A2 Site Investigation

Technical Note

24022-A2SI-XX-XX-TN-Y-0002-01

Project	13 Belsize Crescent
Project No.	24022
Subject	Covering Note to Basement Impact Assessment
Client	Edmund Lehmann

Document Reference	Status	Revision	Issued	Approved	Date
24022-A2SI-XX-XX-TN-Y-0002-00	For Planning	01	Hamed Shariff MEng(Hons), CEng MICE **Associate**	Alex Nikolic BEng(Hons), MSc, DIC, CEng MICE, MSt(Cantab) **Director**	12.12.2023

1. Introduction

A2 Site Investigation Limited (A2SI) has been appointed by Edmund Lehmann to review the impact of the proposed basement at 13 Belsize Crescent in Central London on the local geological, hydrogeological and hydrological regimes.

A *Basement Impact Assessment* (BIA) (ref. 24022-A2SI-XX-XX-RP-Y-0005-04) was submitted to the London Borough of Camden for the proposed scheme (application reference 2023/0692/P). This document is included as Appendix B. The scheme covered in the BIA comprised partial demolition of internal superstructure elements and excavation of a new basement supported by reinforced concrete underpins, cast in sequence in bays. The front portion of the basement would have a structural slab level (SSL) of 2.27mOD, with the rear locally deepened (SSL at 0.76mOD) and extended into the back garden for a proposed pool.

An updated scheme is under consideration which comprises a reduced basement footprint with a single SSL at 2.27mOD. A comparison in plan and section of the original and updated scheme is shown in Appendix A. The construction methodology and sequencing remain unchanged (underpins, in-situ reinforced concrete retaining walls cast in bays, and *top-down* methodology).

This technical note comprises a review of findings of the BIA undertaken for the original scheme geometry (as referenced above) in the context of the updated basement geometry. This includes a discussion of the screening and scoping of the BIA, the previous investigation works undertaken, and the findings of the ground movement assessment (GMA).

2. Review of BIA Screening and Scoping

The BIA identified four screening questions in the *Stability* flow chart that were taken forward for scoping. The four questions can be summarised by the two statements below:

- London Clay is the shallowest stratum on site and there is a history of shrink-swell subsidence in the local area (*Stability*[5], *Stability*[7]).
- The proposed basement excavation is adjacent to neighbouring structures and a public highway, and will increase the differential depth of foundations relative to neighbouring properties (*Stability*[12], *Stability*[13]).

The proposed change to the size and extent of the basement will not impact the risk of shrink-swell subsidence on the new substructure and the volume change potential of the London Clay will be considered as part of the design of the structure.

The updated basement geometry has lowered the differential depth of the proposed foundations relative to neighbouring properties by two meters in the rear of the site, reducing the impact of the works. No substantial changes to the front portion of the basement are proposed, and the impact to the adjacent public highway will remain in line with that noted in the BIA.

3. Review of Previous Investigation Works

A site-specific ground investigation was undertaken to support the BIA. The investigation comprised the following key elements and more details can be found in the *Factual Report* in Appendix C:

- 4 no. modular dynamic sampler boreholes to depths of up to 6.0m. 1 no. location in the ground floor level front garden, 1 no. in the property footprint and 2 no. in the rear garden.
- 1 no. modular cable percussion borehole to a depth of 20.0m.
- 2 no. structural trial pits on the party walls to determine existing foundation details.
- 3 no. shallow ground sample locations in the rear garden for additional contamination testing.
- Installation of 3 no. gas/vapour monitoring wells (WS1, WS2, HP1).
- Post-site work monitoring of groundwater ground gas (6 no. monitoring visits).
- In-situ and laboratory geotechnical and geo-environmental laboratory testing.

Considering the changes to the proposed basement geometry and interface with the Party Walls, the investigation above is applicable to the updated geometry and no further investigative works are anticipated to be required.

4. Review of Ground Movement Assessment Findings

The ground movement assessment, analysing the impact of the proposed basement construction works on surrounding properties, determined that a damage category not exceeding Category 1 – Very Slight is anticipated if the ground movements caused by the wall installation, excavation and scheme construction are limited to the values presented in Table 1.

The updated basement geometry will reduce the maximum underpin and excavation depth associated with the works in the rear of the property, and the values in the table below will not be exceeded where similar construction means and controls are adopted. Therefore, the impact to surrounding properties from the updated geometry is not anticipated to be greater than that predicted for the original scheme.

Table 1 Maximum cumulative ground movement from the BIA for application 2023/0692/P

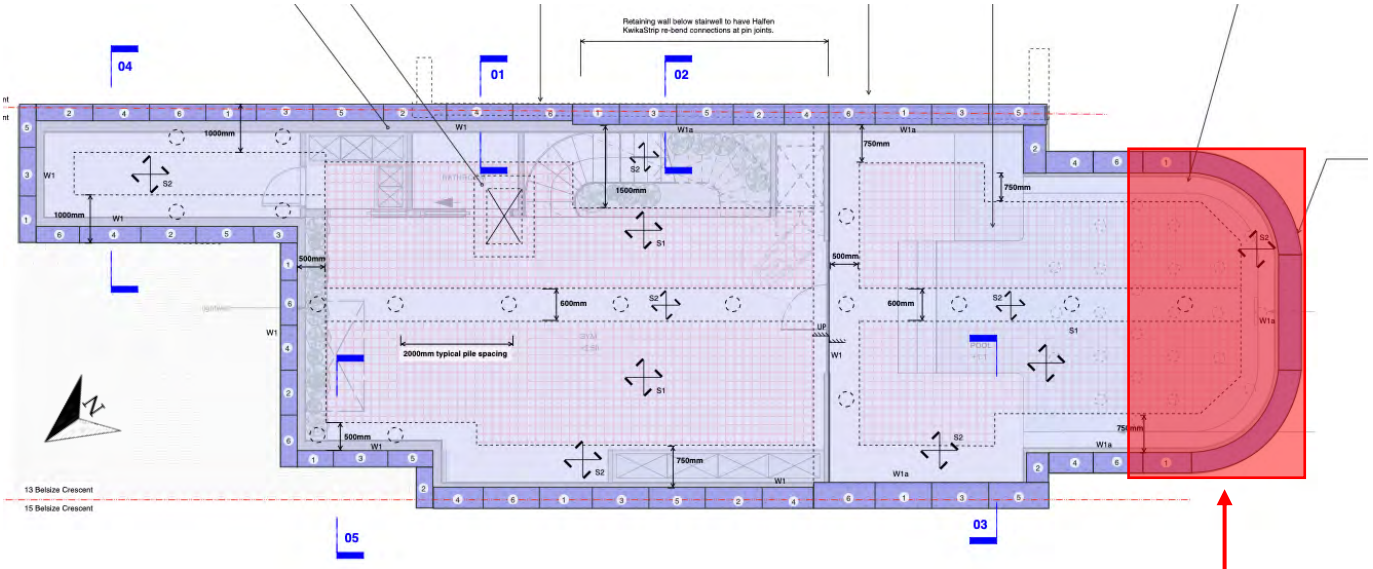
Stage	Maximum Cumulative Ground Movement (mm)	
	Vertical	Horizontal
Underpinning (Installation and Excavation)	7	10
Building Construction (Long-Term)	17	10

Movement at top of underpin walls.

Appendix A: Comparison of Updated and Original Scheme Basement Geometries

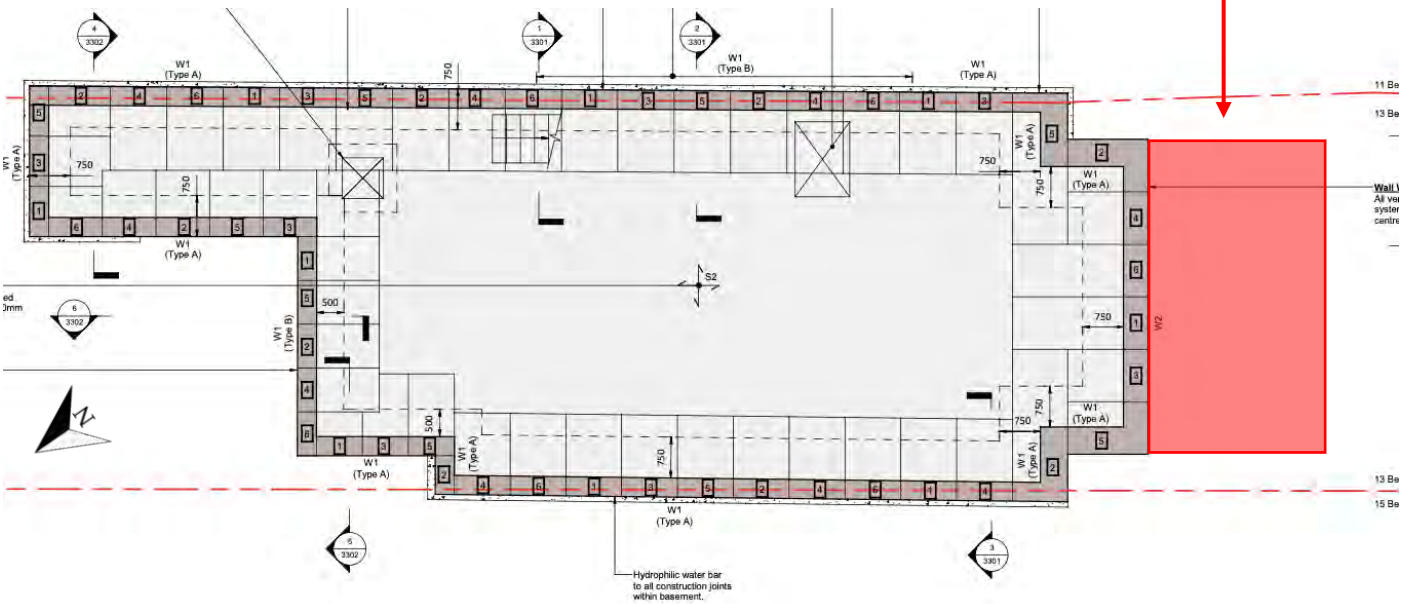
Plan View

Original Scheme

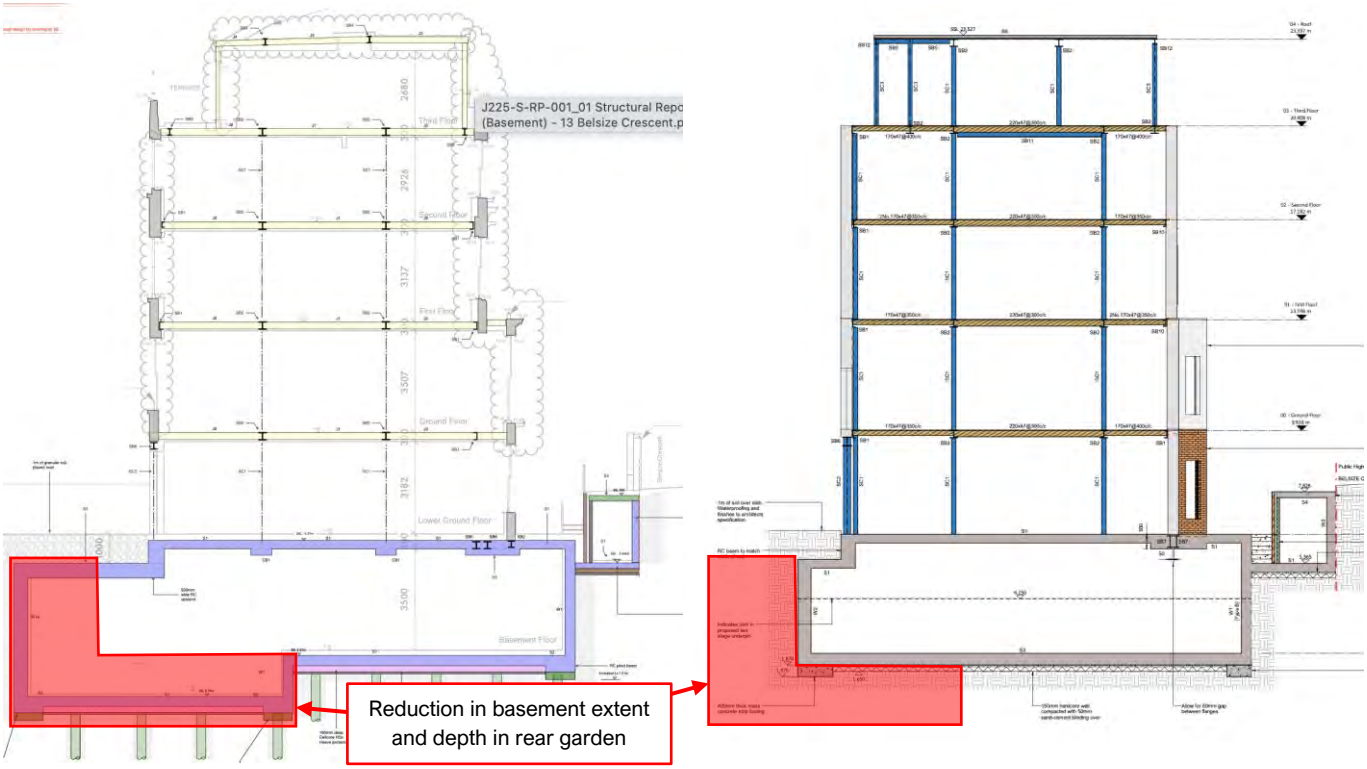


Reduction in basement extent in rear garden

Updated Geometry



Section through Basement (Southwest–Northeast facing Northwest)



Original Scheme **Updated Geometry**

Appendix B: Basement Impact Assessment for Application 2023/0692/P

A2 Site Investigation

13 Belsize Crescent

Basement Impact Assessment

November 2023

24022-A2SI-XX-XX-RP-Y-0005-04

Project Name	13 Belsize Crescent
Project Number	24022
Client	Edmund Lehmann and Jennifer Nguyen
Document Name	Basement Impact Assessment

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24022-A2SI-XX-XX-RP-Y-0005-00	First Issue	-	00	SC	13.03.2023
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24022-A2SI-XX-XX-RP-Y-0005-04	Fifth Issue	Update to GMA	04	HS	02.11.2023

Contents

Appendices

1. Non-Technical Summary

1.1.1. The site location is 13 Belsize Crescent, London, NW3 5QY.

1.1.2. The current development / property comprises a four-storey residential property including a lower ground floor and associated private front and rear gardens. The existing structure is anticipated to comprise concrete floors supported by load-bearing masonry façades and Party Walls.

1.1.3. The proposed development works comprises partial demolition of internal superstructure elements. The ground floor slab will be demolished, a new basement level will be formed and a storeroom will be constructed under the front garden. An underpinned basement with a pool will also be built below ground level. The excavation will be retained by reinforced concrete underpins with mass concrete bailey rails, cast in sequence in bays. The house will be accessible with an external platform lift to the lower ground floor and an internal lift to all floors will be installed.

1.1.4. It is understood that the bulk excavation works and the construction of permanent works elements will take place following the installation of all retention systems, i.e. utilising a *top-down* methodology. The superstructure above will be maintained during the works.

1.1.5. The underpins will be excavated in 1m bays with temporary props to trench sheeting that bear off of the new basement construction. The props will increase the stiffness of the retention systems during construction and reduce the risk of adversely affecting neighbouring structures and/or third-party assets, due to excessive ground movement.

1.1.6. The following assessments are presented in the current document:

- Screening.
- Scoping.
- Additional evidence/assessments (as required), including:
  - Architectural and structural drawings.
  - Ground movement assessment.
- Basement impact assessment.

1.1.7. The ground conditions beneath the site comprise (based on a review of BGS data and site-specific ground investigations):

- Made Ground: to a depth of approximately 1.5m.
- London Clay Formation: The London Clay Formation is expected to be at least 80m thick.

1.1.8. The hydrogeological conditions at the site, relevant to the proposed development, are predicted to comprise:

- The groundwater model is likely to comprise a perched water table, which is sustained within the more permeable superficial strata overlying the low permeability London Clay Formation.
- The pore water pressure distribution within the London Clay is hydrostatic.
- The dominant direction of groundwater flow (if encountered) is anticipated to be in a southeastern direction, towards the River Thames.

1.1.9. The BIA has assessed land stability, and the impacts of the proposed development on neighbouring structures will be limited to Category 1 – Very Slight, in accordance with the Burland Scale. The impact to the adjacent public highway to the front of the property is also considered to be low, based on movements predicted in the ground movement assessment.

1.1.10. The BIA has not identified any hydrological impacts, as there are no surface water features within 500 m of the site boundary. The excavation will be within the London Clay Formation, which is classed as an unproductive stratum.

2. Introduction

2.1. Overview

2.1.1. A2 Site Investigation Limited (A2SI) were engaged by Edmund Lehmann and Jenifer Nguyen to prepare a basement impact assessment (BIA) for the proposed excavation works at the 13 Belsize Crescent site, located in London.

2.1.2. The purpose of this assessment is to consider the potential effects of the proposed works at 13 Belsize Crescent, London, NW3 5QY, on the local hydrology, geology and hydrogeology, and the potential impacts to neighbours and the wider environment.

2.1.3. The location of the proposed development is shown in Figure 2.1

Figure 2.1 13 Belsize Crescent site location.

2.1.4. The development site is located within the jurisdiction of the London Borough of Camden.

2.1.5. The BIA has followed the approach developed by the London Borough of Camden, which is considered to represent current industry best practice.

2.1.6. The BIA comprises the following elements:

- Screening.
- Scoping.
- Additional evidence / assessments (as required), including:
  - Architectural and structural drawings.
  - Ground movement assessment (GMA).
- Basement impact assessment.

2.2. Credentials

2.2.1. The BIA has been reviewed by Hamed Shariff. Hamed is a Chartered Member of the Institution of Civil Engineers (MICE) with several years of experience in geotechnical design, hydrogeological assessment and construction of basements. Hamed is currently an Associate at A-squared Studio Engineers Ltd (A-squared) and has a Master in Engineering from University College London. He also heads the hydrogeological division of A-squared and has experience in groundwater flow modelling and impact reviews.

2.2.2. The BIA has been approved by Alex Nikolic. Alex is a Chartered Member of the Institution of Civil Engineers (MICE) with more than 20 years of industry experience in geotechnical design and construction of ground engineering works. Alex has attained post-graduate qualifications, including a Master of Science in Soil Mechanics (MSc DIC) from the Imperial College London and a Master of Studies (MSt Cantab) in Sustainable Development from the University of Cambridge. Alex was formerly the Director of Ground Engineering at Buro Happold Ltd.

2.3. Sources of Information

2.3.1. The following baseline data has been referenced to complete the BIA in relation to the proposed development:

- *Envirocheck Report* for 13 Belsize Crescent prepared by Landmark Information Group, dated 22nd September 2022 (ref. 301610419_1_1).
- *Phase I Desk Study* prepared by A2SI, dated December 2022 (ref: 24022-A2SI-XX-XX-RP-Y-0001-00).
- *Interpretive Report* prepared by A2SI, dated January 2023 (ref: 24022-A2SI-XX-XX-RP-Y-0003-00.
- *Factual Report* prepared by A2SI, dated January 2023 (ref: 24022-A2SI-XX-XX-RP-X-0001-01).
- *Ground Movement Assessment* prepared by A2SI, dated March 2023 (ref: 24022-A2SI-XX-XX-RP-Y-0004-02).
- *Structural Engineers Report prepared* by Baker Chatterton Structural Design Ltd, dated March 2023 (ref: J225-S-RP-001).
- *Preliminary Unexploded Ordnance (UXO) Risk Assessment* for 13 Belsize Crescent prepared by Brimstone Site Investigation, dated 28th September 2022 (ref. PRA-22-1919).
- Site walkover undertaken by representatives of A2SI on 12th September 2022.
- British Geological Survey, GeoIndex Onshore GIS database (accessed October 2022); https://mapapps2.bgs.ac.uk/geoindex/.
- Department for Environment, Food & Rural Affairs (DEFRA), Magic Map Application (accessed October 2022); http://magic.defra.gov.uk/MagicMap.aspx.
- Historic England, online Aerial Photo Explorer (accessed October 2022); https://historicengland.org.uk/images-books/archive/collections/aerial-photos/.
- Health Protection Agency and British Geological Survey document Indicative Atlas of Radon in England and Wales, 2007.
- *The Lost Rivers of London* by Nicholas Barton, 1962.
- Google Earth (ref. earth.google.com/web/), accessed October 2022.
- Flood Maps for Planning (ref. https://flood-map-for-planning.service.gov.uk/), accessed October 2022).

2.4. Existing Development

2.4.1. The development site is located at 13 Belsize Crescent, London, NW3 5QY. The site has approximate dimensions of 24m-long by 7m-wide, covering an area of approximately 0.02ha.

2.4.2. The existing ground level at the site is approximately 7.0mOD.

2.4.3. The site is within a wider hillside setting and is founded on a gentle slope, with increasing ground level towards Gloucester House School to the northwest. The gradient of the slope is less than 4 degrees in close proximity to the site.

2.4.4. The site is currently occupied by a four-storey residential property including a lower ground floor and associated private front and rear gardens.

2.5. Neighbouring Properties and Infrastructure

2.5.1. The existing structure shares Party Walls with 15 Belsize Crescent to the northwest and 11 Belsize Crescent to the southeast. The two adjacent structures both comprise the same construction as 13 Belsize Crescent and are both four-storey terraced residential properties with lower ground storeys and back gardens.

2.5.2. There are no listed buildings within the zone of influence of the proposed development.

2.5.3. The northeast boundary of the site comprises Belsize Crescent. The southwest boundary of the site comprises Belsize Park Mews.

2.5.4. Asset owners with existing underground services that may be impacted by the proposed development include the following:

- London Borough of Camden and the Greater London Authority.
- Thames Water Ltd – Clean water and wastewater
- BT (BT Group Plc) and Virgin Media Ltd – Telecoms.
- UK Power Networks Ltd – Electricity distribution.
- Cadent Gas Ltd and Southern Gas Networks Plc – Gas.

2.5.5. Asset protection teams for the assets listed in 2.5.4 may require engagement as the design of the proposed development continues. Where necessary, separate GMAs may be required to meet design assurance requirements.

2.6. Proposed Development

2.6.1. The proposed development *Structural Engineers Report* and drawings are included in Appendix B.

2.6.2. The development is planned to be for private residential use.

2.6.3. The development does not include increasing the number of storeys of the existing structure.

2.6.4. The proposed development comprises partial demolition of internal superstructure elements.

2.6.5. The ground floor slab will be replaced and the load-bearing masonry walls will be underpinned to 6.2m below the ground level, with a storeroom will be constructed under the front garden.

2.6.6. The underpins will act as the main load-bearing support for the masonry wall.

2.6.7. The final depth of the underpins will be 0.76m below structural slab level of the basement slab – 0.0mOD in the pool area and 1.51mOD in the remainder of the basement.

2.6.8. The house will be accessible with an external platform lift to the lower ground floor and an internal lift to all floors will be installed.

2.6.9. Temporary props / shoring will be installed in a hit and miss sequence, prior to proceeding with excavation works. Such measures will increase the system stiffness of the retaining walls and reduce the risk of adversely affecting neighbouring structures and third-party assets, due to excessive ground movement.

3. Desk Study

3.1.1. A *Phase I Desk Study* report has been undertaken by A2 Site Investigation Limited for the project. The Desk Study report has been used to inform this BIA.

3.1.2. The Desk Study informs further actions in relation to ground contamination risks. It is provided in Appendix A.

4. Screening

4.1. Subterranean (Groundwater) Flow, Screening Flowchart

Question		Response	Details
1a.	Is the site located directly above an aquifer?	No	The site is underlain by London Clay Formation with no superficial deposits. The London Clay Formation is an unproductive stratum, as noted in the desk study in Appendix A.
1b.	Will the proposed basement extend beneath the water table surface?	No	Based on the ground investigation works conducted, no groundwater has been encountered above the basement formation level.
2.	Is the site within 100m of a watercourse, well (used / disused) or potential spring line?	No	There are no surface water features within 500 m of the site boundary. The nearest surface water feature located is a water feature / fountain associated with Swiss Cottage Open Space (park / garden) 660m south of the site. This water feature is man-made and therefore unlikely to be hydraulicly connected to the site.
3.	Is the site within the catchment of the pond chains on Hampstead Heath?	No	The site is not located within the catchment of the pond chains on Hampstead Heath.
4.	Will the proposed basement development result in a change in the proportion of the hard surfaced / paved areas?	No	The rear extension of the below ground space extends beyond the footprint of the existing structure and hardstanding. 1000mm of granular material will be placed over the basement box at the rear of the development to ensure surface water drainage paths are not impacted. Refer to structural drawings in Appendix B and the Flood Risk Assessment for more information.
5.	As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and / or SUDS)?	No	The proposed development will maintain the existing surface water discharge conditions.
6.	Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath) or spring line?	No	The lowest level of the below ground space is not lower than the mean water level in any local pond.

4.2. Stability Screening Flow Chart

Question		Response	Details
1.	Does the existing site include slopes, natural or man-made, greater than 7 degrees (approximately 1 in 8)?	No	The site is founded on a slope with a gradient less than 4 degrees.
2.	Will the proposed re-profiling or landscaping at the site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8)?	No	There are no re-profiling / landscaping works proposed that will increase the slopes existing on site to gradients greater than 4 degrees.
3.	Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8)?	No	The areas surrounding the site is founded on a slope with a gradient less than 4 degrees.

Question		Response	Details
4.	Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8)?	No	The site is founded on a wider hillside setting, with a slope with a gradient less than 4 degrees.
5.	Is the London Clay the shallowest strata at the site?	Yes	BGS information and site-specific ground investigation proved London Clay to be the shallowest strata at the site.
6.	Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained?	No	No trees will be felled during the development works. The works will not take place in any tree protection zones.
7.	Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site?	Yes	The London Clay strata is usually classified as having a high-volume change potential and hence can lead to seasonal shrink-swell subsidence where buildings are founded in desiccated soils. Anecdotal evidence from neighbours indicates that shrink-swell subsidence is a risk for this site.
8.	Is the site within 100m of a watercourse or a potential spring line?	No	There are no surface water features within 500 m of the site boundary. The nearest surface water feature located is a water feature / fountain associated with Swiss Cottage Open Space (park / garden) 660m south of the site. This water feature is man-made and therefore unlikely to be hydraulicly connected to the site.
9.	Is the site within an area of previously worked ground?	No	The site is not in an area of previously reworked ground.
10.	Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	No	The site is underlain by the London Clay Formation which is an unproductive stratum. Dewatering will likely not be required during construction, to be confirmed by additional site-specific ground investigation.
11.	Is the site within 50m of the Hampstead Heath Ponds?	No	The site is not within 50m of the Hampstead Heath Ponds.
12.	Is the site within 5m of a highway or pedestrian right of way?	Yes	Belsize Crescent, a single-carriageway road, is present directly to the front of the site.
13.	Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes	The differential depth of the foundations of the existing development relative to neighbouring properties will be significantly increased. The maximum increase in foundation depth is 6.2m.
14.	Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No	There are no tunnels in close proximity to the site.

4.3. Surface Water and Flooding Screening Flowchart

Question		Response	Details
1.	Is the site within the catchment of the ponds chains on Hampstead Heath?	No	The site is not located within the catchment of the pond chains on Hampstead Heath.
2.	As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	No	The existing route is expected to be incorporated into the scheme.

Question		Response	Details
3.	Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	No	The rear extension of the below ground space extends beyond the footprint of the existing structure and hardstanding. 1000mm of granular material will be placed over the basement box at the rear of the development to ensure surface water drainage paths are not impacted. Refer to structural drawings in Appendix B and the Flood Risk Assessment for more information.
4.	Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?	No	The proposed lower ground extension and outrigger construction will not extend beyond the footprint of the existing hardstanding/building.
5.	Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	The proposed lower ground extension and outrigger construction will not extend beyond the footprint of the existing hardstanding/building.
6.	Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk from flooding, for example because the proposed basement is below the static water level of nearby surface water feature?	No	The site is in an area with very low risk of flooding due to surface water. The scheme Flood Risk Assessment report is presented in Appendix D.

4.4. Non-Technical Summary of Screening Process

4.4.1. The screening process identifies the following issues to be carried forward to scoping for further assessment:

- London Clay is the shallowest stratum on site and there is a history of shrink-swell subsidence in the local area (4.2[5], 4.2[7]).
- The proposed basement excavation is adjacent to neighbouring structures and a public highway, and will increase the differential depth of foundations relative to neighbouring properties (4.2[12], 4.2[13]).

4.4.2. The other potential concerns considered within the screening process have been demonstrated to be not applicable or not significant when applied to the proposed development.

5. Scoping

5.1. Stability: London Clay is the shallowest stratum on site and there is a history of shrink-swell subsidence in the local area

Hazards

5.1.1. Seasonal shrinking and swelling (subsiding and heaving) of the London Clay Formation underneath the site.

Potential Impacts

5.1.2. Damage to the proposed new foundation / retention systems and neighbouring properties.

Mitigating Factors

5.1.3. The works comprise significant excavation works and the proposed foundations will be founded at depth, limiting the impact of shrink-swell subsidence on the development.

Assessments and Further Actions

5.1.4. A site-specific ground investigation has been undertaken to provide more information about the shrink-swell properties of the near-surface London Clay Formation and groundwater levels.

5.1.5. The findings of the investigation indicate that the London Clay Formation below the site is not desiccated.

5.1.6. Seasonal shrink-swell of the London Clay Formation will be considered as part of the design of foundations.

5.2. Stability: The proposed basement excavation is adjacent to neighbouring structures and a public highway, and will increase the differential depth of foundations relative to neighbouring properties

Hazards

5.2.1. Deep excavations will be carried out adjacent to neighbouring structures.

5.2.2. The site is immediately adjacent to “Belsize Crescent”, which is a single carriageway road.

Potential Impacts

5.2.3. Collapse of the excavation and associated impact on surrounding assets.

5.2.4. Impact of ground movement to Belsize Crescent resulting in cracking, damage and/or collapse.

5.2.5. The proposed development will increase the differential foundation depths with neighbouring properties and the public highway. Ground movements arising due to construction and excavation activities may damage these properties.

Mitigating Factors

5.2.6. Temporary propping of the basement walls is proposed during construction works to ensure no significant movements or instability of the surrounding roads arise.

5.2.7. Deposits underlying the development are largely natural and anticipated to be relatively stable, i.e. London Clay Formation.

5.2.8. Several basements of similar depth and scale have been successfully constructed throughout London within similar geological conditions and urban settings.

5.2.9. A ground movement assessment has been undertaken for the neighbouring buildings, and this indicates maximum vertical and horizontal movement of 8mm and 7mm, respectively, along the road.

Assessments and Further Actions

5.2.10. A ground movement assessment has been performed to determine the impact of proposed excavation works on the neighbouring properties, discussed in Section 8.2. The assessment predicts a maximum damage classification of Category 1 – very slight for the neighbouring properties, in accordance with the Burland Scale.

5.2.11. An assessment of the ground movements of the neighbouring roads associated within the proposed works will be undertaken as part of the detailed design to confirm that there is no significant impact during construction.

5.2.12. Various additional ground movement assessments may be required to determine the impact of the works on surrounding buried utilities and other third-party assets surrounding the site. These assessments should confirm anticipated damage categories in accordance with performance limits set by the relevant third-party asset protection teams.

5.2.13. Appropriate ground movement monitoring should be implemented during construction to assess the performance of the earth retention system (baseline monitoring pre-commencement of the works should be carried out to determine any potential existing movement trends).

6. Site Investigation

6.1.1. A site-specific ground investigation was carried out in September and December 2022 by A2SI to support the design of the proposed below-ground space.

6.1.2. The *Factual Report* prepared by A2SI summarising the works undertaken is included as Appendix C.

6.1.3. The investigative works included the following:

- 4 no. modular dynamic sampler boreholes to depths of up to 6.0m. 1 no. location in the ground floor level front garden, 1 no. in the property footprint and 2 no. in the rear garden.
- 1 no. modular cable percussion borehole to a depth of 20.0m.
- 6 no. post-fieldwork groundwater and gas/vapour monitoring rounds.
- 1 no. hand pit with SPT in the front garden to determine material beneath the proposed storage structure.
- Installation of 3 no. gas/vapour monitoring wells (WS1, WS2, HP1).
- 2 no. structural trial pits on the party walls to determine existing foundation details.
- 3 no. shallow ground sample locations in the rear garden for additional contamination testing.
- Post-site work monitoring of ground gas (6 no. monitoring visits).
- 27no. standard penetration tests (SPT).
- VOC head-space testing using a PID.
- 8 no. moisture content tests.
- 8 no. classification/index tests(4 Point Liquid & Plastic Limit).
- 6 no. BRE Suite D tests.
- 10 no. Soil Organic Matter (SOM).
- 10 no. Total Organic Carbon (TOC).
- 10 no. Fraction Organic Carbon (FOC).
- 10 no. pH.
- 10 no. Water soluble sulphate.
- 10 no. TPHCWG including BTEX and MTBE.
- 10 no. Speciated Polyaromatic Hydrocarbons (PAHs) (EPA16).
- 10 no. Asbestos ID (with quantification if asbestos identified).
- 10 no. Heavy metals and metalloids suite.

6.1.4. The locations of the ground investigation positions are shown in Figure 6.1.

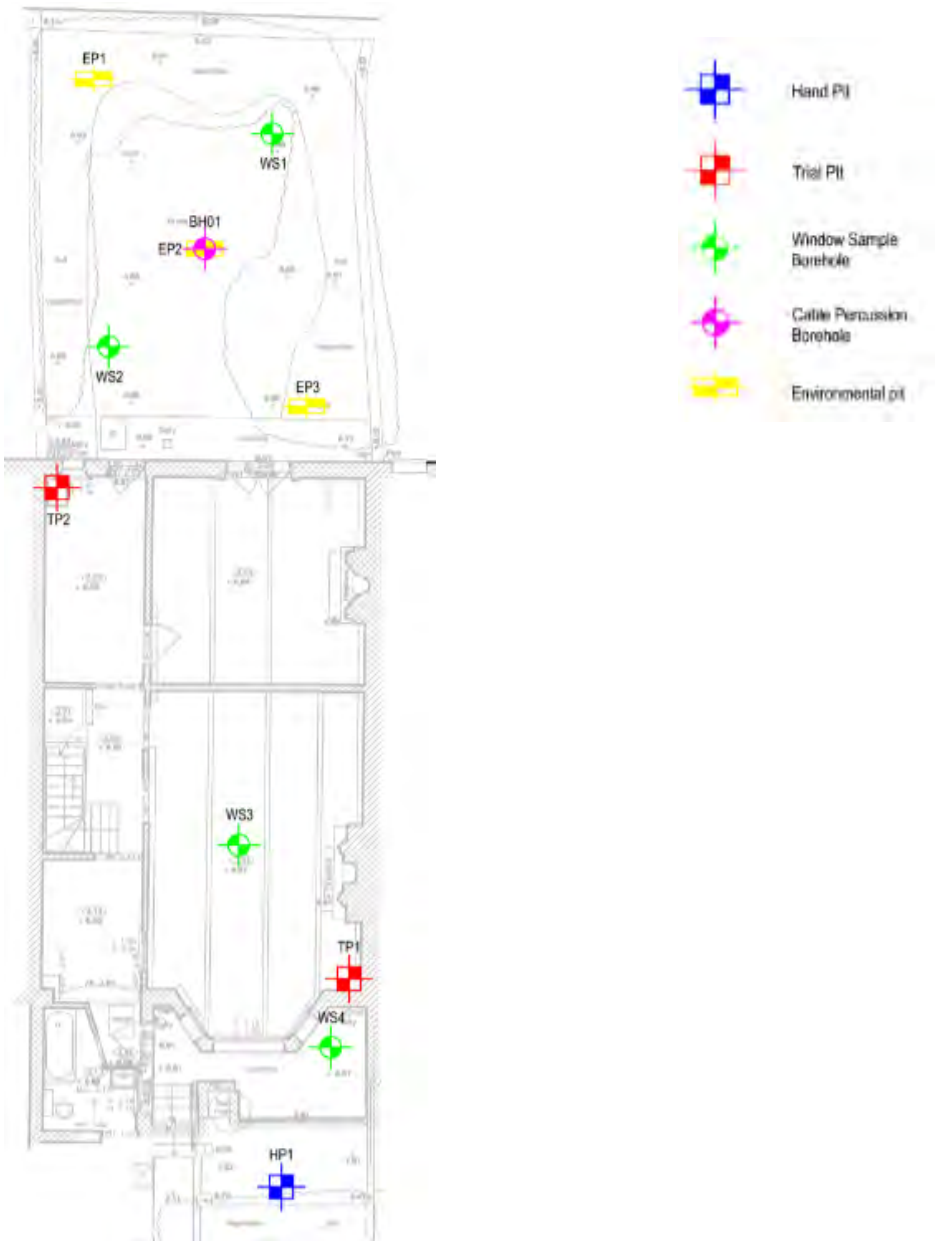

Figure 6.1 Exploratory hole locations

6.1.5. The encountered ground conditions at the site are summarised in Table 1.

6.1.6. Groundwater monitoring in WS01 did not encounter groundwater in the Made Ground.

Table 1 Encountered stratrigraphic profile

Stratum	Depth Encountered (m)[1]	Thickness (m)	Description
Made Ground	0.0	1.5	Soft to firm orangish brown slightly gravelly silty CLAY. Gravel is sub-angular, fine to medium concrete and flint.
London Clay	1.50	90.0	Stiff brown clay with partings of silt fine sand

1. Depth below lower ground floor finished floor level.

7. Construction Methodology / Engineer Statements

7.1. Outline Temporary and Permanent Works Proposals

7.1.1. The outline basement construction proposal is to construct the basement using a *top-down* methodology.

7.1.2. Standard means and methods of excavation are expected to be suitable to excavate the basement, based upon the ground conditions proven by means of ground investigation works.

7.1.3. The excavation will be retained by reinforced concrete underpins with mass concrete bailey rails and reinforced concrete walls.

7.1.4. The front basement wall adjacent to Belsize Crescent will be constructed using underpinning methods to minimise the impact of the works on the road.

7.1.5. The rear basement extension reinforced concrete walls will be constructed using a sequential pin construction method to avoid undermining the foundations of the adjacent properties and walls.

7.1.6. Design of the retaining walls and temporary propping shall be carried out in accordance with the relevant Eurocodes/British Standards, non-conflicting codes of practice, and associated design best practices.

7.1.7. It is anticipated that any groundwater inflow during excavation arising from finite bodies of perched ground water can be suitably managed/mitigated with localised pumping where required.

7.2. Ground Movement and Damage Impact Assessment

7.2.1. A GMA has been carried out in accordance with CIRIA C760 and takes into account the construction methodology and site-specific ground and groundwater conditions. The GMA is included as Appendix C.

7.2.2. All structures / properties within the zone of influence of the proposed development have been assessed.

7.2.3. The following assumptions have been made within the GMA:

- New underpins are assumed to be founded in the London Clay Formation.
- The buildings included in the GMA are assumed to be founded on ground surface.
- The walls of the above-mentioned buildings are assumed to behave as equivalent beams.

7.2.4. The ground movements resulting from the works comprise deformations arising from the following mechanisms:

- Installation of the underpins.
- Bulk excavation works.
- Heave and settlements due to the unloading / load redistribution of London Clay Formation.

7.2.5. The following structures were assessed, having been identified as falling within the zone of influence of the proposed development:

- 11 Belsize Crescent
- 15 Belsize Crescent

7.2.6. The evaluated potential damage/impact is contained within Category 1 – Very Slight, in accordance with the Burland Scale for both the base assessment and sensitivity check. The building damage categories are based on the worst case ground movements which are those detailed in Table 5.2 of the GMA in Appendix C.

7.2.7. An outline impact review of the works on Belsize Crescent has also been undertaken. The road is anticipated to experience horizontal and vertical movement of 8mm and 7mm, respectively. These movements are based on movement contour plots provided in Section 5 of the GMA in Appendix C.

7.2.8. The expected ground movements resulting from the proposed works are proposed to be limited by means of temporary propping, which is planned to be installed before the excavation phase.

7.2.9. The following mitigation measures are proposed to reduce ground movements and damage:

- Design of the temporary propping measures shall be carried out in accordance with the relevant Eurocodes, non-conflicting codes of practice, and associated design best practice.
- Underpinning works to be performed by an experienced ground engineering contractor.
- Frequent monitoring of neighbouring properties to be carried out during excavation, to validate ground movement predictions against reality.
- Development of a monitoring-trigger-action plan that identifies trigger levels, responsible personnel and actions to be followed in the event of a trigger level exceedance.
- Incorporating stiff, high level props into the temporary works design of the excavation, so as to provide a high stiffness wall. Design details regarding minimum wall flexural stiffness, prop stiffness and arrangement, shall be defined as part of detailed design development.
- Designated areas for stacking and storing materials behind the underpins should be identified. These should be located away from sensitive structures. The design of the underpins should incorporate an appropriate surcharge load to the rear of the wall, to capture effects of stacking and storing materials, vehicle traffic, etc.
- The GMA did not consider the impact of the proposed development on existing buried utilities (e.g. Thames Water sewer assets). It is expected that these assets will be assessed (if applicable to the proposed works) following engagement of the asset owner and direction from the asset protection team, with regards to establishing limiting performance criteria.

7.3. Control of Construction Works

7.3.1. Following the selection of a Principal Contractor, a Construction Method Statement should be developed, which will cover the items outlined in this section in detail.

7.3.2. Work method statements developed for main stages of the construction works, outlining the means and methods of safely carrying out the works.

7.3.3. Details of temporary propping and temporary works, required to ensure structural stability is maintained throughout demolition and excavation operations.

7.3.4. Construction traffic management plans.

7.3.5. Detailed development of structural and environmental monitoring strategy, developed to control construction works and maintain movements/damage impacts within the predicted limits and monitor environmental impacts, including:

- A structural monitoring layout plan of instrumentation/survey points/critical sections.
- Programme/frequency of monitoring.
- Trigger values derived for each of the structures within the zone of influence of the proposed works.
- Contingency actions and project team lines of responsibility.

8. Basement Impact Assessment

8.1. General

8.1.1. The Conceptual Site Model (CSM) is described below:

- The ground conditions of the site comprise Made Ground overlying London Clay Formation.
- Whilst groundwater monitoring did not encounter groundwater, it is anticipated that finite bodies of local perched groundwater are present within the Made Ground above the London Clay Formation, and it is assumed that the pore pressure distribution within the London Clay Formation will be approximately hydrostatic from the top of the formation.
- The current development / property comprises a four-storey terraced masonry residential property, inclusive of a lower ground floor. The development shares Party Walls with the adjacent properties.
  Neighbouring buildings are assumed to be founded near surface.
- The proposed development may result in damage to the neighbouring buildings. Any potential damage will be mitigated by appropriate construction means and methods (such as temporary propping/shoring and controlled excavation operations).

8.2. Land Stability / Slope Stability

8.2.1. It is assumed that all new substructure elements will be founded on the London Clay Formation, which is considered to be a suitable founding stratum.

8.2.2. The risk of movement and damage to this development due to volumetric changes of the London Clay Formation will be considered as part of the scheme design of the development. Heave mitigation measures (if appropriate) will be adopted, and the relevant soil structure interaction mechanisms will be reviewed.

8.2.3. A GMA has concluded that ground movements caused by excavation and construction of the proposed development will be limited. The upper bound damage category for surrounding structures within the zone of influence of the proposed development has been assessed as Category 1 – Very Slight in accordance with the Burland Scale.

8.2.4. The BIA has concluded that risks to the adjacent properties, public highway, slopes and infrastructure (including ultimate and serviceability limit state considerations) are limited and will be mitigated in a reasonable fashion as part of design development.

8.3. Hydrology and Groundwater Flooding

8.3.1. The BIA has concluded that there is no risk of groundwater flooding.

8.3.2. The BIA has concluded that there are no impacts to the wider hydrogeological environment.

8.4. Hydrology, Surface Water Flooding and Sewer Flooding

8.4.1. The BIA has concluded that there is a very low risk of surface water flooding.

8.4.2. The BIA has concluded that there are no impacts to the wider hydrological environment.

Appendix A: Phase I Desk Study

A2 Site Investigation

13 Belsize Crescent

Phase I Desk Study

March 2023

24022-A2SI-XX-XX-RP-Y-0001-01

Project Name	13 Belsize Crescent
Project Number	24022
Client	Edmund Lehmann and Jennifer Nguyen
Document Name	Phase I Desk Study

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Document Reference	Status	Notes	Revision	Issued by	Date
24022-A2SI-XX-XX-RP-Y-0001-00	First Issue	-	00	CM	13/12/2022
24022-A2SI-XX-XX-RP-Y-0001-01	Second Issue	-	01	KG	31/03/2023

Contents

Appendices

1. Introduction

A2 Site Investigation Limited (A2SI) has been engaged by Edmund Lehmann and Jennifer Nguyen to prepare a phase I desk study report for the proposed development at 13 Belsize Crescent, London, NW3 5QY (herein called the 'site').

1.1. Study Aims and Objectives

The desk study develops an initial Conceptual Site Model (CSM) and provides a qualitative Preliminary Risk Assessment (PRA) for the proposed development in accordance with the principles set out in *Land Contamination Risk Management* (LCRM) guidance, published by the Environment Agency on the UK Government website. The desk study has also been prepared in the context of the *National Planning Policy Framework* (NPPF) and *The Building Regulations 2010, Approved Document C - Site preparation and resistance to contaminants and moisture (2004 Edition incorporating 2010 and 2013 amendments)*. The desk study includes an assessment of whether there are any unacceptable risks (ref. *LCRM* guidance) which require further geo-environmental investigation.

Potential historical and current sources of contamination have been identified based on information available in the public domain (including information sources referenced in Section 1.2).

The proposed development is described in more detail in Section 6 but can generally be described as the renovation of existing floors, with potential for outbuilding and an access lift within the front garden of the property from the lower to upper ground floor levels.

Preliminary geotechnical assessment is not included in this desk study.

The outcomes of this desk study have been developed based on information current at the time of writing.

1.2. Information Sources

The primary sources of information which have informed the assessments presented herein include the following:

- *Envirocheck Report* for 13 Belsize Crescent prepared by Landmark Information Group, dated 22nd September 2022 (ref. 301610419_1_1), included in Appendix B.
- *Preliminary Unexploded Ordnance (UXO) Risk Assessment* for 13 Belsize Crescent prepared by Brimstone Site Investigation, dated 28th September 2022 (ref. PRA-22-1919), included in Appendix C.
- Site walkover undertaken by representatives of A2SI on 12th September 2022.
- British Geological Survey, GeoIndex Onshore GIS database (accessed October 2022); https://mapapps2.bgs.ac.uk/ geoindex/.
- Department for Environment, Food & Rural Affairs (DEFRA), Magic Map Application (accessed October 2022); http://magic.defra.gov.uk/MagicMap.aspx.
- Historic England, online Aerial Photo Explorer (accessed October 2022); https://historicengland.org.uk/images-books/archive/collections/aerial-photos/.
- Health Protection Agency and British Geological Survey document Indicative Atlas of Radon in England and Wales, 2007.
- *The Lost Rivers of London* by Nicholas Barton, 1962.
- Google Earth (ref. earth.google.com/web/), accessed October 2022.
- Flood Maps for Planning (ref. https://flood-map-for-planning.service.gov.uk/), accessed October 2022).

2. Site Setting

2.1. Development Location and Current Site Use

The development site is located at 13 Belsize Crescent, London, NW3 5QY, as shown in Figure 2.1. The approximate National Grid reference for the site is 526790, 184970 and the site footprint covers approximately 0.02 hectares. The approximate ground surface elevation at the site is 70.0 m above Ordnance Datum with the ground surface levels in the surrounding area falling towards the south. The development site falls within the administrative boundaries of the London Borough of Camden and currently includes a four-storey residential property including a lower ground floor and associated private front and rear gardens.

The existing structure is anticipated to comprise concrete floors supported by load bearing masonry façades and Party Walls.

The foundations are expected to be shallow brick corbelling.

The current land uses within a 250 m radius surrounding the site are summarised in Table 2.1.

Figure 2.1 Location of the proposed development (red line reflects the site boundary used for this assessment)

Table 2.1 Surrounding land uses summary

Bearing from Site	Features directly adjacent to the site boundary	Other identified land uses and key structures
North	Belsize Crescent – single carriageway road	Multi-storey terraced houses and apartments with associated rear soft landscaping are present approximately 14 m north along Belsize Crescent. Marie Curie Hospice and limited associated soft landscaping is approximately 150 m northeast and several schools including Gloucester House school ~150 m northwest, St Christopher School ~ 240 m northeast as well as St Mary's School is approximately 250 m northwest of the site.
South	Belsize Park Mews – two-storey terraced residential buildings No. 11 Belsize Crescent – four-storey residential property and associated rear garden	Belsize Park Mews single carriageway cobbled road is approximately 7 m south with residential properties beyond. Daleham Mews is ~20 m south of the site and beyond this are residential homes with associated soft landscaping.

Bearing from Site	Features directly adjacent to the site boundary	Other identified land uses and key structures
		Approximately 110 m south, are a series of small commercial units predominantly retail shops. Hampstead Mother and Baby Home is approximately 140 m southwest. St Peter's Church (no associated graveyard present) is approximately 180 m southeast.
East	No. 11 Belsize Crescent – four-storey residential property and associated front garden	Belsize Lane high street lined with small commercial buildings including retail units and restaurants, is located approximately 60 m east. Multi-storey terraced houses, offices and apartments with associated soft landscaping are located beyond Belsize Lane to the east of the site.
West	No. 15 Belsize Crescent – four-storey residential property and associated rear garden No. 10 Belsize Park Mews – two-storey residential property	Multi-storey terraced houses and apartments with associated soft landscaping are located beyond Belsize Park Mews to the west. Oleson Tuition german language school and associated soft landscaping is located approximately 100 m west. North Bridge House Nursery and associated soft landscaping is located approximately 230 m west of the site.

2.2. Site Walkover

A site walkover was undertaken by A2SI on the 12th September 2022. A summary is presented in this Section 2.2. Walkover records are included as Appendix D and these should be reviewed alongside the summary details below.

The site is a four-storey terrace residential property with a small paved front garden and a larger rear external garden. The site contains a lower ground floor which leads out into the rear garden and a very small basement / vault covering an area beneath the lower ground floor footprint to the northeast of the building. The rear garden is located towards the southwest and comprises of soft grass and a small concrete hardstanding patio against the building line with vegetation along the wall perimeter. Manhole covers and surface water drains were noted within the concrete portion of the rear garden. The ground floor comprises of a hallway with stairs leading up to the first floor, a large living room, a small kitchen with sink and a small bathroom with a bath.

At the top of the wooden stairs to the lower ground floor is the electric fuse box. Most of the lower ground floor has had its soft fittings removed however, a toilet with a small sink and bath are still present. A small flight of stairs takes you down into the basement where the gas meter reading box is fixed to the wall and a rectangular foul water man hole cover is present. The basement is empty apart from these utilities.

The site is surrounded by similar residential properties with gardens towards the north, west and east. Towards the south is the Belsize Park Village Square where small commercial buildings of coffee shops and retail units are noted.

The walls of the residential home make up much of the site boundary to the northwest and southeast however, a bricked wall separates the site from the adjacent properties within the front and rear garden areas. This wall is approximately 1.20 m tall.

During the walkover, there were no obvious signs of hazardous chemical storage or storage tanks (both above or below ground).

During the walkover, it was noted that there were no obvious on-site features which could be considered viable sources of significant contamination.

2.3. Planning Records

The London borough of Camden Local Authority Planning Portal has been searched for relevant records. The following Planning reference numbers have been identified with respect to previous applications made for the site (ordered by decade):

- 2022/3739/P – 13 Belsize Crescent. Replacement of rear lower ground floor doors and window with bi-folding doors. Awaiting decision.
- 2022/3736/P – 13 Belsize Crescent. Replacement of two sash windows with French doors and glazed balustrades at upper ground floor rear. Awaiting decision.
- 2022/1803/P – 13 Belsize Crescent. Use of the property as a single residential unit (Class C3). Decision granted.
- 2019/2473/P – 13 Belsize Crescent. Erection of timber outbuilding in rear garden and alterations to lower ground floor fenestration at rear of dwelling. Withdrawn decision.
- 2019/3562/INVALID – 13 Belsize Crescent. Conversion of 1x 6-bed single family dwelling into 2x self-contained 3-bed flats; erection of garden shed. Withdrawn decision.
- TPX0106940 – 13 Belsize Crescent. 2 x lime - fell to ground level. Works approved, with conditions.
- TCX0106619 – 13 Belsize Crescent. Fell 1 x bay tree & 2 x lime at front of property. Object to works – Tree preservation order to be served.
- PWX0002755 – 13 Belsize Crescent. Minor elevational alterations at lower ground and ground floor levels. (Plans submitted). Application withdrawn.
- TCX0006738 – 13 Belsize Crescent. Fell one Bay Leaf Tree and reduce two Lime Trees in front garden. No objection to works.
- PWX0002678 – 13 Belsize Crescent. Change of use of the lower ground and ground floor flats into one self contained maisonette. Permission granted.
- TC9906694 – 13 Belsize Crescent. Fell and replace 1 X Lime and fell 1 X Bay in front garden. No objection to works.
- TC9706189 – 13 Belsize Crescent. Reduction of 2 X Limes to previous reduction points and reduction of 1 X Bay. No objection to works.
- 8992132 – 13 Belsize Crescent. Advice on Pruning Bay tree in front garden. Agree to remove tree without replacement.
- G7/8/33/33075(R1) - 13 Belsize Crescent, NW3 The erection of a roof extension to provide extra residential accommodation. Permission granted.

No relevant geo-environmental reports within a 250m radius of the site have been identified.

2.4. Regulatory Consultation

Requests for information have been made to the following bodies:

- Environment Agency (EA), contacted via email on the 29th of September 2022 (see Appendix E). Response received 20th of October 2022.
- Camden Borough Council (CBC), contacted via email on the 23rd of September 2022 (see Appendix E). Response received 10th of October 2022.

CBC Identified two records of historical industrial land uses within the surrounding 100 m of the site which represent a medium risk of contamination:

- 1952 - 1955: Motor Vehicles and Garages – 36 m southeast
- 1894 - 1896: Depot/Warehouse – unverified location

As stated by the council, planning condition would be recommended for a detailed site investigation (desk top study, walkover survey and intrusive investigation) and if necessary, remediation works.

Copies of the regulatory consultation undertaken are included as Appendix E.

2.5. Unexploded Ordnance

A Stage 1 Preliminary UXO Risk Assessment has been carried out by Brimstone Site Investigation, included in Appendix C. Although it was situated over 7 km from the Luftwaffe's primary aiming point for raids on London (the City of London), Hampstead was subjected to large scale air raids during WWII. Although the wartime figures for the wider borough suggest a high bombing density, the targets of opportunity nearby may have increased the local bombing density. Nine bomb strikes were recorded in the vicinity of the Site (with the closest being approximately 45 m northeast).

The Site is recorded as sustaining no damage within London County Council bomb damage mapping. Furthermore, post-WWII aerial photography corroborates this, with the Site appearing to have remained relatively untouched. No rubble/debris was likely present, increasing the likelihood that evidence of a UXB would have been observed, had one struck the Site.

The Site was occupied by a residential property throughout WWII. Access is therefore anticipated to have remained frequent throughout the war due to the lack of damage on Site and to nearby/adjacent residential properties.

As the redevelopment of the basement will disturb likely untouched soil, this heightens the likelihood of finding a UXB. However, due to the lack of bomb damage and recorded bomb strikes on Site, coupled with wartime conditions conducive to the detection of a UXB strike, the likelihood of encountering a German UXB is not considered to be elevated.

A Stage 2 Detailed Risk Assessment is **not** considered necessary prior to works commencing. However, the possibility of UXO remaining on Site cannot be completely ruled out at desktop stage. Therefore, a UXO Safety Awareness Briefing to all personnel conducting ground works would be considered prudent.

The above provides a summary of the available UXO risk assessment. However, the full assessment provided in Appendix C must be referred to and takes precedence.

3. Geological Setting

3.1. Regional Geological Overview

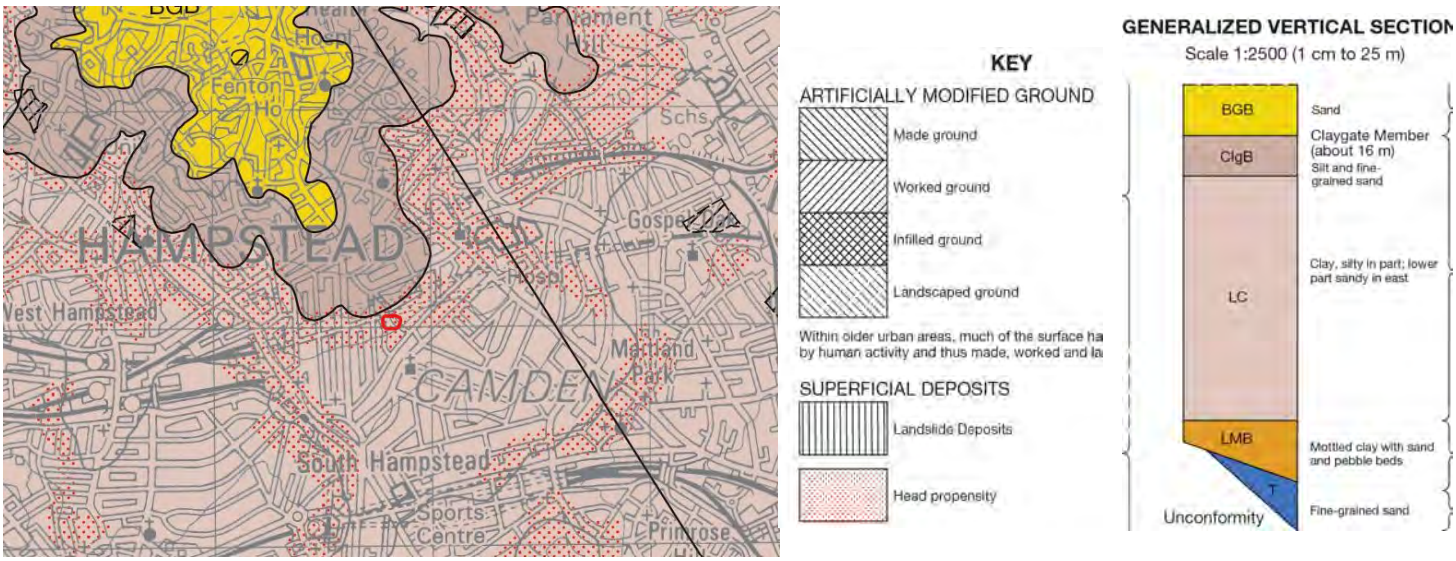
The development site is located within the London Basin, which refers to an approximately triangular synclinal structure in which the sedimentary units underlying London and much of southeast England were deposited. The London Basin is comprised of the following formations, in order of decreasing depth:

- A deep (~200 m thick) layer of Chalk, deposited throughout the Upper Cretaceous period, forms the base of the basin and is the principal aquifer of the region.
- The Thanet Formation, which comprise fine, silty glauconitic sands originating in shallow seas.
- The Lambeth Group, a depositionally and geographically complex unit which comprises layers of sands and gravels, shelly and mottled clays, minor limestones and lignites, and occasional sandstone and conglomerate.
- The London Clay Formation, a fine-grained deposit of silty locally sandy clay which is the dominant Thames Group Deposit. Contains layers of weakly to strongly cemented claystones.
- Superficial (drift) deposits: River Terrace Deposits (comprising mainly gravels and sands) and Alluvium (fine, often organic soils) aggraded/deposited by the River Thames and its tributaries on top of the London Clay.

3.2. Site Geology and Anticipated Ground Conditions

Figure 3.1 illustrates the location of the development within the context of a regional geological map. The map illustrates the spatial distribution of superficial (drift) deposits and bedrock outcrops at the ground surface. Made Ground is generally not shown but is assumed to be present on site due to historical demolition and construction works.

The geology map indicates that the superficial deposits on site are generally absent though it is likely that a layer of Head Deposits may be encountered in this area. The London Clay Formation is present directly beneath the anthropogenic deposits and anticipated Head. The London Clay is then underlain by the Lambeth Group over Thanet Sands overlying the Chalk.



Approximate site location marked by red circle.

Figure 3.1 Geological context of the site

The British Geological Survey (BGS) Geology of Britain web map services provide access to the geographic locations and logs of historical borehole investigations and well installations. Historical boreholes surrounding the site are shown in Figure 3.2. The following

historical records have been reviewed as part of this assessment; TQ28SE3106, TQ28NE38 and TQ28SE46. Table 3.1 summarises the preliminary ground model adopted in this desk study, based on the information reviewed.

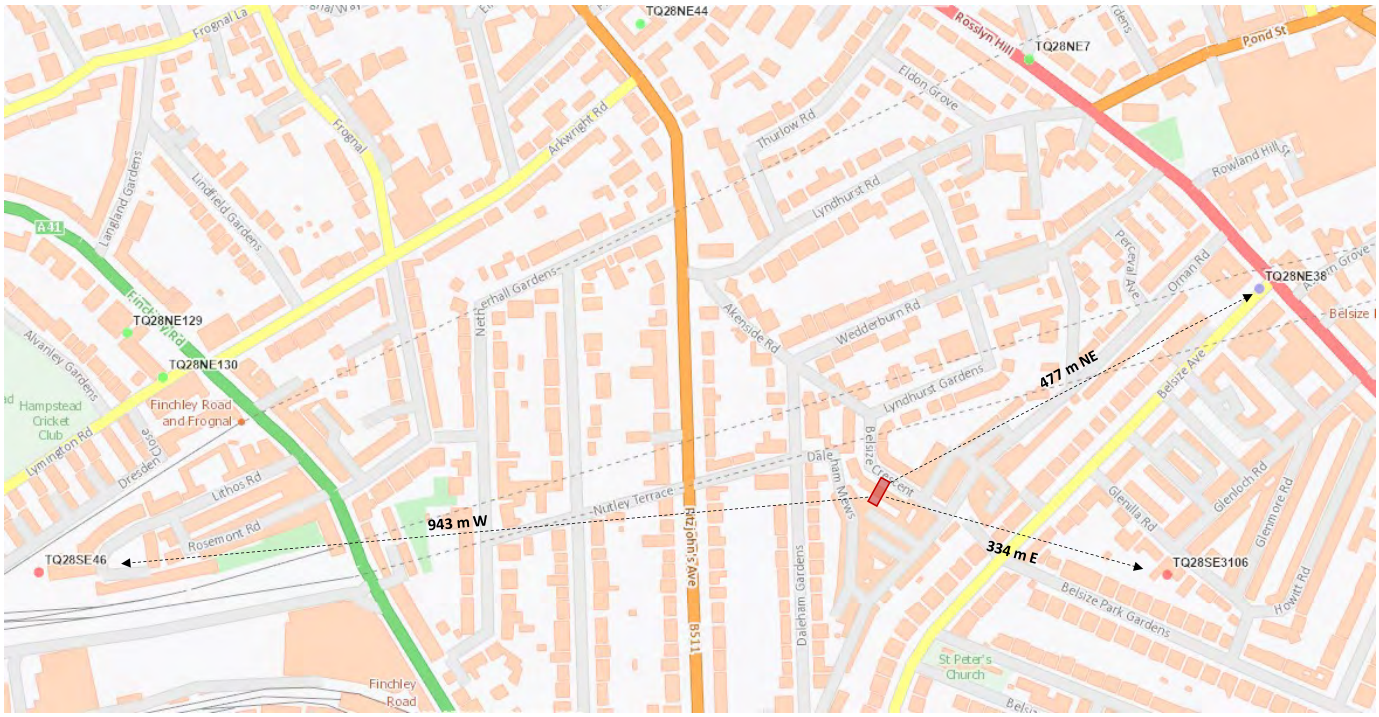


Figure 3.2 Locations of BGS boreholes in close proximity to the site boundary

Table 3.1 Preliminary ground model

Unit	Elevation[1] (mOD)	Depth[1] (m bgl)	Thickness (m)	Description
Made Ground	+70.00	0.00	1.50	Variable anthropogenic deposits
London Clay Formation	+68.50	1.50	79.50	Stiff brown clay with partings of silt fine sand
Lambeth Group	-11.00	81.00	7.50	Vertically and laterally variable sequences mainly of clay, some silty or sandy, with some sands and gravels, minor limestones and lignites and occasional sandstone and conglomerate
Thanet Sand Formation	-18.50	88.50	7.50	Grey locally silty fine sand with a bed of fine to coarse flint gravel at the base
White Chalk Subgroup	-26.00	96.00	>177.09 (not proven)	Generally, very weak to weak, low to medium density white chalk with nodular flint beds common: brown and phosphatic in upper part.

1. Elevation and depth refer to top of stratum.

3.3. Groundwater and Hydrogeology

The preliminary groundwater regime evaluation is based on data regarding the site setting, general geomorphology and relevant project experience in the area.

The groundwater model is likely to comprise a perched water table, which is sustained within the more permeable superficial strata overlying the low permeability London Clay Formation. It is anticipated that the pore water pressure distribution within the London

Clay Formation is likely to be in hydrostatic equilibrium with an average or mean perched water table level. Whilst it is considered that the pore water pressure distribution within the London Clay and upper Lambeth Group clays is hydrostatic, it is likely that the lower portion of the Lambeth Group, Thanet Sands and Chalk Formation are underdrained. Due to historical dewatering from the Chalk aquifer at depth, underdrainage effects are frequently observed within the strata at depth within the London Basin.

The London Clay Formation is listed as Unproductive Strata. Unproductive Strata are low permeability strata which are not considered to retain significant quantities of groundwater. If groundwater is present within Unproductive Strata, for example within more permeable lenses or small fissures, it is typically discontinuous, of low value and very low sensitivity.

The underlying Lambeth Group and Thanet Formation are classified as a Secondary A Aquifer, defined as containing permeable layers capable of supporting water supplies at a local rather than strategic scale, in some cases forming an important source of base flow to rivers. These strata are aquifers formerly classified as Minor Aquifers.

The White Chalk Subgroup (Bedrock) is classified as a Principal Aquifer, defined as containing rock or drift deposits that have high intergranular and/or fracture permeability and provide high levels of water storage and transmission.

The Groundwater Vulnerability Map of England and the Environment Agency website have been reviewed to determine the aquifer designations for the underlying geology at the site.

Data available from historical BGS boreholes does not indicate any presence of a shallow groundwater table.

The dominant direction of groundwater flow (if encountered) is anticipated to be in a southeastern direction, towards the River Thames.

The site is not identified as being located within a groundwater Source Protection Zone (SPZ), however there is an SPZ II recorded within 342 m south and SPZ I 1,228 m southeast of the site. The SPZ is understood to be associated with the bedrock aquifers within the Chalk.

Localised perched water may also be present associated with any Made Ground at the site.

According to the Landmark Envirocheck database, there are currently four licensed groundwater abstractions (with multiple abstraction points) within 1 km of the site as detailed below:

- London Borough Of Camden (located 676 m south of site) with the abstraction use of Municipal Grounds: Spray Irrigation – Direct
- London Borough Of Camden (located 696 m south of site) with the abstraction use of Municipal Grounds: Lake and Pond Throughflow
- London Borough Of Camden (located 696 m south of site) with the abstraction use of Municipal Grounds: General Washing/Process Washing
- London Borough Of Camden (located 696 m south of site) with the abstraction use of Municipal Grounds: Spray Irrigation – Direct

3.4. Hydrology

There are no surface water features within 500 m of the site boundary. The nearest surface water feature located is a water feature / fountain associated with Swiss Cottage Open Space (park / garden) 660 m south of the site. This water feature is man-made and therefore unlikely to be hydraulically connected to the site.

There are currently no licensed surface water abstractions within 500 m of the site.

The Regents Canal is located 1.75 km southeast of the site. The structure of the canal is expected to be concrete lined and considered unlikely to be hydraulically connected to the site, hence not assessed further as a receptor. The River Thames is located 5.83 km to the southeast flowing in an easterly direction.

The review of historical maps in The Lost Rivers of London (1962) has identified features within 500 m of the site boundary. Tributaries of a lost river of London, the Tyburn river, are present approximately 200 m to the west and 300 m to the east of the site boundary both flowing in a southerly direction.

3.5. Geological Hazards

The British Geological Survey and Environment Agency (EA) hazard mapping have identified the following potential geotechnical hazards at the site:

- *Very Low* potential for collapsible ground stability hazards.
- *No Hazard* from compressible ground stability hazards.
- *No Hazard* from ground dissolution stability hazards.
- *Very Low* potential for landslide ground stability hazards.
- *Moderate* potential for shrinking or swelling clay ground stability hazards.
- *Very Low* from running sand ground stability hazards.

3.6. Mining and Mineral Extraction

The site is not listed within the Envirocheck Report as within an area affected by coal mining.

There are no BGS Mineral Site entries listed within the Envirocheck Report within 500 m of the site.

No record of mining instability, man-made mining cavities or natural cavities have been recorded within 500 m.

3.7. Radon

The Envirocheck Report indicates that the site is within a Lower Probability Radon Area (with less than 1% of homes estimated to be at or above the Action Level). Radon risk mapping included in *BRE 211: Radon – Guidance on Protective Measures for New Buildings (2015)* indicates that without a site-specific Radon Risk Report the maximum requirement for radon protection is 'None'.

A new basement is to be incorporated into the proposed development. As indicated in *BRE211 (2015)*, all basements are at increased risk of elevated levels of radon, regardless of geographic location. Therefore, despite the radon risk mapping, it is recommended that appropriate radon protection is provided for the new basement. An appropriate radon protection strategy which is compatible with the building waterproofing should be developed by a suitable waterproofing and radon specialist.

4. Site History

Detailed historical maps, fire insurance plans and aerial photographs of the site and surrounding area dated between 1850 and 2022 (at scales of 1:1,056, 1:1,250, 1:2,500, 1:5,280, 1:10,000, 1:10,560 and 1:25,000), provided as part of the Envirocheck Report (Appendix B), have been reviewed as part of the study. This process has been undertaken to identify any former land uses at the site and within the surrounding area that may have geo-environmental implications for the proposed redevelopment.

The findings are summarised in Table 4.1. Only features considered to have a potential geo-environmental impact on the site and usually within a notional 250 m radius of the site boundaries are presented and discussed, with the exception of any potentially infilled land which is identified within 500 m of the site. Any distances quoted for features remote from the site have been scaled from the maps and are approximate. Other information sources available in the public domain have also been reviewed to support this assessment, including the Historic England online Aerial Photo Explorer and historical aerial photographs available on Google Earth.

Table 4.1 History of the site and surrounding areas

Historical Feature	Distance and Bearing from Site	Date of First Map Appearance	Date of Last Map Appearance	Potential to Impact the Site
	On-Site			
Open field	-	1850	1882	No
Terraced residential property	-	1896	2022	Yes
	Off-Site			
Burdetts Garage	36 m SE	1952	1955	Yes
Belsize Railway Tunnel	50 m N	1871	2022	Yes
Belsize Farm	100 m SW	1871	1882	No (Due to distance from the site and anticipated ground model, migration of contamination onto site is unlikely)
Electrical Substation	200 m S	1952	1991	No (Due to distance from the site and anticipated ground model,

Historical Feature	Distance and Bearing from Site	Date of First Map Appearance	Date of Last Map Appearance	Potential to Impact the Site
				migration of contamination onto site is unlikely)
Electrical Substation	250 m NW	1965	1991	No (Due to distance from the site and anticipated ground model, migration of contamination onto site is unlikely)
Marie Curie Hospital	170 m NE	1991	2022	No (Due to distance from the site and anticipated ground model, migration of contamination onto site is unlikely)

5. Environmental Setting

5.1. Regulatory Data

Regulatory data from the Envirocheck Report in close proximity to the development site (generally within 250 m of the site boundary, with the exception of landfill and infilled ground which is identified within 500 m of the site) has been summarised in Table 5.1. The information provided for each item in Table 5.1 has been summarised from the Envirocheck Report for risk assessment purposes. For a full breakdown of the regulatory data refer to the Envirocheck Report in Appendix B.

Table 5.1 Summary of regulatory data

Item	Distance and Bearing from Site	Information	Potential to Impact the Site
Agency & Hydrogeological			
Local Authority Pollution Prevention and Controls *Records on site*: 0 *Records within 0-250m*: 1	74 m E	**Name**: Pyramid Cleaners **Status**: Permitted **Type**: Local Authority Pollution Prevention and Control	No (Due to anticipated ground model, migration of contamination onto site is unlikely
Waste and Landfill			
Potentially Infilled Land (Non-Water) *Records on site*: 0 *Records within 0-250m*: 1 *Records within 250-500m*: 2	56 m NW	**Use**: Unknown Filled Ground (Pit, quarry etc) **Date of Mapping**: 1996	Yes
	315 m W	**Use**: Unknown Filled Ground (Pit, quarry etc) **Date of Mapping**: 1991	No (Due to anticipated ground model, migration of contamination onto site is unlikely
	362 m NW	**Use**: Unknown Filled Ground (Pit, quarry etc) **Date of Mapping**: 1996	No (Due to anticipated ground model, migration of contamination onto site is unlikely
Facilities Registered as using Hazardous Substances			
No relevant records			
Industrial Land Uses and Points of Interest *(potential sources of contamination are identified within 100 m of the site boundary, and more distant potential sources of contamination are identified where the anticipated shallow groundwater flow direction towards the southeast indicates a viable pathway to the site may be present)*			
	47 m S	**Type:** Garage Services **Status:** Inactive	Yes

Item	Distance and Bearing from Site	Information	Potential to Impact the Site
Contemporary Trade Directories and Points of Interest *Records on site*: 0 *Records within 0-250m*: 29 **(only records based on the criteria in the section heading are shown opposite for risk assessment purposes. See Appendix B for all records)**	52 m SW	**Type:** Garage Services **Status:** Inactive	Yes
	72 m SW	**Type:** Garage Services **Status:** Inactive	No (Due to anticipated ground model, migration of contamination onto site is unlikely
	73m S	**Type:** Electrolysis **Status:** Inactive	No (Non-industrial use – not considered a potential source of contamination)
	86m S	**Type:** Carpet, Curtain & Upholstery Cleaners **Status:** Active	No (Due to anticipated ground model, migration of contamination onto site is unlikely
	86m S	**Type:** Dry Cleaners **Status:** inactive	No (Due to anticipated ground model, migration of contamination onto site is unlikely
	76m E	**Type:** Pyramid Cleaners – Dry Cleaners **Status:** Active	No (Due to anticipated ground model, migration of contamination onto site is unlikely

5.2. Flood Risk

The site is classified as having a no risk of groundwater flooding at surface level (30-year return, 100-year return and 1000-year return).

Flood Maps for Planning (ref. https://flood-map-for-planning.service.gov.uk/, accessed 20th October 2022) indicates that the site is located in a Flood Zone 1 i.e. there is a low probability of flooding.

No further consideration of flood risk is given in this report. Specialist flood risk advice should be sought with regards to drainage and flooding.

5.3. Ecology, Flora and Fauna

No records of potentially sensitive ecological receptors as defined by the *Environmental Protection Act (1990) Part 2a (as amended)* have been identified.

An assessment of potential invasive species is not included in this report.

6. Proposed Development

The scheme for the proposed development comprises partial demolition of internal superstructure elements. The floor slab will be replaced and underpinned, with a new basement (comprising the swimming pool) constructed under majority of the building footprint. It is proposed that the current ground floor level will be lowered by approximately 0.30 - 0.50 m depth and the new basement will be constructed to approximately 7 m below the existing ground floor level. The house will be accessible with an external platform lift to the lower ground floor and an internal lift to all floors will be installed. Internal lower ground floor with rear garden (Figure 6.2) and a new basement (Figure 6.3) proposal plans are shown below. The section view of the proposed development can be seen in Figure 6.1. A full architectural drawing pack (by Undercover Architecture) of the proposed development can be found in Appendix F.

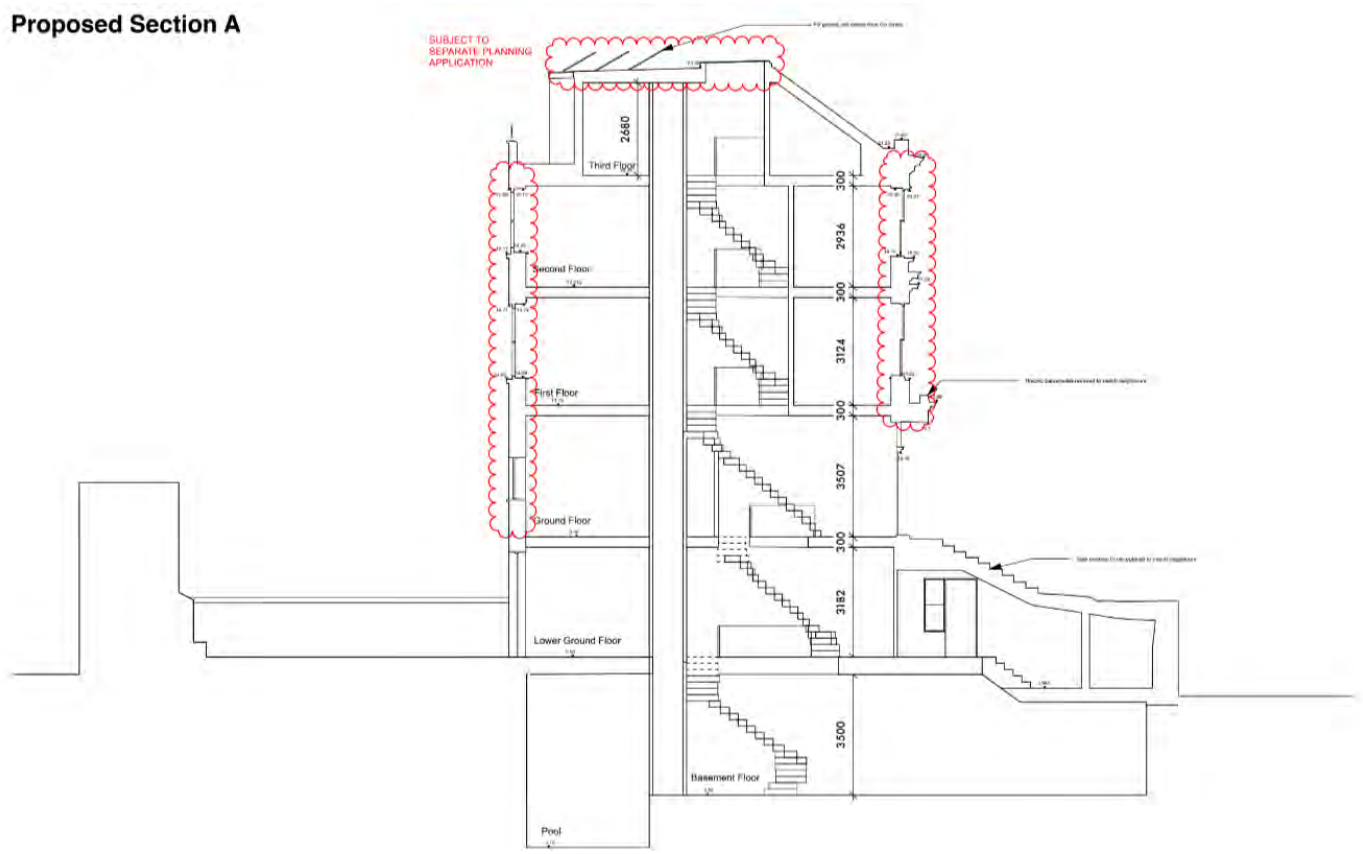


Figure 6.1 Section view of the proposed development

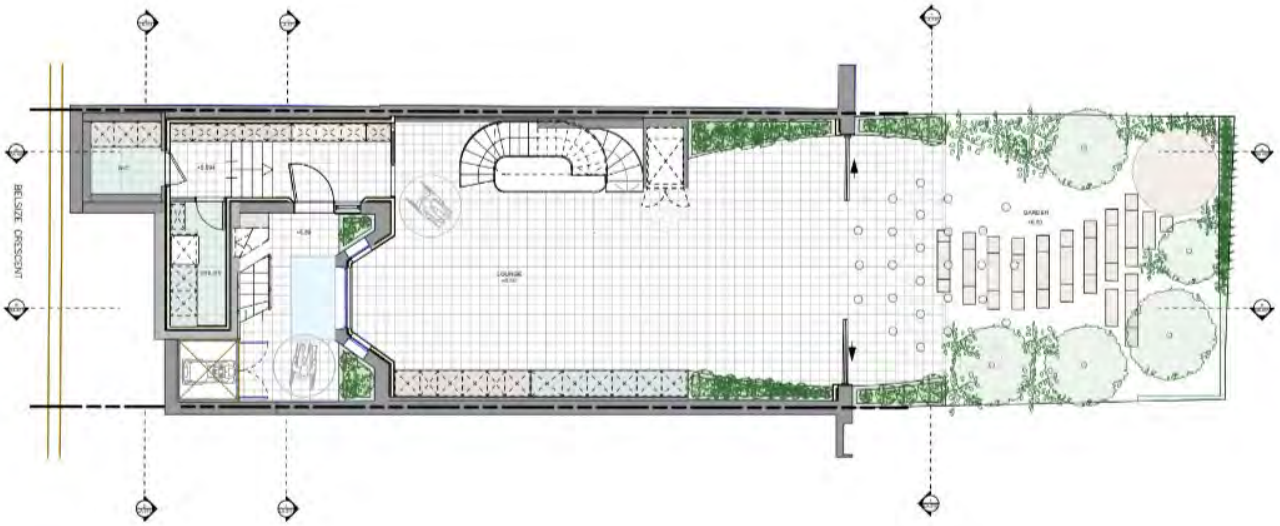


Figure 6.2 Plan view of the proposed Lower Ground Floor with the garden space

Figure 6.3 Plan view of the proposed basement floor

7. Conceptual Site Model (CSM) and Preliminary Risk Assessment (PRA)

A means to qualitatively assess the risk posed by potential land contamination to a proposed development is to prepare an initial CSM and carry out a PRA. An initial CSM represents the characteristics of the site which influence the possible relationships between identified potential contaminant sources, pathways and receptors. A PRA is undertaken for each potentially complete south-pathway-receptor linkage (potential contaminant linkage). The PRA assessment matrix used in this report is included as Appendix A. The risk assessment approach is in accordance with the principles set-out in the *Land Contamination Risk Management* (LCRM) guidance, published by the Environment Agency on the UK Government website.

An initial CSM and PRA for the proposed development is set-out below in consideration of all the information detailed in the earlier sections of this report. Should any changes be made to the proposed development compared to the details presented herein, or should any new information become available, then the PRA must be updated.

7.1. Potential Contaminants of Concern

The potential contamination sources identified as part of this assessment are summarised in this section. Off-site potential sources of contamination within 100 m of the site boundary are identified and considered further, as well as potential sources of contamination within 250 m of the site boundary where the anticipated groundwater flow direction towards the southeast indicates a pathway to the site may be present. Relevant potential ground gas sources within 500 m of the site are also identified.

Current and former residential land-uses, retail units, offices and other general commercial uses (non-industrial) are not considered potential sources of contamination unless stated otherwise.

Naturally occurring radon risks are discussed in Section 3.

Please be aware that the nature of historical records mean that every potential source of contamination may not be detailed in the available documents. Therefore, there is potential for additional sources of contamination to be present.

7.1.1. On-Site Sources

- Made Ground associated with residential site construction and use – heavy metals, acids / alkalis, PAHs, TPHs, elevated sulphates and ground gases.

Asbestos containing materials (ACMs) may be present in the current building fabric. Mitigation measures are described below.

The reader should also be aware that the London Clay Formation presents potential for sulphate ‘attack’ on newly installed below ground concrete structures.

7.1.2. Off-Site Sources

- Railway Tunnel 50 m north - heavy metals, acids / alkalis, PAHs, VOCs, TPHs and elevated sulphates.
- Garages 36 m southeast, 52 m southwest and 72 m southwest - heavy metals, acids / alkalis, PAHs, TPHs, SVOCs, VOCs and elevated sulphates.
- Unknown Filled Ground (pit quarry etc) 56 m northwest – heavy metals, acids / alkalis, PAHs, TPHs, elevated sulphates and ground gases.
- Depot/Warehouse (<100 m from the site, unverified location, identified by the CBC) - heavy metals and metalloids, acids / alkalis, PAHs, TPHs, SVOCs and VOCs.

Asbestos has been indicated for potential off-site sources however due to the nature of the ground model (unproductive strata) the potential pathway to the site is considered unlikely.

Notes -

PAHs – polycyclic aromatic hydrocarbons

TPHs – Total Petroleum Hydrocarbons also including benzene, toluene, ethylbenzene and xylenes (BTEX)

VOCs – volatile organic compounds

SVOCs – semi-volatile organic compounds

Asbestos – potential free fibres, debris and / or fragments of asbestos containing material (ACM).

7.2. Potential Pathways

The potential pathways identified as part of this assessment include:

7.2.1. On-Site Human Health

- Dermal contact or ingestion of soils at the site.
- Inhalation of ground gas, soil vapour or soils at the site.
- Consumption of water from impacted water supply pipes installed as part of the proposed redevelopment.

7.2.2. Off-Site Human Health

- Inhalation of wind-blown soil derived from the site.
- Migration off-site at shallow depth via preferential pathways and / or shallow perched groundwater followed by direct contact / inhalation / ingestion of contaminated soils.
- Off-site migration of ground gas or soil vapour followed by accumulation and inhalation within neighbouring properties.
- Migration off-site at shallow depth via preferential pathways and / or shallow perched groundwater followed by impact to water supply pipes and ingestion.

7.2.3. On-Site Buildings and Below Ground Structures

- Direct contact of ‘aggressive’ ground and / or grossly impacted soils with building structures / foundations.
- Accumulation of ground gas or soil vapour within buildings followed by ignition.

7.2.4. Off-Site Buildings and Below Ground Structures

- Migration off-site via preferential pathways, shallow groundwater and / or shallow perched groundwater followed by direct contact with building structures / foundations.
- Off-site migration of ground gas or soil vapour followed by accumulation within buildings and ignition.

7.2.5. Controlled Waters

- Leaching from the unsaturated zone.
- Perched water percolation and / or lateral migration.
- Migration via advection and diffusion in the saturated zone.
- Vertical and lateral migration of free-phase product in the unsaturated and saturated zones.

7.2.6. Sensitive Ecology, Flora and Fauna

- On-site ingestion / dermal contact / inhalation / root uptake.
- Off-site migration at shallow depth via preferential pathways and / or shallow perched groundwater followed by ingestion / dermal contact / inhalation / root uptake.
- Off-site migration via controlled waters pathways followed by ingestion / dermal contact / inhalation / root uptake.

7.3. Potential Receptors

The potential receptors identified as part of this assessment include:

- Human health of proposed site end users (commercial users and occasional maintenance workers).
- Human health of off-site commercial end users (closest 15 m from site in all directions) and residential end users (closest directly northwest and southeast of the site at 15 & 11 Belsize Crescent respectively) in the vicinity of the site in all directions. Open garden space is present immediately southwest of the site.
- Property including on-site (proposed) and off-site buildings and below ground structures (buried concrete and underground services).
- Flora and fauna in proposed soft-landscaped areas.

New foundation systems associated with the proposed redevelopment are not anticipated to penetrate the base of the London Clay Formation. Therefore, bedrock aquifers and associated SPZ associated with the Chalk Aquifer beneath the London Clay Formation are not considered further in this assessment as there is no risk of preferential pathways being created via piling. The Client should inform A2SI of the foundation termination depths once final designs have been prepared so that no requirement for a foundation works risk assessment can be confirmed. The abstraction points listed in section 3.3 of this report are understood to be sourced from the bedrock aquifer within the Chalk, so for the same reasons it is considered there is no pathway from site to the abstraction points.

Due to nature of the ground model (London Clay Formation – Unproductive Strata), the distance to the River Thames (approximately 5.8 km to the southeast) it is considered that a viable pathway is not present between the site and any nearby potential receptors, including the River Thames.

The London Clay Formation provides no viable pathway for potential on-site contamination to migrate to the tributaries of the lost river Tyburn, located 200 m west and 300 m east of the site, so these are not considered hydraulically connected to the site and therefore are not assessed any further as potential sensitive receptors in this report.

The London Clay Formation is Unproductive Strata so shallow groundwater beneath the site is not considered a sensitive controlled waters receptor and not assessed further.

Risks to site workers and the environment (from potential land contamination) during the construction phase of the proposed redevelopment can be appropriately managed by successful implementation of construction phase risk assessments and method statements (RAMS). The associated construction phase risks from potential contamination are not considered further in this document but should be appropriately considered and mitigated by the Principal Contractor in their preparation and implementation of construction phase RAMS and Construction Phase Plan (CPP).

7.4. Summary of Potential Contaminant Linkages

The information presented in this assessment has been compiled to produce a summary of the identified potential contaminant linkages, based on the initial CSM presented herein. Table 7.1 presents a PRA for the proposed redevelopment based on the identified potential contaminant linkages. This assessment has been performed considering the details of the proposed development presented in this report. Qualitative risk classifications are provided in accordance with *CIRIA C552: Contaminated Land Risk Assessment, A Guide to Good Practice (Rudland et al., 2001)* (see summary in Appendix A). Where no potentially complete contaminant linkage is identified then no risk classification is provided.

Table 7.1 Preliminary Risk Assessment (PRA)

Potential Contaminant Source	Potential Pathway	Potential Receptor	Potential Contaminant Linkage	Risk Level Classification
On-site See Section 7.1.1	Direct contact with soil	Human health of proposed site end users (see Section 7.3)	Yes (Pathways available in localised areas of proposed garden / soft landscaping and for occasional maintenance workers)	Low to moderate
	Inhalation of windblown soil			Low to moderate
	Ingestion of soil			Low to moderate
	Impact to water supply pipes followed by ingestion of contaminated water supply		Yes (The residential site history means it is unlikely that significant hydrocarbon contamination is present which could impact new water supply pipes)	Low
	Ground gas generation and inhalation		Yes (Made Ground represents a potential source of ground gas)	Low to moderate
	Soil vapour generation and inhalation		Yes (The residential site history means it is unlikely that significant volatile contamination is present)	Low
	Inhalation of windblown soil from the site	Off-site human health (see Section 7.3)	Yes (Domestic gardens with open ground are present in the near vicinity. However, based on the residential history it is unlikely that there is notable contamination migrating off-site)	Low
	Off-site migration and direct contact with impacted soil			Low
	Off-site migration and ingestion of impacted soil			Low
	Impact to water supply pipes followed by ingestion of contaminated water supply			Low
	Ground gas generation, off-site migration and inhalation		Yes (On-site Made Ground represents potential sources of ground gas but given the site history the elevated risks are restricted to on-site receptors)	Low
	Soil vapour generation, off-site migration and inhalation		Yes (The residential site history means it is unlikely that	Low

Potential Contaminant Source	Potential Pathway	Potential Receptor	Potential Contaminant Linkage	Risk Level Classification
			significant volatile contamination is present)	
	Direct contact	On-site below ground structures (proposed)	Yes (Buried structures may be subjected to sulphate 'attack')	Low to moderate
	Migration followed by ignition of ground gas		Yes (Made Ground represents a potential source of ground gas)	Low to moderate
	Migration followed by ignition of soil vapour		Yes (The residential site history means it is unlikely that significant volatile contamination is present)	Low
	Off-site migration followed by direct contact	Off-site below ground structures	Yes (On site contamination is unlikely to migrate off site and impact adjacent building structures)	Low
	Off-site migration followed by ignition of ground gas		Yes (On-site Made Ground represents potential sources of ground gas but given the site history the elevated risks are restricted to on-site receptors)	Low
	Off-site migration followed by ignition of soil vapour		Yes (The residential site history means it is unlikely that significant volatile contamination is present)	Low
	On-site ingestion / dermal contact / inhalation / root uptake	Flora and fauna in proposed soft-landscaped areas at the site	Yes (Very limited soft-landscaping is proposed and it is of low ecological sensitivity)	Low
	Off-site migration at shallow depth followed by ingestion / dermal contact / inhalation / root uptake	Off-site flora and fauna in soft-landscaped areas nearby	Yes (Very limited soft-landscaping is in the immediately surrounding area and it is of low ecological sensitivity)	Low
Off-site See Section 7.1.2	On-site migration followed by direct contact or ingestion of soil	Human health of proposed site end users (see Section 7.3)	Yes (No significant off site sources potential sources of contamination identified with the potential to impact soils beneath the site at shallow depth)	Low
	Inhalation of windblown soil from off-site			Low

Potential Contaminant Source	Potential Pathway	Potential Receptor	Potential Contaminant Linkage	Risk Level Classification
	On-site migration followed by impact to water supply pipes and ingestion of the water supply			Low
	Ground gas generation, on-site migration and inhalation		Yes (Potential ground gas sources in the surrounding area associated with the filled ground 56m northwest have been identified. The underlying ground model (cohesive clay) reduces the potential for ground gas to migrate onto site, however at this stage low to moderate risk is assessed on a conservative basis)	Low to moderate
	Soil vapour generation, on-site migration and inhalation		Yes (Potential vapour sources in the surrounding area have been identified. The underlying ground model (cohesive clay) reduces the potential for vapours to migrate onto site, however at this stage low to moderate risk is assessed on a conservative basis)	Low to moderate
	On-site migration followed by direct contact	On-site below ground structures (proposed)	Yes (It is unlikely that gross contamination with potential to damage structures is migrating onto site)	Low
	On-site migration followed by ignition of ground gas		Yes (Potential ground gas sources in the surrounding area associated with the filled ground 56m northwest have been identified. The underlying ground model (cohesive clay) reduces the potential for ground gas to migrate onto site, however at this stage low to moderate risk is assessed on a conservative basis)	Low to moderate
	On-site migration followed by ignition of soil vapour		Yes (Potential vapour sources in the surrounding area have been identified. The underlying ground model (cohesive clay) reduces the potential for vapours to migrate onto site, however at this stage low to moderate risk is	Low to moderate

Potential Contaminant Source	Potential Pathway	Potential Receptor	Potential Contaminant Linkage	Risk Level Classification
			assessed on a conservative basis)	
	On-site ingestion / dermal contact / inhalation / root uptake	Flora and fauna in proposed soft-landscaped areas at the site	Yes (Very limited soft-landscaping is proposed and it is of low ecological sensitivity)	Low

The PRA has identified potential contaminant linkages with a maximum low to moderate risk classification.

Based on the results of the PRA, it is considered that there are no unacceptable risks (ref. *LCRM* guidance) to controlled waters and flora and fauna.

Unacceptable risks (ref. *LCRM* guidance) have been identified with respect to human health and below ground structures. Therefore, it is recommended that appropriately targeted ground investigation is undertaken for geo-environmental purposes to enable a refinement of the CSM and geo-environmental assessments for the specifically identified unacceptable risks. The next stage of geo-environmental assessment should include a generic quantitative risk assessment (GQRA) for human health and controlled waters purposes. Appropriate assessments should also be made with respect to the proposed on-site buildings and structures, including an assessment of the risk from sulphate 'attack' to foundations. The recommended ground investigation and assessments should be undertaken and presented in a 'Phase II' type geo-environmental interpretive report in accordance with *BS10175:2011 Investigation of Potentially Contaminated Sites – Code of Practice* and *LCRM* guidance.

The risk represented by potential ACMs in the current building fabric can be addressed by commissioning an asbestos Demolition and Refurbishment Survey for the relevant areas of the current building to be demolished and / or renovated. If ACMs are identified then their onward management should be informed by an asbestos specialist, but it is considered that appropriate ACM removal will be required prior to any phases of demolition.

8. Closing Remarks

A2 Site Investigation Limited was appointed by Edmund Lehmann and Jennifer Nguyen to prepare a phase I desk study report for the proposed development at 13 Belsize Crescent. The desk study provides an initial Conceptual Site Model (CSM) and qualitative Preliminary Risk Assessment (PRA) for the proposed development in accordance with the principles set out in *Land Contamination Risk Management* (LCRM) guidance, published by the Environment Agency on the UK Government website. The desk study has also been prepared in the context of the *National Planning Policy Framework* (NPPF) and *The Building Regulations 2010, Approved Document C - Site preparation and resistance to contaminants and moisture (2004 Edition incorporating 2010 and 2013 amendments)*.

The site currently includes a four-storey residential building with a single-level lower ground floor over the majority of the building footprint. The scheme comprises the refurbishment of the existing structure on site, which includes partial demolition on the building interior. The existing foundations will be reused, the floor slab will be replaced and underpinned to a level still to be decided and a storeroom will be constructed under the front garden.

The ground conditions at the site indicate the presence of London Clay Formation underlain by the Lambeth Group deposits. Made Ground of variable thickness is anticipated to be present across the site based on the identified site history.

The outcome of the preliminary UXO report concluded that the risk associated with (any) very shallow buried UXO may have been partially mitigated. The risk associated with (any) shallow or deep buried UXO almost certainly remains unmitigated. Although it was situated over 7km from the Luftwaffe's primary aiming point for raids on London (the City of London), Hampstead was subjected to large scale air raids during WWII. The Site is recorded as sustaining no damage within London County Council bomb damage mapping. Furthermore, post-WWII aerial photography corroborates this, with the Site appearing to have remained relatively untouched. No rubble/debris was likely present, increasing the likelihood that evidence of a UXB would have been observed, had one struck the Site. As the redevelopment of the storeroom will disturb likely untouched soil, this heightens the likelihood of finding a UXB. However, due to the lack of bomb damage and recorded bomb strikes on Site, coupled with wartime conditions conducive to the detection of a UXB strike, the likelihood of encountering a German UXB is not considered to be elevated. Subsequently, further research is not considered necessary however, a UXO safety briefing is recommended.

The PRA has identified potential contaminant linkages with a maximum low to moderate risk classification.

Based on the results of the PRA, it is considered that there are no unacceptable risks (ref. *LCRM* guidance) to controlled waters and flora and fauna.

Unacceptable risks (ref. *LCRM* guidance) have been identified with respect to human health and below ground structures. Therefore, it is recommended that appropriately targeted ground investigation is undertaken for geo-environmental purposes to enable a refinement of the CSM and geo-environmental assessments for the specifically identified unacceptable risks. The next stage of geo-environmental assessment should include a generic quantitative risk assessment (GQRA) for human health and controlled waters purposes. Appropriate assessments should also be made with respect to the proposed on-site buildings and structures, including an assessment of the risk from sulphate 'attack' to foundations. The recommended ground investigation and assessments should be undertaken and presented in a 'Phase II' type geo-environmental interpretive report in accordance with *BS10175:2011 Investigation of Potentially Contaminated Sites – Code of Practice* and *LCRM* guidance.

The risk represented by potential ACMs in the current building fabric can be addressed by commissioning an asbestos Demolition and Refurbishment Survey for the relevant areas of the current building to be demolished and / or renovated. It is considered that appropriate ACM removal will be required prior to any phases of demolition. If ACMs are identified then their onward management should be informed by an asbestos specialist.

The property is in a lower probability radon area however as there is a significant basement proposed it is recommended that appropriate radon protection is provided.

Risks to site workers and the environment (from potential land contamination) during the construction phase of the proposed redevelopment can be appropriately managed by successful implementation of construction phase risk assessments and method statements (RAMS). The associated construction phase risks from potential contamination should be appropriately considered and mitigated by the Principal Contractor in their preparation and implementation of construction phase RAMS and Construction Phase Plan (CPP).

This desk study should be made available to those preparing the operational site Health & Safety File for the proposed development.

In case of any new water supply pipes being installed, their final specification should be based on the risk assessments and recommendations presented herein and also agreed with the utility provider. It is likely that standard water supply pipe construction is suitable for any new water supply pipes installed.

Should any changes be made to the proposed development compared to the details presented herein, or should any new information become available, then the assessments included in this desk study must be updated.

The Client should inform A2SI of the foundation termination depths once final designs have been prepared so that no requirement for a foundation works risk assessment can be confirmed.

Appendix A: Qualitative Risk Assessment Matrix

A2SI qualitative risk assessment for geo-environmental purposes is undertaken in accordance with *CIRIA C552: Contaminated Land Risk Assessment, A Guide to Good Practice (Rudland et al., 2001)*. The CIRIA C552 risk categories and the assessment methodology are summarised below in Table A.1, Table A.2 and Table A.3. Potential magnitude and potential likelihood are both classified to enable a risk rating to be assessed.

Potential magnitude takes into account the potential consequences should a complete source–pathway–receptor linkage be present. Potential magnitude is classified as per Table A.1.

Table A.1 Definition of potential magnitude of consequence

Category	Definition
Severe	Acute risks to human health, catastrophic damage to buildings / property, major pollution to controlled waters.
Medium	Chronic risk to human health, pollution of sensitive controlled waters, significant effects on sensitive ecosystems or species, significant damage to buildings or structures.
Mild	Pollution of non-sensitive waters, minor damage to buildings or structures.
Minor	Damage to non-sensitive ecosystems or species.

Potential likelihood takes into account the presence of the hazard and receptor as well as the integrity of the pathway for exposure, i.e., whether a source-pathway-receptor linkage is present or not. Potential likelihood is classified as per Table A.2.

Table A.2 Definition of potential likelihood of exposure

Category	Definition
High Likelihood	Pollutant linkage may be present and is almost certain to occur in the long-term. Or there is evidence of harm to the receptor.
Likely	Pollutant linkage may be present, and it is probable that it will occur over the long-term.
Low Likelihood	Pollutant linkage may be present, and there is a possibility that it will occur, although there is no certainty that it will do so.
Unlikely	Pollutant linkage may be present, but it is improbable that it will occur.

The potential magnitude of consequence and the potential likelihood of exposure are assessed in accordance with the risk matrix presented in Table A.3.

Table A.3 Geo-environmental risk assessment matrix

		Potential Magnitude of Consequence			
		Severe	Medium	Mild	Minor
Potential Likelihood of Exposure	High Likelihood	Very High	High	Moderate	Low to Moderate
	Likely	High	Moderate	Low to Moderate	Low
	Low Likelihood	Moderate	Low to Moderate	Low	Very Low
	Unlikely	Low to Moderate	Low	Very Low	Very Low

Appendix B: Envirocheck Report

Geology 1:50,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WGR	Worked Ground (Undivided)	Void	Not Supplied - Holocene
	MGR	Made Ground (Undivided)	Artificial Deposit	Not Supplied - Holocene

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	STGR	Stanmore Gravel Formation	Sand and Gravel	Not Supplied - Pleistocene

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	LC	London Clay Formation	Clay, Silt and Sand	Not Supplied - Ypresian
	CLGB	Claygate Member	Clay, Silt and Sand	Not Supplied - Ypresian
	BGS	Bagshot Formation	Sand	Not Supplied - Ypresian

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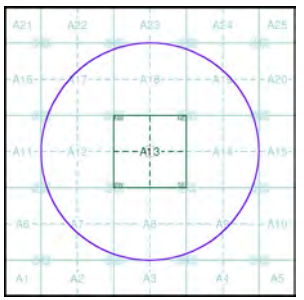
Geology 1:50,000 Maps

This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published paper maps.
The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page. Not all layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:50,000 Maps Coverage

Map ID:	**1**
Map Sheet No:	**256**
Map Name:	**North London**
Map Date:	**2006**
Bedrock Geology:	**Available**
Superficial Geology:	**Available**
Artificial Geology:	**Available**
Faults:	**Not Supplied**
Landslip:	**Available**
Rock Segments:	**Not Supplied**

Geology 1:50,000 Maps - Slice A



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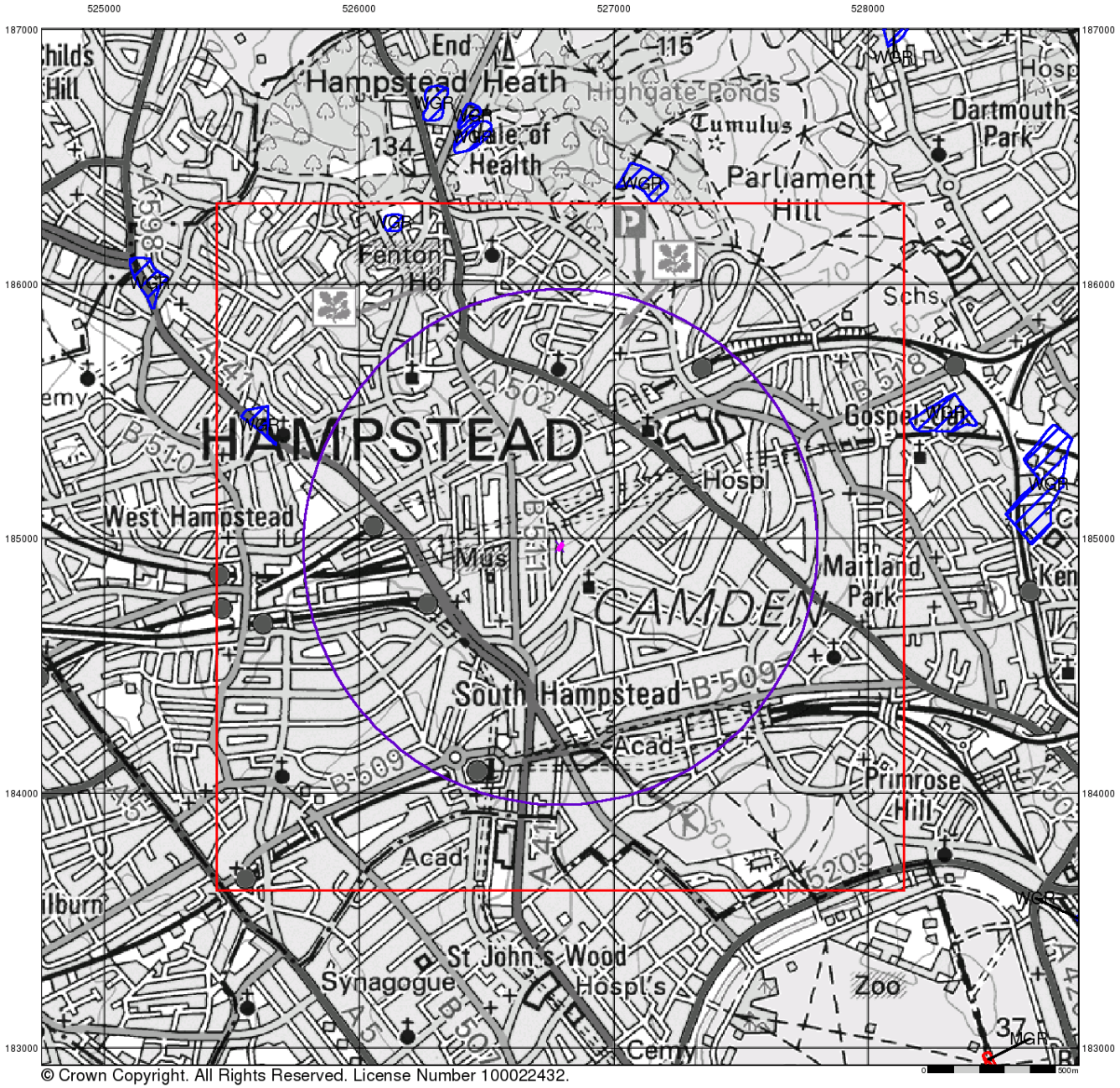
Search Buffer (m):	1000

Site Details:

13, Belsize Crescent, LONDON, NW3 5QY



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Artificial Ground and Landslip

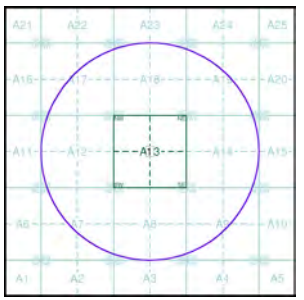
Artificial ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Information about previously developed ground is especially important, as it is often associated with potentially contaminated material, unpredictable engineering conditions and unstable ground.

Artificial ground includes:

- Made ground - man-made deposits such as embankments and spoil heaps on the natural ground surface.
- Worked ground - areas where the ground has been cut away such as quarries and road cuttings.
- Infilled ground - areas where the ground has been cut away then wholly or partially backfilled.
- Landscaped ground - areas where the surface has been reshaped.
- Disturbed ground - areas of ill-defined shallow or near surface mineral workings where it is impracticable to map made and worked ground separately.

Mass movement (landslip) deposits on BGS geological maps are primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground. The dataset also includes foundered strata, where the ground has collapsed due to subsidence.

Artificial Ground and Landslip Map - Slice A



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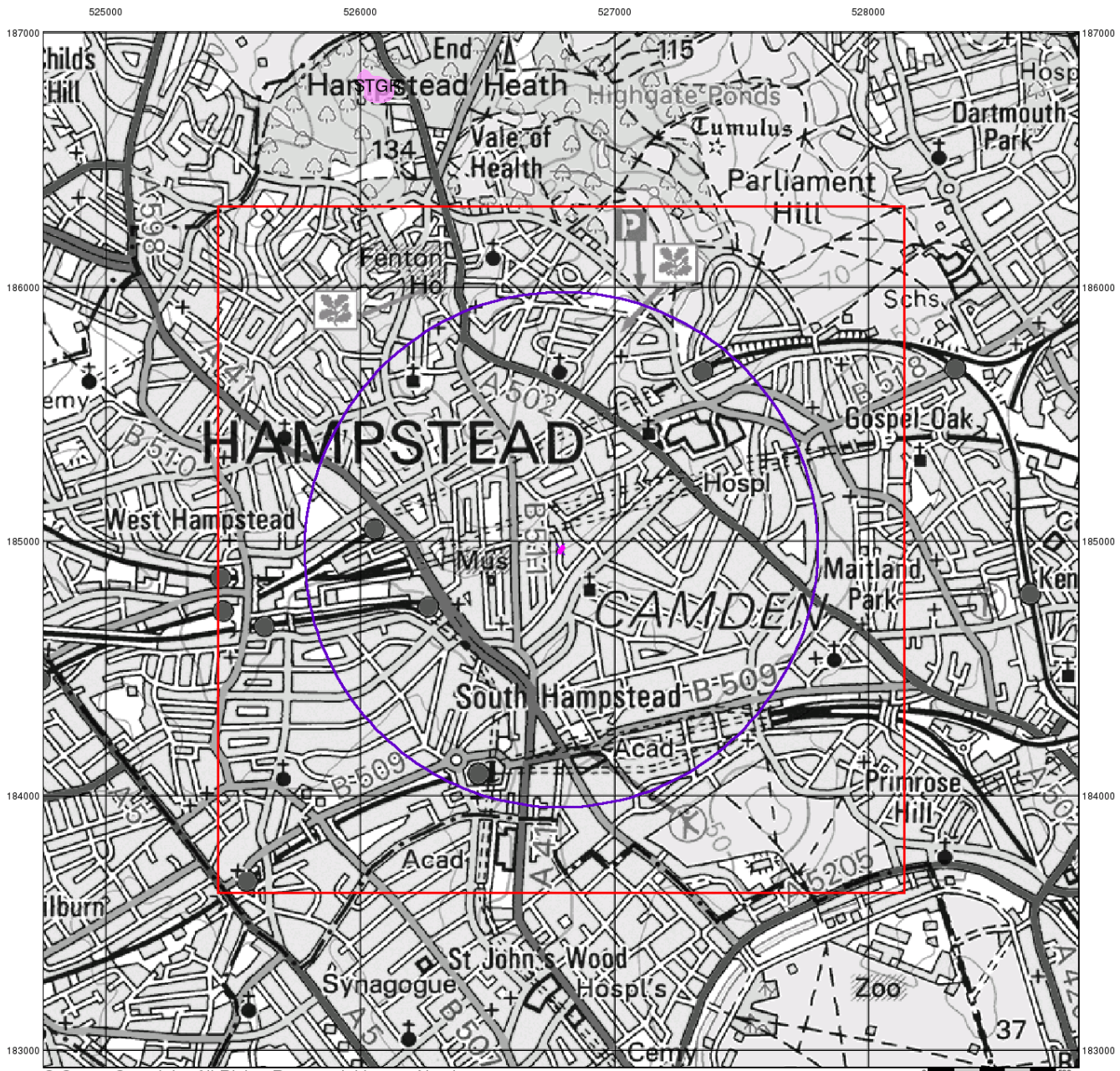

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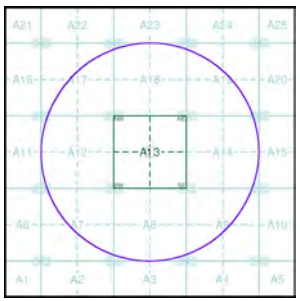
Superficial Geology

Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, the Quaternary, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A



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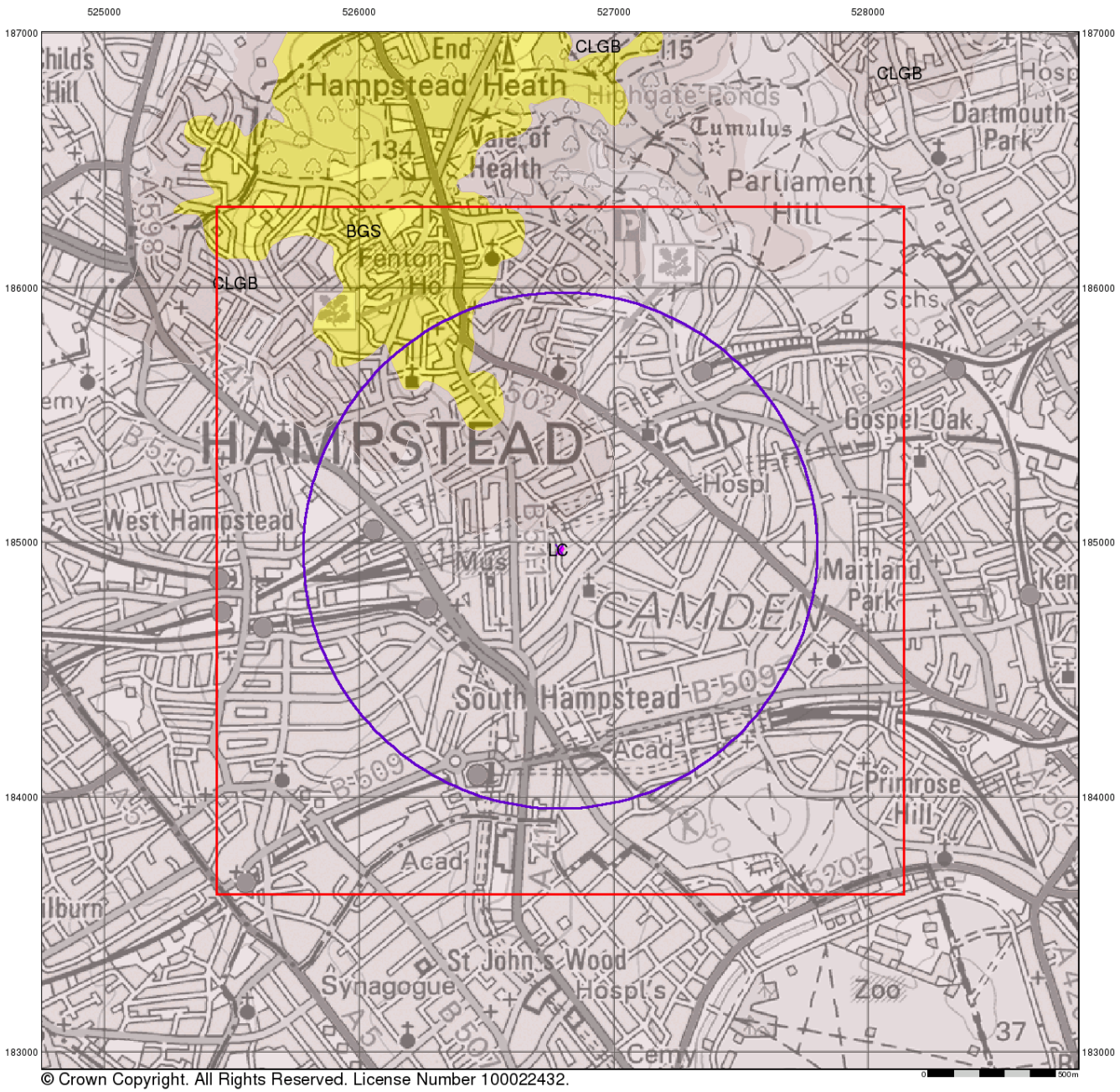

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Bedrock and Faults

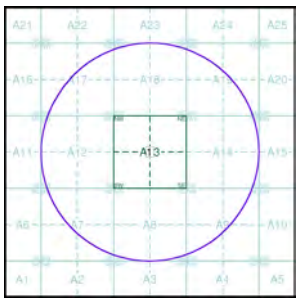
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults (e.g. normal, thrust), and thin beds mapped as lines (e.g. coal seam, gypsum bed). Some of these are linked to other particular 1:50,000 Geology datasets, for example, coal seams are part of the bedrock sequence, most faults and mineral veins primarily affect the bedrock but cut across the strata and post date its deposition.

Bedrock and Faults Map - Slice A



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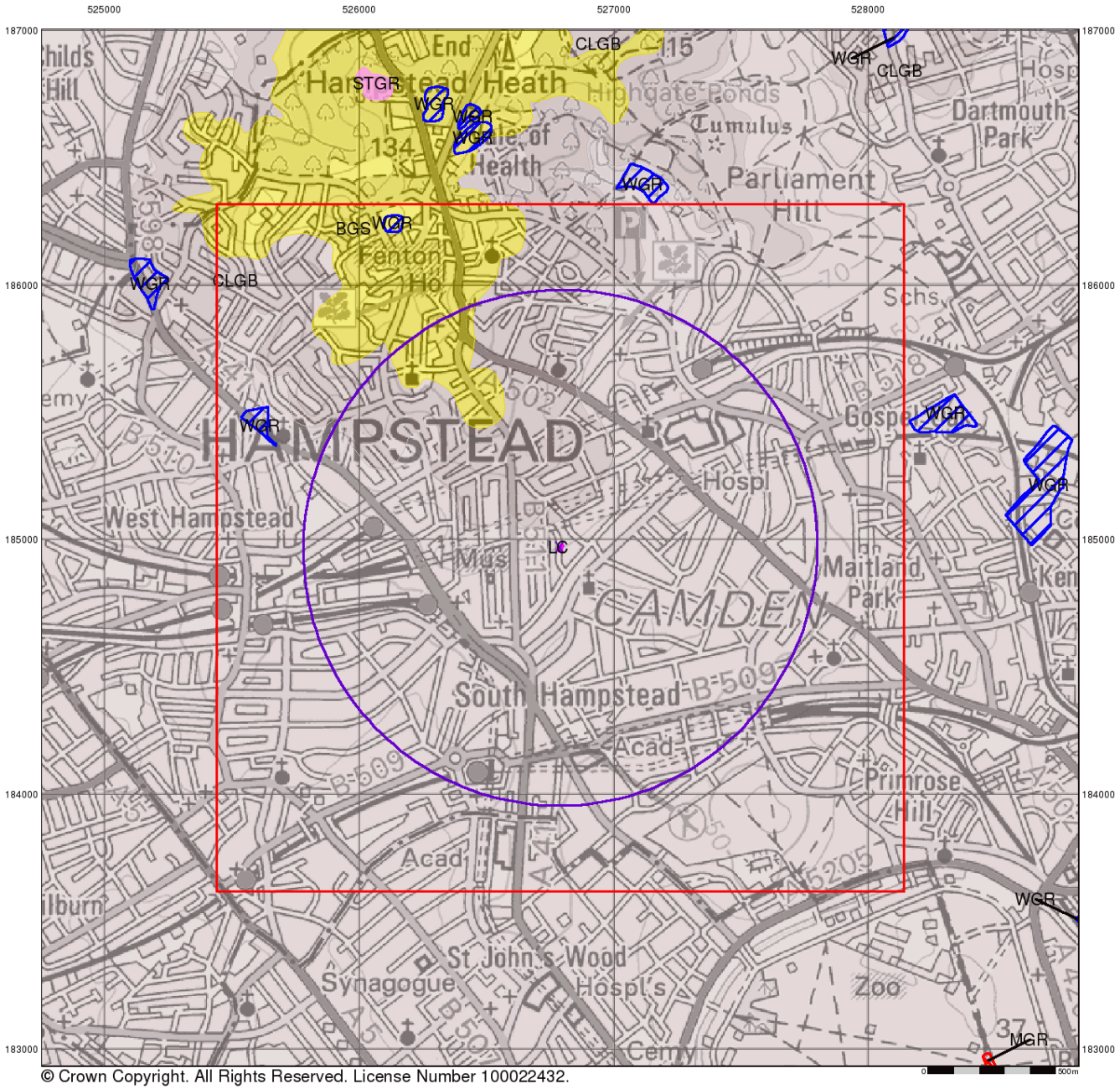

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Combined Surface Geology

The Combined Surface Geology map combines all the previous maps into one combined geological overview of your site.

Please consult the legends to the previous maps to interpret the Combined "Surface Geology" map.

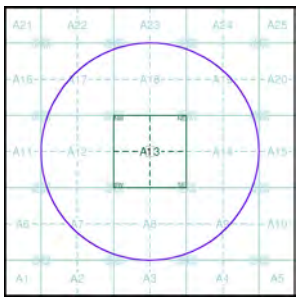
Additional Information

More information on 1:50,000 Geological mapping and explanations of rock classifications can be found on the BGS website. Using the LEX Codes in this report, further descriptions of rock types can be obtained by interrogating the 'BGS Lexicon of Named Rock Units'. This database can be accessed by following the 'Information and Data' link on the BGS website.

Contact

British Geological Survey
Kingsley Dunham Centre
Keyworth
Nottingham
NG12 5GG
Telephone: 0115 936 3143
Fax: 0115 936 3276
email: enquiries@bgs.ac.uk
website: www.bgs.ac.uk

Combined Geology Map - Slice A



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Site Area (Ha):	0.02
Search Buffer (m):	1000

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Historical Mapping Legends

Ordnance Survey County Series 1:10,560

Gravel Pit
Sand Pit
Other Pits
Quarry
Shingle
Orchard
Osiers
Reeds
Marsh
Mixed Wood
Deciduous
Brushwood
Fir
Furze
Rough Pasture
Arrow denotes flow of water
Trigonometrical Station
Site of Antiquities
Bench Mark
Pump, Guide Post, Signal Post
Well, Spring, Boundary Post
·285 Surface Level
Sketched Contour
Instrumental Contour
Main Roads
Fenced
Un-Fenced
Minor Roads
Fenced
Un-Fenced
Sunken Road
Raised Road
Road over Railway
Railway over River
Railway over Road
Level Crossing
Road over River or Canal
Road over Stream
Road over Stream
County Boundary (Geographical)
County & Civil Parish Boundary
Administrative County & Civil Parish Boundary
Co. Boro. Bdy. County Borough Boundary (England)
Co. Burgh Bdy. County Burgh Boundary (Scotland)
R.D. Bdy. Rural District Boundary
Civil Parish Boundary

Ordnance Survey Plan 1:10,000

Chalk Pit, Clay Pit or Quarry
Gravel Pit
Sand Pit
Disused Pit or Quarry
Refuse or Slag Heap
Lake, Loch or Pond
Dunes
Boulders
Coniferous Trees
Non-Coniferous Trees
Orchard
Scrub
Coppice
Bracken
Heath
Rough Grassland
Marsh
Reeds
Saltings
Building
Direction of Flow of Water
Shingle
Sand
Glasshouse
Pylon
Pylon
Electricity Transmission Line
Sloping Masonry
Cutting
Embankment
Standard Gauge Multiple Track
Road Under
Road Over
Level Crossing
Foot Bridge
Standard Gauge Single Track
Siding, Tramway or Mineral Line
Narrow Gauge
Geographical County
Administrative County, County Borough or County of City
Municipal Borough, Urban or Rural District, Burgh or District Council
Borough, Burgh or County Constituency
Shown only when not coincident with other boundaries
Civil Parish
Shown alternately when coincidence of boundaries occurs

BP, BS	Boundary Post or Stone	Pol Sta	Police Station
Ch	Church	PO	Post Office
CH	Club House	PC	Public Convenience
F E Sta	Fire Engine Station	PH	Public House
FB	Foot Bridge	SB	Signal Box
Fn	Fountain	Spr	Spring
GP	Guide Post	TCB	Telephone Call Box
MP	Mile Post	TCP	Telephone Call Post
MS	Mile Stone	W	Well

1:10,000 Raster Mapping

Gravel Pit
Refuse tip or slag heap
Rock
Rock (scattered)
Boulders
Boulders (scattered)
Shingle
Mud
Mud
Sand
Sand
Sand Pit
Slopes
Top of cliff
General detail
Underground detail
Overhead detail
Narrow gauge railway
Multi-track railway
Single track railway
County boundary (England only)
Civil, parish or community boundary
District, Unitary, Metropolitan, London Borough boundary
Constituency boundary
Area of wooded vegetation
Non-coniferous trees
Non-coniferous trees (scattered)
Coniferous trees
Coniferous trees (scattered)
Positioned tree
Orchard
Coppice or Osiers
Rough Grassland
Heath
Scrub
Marsh, Salt Marsh or Reeds
Water feature
Flow arrows
MHW(S) Mean high water (springs)
MLW(S) Mean low water (springs)
Telephone line (where shown)
Electricity transmission line (with poles)
BM 123.45 m Bench mark (where shown)
Triangulation station
Point feature (e.g. Guide Post or Mile Stone)
Pylon, flare stack or lighting tower
Site of (antiquity)
Glasshouse
General Building
Important Building

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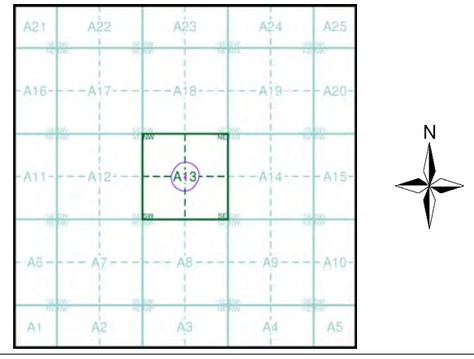
Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Middlesex	1:10,560	1873 - 1882	3
Middlesex	1:10,560	1879	4
London	1:10,560	1896	5
Essex	1:10,560	1920	6
London	1:10,560	1920	7
Essex	1:10,560	1938	8
London	1:10,560	1938	9
Historical Aerial Photography	1:10,560	1950	10
Ordnance Survey Plan	1:10,000	1951	11
Ordnance Survey Plan	1:10,000	1957 - 1958	12
Ordnance Survey Plan	1:10,000	1968	13
Ordnance Survey Plan	1:10,000	1974 - 1976	14
London	1:25,000	1985	15
Ordnance Survey Plan	1:10,000	1991 - 1996	16
10K Raster Mapping	1:10,000	1999	17
10K Raster Mapping	1:10,000	2006	18
VectorMap Local	1:10,000	2021	19

Historical Map - Slice A



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Slice: A
Site Area (Ha): 0.02
Search Buffer (m): 1000

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Russian Military Mapping Legends

1:5,000 and 1:10,000 mapping

a. Not drawn to scale b. Drawn to scale

- Government and Administrative Buildings
- Military and Industrial Buildings
- Military and Communication Areas
- Subway Entrance
- Fireproof Building
- Prominent Fireproof Building
- Non-fireproof Building
- Non-fireproof Building (non-dwelling)
- Factory, mill, and flour mill, with chimneys
- Factory, mill, and flour mill, without chimneys
- Power Station, drawn to scale
- Hydroelectric Power Station
- Radio Station, drawn to scale
- Telephone Station, drawn to scale
- Abandoned Open-pit Mine or Quarry
- Open-pit Salt Mine
- Pit
- Oil Deposit or Well
- Oil Seepage
- Tailings Pile
- Fuel Storage Tanks
- Natural Gas Tank
- Bench Mark
- Drill Hole
- Burial Mound
- Triangulation Point on Burial Mound
- Single-track Railroad
- Double-track Railroad and Station Building
- Coniferous Forest
- Deciduous Forest
- Mixed Forest
- Lawns
- Citrus Orchard
- Wet Ground
- Scattered Vegetation

243,8 Values for prominent elevations

186.0 Numbers for spot elevations, depth soundings, contour lines, etc.

0,2 Velocity of the current, width of river bed, depth of river

180/12 180/12 Fractional terms: length and capacity of bridges; depth of fords and condition of the river bottom; height of forest and the diameter of trees

Russian Alphabet (For reference and phonetic interpretation of map text)

А а (A)	З з (Z)	П п (P)	Ч ч (CH)
Б б (B)	И и (I)	Р р (R)	Ш ш (SH)
В в (V)	Й й (Y)	С с (S)	Щ щ (SHCH)
Г г (G)	К к (K)	Т т (T)	ъ (–)
Д д (D)	Л л (L)	У у (U)	ы (Y)
Е е (E)	М м (M)	Ф ф (F)	ь (')
Ё ё (YO)	Н н (N)	Х х (KH)	Э э (E)
Ж ж (ZH)	О о (O)	Ц ц (TS)	Ю ю (YU or IU)
			Я я (YA or IA)

1:25,000 mapping

a. Not drawn to scale b. Drawn to scale

- Government and Administrative Buildings
- Military and Industrial Buildings
- Military and Communication Areas
- Subway Entrance
- Partly Demolished Buildings
- Demolished Buildings
- Built-Up Area with Fireproof Buildings Predominant
- Built-Up Area with Non-Fireproof Buildings Predominant
- Individual Fireproof Building
- Prominent Industrial Building
- Individual Dwelling, Fireproof
- Ruins of an Individual Dwelling
- Factory or Mill Chimney
- Factory or Mill with Chimney
- Factory or Mill without Chimney
- Mine or Open Pit Mine
- Operating Shaft or Mine
- Non-Operating Shaft or Mine
- Salt Mine
- Tailings Pile
- Pit
- Stone Quarry
- Gas Pump or Service Station
- Fuel Storage or Natural Gas Tank
- Oil or Natural Gas Derrick
- Small Hydroelectric Power Station
- Power Station
- Transformer Station
- Cemetery
- Burial Mound (height in metres)
- Triangulation Point on Burial Mound
- Triangulation Point
- Bench Mark
- Bench Mark (monumented)
- Telegraph Office
- Telephone Station
- Radio Station
- Radio Tower
- Airfield or Seaplane Base
- Landing Strip
- Main Highway
- Highway under Construction
- Improved Dirt Road (former truck road)
- Double-track Railroad with First Class Station
- Dismantled Railroad
- Railroad Under Construction
- Shore Embankment
- River or Ditch with Embankment
- Direction and velocity of current
- Well
- Water Reservoir or Rain Water Pit
- Spring
- Isobath with value
- Heavy (Index) Contour Line
- Contour Line and Value
- Half Contour Line
- Spot Elevation Value
- Coniferous
- Deciduous
- Mixed
- Scrub

Key to Numbers on Mapping

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Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Middlesex	1:10,560	1873 - 1882	3
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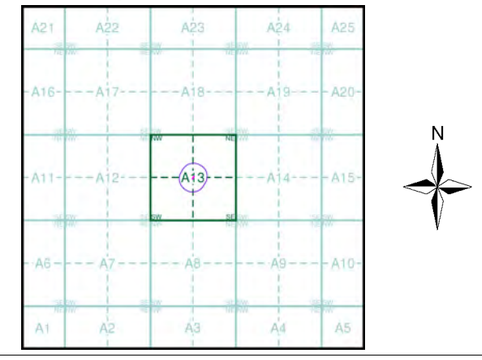
VectorMap Local	1:10,000	2021	19

Russian Map - Slice A



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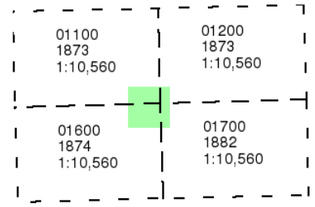
Middlesex

Published 1873 - 1882

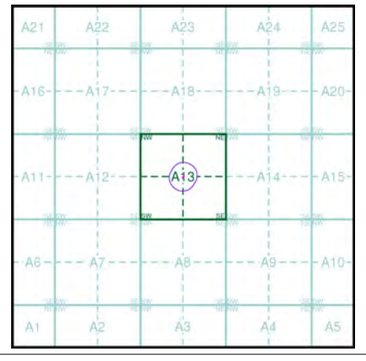
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



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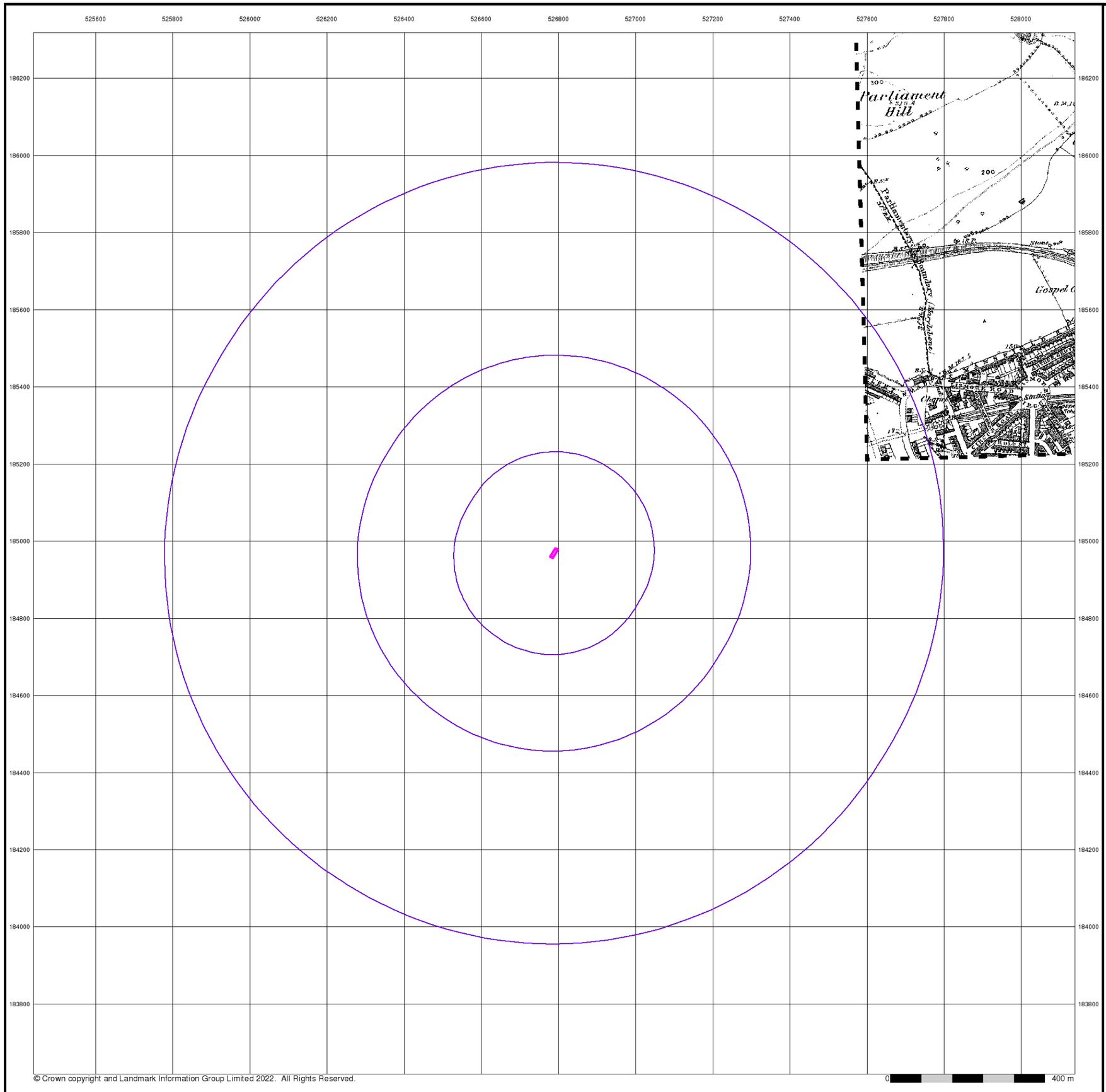

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Middlesex

Published 1879

Source map scale - 1:10,560

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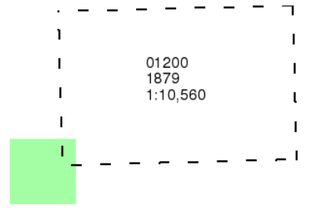
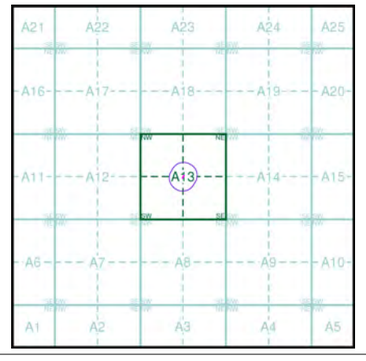


Historical Map - Slice A



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London

Published 1896

Source map scale - 1:10,560

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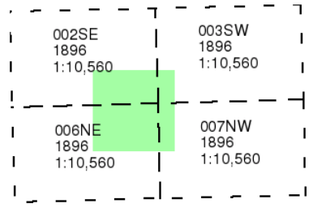
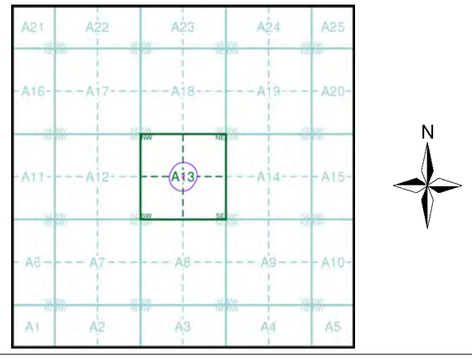


Historical Map - Slice A



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Search Buffer (m):	1000

Site Details

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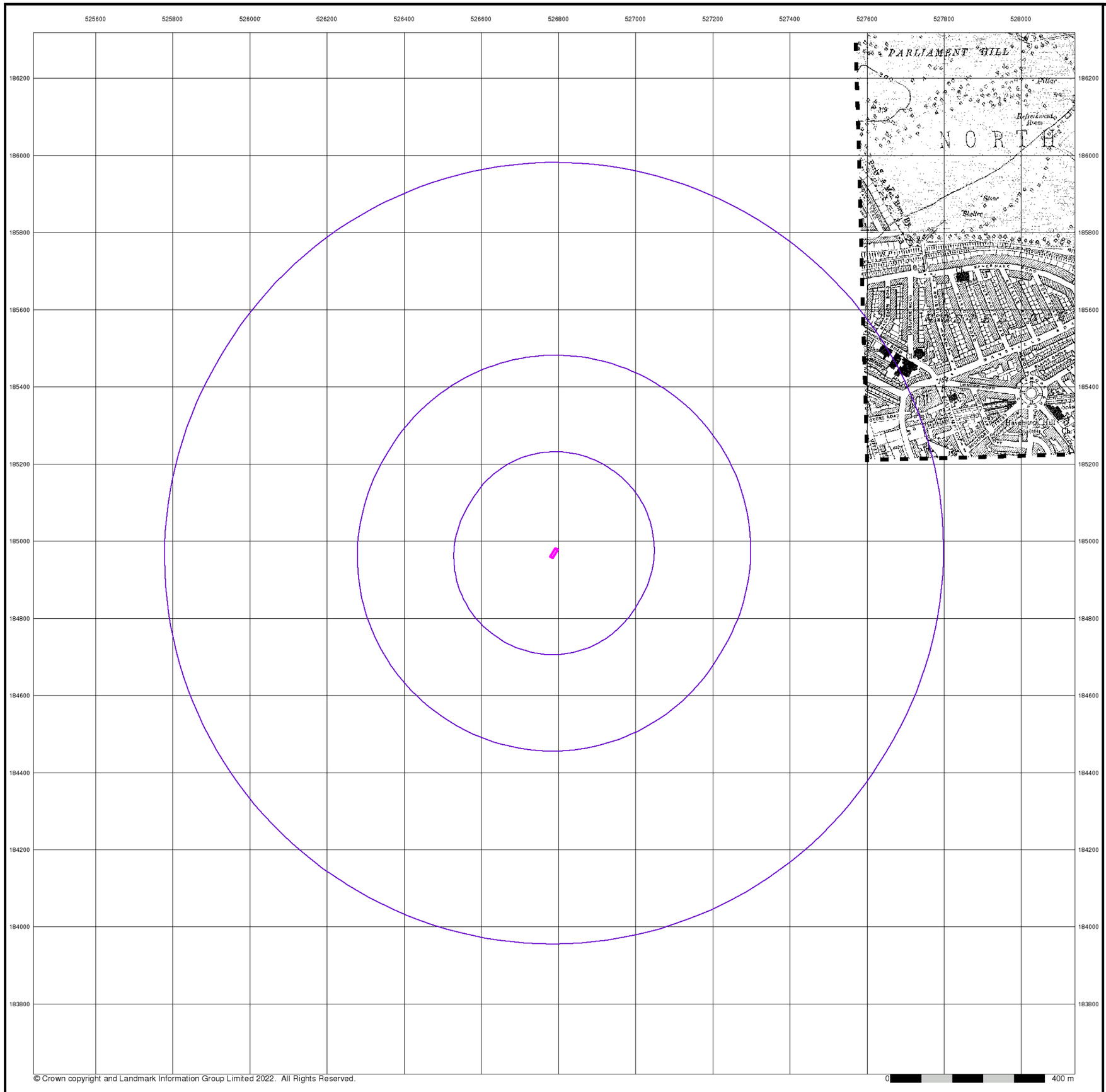

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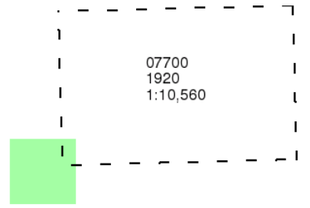
Essex

Published 1920

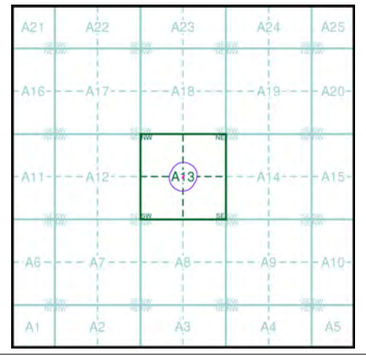
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number:	301610419_1_1
Customer Ref:	24022
National Grid Reference:	526790, 184970
Slice:	A
Site Area (Ha):	0.02
Search Buffer (m):	1000

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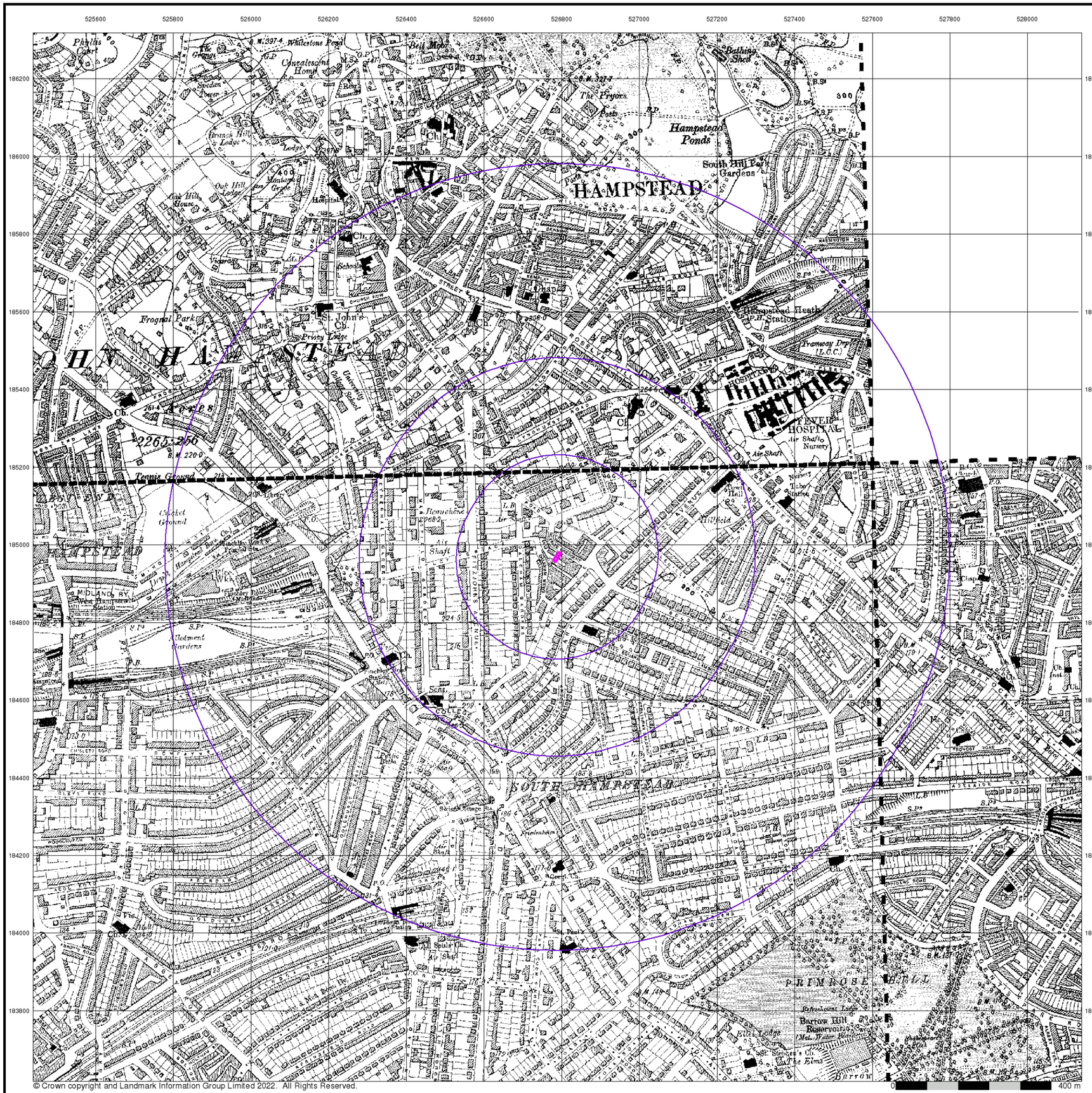

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London

Published 1920

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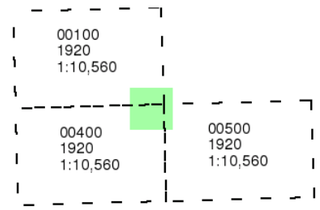

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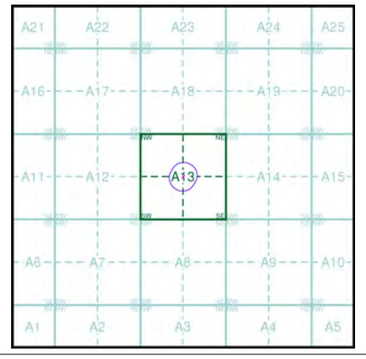

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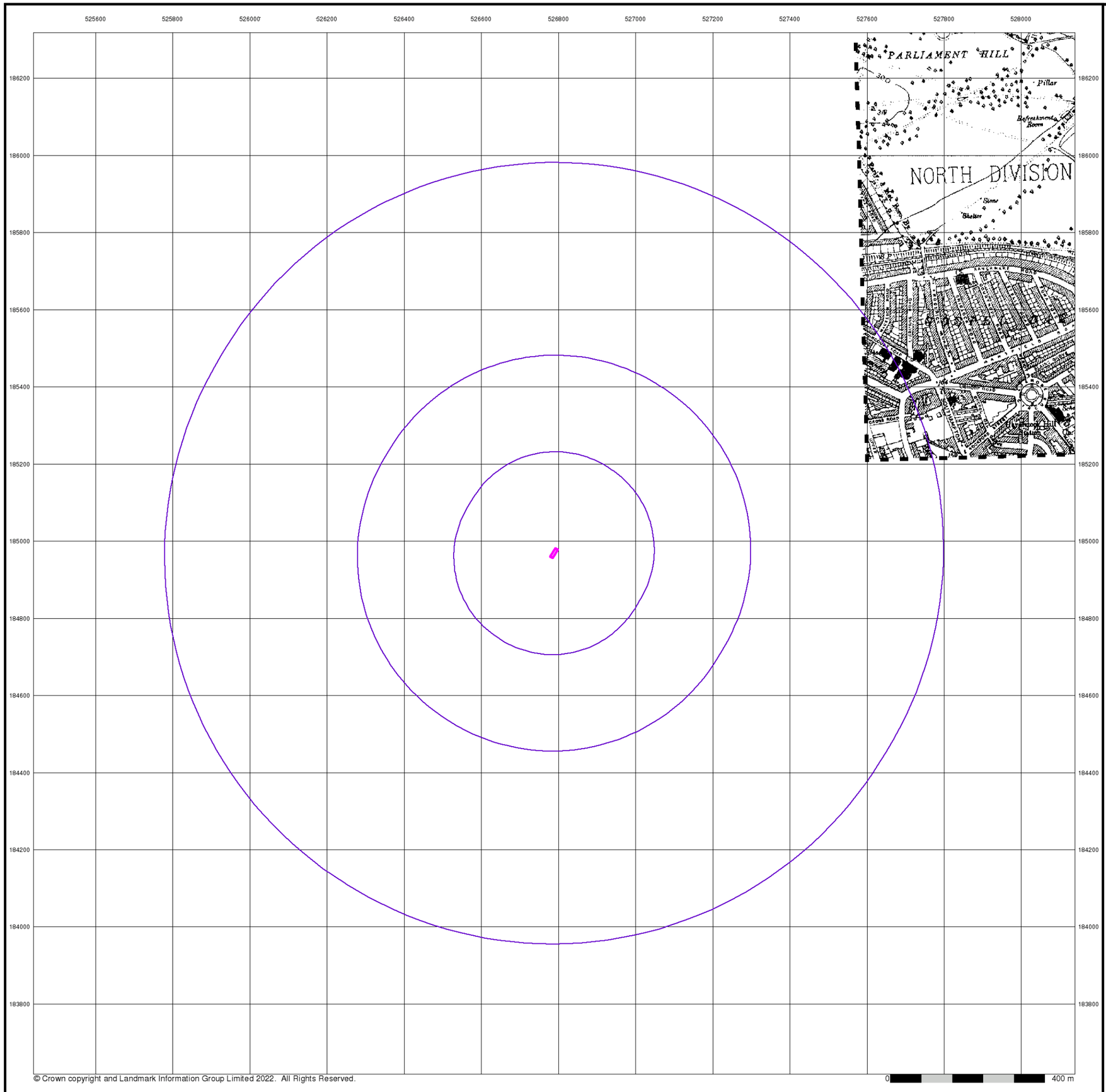

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Essex

Published 1938

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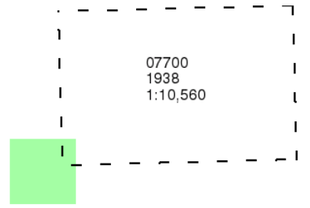
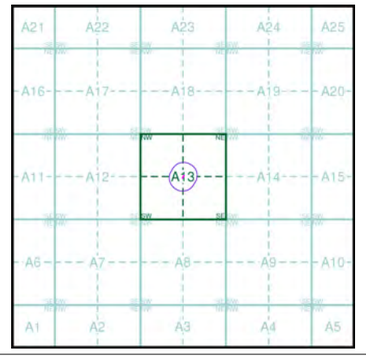


Historical Map - Slice A



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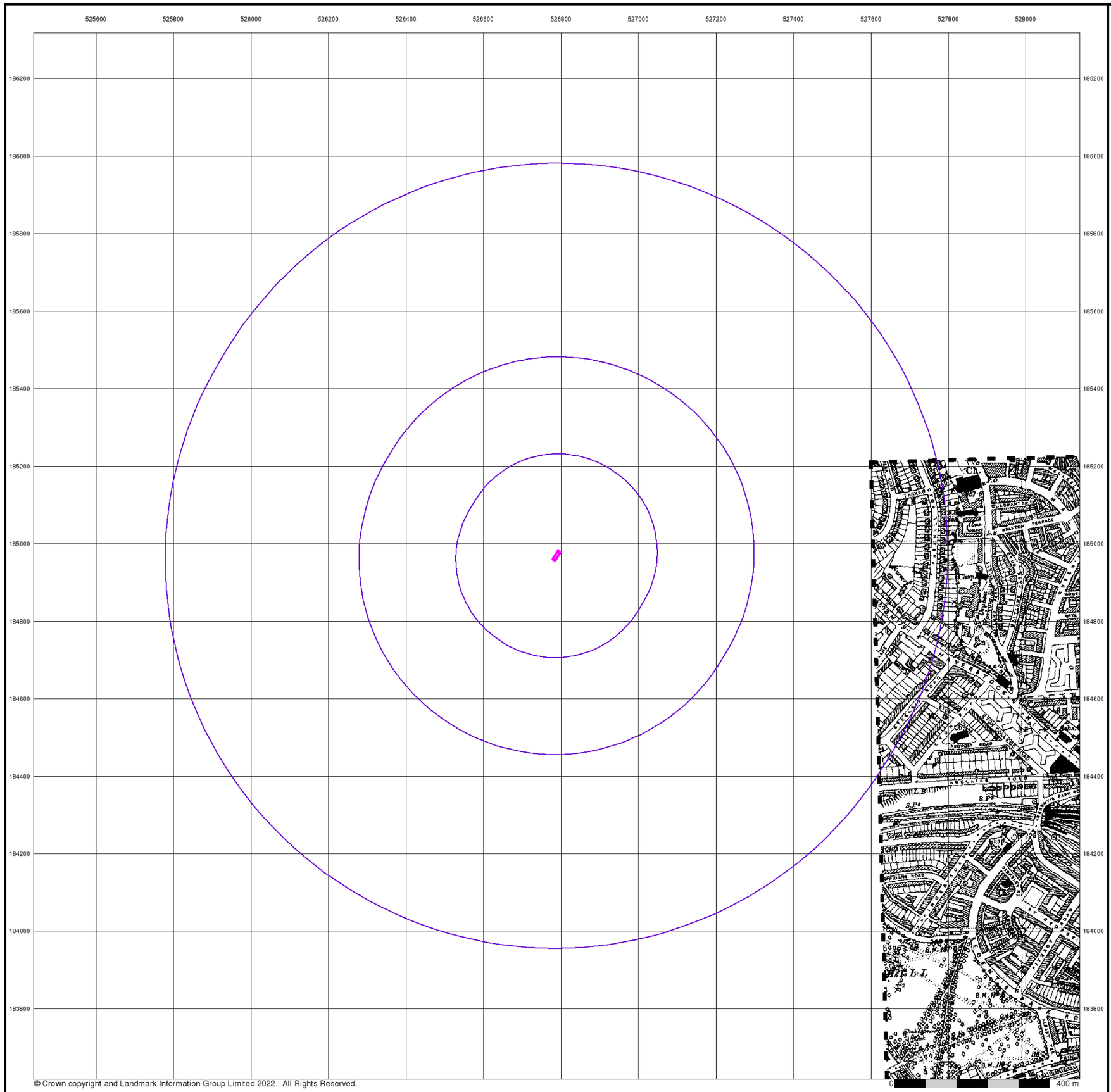

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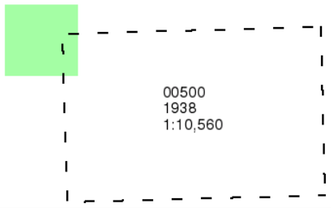
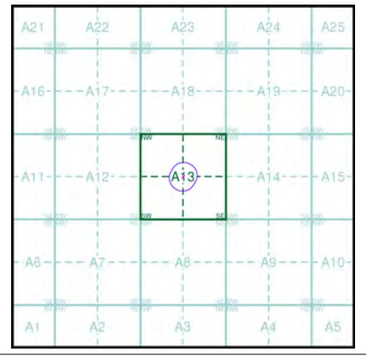


Historical Map - Slice A



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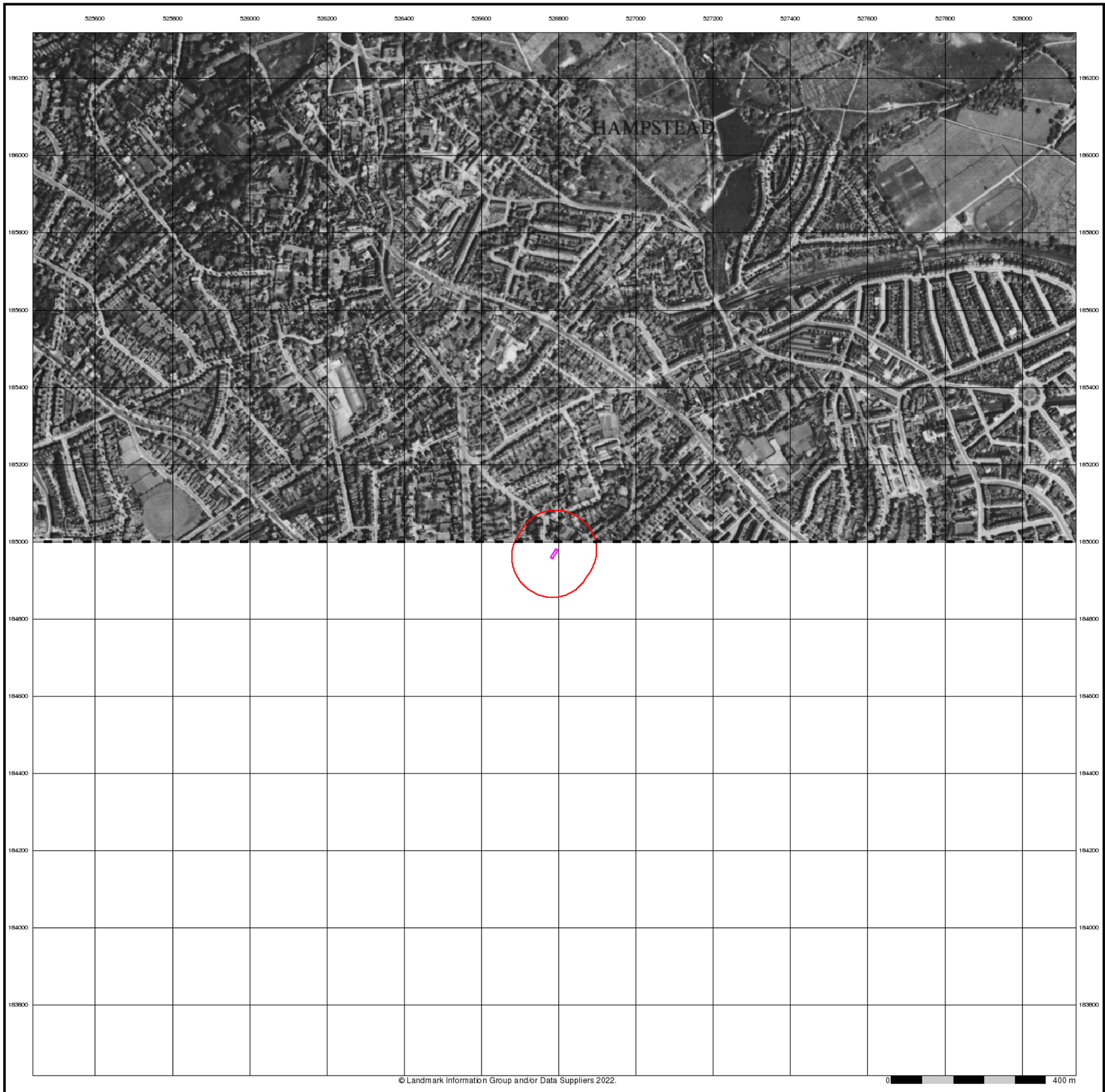

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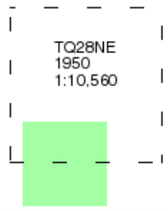
Historical Aerial Photography

Published 1950

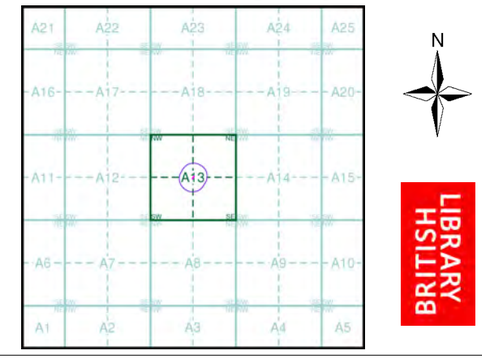
Source map scale - 1:10,560

The Historical Aerial Photos were produced by the Ordnance Survey at a scale of 1:1,250 and 1:10,560 from Air Force photography. They were produced between 1944 and 1951 as an interim measure, pending preparation of conventional mapping, due to post war resource shortages. New security measures in the 1950's meant that every photograph was re-checked for potentially unsafe information with security sites replaced by fake fields or clouds. The original editions were withdrawn and only later made available after a period of fifty years although due to the accuracy of the editing, without viewing both revisions it is not easy to spot the edits. Where available Landmark have included both revisions.

Map Name(s) and Date(s)



Historical Aerial Photography - Slice A



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