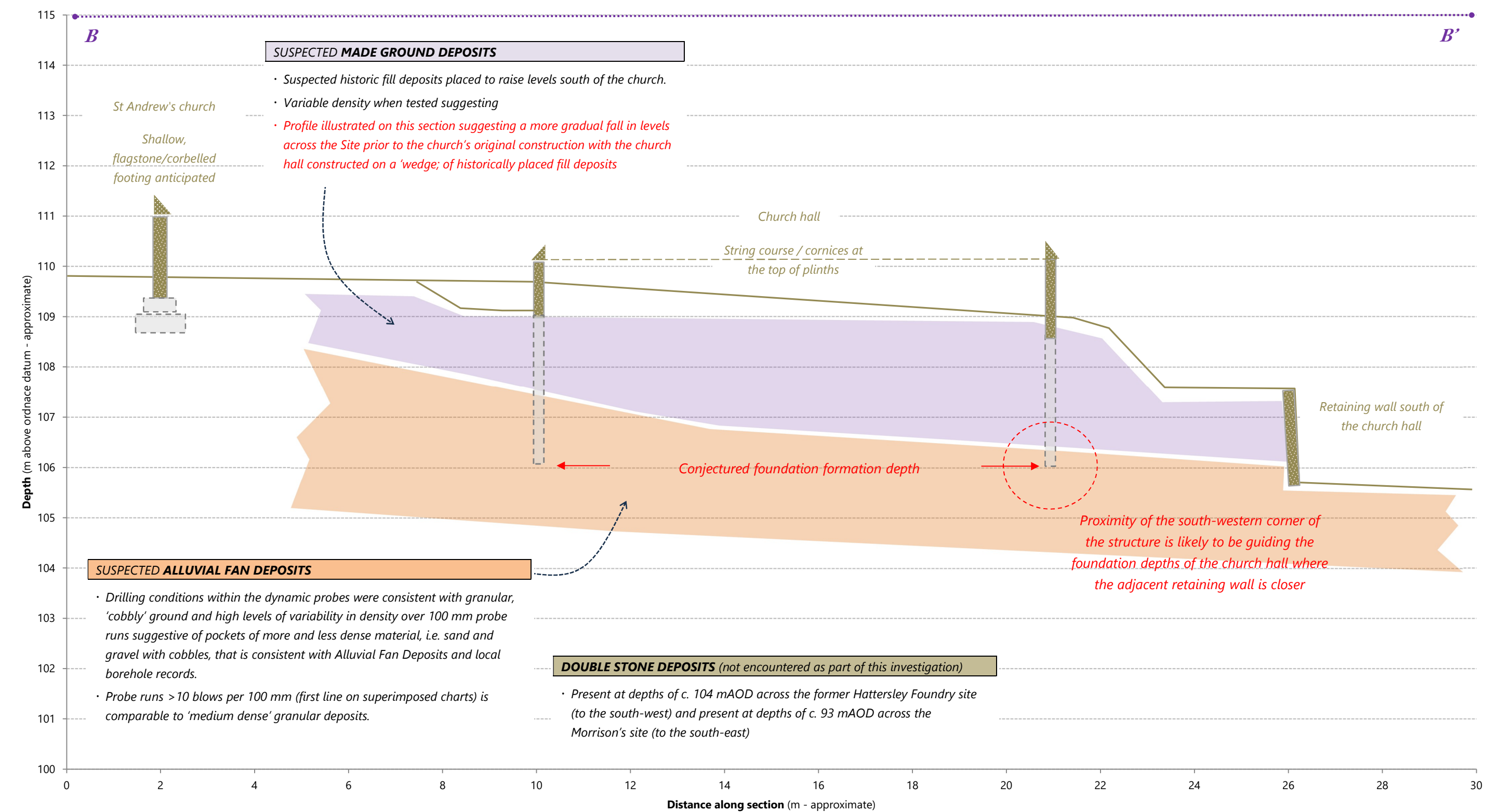
Based on the revealed ground conditions, ground-related hazards identified that could influence the proposed development all relate to the presence of the Made Ground deposits with the depth and inherent variability/instability of these soils informing design decisions.
Please refer to Section 6.0 for further commentary and advice.

5.0 Ground Model – Profile



Illustrative / conceptual only – do not scale from drawing

5.0 Ground Model – Profile



Illustrative / conceptual only – do not scale from drawing

6.0 Ground Engineering – Risk Management & Design Considerations

① **Topographical survey and development levels:** The following design advice carries through assumptions and estimations of existing ground levels and proposed formation levels from satellite imagery. In general, the advice is not expected to vary should more accurate, surveyed levels become available however, attention is drawn to this.

The main design considerations include, but are not limited to;

- > Low to moderate imposed loads of the proposed extension;
- > Anticipated ‘shallow’ spread footings supporting the existing church;
- > ‘Deep’ spread footings supporting the existing church hall; and,
- > The presence of moderate to high strength bedrock deposits (Doubler Stone sandstone) at depths that locally lie between 93 and 104 mAOD (based on satellite imagery data).

Ground-related hazards: Based on the revealed ground conditions, ground-related hazards identified that could influence the proposed development all relate to the presence of the Made Ground deposits with the depth and inherent variability/instability of these soils informing design decisions.

① **Utilities:** Utility strikes represent one of the highest background threats of injury, death and programme delays of all the ground-related hazards. The presence of existing utilities is a hazard that presents for all groundworks activities and hence is generally subject to separate investigations and assessments by utility specialists. Reference is included within this Report for completeness.

6.1 General Groundworks

Excavations are expected to be progressed at typical rates through the shallow Topsoil into the Made Ground deposits employing a medium sized excavator, e.g. 3CX with any bucket.

Excavations taken deeper than 1.00 m below ground level are expected to be subject to increasing instability within the Made Ground deposits and are therefore likely to require short-term temporary support.

① **Excavation access** personnel access into any excavations should only be undertaken with adequate support and appropriate risk assessment. Further guidance is available¹².

Excavations are expected to be generally free draining in the Made Ground deposits with a pump unlikely to be required unless more silty deposits are encountered.

Earthworks (cut and fill). No cut and fill operations are expected to be required as part of the proposed development (beyond shallow surface scrape to achieve formation levels across both development areas).

Material suitability for re-use (geotechnical and environmental).

Re-use of excavated materials is unlikely to be sought in this scenario with most excavation arisings likely to be removed from Site.

① **Materials management planning:** For all scenarios, developing a strategy for management of materials and waste streams in advance of the works is recommended to minimise handling and maintain soil conditioning, e.g. not repeatedly handling or compacting.

Waste classification of excavation arisings for any material surplus to requirements (requiring disposal) will need to be agreed with the groundworks contractor in line with current guidance¹³. Groundworks contractors have access to waste brokerage firms and landfills directly where acceptance criteria can vary and, as such, are generally best placed to confirm waste classifications. On this basis, it is recommended that any waste classification is confirmed in advance by the groundworks contractor with the following advice offered on a preliminary basis.

Any Made Ground deposits recovered from Site are likely to comprise construction materials placed as part of the church or church hall’s original development, e.g. sub-base deposits beneath hardstanding surfaces, but may also include discarded construction materials placed as part of the structures’ original construction. Overall, these materials are anticipated to be natural, and therefore also likely to be classed as Soil and Stones (EWC 17 05 04) if requiring off-Site disposal however, attention should be given to the potential presence of discrete pockets of material that may change this classification, e.g. asbestos containing material.

The waste classification of soils is something that should be approached in a step-wise manner first confirming whether or not a soil is Hazardous or Non-Hazardous (through solid soil testing) followed by Waste Acceptance Criteria testing only when and where off-Site disposal is confirmed as the fate for the material.

If and where there are any questions relating to the waste classification process, these can be referred to the Author of this Report.

6.2 Structural Engineering

Proposed foundations (church hall extension): Foundation options in this setting but will be guided by the presence of a deep profile of low, or variable, strength soils (likely Made Ground deposits) across the existing church hall footprint.

① **Foundation optioneering:** Decisions on a foundation solution are guided by both technical and financial constraints. The advice below sets out lines of evidence for what the Author considers likely to be both the most technically suitable and cost-beneficial foundation solution. It should be borne in mind that other factors, e.g. contractor preferences or lead-in times and construction speeds, can have equal bearing on the ultimate decision.

The use of a **piled foundation solution** is recommended in this scenario guided by:

- a) The requirement to transfer structural loads onto the Alluvial Fan Deposits (or deeper sandstone of the Double Stone Formation) that, across the southern portion of the proposed extension, may be as deep as 3 m below ground level;
- b) The requirement to limit total settlement to levels that are as low as practicable given the potential for otherwise acceptable levels of settlement across a detached structure to give rise to excessive differential settlement, N.B. limiting the likelihood of excessive differential settlement be achieved with spread footings through construction sequencing and provision of adequate movement joints; and,

¹² CIRIA Report 97 - Trenching Practice - Second Edition (1992)

¹³ [Waste classification technical guidance - GOV.UK](#)

- c) The requirement for extensive and likely costly temporary works associated with a spread footing, as indicated to have been required as part of the original church structure’s construction

Alternatives to a piled foundation solution are not considered further for the following reasons.

- > The use of a rafted foundation solution is not recommended here given the apparent presence of a ‘wedge’ of Made Ground deposits across the proposed extension footprint that would likely give rise to excessive levels of differential settlement.

Very conservative design assumptions and/or extensive additional investigations, e.g. cone penetration testing could be employed to explore this option further.

- > The use of linear or square, spread footings is not recommended here given the requirement for ‘deep’ formation depths that give rise to the requirement for extensive temporary works (deep, supported excavations).

Piling systems are continuously evolving and it is therefore recommended that the advice of a piling contractor is sought to confirm the viability/suitability of different systems.

Specific advisories:

- > Based on the revealed ground conditions and anticipated nature of the Alluvial Fan deposits (that can include discrete cobble beds) the use of steel driven piles is likely to be the most favourable piling system; and,
- > For preliminary design purposes, bedrock (target depth for piles) could be taken as depths of between 93 to 104 mAOD that, with reference to the ground level across the church hall, would result in maximum pile lengths of around 16 m. It is noted that bedrock was present within 3 m of ground level across the former Hattersley Foundry site to the south-west that, relative to the Site, would translate to pile lengths of between 5 and 6 m.
- > It is understood that the proposed link structure will impart new structural loads onto the existing church structure that are either relatively low (< 15 % increase in imposed load) or, where necessary, can be provided cantilever support from piles remote from the existing church structure.

Floor slab design will be guided by the selected foundation solution.

Specific advisory:

- > The revealed ground conditions and recommended use of a piled foundation solution guides the adoption of a suspended ground floor slab.

Proposed foundations (ancillary structures): The inclusion of a new ramp access to the eastern elevation of the church hall will require a new foundation or foundations. The exact details of this ramp structure are unknown but it appears to comprise a ‘solid’ structure supported by load bearing masonry.

A present, the ground conditions locally comprise variably dense, openly voided fill deposits comprised of discarded construction materials, e.g. intact breezeblocks and concrete cobbles.

This material stands to give rise to levels of settlement that are more than 25 mm when loaded.

Similarly, the proximity of the adjoining retaining wall guides the requirement for a deep formation depth to avoid excessive lateral loading on this adjoining structure. This appears to have been the same design principle applied to the construction of the existing church hall.

It is therefore recommended that this access ramp is also piled. Attention will need to be given to vibration tolerances/loadings.

For vibration loadings, peak particle velocities (PPV) degrade logarithmically with distance with the threshold for residential dwellings (as a reference for the adjoining retaining wall) being 5 to 15 mm/s with other mitigation measures, e.g. cut-off trenches, possible where necessary. In any case, the acceptable limit will need to be set by the appointed piling contractor and the structural engineer.

Buried concrete placed in all soils encountered as part of this investigation is recommended to be conservatively designed to suit DS-2 AC-2 classifications¹⁴ based on the Author’s experience of testing the Alluvial Fan Deposits locally and the anticipated variability in the Made Ground deposits.

For buried concrete design purposes, groundwater should be regarded as ‘mobile’.

6.3 Civil Engineering

Hard-standing sub-grades will be subject to final design levels being agreed however, based on the revealed ground conditions and likely formation levels, the sub-grade across the car park extension is expected to comprise ‘sandstone fill’ that is expected to offer ‘good’ levels of support with a preliminary CBR of at least 4.0 % recommended when hardstanding is constructed from this formation (minimum depth 0.50 m below ground level).

Specific advisory:

- > The presence of former tree roots and relic roots within HP103 will guide the requirement for ‘chasing out’ this and other degradable material from the formation. The main mass of root systems are typically within 1 m of the ground surface and therefore deeper excavations outside of the main root ball are unlikely.

General advisory:

- > Through the process of the groundworks this material is expected to be extensively disturbed and/or compacted resulting in changes to its in-situ strength and therefore proof rolling of all formations using a minimum 500 mm wide vibratory roller is recommended to locate any soft spots and allow treatment (excavation and replacement with a suitable granular fill).

Drainage of the existing Site is expected to be controlled by drainage to the existing piped network.

Drainage to ground has not been explored in this scenario given the space restrictions / proximity of any drainage to ground infrastructure to existing structure ground.

The proposed car park extension replaces an existing area of soft landscaping across which drainage to ground is expected to be occurring in all but prolonged periods of heavy rainfall. The use of permeable paving is suggested to limit total piped discharge volumes.

Water supply pipes will likely all be laid within Made Ground deposits (c. 700 mm depth) the nature of which could vary across the pipe run.

Where laid at these depths, in these deposits, the soils are expected to present a low risk to water supply pipes (low likelihood of free phase hydrocarbons etc.) however, chemical testing is likely to be required by the water supplier to

⁵ [4.2 Building near trees - NHBC Standards 2021](#)

¹⁴ [BRE Special Digest 1 \(2005\) Concrete in aggressive ground. 3rd Edition. \(2017\)](#)

confirm this. At this stage this has not been completed with the cost of such testing commonly more than precautionary selection of material for new supply pipes.

On this basis, the use of barrier pipe (PE/Al/PE) is recommended for water supply pipes.

6.4 Landscaping

Soft landscaping formations are expected to be close to the existing levels within the soft landscaping potentially remaining largely unchanged/unaltered through the development works.

If required, imported soil forming materials should be sourced from a reputable supplier and tested ‘at source’ to confirm they are suitability for use. The suitability of the imported soil forming material should be confirmed in line with the local planning authority’s guidance.

6.5 Mechanical Engineering

Ground source heat pumps: Open loop ground source heat pumps screen as being favourable on the Site¹⁵. Closed loop systems are generally viable across a much broader range of geological and hydrogeological conditions.

Further testing, including a field trial would be recommended to confirm the performance of any borehole-based ground source heat pump system and the advice of a specialist consultant sought.

Attention should be given to:

- > Drilling conditions are expected to be generally favourable on Site noting that casing through the Alluvial Fan Deposits would be required; and,
- > The Doubler Stone Formation is a sandstone dominated sequence of rock. Sandstone typically has thermal conductivity of 2.80 W m⁻¹ K⁻¹ and thermal diffusivity of 1.645 x 10⁻⁶ m² s⁻¹ ¹⁶.

Artesian conditions could be encountered in this steeply profiled catchment.

Further guidance is available^{17, 18}.

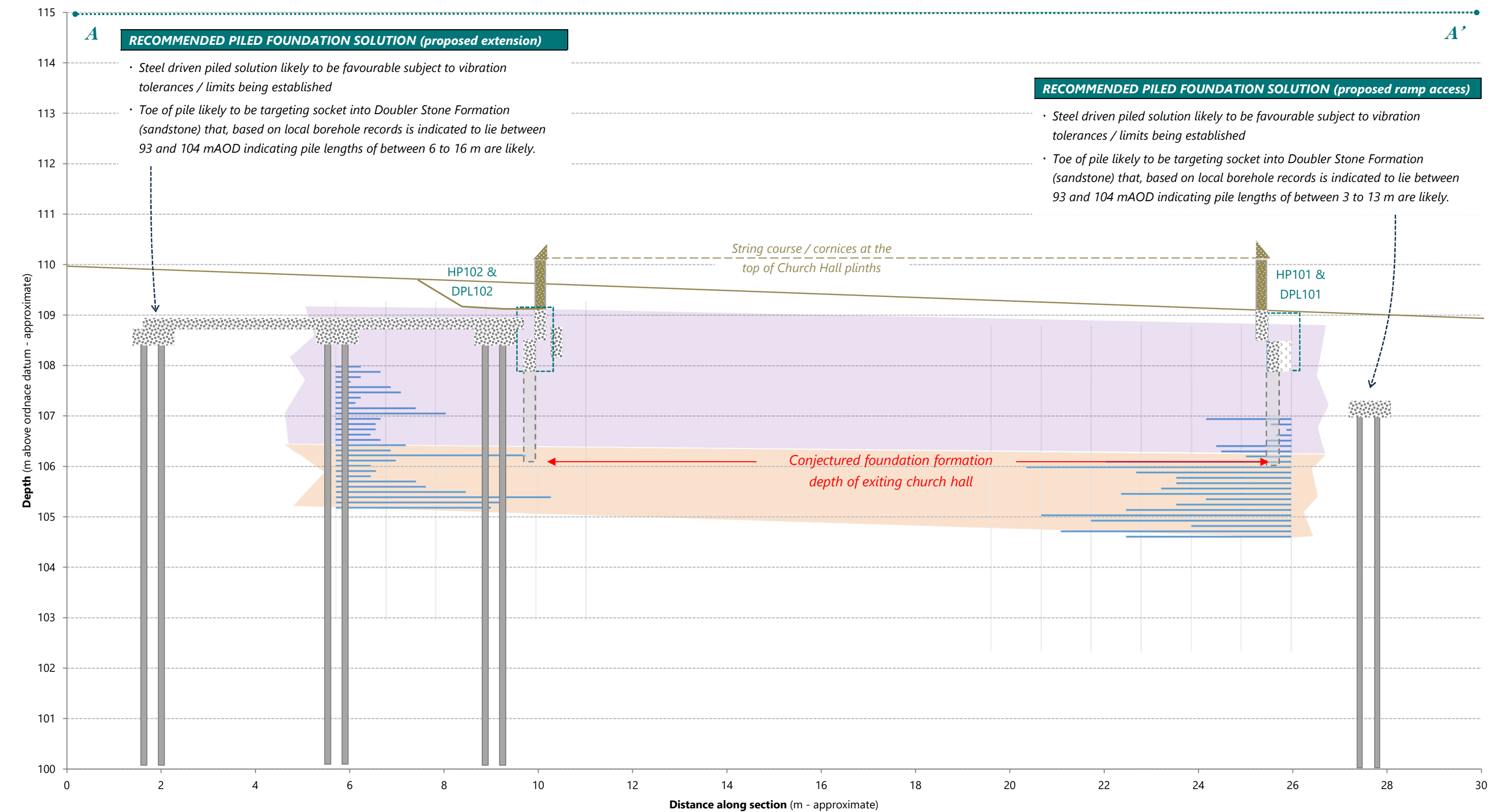
¹⁵ [GSHP \(bgs.ac.uk\)](#)

¹⁶ Busby et. Al. (undated) Initial Geological Considerations before Installing Ground Source Heat Pump Systems

¹⁷ [Geothermal energy - British Geological Survey \(bgs.ac.uk\)](#)

¹⁸ [Who Are The Ground Source Heat Pump Association | GSHPA](#)

Post-Development Conceptualisation



Illustrative / conceptual only – do not scale from drawing

7.0 Conclusions and Recommendations

7.1 Conclusions

In conclusion, the Ground Investigation Report finds;

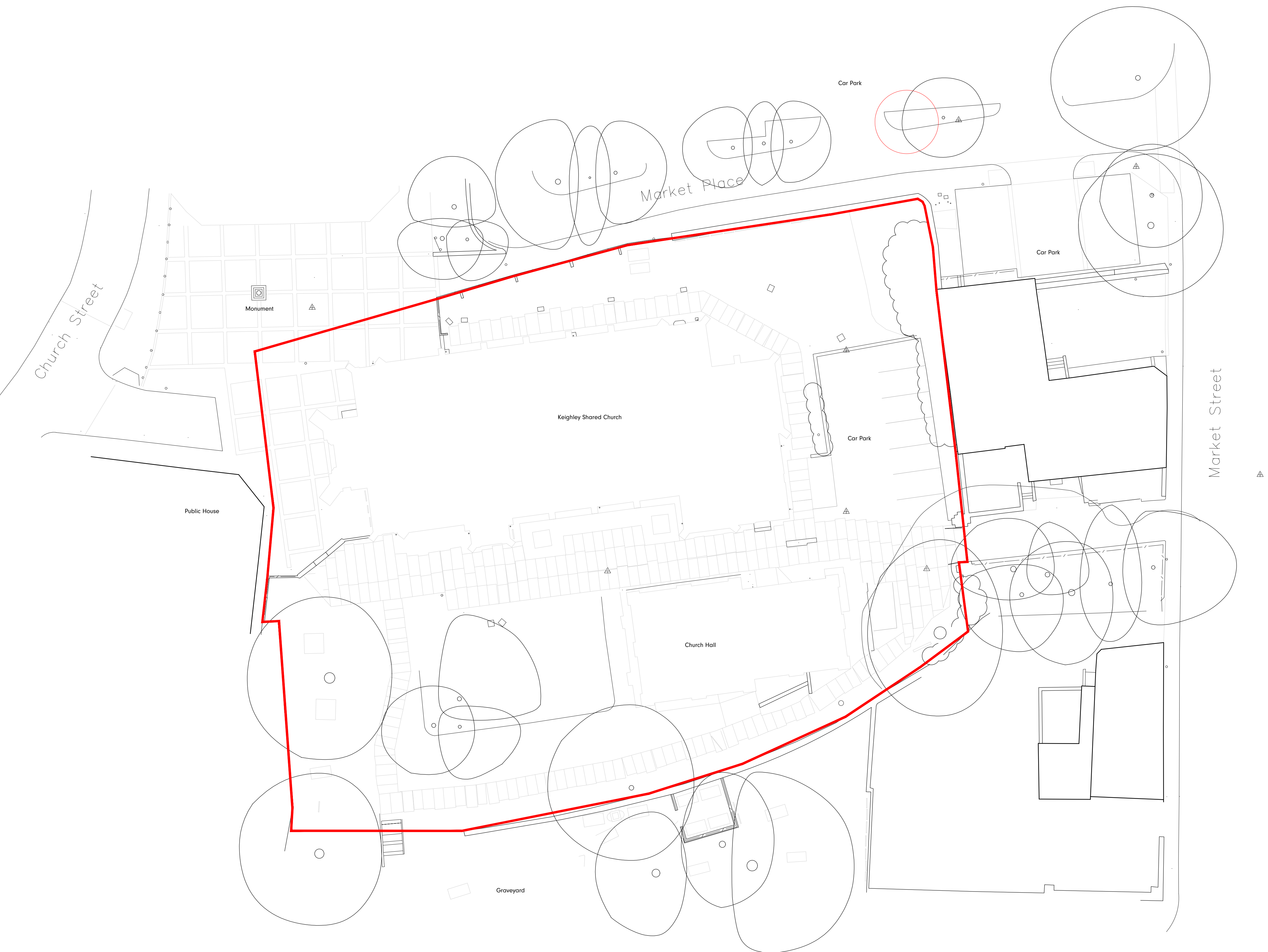
- > Ground conditions are consistent with those anticipated with an apparent ‘wedge’ of Made Ground deposits beneath the existing church hall structure a defining feature of the ground conditions on this Site.
- > Further investigation is not recommended but may be required to refine pile design parameters or subject to any design changes or requests from appointed contractors.
- > Risk mitigation is not recommended to address ground-related hazards to acceptably low levels however, general advice with respect to ground engineering risk management and design considerations is presented throughout Section 6.0 of this Report.

7.2 Recommendations

Recommended follow-on work includes:

1. Submission of the Ground Investigation Report to the project design team and the local planning authority and other stakeholders, e.g. building control.

① **Photographic diary of the groundworks:** *It is recommended that a photographic record of the groundworks is maintained to document the physical condition and nature of the ground conditions across the Site. This will serve as a valuable record for the project as well as any future planned works on the Site.*



Existing Site Plan
1:200

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NOTES

 Drawing based on survey information provided by third party measured surveys. Any discrepancies to be reported to the architect.

Scale 1:200
0 2000 5000 10000 15000mm

- 11.01.2025	R3W
INITIAL ISSUE	
REVISION - DATE	DRWN CHKD

FOR INFORMATION

Keighley Shared Church
Keighley
BD21 5HT

FOR
Church on the Green
Neighbourhood Foundation

Existing Site Plan

Scale 1:200 @ A1

HALLIDAY CLARK
ARCHITECTS

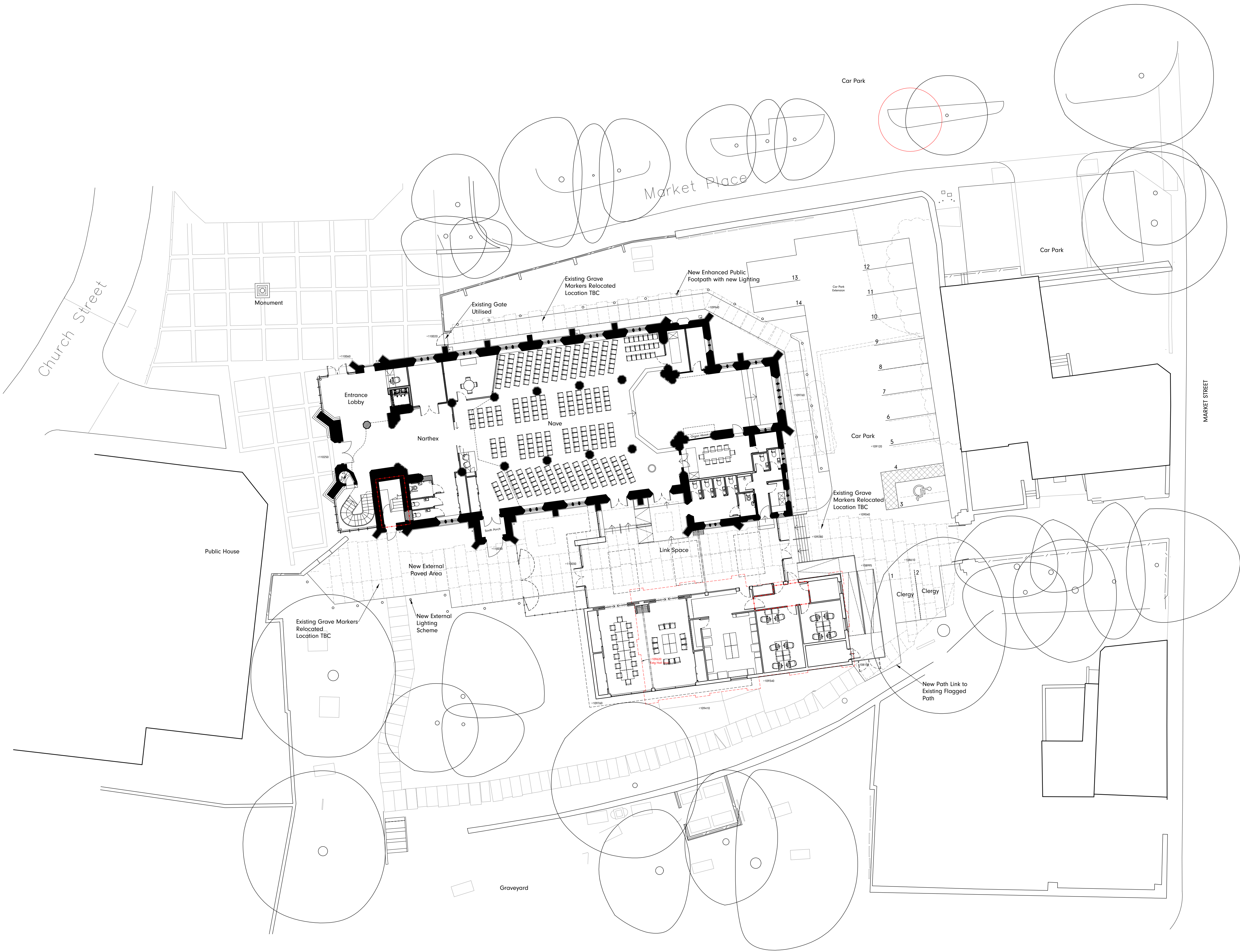
Halliday Clark Limited
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Ilkley LS29 8FL

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Dwg. No. 939.01(SK)012

Rev.

Proposed Site Plan
1:200



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NOTES

N
W
E
S

Drawing based on survey information provided by third party measured surveys. Any discrepancies to be reported to the architect.

Scale 1:200
0 2000 5000 10000 15000mm

D - 19.07.2024 GA Plan updated following changes to GA Plan	JL	
C - 11.08.2023 GA Plan updated following changes to GA Plan	JL	
B - 08.06.2023 Plans now based on accurate survey information	JL	
A - 19.04.2023 Updated following updates to proposed floor plans.	JL	
- 23.03.2023 INITIAL ISSUE	JL	RJW
REVISION - DATE	DRWN	CHKD

FOR COMMENT

St Andrews Church
Keighley
BD21 5HT

FOR
Church on the Green
Neighbourhood Foundation

Proposed Site Plan
Option 1 - Full Scheme
Scale 1:200 @ A1

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Rev. D

SOIL AND
STRUCTURES

Key to exploratory hole
symbols and abbreviations

SAMPLE TYPES

ACM - Asbestos sample	AMAL - Amalgamated sample	B - Bulk disturbed sample
BLK - Block sample	C - Core sample	CBR - CBR test sample
D - Disturbed sample	ES - Environmental sample	EW - Environmental water sample
G - Gas sample	J - Jar sample	L - Liner sample
TW - Pushed thin wall sample	U - Undisturbed sample	UT - Undisturbed thin wall sample
W - Water sample		

IN-SITU TESTS

HV - Hand shear vane	HV(r) - Hand shear vane residual	PID - Photo ionisation detector
PP - Hand penetrometer	SPT - Standard penetration test	SPT(C) - SPT using cone

GROUNDWATER



Groundwater strike



Groundwater rest level

ROTARY CORE DETAILS

TCR - Total core recovery (%)	SCR - Solid core recovery (%)	RQD - Rock quality designation (%)
FI - Fracture index	NI - Non-intact core	AZCL - Assumed zone of core loss

LEGEND

	Topsoil		Clay		Chalk		Sand backfill
	Peat		Silt		Breccia		Gravel backfill
	Made ground		Sand		Conglomerate		Arisings
	Concrete		Gravel		Metamorphic		Bentonite
	Wood		Cobbles		Igneous		Concrete
	Brick		Boulders				Grout
	Bituminous material		Mudstone				Plain pipe
	Gypsum		Siltstone				
	Coal		Sandstone				Slotted pipe
	Void		Limestone				

Sheet 1 of 1

SOIL AND STRUCTURES	Hand Pit				HP101 PHOTO PAGE
	Hole Type HP	Easting 406098.00	Northing 440973.00	Ground Level (m) 109.00	Scale 1:10
	Project Name St Andrews Church, Keighley	Project No. 20442		Start Date 2024-10-25	End Date 2024-10-25
Client Church on the Green Neighbourhood Foundation		Contractor Soil and Structures Ltd		Consultant Soil and Structures Ltd	
Remarks PURPOSE: Investigation of existing foundations and general coverage of the Site / ground truthing. TERMINATION: Deeper excavation impractical. GROUNDWATER: none encountered. STABILITY: spalling throughout depth. LOCATION: taken off freeware software. GL: taken off satellite imagery. FOUNDATION: Top of footing = 600 mm below ground level or 1620 mm below underside of plinth cornice. Projection = 150 mm to edge of concrete; 400 mm to edge of outer breezeblock wall (suspected formwork). Base of footing = not proven but footing face was exposed/voided and 'scraped' using a pinch bar to depth of 1.85 m below ground level where 'soft' resistance was encountered. OTHER: no evidence of potentially polluting or harmful material.				Method, Plant, Stability, Dimensions 0.00 - 1.15m HP Hand tools Spalling throughout L = 1.00m W = 0.60m	
Checked By: RB Approved By: RB Status: FINAL				Logger RB	

SOIL AND STRUCTURES					Hand Pit					HP102	
										Sheet 1 of 1	
					Hole Type HP		Easting 406077.00		Northing 440975.00		Ground Level (m) 109.50
Project Name St Andrews Church, Keighley					Project No. 20442		Start Date 2024-10-25		End Date 2024-10-25		
Client Church on the Green Neighbourhood Foundation					Contractor Soil and Structures Ltd			Consultant Soil and Structures Ltd			
Inst/ Backfill	Water Levels	Samples and Tests			Level (m)	Depth (thickness) (m)	Strata				
		Depth (m)	Type/ Ref	Results			Legend	Description			
					109.15	0.35		Light grey and light brownish grey, slightly silty, sandy, medium, angular GRAVEL of limestone [MADE GROUND - Type 1]			
						0.85		Multicoloured, fine, rounded GRAVEL. [MADE GROUND - Pea gravel]			
					108.30	1.20		End of Trial Pit at 1.20m			
Remarks PURPOSE: Investigation of existing foundations and general coverage of the Site / ground truthing. TERMINATION: Deeper excavation impractical. GROUNDWATER: none encountered. STABILITY: spalling throughout depth. LOCATION: taken off freeware software. GL: taken off satellite imagery. FOUNDATION: Top of footing = 700 mm below ground level or 1610 mm below underside of plinth cornice. Projection = 150 mm to edge of concrete; no evidence of outer breezeblock wall. Base of footing = not proven but footing face was porbed using a pinch bar to depth of 1.30 m below ground level where 'soft' resistance was encountered. OTHER: no evidence of potentially polluting or harmful material.							Method, Plant, Stability, Dimensions			Logger	
							0.00 - 1.20m HP Hand tools Collapsing in pea gravel L = 0.50m  W = 0.40m			RB	
Checked By: RB Approved By: RB Status: FINAL											

SOIL AND STRUCTURES	Hand Pit				HP102 PHOTO PAGE
	Hole Type HP	Easting 406077.00	Northing 440975.00	Ground Level (m) 109.50	Scale 1:10
	Project Name St Andrews Church, Keighley		Project No. 20442	Start Date 2024-10-25	End Date 2024-10-25
Client Church on the Green Neighbourhood Foundation		Contractor Soil and Structures Ltd		Consultant Soil and Structures Ltd	
Remarks PURPOSE: Investigation of existing foundations and general coverage of the Site / ground truthing. TERMINATION: Deeper excavation impractical. GROUNDWATER: none encountered. STABILITY: spalling throughout depth. LOCATION: taken off freeware software. GL: taken off satellite imagery. FOUNDATION: Top of footing = 700 mm below ground level or 1610 mm below underside of plinth cornice. Projection = 150 mm to edge of concrete; no evidence of outer breezeblock wall. Base of footing = not proven but footing face was porbed using a pinch bar to depth of 1.30 m below ground level where 'soft' resistance was encountered. OTHER: no evidence of potentially polluting or harmful material.				Method, Plant, Stability, Dimensions 0.00 - 1.20m HP Hand tools Collapsing in pea gravel L = 0.50m W = 0.40m	
Checked By: RB Approved By: RB Status: FINAL				Logger RB	

Sheet 1 of 1

SOIL AND STRUCTURES	Hand Pit				HP103 PHOTO PAGE
	Hole Type HP	Easting 406099.00	Northing 441003.00	Ground Level (m) 109.00	Scale 1:10
	Project Name St Andrews Church, Keighley	Project No. 20442		Start Date 2024-10-25	End Date 2024-10-25
Client Church on the Green Neighbourhood Foundation		Contractor Soil and Structures Ltd		Consultant Soil and Structures Ltd	
					
Remarks PURPOSE: Targeting proposed car park extension and ground truthing where DCP103 was completed. TERMINATION: Refusal in sandstone fill. GROUNDWATER: none encountered. STABILITY: stable throughout. LOCATION: taken off freeware software. GL: taken off satellite imagery. OTHER: no evidence of potentially polluting or harmful material.				Method, Plant, Stability, Dimensions 0.00 - 0.75m HP Hand tools Stable L = 0.30m W = 0.30m	
Checked By: RB Approved By: RB Status: FINAL				Logger RB	

SOIL AND STRUCTURES	Hand Pit				HP103 PHOTO PAGE
	Hole Type HP	Easting 406099.00	Northing 441003.00	Ground Level (m) 109.00	Scale 1:10
	Project Name St Andrews Church, Keighley		Project No. 20442	Start Date 2024-10-25	End Date 2024-10-25
Client Church on the Green Neighbourhood Foundation		Contractor Soil and Structures Ltd		Consultant Soil and Structures Ltd	
Remarks PURPOSE: Targeting proposed car park extension and ground truthing where DCP103 was completed. TERMINATION: Refusal in sandstone fill. GROUNDWATER: none encountered. STABILITY: stable throughout. LOCATION: taken off freeware software. GL: taken off satellite imagery. OTHER: no evidence of potentially polluting or harmful material.			Method, Plant, Stability, Dimensions 0.00 - 0.75m HP Hand tools Stable L = 0.30m W = 0.30m		
Checked By: RB Approved By: RB Status: FINAL			Logger RB		

In-Situ Testing

Dynamic Penetration Testing

SOIL AND STRUCTURES

Project Details

Name St Andrew's Church, Keighley
Reference 20442

Test Dates

Start 25/10/2024
End 25/10/2024

Weather

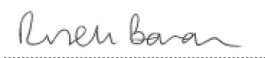
Preceding 24 hrs Wet, 10-15 deg
During testing Dry, 10-15 deg

General Notes

1. Where 'deflection' is reported this relates to the rods being moved $>10^\circ$ off vertical
2. All results after the 'deflection' is noted are highlighted orange - use with caution
3. Where 'deflection' is reported as the test end, this relates to the rods being moved $>20^\circ$ off vertical
4. Where 'ceased' is reported this relates to needing to abandon the test due to external factors, e.g. vehicle movement
5. Where 'redused' is reported this relates to test ending due to maximum blow count being exceeded

Author Russell Bowman
BSc (Hons) MSc CEng CWEM MCIWEM

Signed

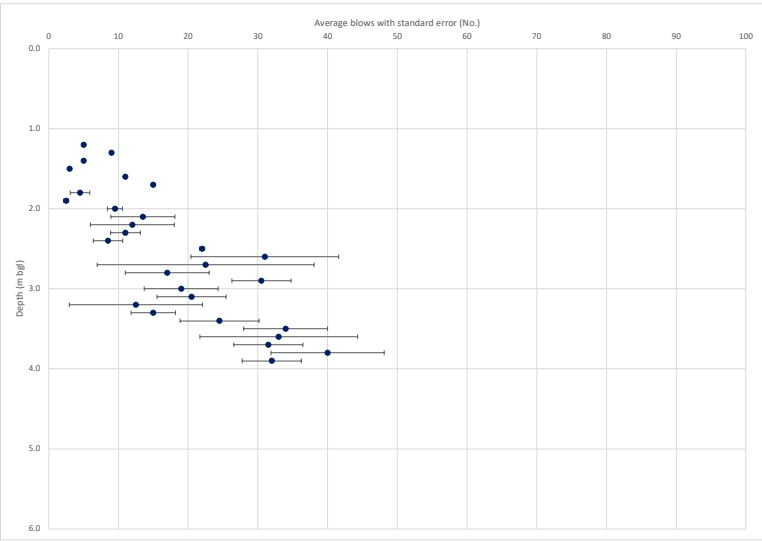
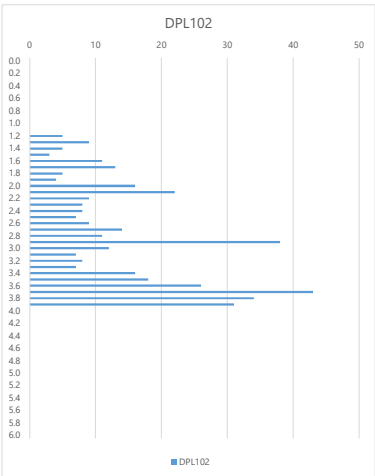
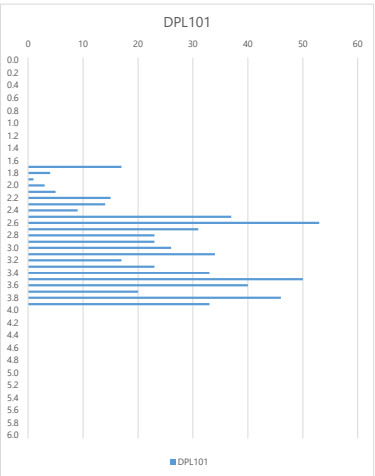

.....

Test Method

Method Dynamic Probing (Light)

Guidance BS 5930:2015 Code of practice for ground investigations (+A1:2020)

	DPL101	DPL102	Mean	St Dev	St Err
0.0					
0.1					
0.2					
0.3					
0.4					
0.5					
0.6					
0.7					
0.8					
0.9					
1.0					
1.1					
1.2		5	5		
1.3		9	9		
1.4		5	5		
1.5		3	3		
1.6		11	11		
1.7	17	13	15	3	1
1.8	4	5	5	1	0
1.9	1	4	3	2	1
2.0	3	16	10	9	5
2.1	5	22	14	12	6
2.2	15	9	12	4	2
2.3	14	8	11	4	2
2.4	9	8	9	1	0
2.5	37	7	22	21	11
2.6	53	9	31	31	16
2.7	31	14	23	12	6
2.8	23	11	17	8	4
2.9	23	38	31	11	5
3.0	26	12	19	10	5
3.1	34	7	21	19	10
3.2	17	8	13	6	3
3.3	23	7	15	11	6
3.4	33	16	25	12	6
3.5	50	18	34	23	11
3.6	40	26	33	10	5
3.7	20	43	32	16	8
3.8	46	34	40	8	4
3.9	33	31	32	1	1
4.0					
4.1					
4.2					
4.3					
4.4					
4.5					
4.6					
4.7					
4.8					
4.9					
5.0					
5.1					
5.2					
5.3					
5.4					
5.5					
5.6					
5.7					
5.8					
5.9					
6.0					



Dynamic Cone Penetration [TRL]

SOIL AND STRUCTURES

Test Details

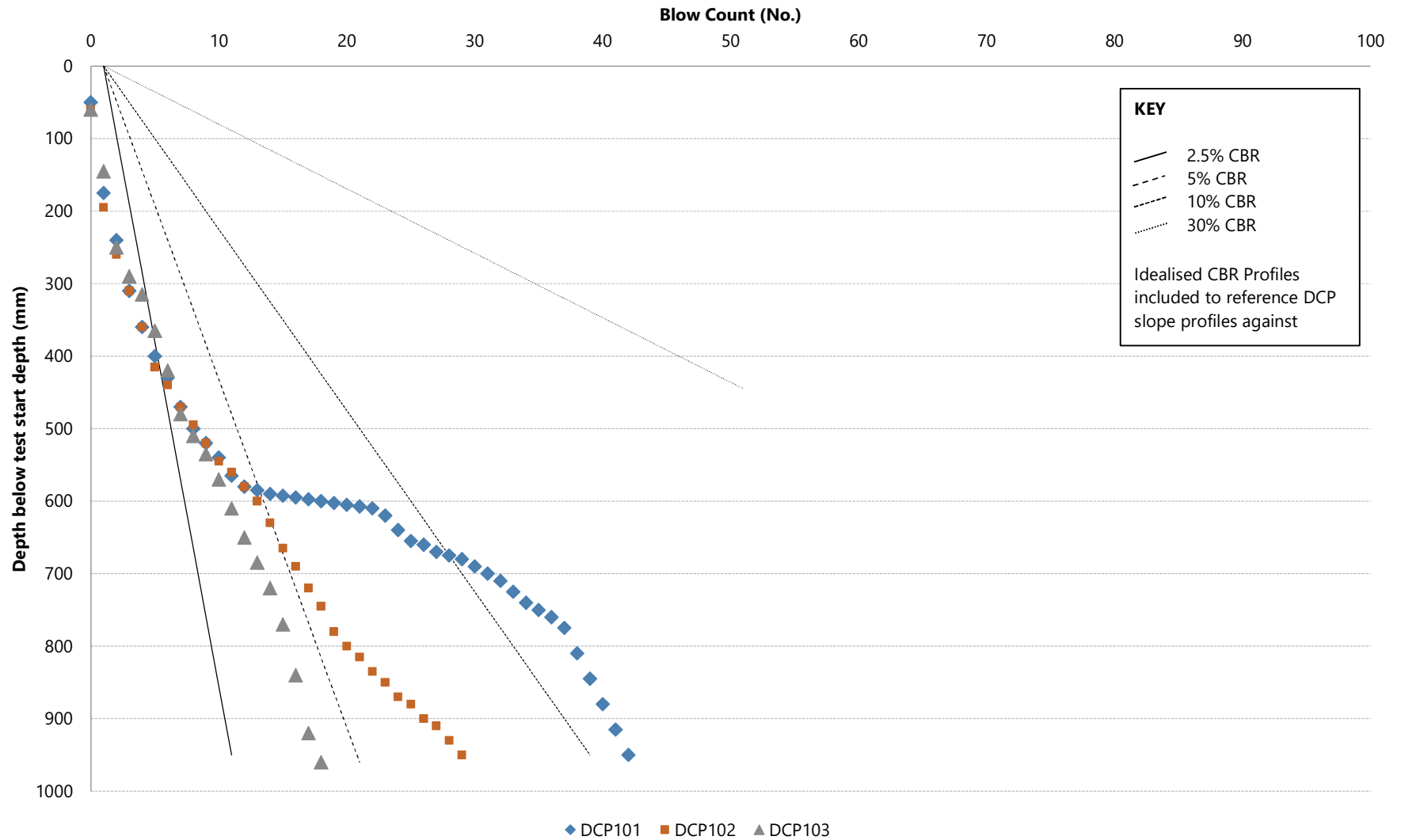
Test Ref.	DCP101	DCP102	DCP103							
Test depth	109.00	109.00	109.00							
Easting	406094	406102	406099							
Northing	441007	441008	441003							
Deflection	No	No	Yes, 290							
Test End	Completed	Completed	Completed							
End Depth	950	950	960							

Test Results

[illegible]

[illegible]

DCP101 to DCP103 - Depth v's Blow Count Plot



Some unforeseen material has been encountered in the ground. This material is suspected as being potentially harmful or polluting. What should you do?

Seek the advice of the project Engineer (*the Engineer may need to seek advice from a ground investigation consultant*).

What will the Engineer do?

The Engineer (or someone on the project team) will contact the local planning authority's contaminated land team to notify them of the encounter. The purpose of this contact is to agree a strategy for responding to and dealing with the unforeseen material. This strategy should be agreed in advance of any work on or around the unforeseen material recommencing.

What will the response strategy involve?

The responsive strategy will depend on the nature of the material encountered but may be as simple as confirming that the material will be excavated and disposed of off-site at a suitably licensed facility.

Do regulators have to be notified?

Advance notification is always recommended to avoid any response strategy being deemed inappropriate. There may or may not be a legal requirement for notification depending on the nature of the material encountered. In any case, the local planning authority's pollution control or contaminated land team should be able to assist finding the most cost-effective means of dealing with the material.

Purpose of this Guidance Note

- > Support developers working on small development sites; and,
- > Support decision making in scenarios where the likelihood of potentially harmful or polluting material being present in the ground has been assessed as low or unlikely (i.e. no remediation strategy has been put in place) but cannot be discounted.

General Commentary

A core aim of 'contaminated land'¹ planning condition(s) is to ensure that, once completed, the development can be deemed 'suitable for use'. Or, in other words, to ensure that end users (residents and visitors) will not be exposed to unacceptable levels of risk.

On any site where development works have previously taken place there is always the potential for potentially harmful or polluting material to have been introduced into the ground. Common examples of this include; fragments of asbestos containing material from old out-buildings, ash deposits from where coal ash was formerly tipped in a garden or localised fuel spillages.

Whilst ground investigation aims to remove as much uncertainty as possible from the ground, it is rarely cost-beneficial to investigate 100 % of any given development site. For this reason, unforeseen or unexpected material may be encountered during development works.

¹ 'Contaminated land' is strictly a legal definition of land that has been determined as such under Part 2A of the Environmental Protection Act. The term 'contamination' is often used as short-hand for material that may be chemically unsuitable (potentially harmful or polluting).

General Guidance on Material Suitability

Suitability (in general): A *soil* becomes a *material* once excavated. This Guidance Note advice with respect to the suitability of soils to remain on Site and the suitability of materials recovered from Site.

The materials are given preliminary classifications based on those set out within the Manual of Contract Documents for Highways Works¹.

Geotechnical suitability: If and where earthworks (cut and fill) are planned as part of the works then strength and compaction testing is typically recommended to inform the earthworks specification. Subject to the earthwork design details being finalised, it is common for additional geotechnical testing, e.g. compaction testing, to be recommended to confirm suitability.

Chemical suitability: Chemical suitability is assessed in the context of the historical and geological setting of the Site as well as against the proposed end use of the Site. This assessment forms a core part of the current planning framework as laid out within the Environment Agency's Land Contamination Risk Assessment guidance².

General Guidance on Materials Management

Materials management: In general, once material is excavated from the ground it could be deemed a 'waste' unless it has a specified use. This also applies to materials intended for re-use on Site.

For natural materials, re-use on Site is generally not regulated apart from in specific scenarios.

For non-natural deposits (Made Ground) additional protocols need to be followed (CL:AIRE Code of Practice³) to demonstrate that the material is suitable for re-use and therefore, not a waste.

¹ Manual of Contract Documents for Highways Works, Volume 1 Specification for Highway Works – Series 600 Earthworks (2016)

² [Land contamination risk management \(LCRM\)](https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm) - GOV.UK (www.gov.uk)

³ CL:AIRE The Definition of Waste: Development Industry Code of Practice Version 2 (2011)