PICK EVERARD

Phase I and II Geo-Environmental Site Investigation Report

RBG Kew Learning Centre
Royal Botanical Gardens Kew

Royal Botanic Gardens Kew

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Document History

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PICK EVERARD

Executive Summary

Site Description	The site comprises an irregular shaped plot of land within Kew Gardens, Richmond, centred upon White Peaks Café. The area around the café is laid to hardstanding, with paved footpaths and outdoor seating, interspersed with soft landscaping.
Proposed Development	A 2-storey learning centre with a large seminar room, teaching spaces and associated amenities and utilities.
Site History	Historically the site has formed part of the Royal Botanical Gardens since before the time of earliest available mapping data. Since the late 19th Century, the site has since largely remained unchanged, however by the early 2003 a building had been established in the west of site and would later be expanded upon to form White Peaks Café. The surrounding area of site has been dominated by the grounds and buildings of the Royal Botanical Gardens throughout available mapping history.
Geology/Hydrology and Hydrogeology	The site is shown to be underlain by superficial deposits of the Kempton Park Gravel Member (Secondary A Aquifer), overlying bedrock of the London Clay Formation (Unproductive Strata). The site is outside any groundwater Source Protection Zone. There are six groundwater abstraction points within 500m of the site, three of which listed as active. The site is shown to be within Flood Zone 3.
Preliminary Contamination Assessment	Based on the information reviewed during this survey, the greatest risks from land contamination are considered to be low / moderate risks to construction workers. Ground gas is also considered to pose low / moderate risks to future site users. All other risks are considered to be low or very low at this stage.
Preliminary Geotechnical Assessment	Traditional strip or trench fill foundations are likely to be achievable within the Kempton Park Gravel Member, although will require deepening through Made Ground. Floor slabs should be designed according to the required performance parameters of the building, although consideration should be given to suspended slabs where necessary. Foundations may also require deepening for tree influence in areas of cohesive deposits. Naturally occurring pyritic strata is anticipated beneath site. Buried obstructions in the form of former foundations may also be present beneath the site. Conventional soakaway drainage may be appropriate within the Kempton Park Gravel Member.
Ground Conditions	Ground conditions were found to comprise shallow Topsoil and Made Ground (to a maximum depth of 2.60m bgl) overlying superficial Kempton Park Gravel deposits (to a maximum depth of 8.00m bgl), above bedrock of the London Clay Formation, to a maximum proven depth of 15.00m bgl. The Kempton Park Gravel Member was generally recorded as medium dense to very dense, clayey sands and gravels. The London Clay Formation was recorded as firm to stiff grey clays. Groundwater was not encountered during the investigation works, however was recorded between 2.065m bgl and 2.075m bgl during the subsequent monitoring visits.
Contamination and	The results of the investigation confirm that contaminant concentrations across the site do not exceed Pick Everards TSV's protective of human health receptors.

Remediation	Accordingly, the risk to human health is considered to be low, and specific remedial measures will not be necessary. It is considered that there is no risk to controlled waters beneath the site exists, and further investigation is not required. A Gas Screening Value (GSV) of 0.0062 has been calculated in accordance with BS8485:2015+A1:2019, using the highest CO_2 concentration and the highest flow rate recorded. The maximum recorded concentration of CO_2 places the site within a Characteristic Situation 2 and as such ground gas protection measures are required.
Geotechnical Assessment	Should traditional strip, or trench fill, foundations be incorporated into the proposed development, an allowable bearing capacity of at least 150kN/m2 at a minimum depth of 1.20m bgl should be achievable, assuming 600mm wide foundations and limiting settlement to less than 25mm. If higher loads are required, then piled foundations may be necessary to provide an adequate bearing capacity for the proposed development. Alternatively ground improvement options could be considered to avoid piling, or existing Made Ground could be excavated and replaced with imported compacted granular material. Foundations should also extend below the depth of any former structures (e.g., historical foundations), and will require additional deepening for tree influence. Heave precautions will also be necessary. Floor slabs should be designed considering the required performance criteria for the proposed structures. A suspended floor slab is likely to be the preferred option due to the thickness of Made Ground. Buried concrete should be designed based on a Sulphate Class of DS-1 and an Aggressive Chemical environment for Concrete classification of AC-1 within the Made Ground, to DS-1 and AC-2z within the Kempton Park Gravel Member, and to DS-4 and AC-4 within the London Clay Formation. It is considered that traditional sumping and pumping techniques should be sufficient to deal with any groundwater ingress during foundation excavations. It should also be noted that significant granular deposits were encountered. These are unlikely to remain stable for long periods of time, and consideration should be given to the temporary shoring and support of foundation excavations where necessary.
Recommendations	The following further works are recommended: • Groundwater testing to aid foundation design below the water table. This report should be submitted to the local authority for comment and approval.
This sheet is intended as a summary of the assessment of the site in relation to ground contamination and geotechnical conditions. It does not provide a definitive engineering analysis.	

Contents

1.0 Introduction

1.1 General

Pick Everard was instructed by Royal Botanical Gardens Kew (the Client) to undertake a combined Phase I and II Geo-Environmental Investigation at Kew Gardens, Richmond, London TW9 3AE (the Site). The objectives of this investigation were:

- To review the following information pertinent to the site:
    - Historical ordinance Survey Maps (Appendix A)
    - Environmental reports that include, but are not limited to, the following data: Environment, hydrological, geological, hydrogeological, industrial, and sensitive land use (Appendix B);
    - Current maps, plans and photographs; and
    - Geological maps and records.
- To determine the likelihood of land contamination being present and identify any associated potential environmental risks and liabilities, presented as a conceptual site model;
- To undertake a preliminary geotechnical appraisal of the site;
- To undertake an intrusive investigation of the site to identify ground conditions, and collect samples for environmental and geotechnical analysis;
- To provide information to support a Generic Quantitative Risk Assessment with respect to contaminated land and provide an updated conceptual site model;
- To identify the geotechnical properties of the underlying geology to assist in foundation, floor slab and infrastructure design;
- To identify the ground gas regime beneath the site and provide recommendations to mitigate the ground gas risk;
- To provide preliminary waste classification information to support the proposed development; and
- To provide recommendations for further investigation and remediation (where necessary).

This assessment has been conducted in general accordance with industry guidance including DEFRA/EA Guidance Land Contamination: Risk Management (LCRM) [1] and BS10175: Investigation of Potentially Contaminated Sites – Code of Practice [2]. Specific surveys related to any environmental elements other than those described above have not been undertaken and, if required, such surveys should be undertaken by an accredited organisation. Where this assessment has revealed information that may have implications

for the site, such as the obvious presence of invasive species, asbestos, or protected species, this has been noted for information.

1.2 Scope of Work

In order to achieve the objectives above, the following scope of works has been undertaken:

- Review of available data relevant to the site setting and history;
- Development of an initial CSM;
- Preliminary qualitative risk assessment;
- Preliminary geotechnical appraisal;
- Intrusive site investigation and subsequent ground gas monitoring;
- A human health Generic Quantitative Risk Assessment (GQRA);
- A ground gas risk assessment;
- A geotechnical appraisal; and
- Remedial recommendations.

2.0 Site Setting

2.1 Site Location

The site is located on the Kew Gardens Estate, Richmond, London TW9 3AE, centred on NGR 518477, 177330, and covers an area of approximately 1.41ha. The site location is shown in Figure 1 below.

Figure 1 – Site Location

2.2 Site Description

2.2.1 General

The site comprises an irregular shaped area within Kew Gardens and is centred around the White Peaks Café. The area immediately surrounding the café is laid to hardstanding, with paved footpaths and outdoor seating, interspersed with soft landscaping beyond. The southern and eastern ends of site are laid to turf, intersected with footpaths, with sparse tree coverage throughout. North of the café, a road runs up through the grounds of Kew Gardens to connect with Ferry Lane, from which the site is accessible.

2.2.2 Potential On-Site Sources and Evidence of Contamination

The site walkover identified the following potential source of contamination:

- Likely presence of Made Ground from the construction of White Peaks Café and adjacent development works.

2.2.3 Surrounding Land Use

The site is surrounded by the grounds of Royal Botanical Gardens Kew in all directions, and is immediately bounded by:

North - An access road, with the Royal Kitchens and Kew Palace beyond;

East – Outdoor seating and tented education area with open landscaped areas beyond; and

South – Kew Children's Garden, and open landscaped areas;

West –Kew Family Kitchen & Shop, children's play area, and greenhouses of the Royal Botanical Gardens.

2.2.4 Sensitive Land Use

The site is located within an Site of Special Scientific Interest (SSSI) Impact Risk Zone.

2.3 Proposed Development

It is understood that the client is proposing to demolish the existing 'White Peaks Cafe' and construct a 2-storey learning centre with a large seminar room, teaching spaces and associated amenities and utilities.

The proposed development plan is included as Drawing 210699-PEV-ZZ-ZZ-DR-C-0501_P02.

3.0 Site History

3.1 Historical Maps and Plans

The following is a summary of the relevant history of the site and its immediate surroundings, based on a review of historical Ordnance Survey maps and plans. Available Ordnance Survey (OS) mapping dates back to 1857 and is presented in Appendix B.

Date (and Scale) of Map	Significant Observations
1865-68 (1:10,560)	**On-site**: The site formed part of Kew Palace Grounds and the Royal Botanical Gardens. And generally comprised landscaped gardens and footpaths. Several buildings (part of a larger complex that extended off site) were recorded in the north, and a nursery extended onto the site from the west. **Off-site**: The Royal Gardens surrounded the site on all sides, primarily comprising landscaped gardens and managed woodland. Kew Palace bordered the site to the north, and a nursery bordered the site to the west. The River Thames was recorded approximately 50m to the north-west, with the town of Brentford beyond. Two ditches were present in close proximity to the southern corner of site. A lake was recorded approximately 500m to the south-west and a pond 400m to the south-east of the site. Two mounds were recorded adjacent to the pond, with one identified as 'The Temple of Eotus'. To the east of site were several buildings, identified as museums, residences, and churches present alongside Richmond Road. A railway line was also recorded approximately 800m to the south-east.
1893-94 (1:10,560)	**On-site**: No significant changes. **Off-site**: Brentford was recorded in detail beyond the River Thames to the north. Several industrial sites were mapped within the town, including a gas works 400m to the north, with water works, reservoirs, and filtering beds beyond. To the east, the area beyond Richmond Road was shown to have been developed into residential estates.
1896 (1:1,056)	**On-site**: No significant changes. **Off-site**: A depot complex was recorded adjacent to the western site boundary, and the nursery had reduced in footprint.
1913 (1:2,500)	**On-site**: The buildings in the north of the site were no longer recorded and are presumed to have been demolished. **Off-site**: The former ditches south of the site are no longer shown, presumably infilled.
1974 (1:10,000)	**On-site**: A small building had been constructed in the west of the site, and another building was recorded to extend onto site from the north-west. **Off-site**: A large structure was recorded along the north-west boundary of the site

Date (and Scale) of Map	Significant Observations
	with a car park and several smaller buildings beyond. Landscaped gardens approximately 100m to the north were identified as 'Kew Palace Gardens'.
1977-1980 (1:1,250)	**On-site**: No significant changes. **Off-site**: The buildings adjacent to the north-west boundary had been further expanded.
1987(1:10,000) **& 1986-1991** (1:1,250)	**On-site**: Two small buildings were recorded extending onto site from the north-west, and a tank was recorded onsite, adjacent to these buildings. **Off-site**: The Princess of Wales Conservatory was recorded constructed approximately 300m to the east, and two ponds were noted approximately 250m to the north-east, alongside two new buildings. A building had been constructed adjacent to the eastern boundary of the site.
2003 (1:1,250)	**On-site**: The tank and small buildings in the north-west were no longer shown. The small building in the west of site had been expanded. **Off-site**: Buildings bordering the site to the west were now shown as one large building identified as 'Lower Nursery', with several small buildings constructed to its south-west.
2010 (1:10,000)	**On-site**: A new structure was shown on site that matches the layout of the current White Peaks Café. **Off-site**: No significant changes.
2022 (1:10,000)	**On-site**: No significant changes. **Off-site**: Several new structures had been constructed west of the Lower Nursery.

Table 1 – Site History

3.2 Summary

The site has formed part of the Royal Botanical Gardens since before the earliest available mapping data. In the late 19th Century, the site was primarily occupied by open grassed fields with sparse tree coverage intersected by footpaths. Since this time the site has largely remained unchanged, with the exception of the occasional construction and demolition of small buildings and structures on the site's western and north-western ends. By the early 21st Century a building had been established on the west of site and would later be expanded to form White Peaks Café.

The surrounding area of site has been dominated by the grounds and buildings of the Royal Botanical Gardens throughout available mapping history. Throughout the 20th Century, buildings bordering the site to the north and west were steadily expanded upon with the development of the Royal Botanical Gardens.

4.0 Geology, Hydrology and Hydrogeology

4.1 Geology

The British Geological Society (BGS) online GeoIndex records that the site is underlain by superficial sands and gravels of the Kempton Park Gravel Member, over bedrock clays of the London Clay Formation. Superficial Alluvium deposits are recorded 56m north-west of the site.

The Groundsure report identifies the risk from natural ground subsidence to be very low-negligible.

4.1.1 Made Ground

There are 11 records of Made Ground deposits within 500m of the site, the closest located 188m south-east. It is also considered highly likely for a covering of Made Ground to be present beneath site in areas of historic construction and demolition.

4.2 BGS Recorded Boreholes

There are five BGS recorded boreholes within 250m of the site. Two of the borehole's were located upon Brentford Ait (a river island) 175m and 191m north of site and record a sequence of Alluvium, above superficial gravels. The London Clay Formation was encountered between 6.25m and 6.78m bgl.

The remaining three records are from boreholes positioned 207m to 225m north-east of site, and record sequences of superficial gravels to between 5.00-7.30m bgl, with London Clay Formation beneath.

4.3 Mining Activity

The site is not located in a coal mining reporting area and is not within an area impacted by other underground mining activities. There are no records of natural cavities within 500m of site.

There are 11 records of historical surface workings within 250m:

- 19m SW – Unspecified Ground Workings – 1898
- 94m E – Unspecified Heap – 1948
- 144m-149m SE – Unspecified Heap – 1913-1961
- 153m NE – Ponds – 1987
- 157m-201m NW-W – Ponds & Water Bodies – 1894-1961
- 178m-205m SE – Unspecified Heaps & Ground Workings – 1867-1974
- 209m SE – Unspecified Heap – 1933
- 219m W – Dock – 1938

- 220m NE – Unspecified Heap – 1987
- 227m-244m W – Canal – 1894-1938
- 236m-250m NE – Unspecified Hole – 1873-1938

4.4 Radon

The site is located in an area where less than 1% of domestic residences (within a 1km radius) are above the National Radiological Protection Board (NRPB) action level for radon of 200Bq m3. Accordingly, Radon protection measures are not considered necessary for the proposed development.

4.5 Hydrogeology

The superficial Kempton Park Gravel Member is classified by the Environment Agency (EA) as a Secondary A Aquifer, indicating permeable layers capable of supporting water supplies at local rather than strategic scales. The bedrock of the London Clay Formation is classified as unproductive strata. BGS data included in the Groundsure report classifies groundwater vulnerability beneath site as medium.

The site is not located within a groundwater source protection zone (SPZ) related to potable water abstraction. There are however six groundwater abstraction points within 500m of the site. Three of the abstractions are currently recorded as 'active' and are located between 305m and 325m to the north-east.

4.6 Surface Water

The closest surface water feature is The River Thames, located approximately 100m north-west of the site at its closest point. The closest recorded active surface water discharge is approximately 261m to the north, related to the discharge of cooling waters from Kew Gardens into flood gravels. There are five historical discharges recorded, relating to the discharge of cooling waters, miscellaneous, and unspecified trade discharges, into groundwater, the River Thames, and Brentford Creek. The nearest historical discharge is located 348m north-east of the site.

Surface water abstractions are not recorded within 500m of the site.

4.7 Flood Risk

The Environmental Agency Risk of Flooding from Rivers and Sea (RoFRaS) on-site is very low; however, a section of the site is located within Flood Zone 3. As such, a Flood Risk Assessment will be required for the proposed development.

5.0 Industrial, Waste and Environmental Records

5.1 Waste

5.1.1 Landfills

There are two EA records of historic landfill sites located within 500n of the site:

- 254m NW – No Waste Type Given – Last Recorded: 31/12/1865
- 349m N – Inert Waste from Gas Works – Last Recorded: 31/12/1966

There is also one local authority mapping record of a historic landfill site located 445m north of site, with no record of a waste type or years active.

5.1.2 Waste Transfer or Treatment Facilities

Historical or current waste transfer or waste treatment facilities are not recorded within 500m of the site.

5.1.3 Historical Waste Sites

There are two records of historical waste sites located within 500m of the site:

- 396m-397m W – Refuse Destructor – 1915-35
- 487m-488m N-NE – Scrap Yard – 1987-88

5.1.4 Waste Exemptions

There are three records of waste exemptions within 500m of the site:

- 73m-85m W-SW – Disposal of Waste Exemption – Disposal by Incineration
- 320m E – Treating Waste Exemption – Crushing Waste Fluorescent Tubes
- 376m NW – Treating Waste Exemption – Sorting and De-Naturing of Controlled Drugs for Disposal

5.2 Current Land Use / Activities

5.2.1 Current Industrial Data

There are nine current potentially contaminative sites within 250m of the site boundary. These are summarised in Table 2 below;

Distance & Direction	Company	Activity & Category
188m NW	Slipway	Moorings and Unloading Facilities - Water
202m NW	Works	Unspecified Works or Factories – Industrial Features
204m NW	Crane	Travelling Cranes and Gantries – Industrial Features
205m NW	Wharf	Moorings and Unloading Facilities - Water
217m NW	Wharf	Moorings and Unloading Facilities - Water
217m NW	Crane	Travelling Cranes and Gantries – Industrial Features
223m NW	Johns Boat Works Ltd	Marine Equipment Including Boats and Ships – Industrial Products
228m W	Ferry Wharf	Moorings and Unloading Facilities - Water
246m N	Slipway	Moorings and Unloading Facilities - Water

Table 2 – Industrial Sites within 250m

5.2.2 Hazardous Substances

Hazardous substances are not recorded within 500m of the site.

5.2.3 Radioactive Substance Authorisations

There is one record of a Radioactive Substance Authorisation located 450m east of the site at Royal Botanical Gardens Jodrell Laboratory, relating to the disposal of radioactive waste and the keeping and using of radioactive materials. The authorisation has seven entries dating back to 1993, with the latest entry revoked or cancelled in 2015.

5.3 Water Quality

There is one active record of List 1 dangerous substance discharge within 500m of the site, relating to the release of mercury and cadmium into the River Thames 96m north-east of site at Isleworth Polishing & Plating, High Street, Brentford. Two historic records also exist for the same site, shown as inactive.

A licensed pollutant release to public sewers is recorded 422m north-west of the site, for the discharge of special category effluents.

5.4 Pollution Incidents

There are nine pollution incidents recorded within 500m of the site, all incidents date from 2001-2003 and were recorded to have minor or no impact upon receptors. The nearest incident to site was located 95m to the north-east.

5.5 Historical and Active Pollution Prevention and Control License Entries

Part A(1) and Integrated Pollution Prevention and Control License activities are not recorded within 500m of the site boundary.

There is one record of a Part A(2) or Part B and Local Authority Pollution Prevention and Control License activity within 500m of the site boundary., a historical permit for dry cleaning 400m north-west of the site.

6.0 Preliminary Geotechnical Appraisal

6.1 General

The following is a preliminary assessment of the geotechnical constraints associated with the site based on a qualitative review of the desk study information and the proposed development plans provided. The findings may not be representative of actual engineering properties of on-site soils (e.g., Stability, mass structure etc.).

6.2 Made Ground

It is likely that a covering of Made Ground is present beneath the proposed development area, generated from historic construction and demolition on site. Made Ground is not considered suitable as a bearing stratum, unless treated or improved, and may require removal or deepening of foundations. Further investigation is required to confirm the thickness of the underlying Made Ground.

6.3 Foundation Design

Traditional strip or trench fill foundations are likely to be achievable within the Kempton Park Gravel Member. Where foundation depth is likely to exceed 2.50m bgl consideration should be given to an alternate foundation design (piled or raft). Ground bearing floor slabs may be appropriate, subject to the specific design and performance requirements of the building. Where significant volumes of Made Ground or sub floor fill are present, consideration should be given to a suspended floor slab.

6.4 Tree Influence

The bedrock deposits of the London Clay Formation will contain significant clay content. Should these deposits be encountered at a shallow depth, foundations may need to be designed considering the influence of trees and potential heave. A tree survey should be undertaken to determine the impacts upon the proposed development, and further investigation will be required to confirm the plasticity of cohesive soils.

6.5 Concrete Design

The London Clay Formation underlying the site is considered to be potentially pyritic. A ground investigation is required to determine if sulphate concentrations within the soils beneath the site pose a risk to concrete foundations.

6.6 Obstructions

Buried obstructions in the form of former foundations may be present beneath the site. Where these are present beneath the building footprint they should be grubbed up, and new foundations deepened below the depth of the former.

6.7 Drainage and Soakaway

Conventional soakaway drainage may be appropriate within the Kempton Park Gravel Member.

7.0 Preliminary Conceptual Site Model

The key output of a Preliminary Risk Assessment is the initial Conceptual Site Model (CSM). The CSM is a simplification of the environmental setting of the site and is used to identify any potential pollutant linkages, which may exist, produced in general accordance with BS 21365:2020 'Conceptual Site Models for Potentially Contaminated Sites' [3]. Table 1 below shows the CSM undertaken in accordance with the risk matrices (Tables 2-4). The preliminary CSM produced as part of the Phase I works is presented below.

7.1 Potential Contamination Sources

7.1.1 On site

The following sources of contamination are considered based on the current and historic site uses;

- S1 – Potentially Contaminated Made Ground and Shallow Soils – associated with historic construction and demolition. Potential contaminants include TPH, PAH, heavy metals, and asbestos.
- S2 - Ground gas generated in Made Ground and nearby Alluvium deposits.

7.1.2 Off Site

- S3 – Current and historic industrial activities in the nearby area. Potential contaminants include TPH, PAH, and heavy metals.

7.2 Potential Pathways

The following pathways are considered likely at this site;

- P1 – Dermal contact with soils and/or dust;
- P2 – Accidental ingestion of soil or dust;
- P3 – Inhalation of gases, vapours, or dusts;
- P4 – Vertical and lateral migration through shallow soils or within groundwater;
- P5 – Exposure of plants to soil contaminants via root contact;
- P6 – Direct contact with buildings/infrastructure; and
- P7 – Accumulation within confined spaces.

7.3 Potential Receptors

There are a number of receptors that need to be considered as part of the redevelopment process. These are outlined below:

7.3.1 Human receptors

- R1 – Future Site Users – this will include future ground staff, plus visitors;
- R2 – Construction Workers; and
- R3 – Adjacent Land Users – this includes ground staff and visitors of Royal Botanical Gardens Kew.

7.3.2 Environmental

- R4 – Vegetation - this includes the existing and future landscaped areas of the site / proposed development;
- R5 – Controlled waters – Secondary A Aquifer and River Thames;

7.3.3 Other

- R6 – Buildings and buried services/infrastructure;

7.4 Conceptual Site Model

Source	Receptor	Severity	Pathway	Likelihood	Risk
S1 – Potentially Contaminated Made Ground and Shallow Soils – Potential contaminants include TPH, PAH, metals, asbestos.	R1 - Site User	Medium	P1 - Dermal Contact	Unlikely	Low
			P2 - Ingestion	Unlikely	Low
			P3 - Inhalation	Unlikely	Low
			P4 - Migration	Unlikely	Low
			P5 - Plant uptake	Unlikely	Low
	R2 - Construction	Medium	P1 - Dermal Contact	Low	Low/Moderate
			P2 - Ingestion	Low	Low/Moderate
			P3 - Inhalation	Low	Low/Moderate
			P4 - Migration	Unlikely	Low
			P4 - Migration	Unlikely	Very Low
	R4 - Vegetation	Medium	P5 - Plant uptake	Low	Low/Moderate
	R5 – Controlled Waters	Medium	P4 - Migration	Low	Low/Moderate
	R6 - Building	Mild	P6 - Direct Contact	Low	Low
S2 – Ground Gas	R1 - Site User	Medium	P7 - Accumulation	Low	Low/Moderate
	R2 - Construction	Medium	P7 - Accumulation	Low	Low/Moderate
S3 – Current and Historical nearby industrial land use.	R1 - Site User	Medium	P4 - Migration	Unlikely	Low
	R2 - Construction	Medium	P4 - Migration	Unlikely	Low
	R6 - Building	Medium	P4 - Migration	Unlikely	Low

Table 3 – Preliminary Conceptual Site Model

7.5 Risk Assessment Matrices

By identifying the sources, pathways and receptors, an assessment of the risks is made based on the significance and degree of the risk. This assessment considers whether the source contamination can reach a receptor and hence whether it is of major or minor significance.

For the purpose of this report, the environmental risks associated with each potential pollutant linkage have been initially assessed based on the available information using the following matrices.

The risk assessment has been carried out by assessing the severity of the potential consequence, taking into account both the potential severity of the hazard and the sensitivity of the target, based on the categories given below.

Category	Definition
Severe	Acute risks to human health, catastrophic damage to buildings/property, major pollution of 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	Requirement for protective equipment during site works to mitigate health effects, damage to non-sensitive ecosystems or species

Table 4 – Potential Severity of Risk

The likelihood of an event occurring takes into account the presence of the hazard and target and the integrity of the pathway and has been assessed based on the categories given below.

Category	Definition
High likelihood	Pollutant linkage may be present, and risk is almost certain to occur in long term, or there is evidence of harm to the receptor
Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term
Low likelihood	Pollutant linkage may be present, and there is a possibility of the risk occurring, although there is no certainty that it will do so
Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable

Table 5 – Likelihood of Risk Occurrence

The severity of the risk and the likelihood of the risk occurring have been combined in accordance with the following matrix in order to give a level of risk for each potential hazard.

Likelihood Of Occurrence	Severity of Risk			
	Severe	Medium	Mild	Minor
High likelihood	Very High	High	Moderate	Low/Moderate
Likely	High	Moderate	Low/Moderate	Low
Low likelihood	Moderate	Low/Moderate	Low	Very Low
Unlikely	Low/Moderate	Low	Very Low	Very Low

Table 6 – Level of Risk based on Severity Vs Likelihood

8.0 Fieldwork

8.1 General

Pick Everard attended site between 31st January and 3rd February 2022 to undertake intrusive investigation works based on the findings of the Desktop Study above.

The following scope of works was undertaken:

- 1 no. cable percussive borehole (BH01) to a depth of 15.00m bgl;
- 6 no. dynamic windowless sampler boreholes (WS01-WS06) to a maximum depth of 4.00m bgl;
- 1 no. mechanically excavated soakage pit (SA01) to a maximum depth of 2.20m bgl, with subsequent soakage testing in general accordance with BRE365;
- 3 no. diamond core locations through the concrete floor slab;
- 3 no. hand dug foundation inspection pits to a maximum depth of 1.00m bgl
- Installation of 3 no. groundwater/ground gas monitoring wells (WS02-WS04);
- Falling head tests within 2 no. monitoring wells (WS01 and WS02) to assist with drainage design; and
- Collection of soil samples for laboratory chemical and geotechnical analysis.

Upon completion of the intrusive works, a period of groundwater and ground gas monitoring was undertaken between 11th February and 24th March 2022.

The works were undertaken under the full-time supervision of a suitably qualified Pick Everard Geo-Environmental Engineer. Exploratory holes were logged and sampled in general accordance with BS5930:2015 [4]. An Exploratory Hole Location Plan is presented as Drawing No. PE-SK-C-0001, and Exploratory hole logs are presented in Appendix C.

8.2 Cable Percussive Borehole

BH01 was advanced through the sub-surface strata to a depth of 15.00m bgl, and sampling of the recovered materials was undertaken at discrete intervals and at changes in strata. In-situ testing (SPTs) were undertaken at 1.00m intervals within the top 5.00m, and every 1.50m thereafter alternating with U100s. The borehole was backfilled with compacted arisings upon completion.

Representative samples of soils were scheduled for geotechnical and chemical laboratory analysis.

8.3 Dynamic Windowless Sampler Boreholes

WS01-WS06 were advanced through the sub-surface strata to a maximum depth of 4.00m bgl. Sampling of the recovered materials was undertaken at discrete intervals and at changes in strata, and in-situ testing (SPTs) was undertaken at 1.00m intervals throughout the boreholes. Groundwater/ground gas monitoring wells were installed into WS02, WS03 and WS05, with plain sections used to screen out the Made Ground. The remaining locations were backfilled with compacted arisings. Percolation testing was carried out in WS01 and WS02.

Representative samples of soils were scheduled for geotechnical and chemical laboratory analysis.

8.4 Soakaway Pit

One soakaway pit was advanced using a backhoe type excavator in a location chosen based on the proposed development plan provided. The soakage pit was filled with gravel due to its instability and capped with compacted natural arisings.

8.5 Foundation Pits

Three inspection pits were undertaken with the aim of ascertaining the foundation construction details of White Peaks Café. Foundation pit sketches are included in Appendix C.

8.6 Concrete Cores

Three 300mm diameter diamond cores were drilled through the concrete floor slab of the White Peaks Café to provide access for windowless sample boreholes to be drilled in areas covered by hard standing (WS03, WS04, and WS05).

8.7 Laboratory Testing

A summary of the laboratory analysis undertaken on the environmental and geotechnical samples is presented in the table below:

Environmental	Geotechnical
• Moisture Content (7 no.); • Heavy metals (As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn) (7 no.); • Water soluble Boron (7 no.); • Cyanide (total and free) (7 no.); • Polycyclic Aromatic Hydrocarbons (PAH, EPA 16) (7 no.); • Total Petroleum Hydrocarbons – Banded TPH (7 no.) and TPH CWG (4 no.); • Asbestos Identification (7 no.); • pH (7 no.); • Water Soluble Sulphate (7 no.); and • Waste Acceptance Criteria testing (1 no.).	• Moisture Content (7 no.); • Plasticity (7 no.); • Particle Size Distribution (2 no.); • Multistage Triaxial Shear Strength (3 no.); and • BRE Suite B (Pyrite Suite) (4 no.).

Table 7 – Summary of Environmental and Geotechnical Testing Schedules

Laboratory environmental results are presented in Appendix D, and geotechnical results are presented in Appendix E.

9.0 Encountered Subsurface Conditions

The ground conditions encountered during the intrusive investigation are summarised below.

9.1 Topsoil

Topsoil was encountered in three locations (SA01, WS01, WS02), from ground level to between 0.15m and 0.40m bgl. The topsoil was recovered as dark brown, gravelly, sandy, silty topsoil with frequent rootlets.

9.2 Made Ground

Made Ground was encountered in all exploratory locations, with the exception of WS01 and was record from ground level (or the base of topsoil) to between 0.80m and 2.60m bgl. The Made Ground was generally found to comprise brown, gravelly, clayey sand and sandy clay, with brick, concrete, clinker, quartzite, and flint. A layer of quartzite gravel and brick fill was identified within Made Ground deposits in WS03.

In three locations (WS03, WS04, WS05) a concrete floor slab was encountered from ground level to depths ranging between 0.30m bgl and 0.45m bgl.

9.3 Superficial Deposits – Kempton Pak Gravel Member

The Kempton Park Gravel Member was encountered beneath the Made Ground and topsoil, and was recorded up to 8.00m bgl. This was found to comprise medium dense to very dense (increasing with depth) clayey sands and quartzite and flint gravels.

9.4 Bedrock Deposits – London Clay Formation

The London Clay Formation was encountered in BH01 from 8.00m bgl to a maximum proven depth of 15.00m bgl. The stratum was reported to comprise firm to stiff (increasing with depth) grey clays.

9.5 Material Properties

The strength profile within the strata encountered has been assessed by reference to the results of Standard Penetration Tests (SPT's) undertaken within the boreholes. These tests have derived N-Values which have been corrected considering the energy loss induced by the hammer and transmitted by the drive rods. The SPT calibration certificates are presented in Appendix C.

Uncorrected N values and corrected N60 values within sub-surface strata were recorded between 7 and >50 blows, whilst corrected values ranged from 7 to 47. Corrected values are summarised in the graph below:

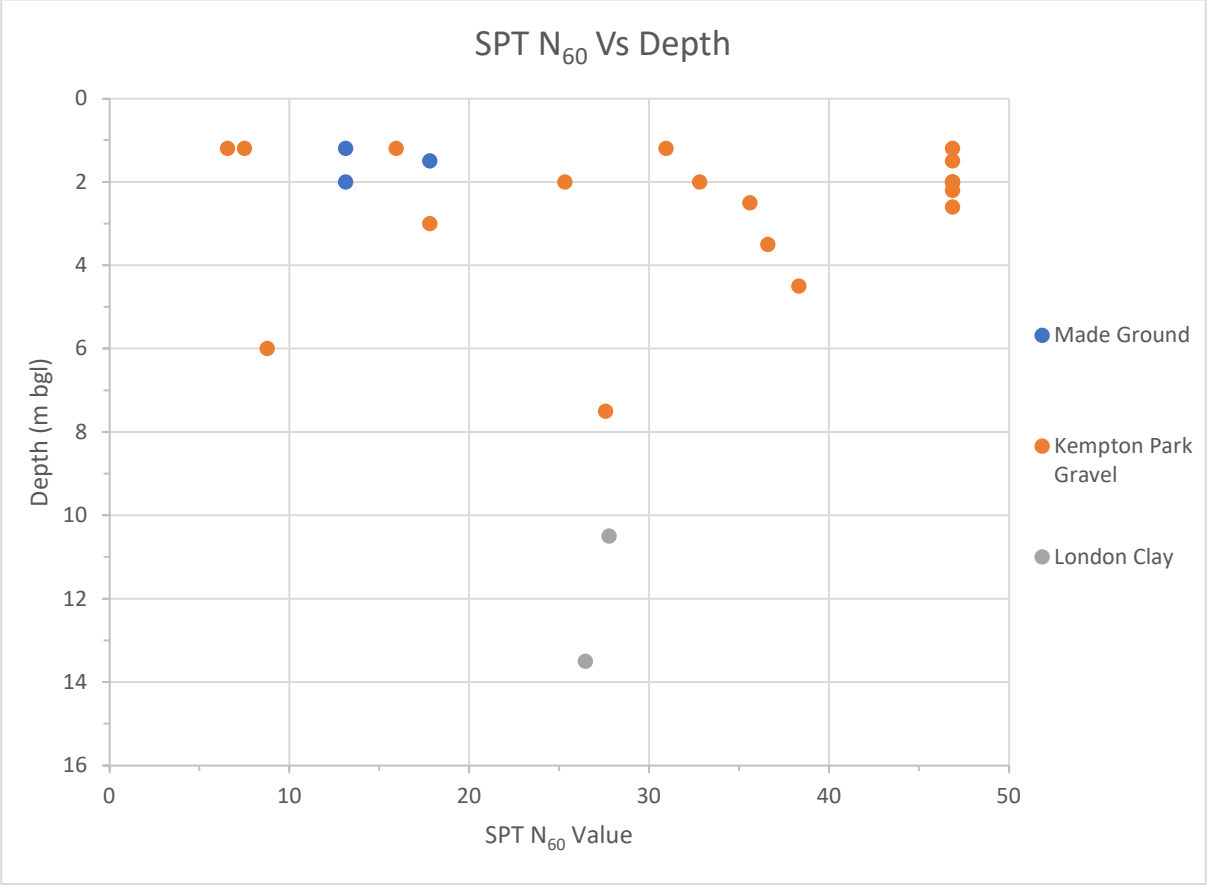

Figure 2 – SPT N_{60} against Depth (m bgl)

The results of the SPTs indicate locally loose but generally medium dense to very dense sands and gravels, over stiff clays.

9.5.1 Particle Size Distribution Testing

Laboratory particle size distribution testing was undertaken on one sample of granular soils taken from within the Kempton Park Gravel Formation, and on one sample of cohesive soils taken from the upper boundary of the London Clay Formation. The results of the testing are summarised in the table below.

Location ID	Depth (m bgl)	Geology	% Gravel	% Sand	% Fines
BH101	6.00	Kempton Park Gravel	89	10	1
BH101	8.00	London Clay	2	16	82

Table 8 – Summary of Particle Size Distribution Testing

9.5.2 Plasticity

Laboratory plasticity testing was undertaken on eight samples of the cohesive soils within the London Clay obtained from site. The results of the testing are summarised in the table below.

Location ID	Depth (m bgl)	% <425um	Plasticity Index
BH101	9.00	100	48
BH101	10.00	100	42
BH101	11.00	100	43
BH101	12.00	100	46
BH101	13.00	100	48
BH101	13.50	100	46
BH101	14.00	100	45
BH101	15.00	100	48

Table 9 – Summary of Plasticity Testing

The analysis indicates that the cohesive soils have a generally high plasticity and a high volume-change potential. Empirical correlation between the SPT N_{60} values and plasticity indicate an approximate mass shear strength (Cu) of between 117kN/m^2 and 125kN/m^2 within the London Clay.

9.5.3 Triaxial Strength Testing

Laboratory multi-stage triaxial shear strength testing was undertaken on three undisturbed samples taken from within the London Clay Formation. The results of the testing are summarised in the table below.

Location ID	Depth (m bgl)	In-Situ Cell Pressure (kPa)	Mode of Failure	Shear Strength (Cu)
BH101	9.00	180	Brittle	120
BH101	12.00	*120	Brittle	110
BH101	15.00	300	Brittle	139

* Cell pressure presented is half of overburden due to sample failure

Table 10 – Summary of Triaxial Shear Strength Testing

The analysis indicates an approximate mass shear strength (Cu) of between 110kN/m2 and 139kN/m2 within the London Clay.

9.6 Groundwater

Groundwater was not recorded in any location during the investigation works. Groundwater levels were subsequently monitored over four weeks between 11th February and 4th March 2022 in three installed locations (WS01, WS02, WS03). During the monitoring, groundwater was only recorded in WS02, consistently at depths ranging from 2.065m bgl and 2.075m bgl. It is noted however that this monitoring

well is 2.10m deep, and so the groundwater detected may be a result of ponding within the well rather than representative of natural groundwater levels.

9.7 Soil Infiltration

Soakaway testing in accordance with BRE 365[5] was undertaken in SA01 on 3rd February 2022. The results of the testing are presented in Appendix C and summarised in the table below:

Test No.	Test Completion Time (Minutes)	Soil Infiltration Rate (m/s)
1	30	$6.64x10^{-5}$
2	30	$4.96x10^{-5}$
3	40	$4.24x10^{-5}$

Table 11 – Summary of Soakaway Testing

Falling head tests were conducted within two boreholes (WS01 and WS02), and each location recorded three successful drainage tests. Infiltration rates were calculated in accordance with The Kent Soakaway Design Guide [6], and the results of the testing are presented in Appendix C.

9.8 Foundation Inspection Pits

Hand dug inspection pits were advanced externally to White Peaks Café to identify foundation construction. All three pits (HP01-03) identified a concrete ground slab, with a thickness of 200mm and 210mm in HP02 and HP03 respectively, and a thickness of 750mm in HP01. Lateral extension was not identified in HP01, whilst HP02 and HP03 noted lateral extensions of 150mm and 100mm from the building's outer wall.

All foundations were noted to be resting upon Made Ground deposits. Foundation sketches are presented in Appendix C.

9.9 Concrete Floor Slab

Concrete floor slab was cored through in three locations within the White Peaks Café for the advancement of windowless sample boreholes (WS03, WS04, WS05). Concrete was found to range from 300mm to 450mm in thickness, and in two locations (WS03 and WS05) was found to rest upon a sub-base of aggregate. No reinforcement bar was noted within the concrete cores.

9.10 Visual or Olfactory Contamination

Fragments of clinker were noted in Made Ground in BH01, WS02 and WS04. No other visual or olfactory evidence of contamination was reported.

Evidence of potential Asbestos Containing Material (ACM) was not observed during the investigation works.

10.0 Contamination Assessment Criteria

10.1 Soils

As part of the Generic Quantitative Risk Assessment (GQRA) soil concentrations have first been screened against Pick Everards' Tier 1 Soil Screening Values (TSVs), adopted from the Suitable 4 Use Levels (S4ULs) published by the LQM/CIEH [7]. Where no published screening values are available Pick Everard have derived their own values using the Contaminated Land Exposure Assessment (CLEA) 1.07 model in accordance with the CLEA framework. All parameters used within the TSVs are the CLEA 1.07 defaults or LQM/CIEH values. Additionally, Soil Organic Matter (SOM) has been altered to include SOMs of 1% and 2.5% along with the default of 6% to better reflect the range of SOM content commonly found within shallow soils on Brownfield sites. This matches the LQM/CIEH approach to SOM [8]. All soil concentrations below TSVs are considered to pose a minimal risk to human health.

In March 2014 DEFRA together with Contaminated Land: In Real Environments (CL:AIRE) published Category 4 Screening Levels (C4SLs) for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI, and lead for soil using the CLEA Model. The C4SLs are considered suitable by DEFRA for use for Part 2A decisions and planning i.e., change of use. Where concentrations of the above determinants exceed the TSVs they have also been screened against C4SLs. Contaminant concentrations below C4SLs are considered to pose an acceptably low risk to human health.

Risks from land contamination in the UK are assessed on the 'suitability for use' principle, whereby pollutant linkages are considered with regard to the intended end use of the site, and the specific exposure pathways and receptors associated with that use. Due to the proposed end use as a learning centre, the risk assessment has initially been undertaken based on a 'Commercial' land use scenario. In selecting the most appropriate screening values for this site, a Soil Organic Matter (SOM) of 1.0% has been used, as these provide the most conservative TSVs. A copy of the assessment criteria is included in Appendix D.

10.2 Phytotoxic Metals

Copper, Zinc and Nickel are considered potentially phytotoxic metals and may pose a detrimental effect to plants growing within the soils on site. Allowable characteristic values for differing types of topsoil are provided within BS3882:2015. These characteristic values have been adopted for use in the phytotoxic risk assessment. Where significant concentrations of other phytotoxic compounds have been identified (for example, elevated or free phase hydrocarbons), commentary has also been provided.

10.3 Controlled Waters

The controlled waters receptors of concern at this site are:

- The underlying Secondary A Aquifer; and
- The River Thames.

The results of the soils testing have been used to undertake a qualitative risk assessment to identify potential contamination that could impact on the controlled waters receptors, and the likely risk.

10.4 Ground Gas

Ground gas investigation has been undertaken in general accordance with the requirements laid out in BS8576:2013. A Ground Gas risk assessment was then undertaken in general accordance with BS8485:2015+A1:2019. A characteristic situation is provided for the site based on the maximum recorded ground gas flow rate, and the maximum recorded steady-state concentrations for methane and carbon dioxide.

11.0 Contamination Assessment

11.1 Human Health Generic Quantitative Risk Assessment

Eight soil samples were obtained and analysed for the contaminants of concern. Of these, seven were obtained from between ground level and 1.00m bgl and have been used in the human health GQRA. The results of the assessment are summarised in the sections below.

11.1.1 Heavy Metals

Seven soils samples were scheduled for analysis of heavy metal concentrations and compared against the TSVs. The results of the analysis are summarised in the table below.

Determinant	TSV	BH01 0.50m	WS01 0.10m	WS02 0.50m	WS03 0.60m	WS04 1.00m	WS05 0.70m	WS06 0.30m
Arsenic	640	11	11	11	7	15	11	10
Boron	240,000	-	-	-	-	-	-	-
Cadmium	190	1	1.1	0.9	0.8	1	1.1	0.8
Copper	68,000	30	30	20	9	20	21	11
Chromium III	8,600	17	24	24	13	24	25	17
Lead	2,300	463	113	56	62	143	81	54
Mercury	25.8	1.46	-	-	2.53	-	-	0.29
Nickel	980	16	18	18	12	20	23	14
Zinc	730,000	38	86	51	98	79	54	36

- Concentrations reported below laboratory method detection limit.

Table 12 –Summary of Reported Heavy Metal Concentrations in Soil Samples (mg/kg).

In addition to the above, concentrations of Chromium VI and Selenium were reported below the laboratory method detection limit in all of the samples analysed.

In summary, none of the reported concentrations of heavy metals exceed the TSVs protective of human health receptors.

11.1.2 Polycyclic Aromatic Hydrocarbons (PAHs)

Seven soil samples were scheduled for analysis of PAH concentrations. Of these, soil sampled from WS05 at 0.70m bgl returned concentrations below the laboratory method detection limit. The results of the analysis on the remaining samples are summarised in the table below.

Determinant	TSV	BH01 0.50m	WS01 0.10m	WS02 0.50m	WS03 0.60m	WS04 1.00m	WS06 0.30m
Acenaphthene	57	-	-	-	0.02	-	-
Acenaphthylene	86.1	-	0.02	-	0.02	0.02	-
Anthracene	520,000	-	0.02	-	0.1	0.05	-
Benzo(a)anthracene	170	0.07	0.23	0.13	0.55	0.26	0.04
Benzo(a)pyrene	44	0.07	0.32	0.2	0.59	0.29	0.04
Benzo(b)fluoranthene	1,200	0.08	0.39	0.22	0.65	0.36	0.05
Benzo(ghi)perylene	3,900	-	0.16	0.12	0.26	0.13	-
Benzo(k)fluoranthene	35	-	0.15	0.08	0.27	0.14	-
Chrysene	350	0.07	0.29	0.17	0.64	0.31	-
Dibenzo(ah)anthracene	3.5	-	-	-	0.06	-	-
Fluoranthene	23,000	0.13	0.36	0.26	1.2	0.56	-
Fluorene	30.9	-	-	-	0.03	0.01	-
Indeno(123-cd)pyrene	500	0.04	0.21	0.15	0.34	0.17	0.03
Naphthalene	76.4	-	-	-	-	-	-
Phenanthrene	22,000	0.06	0.11	0.09	0.5	0.24	-
Pyrene	54,000	0.13	0.33	0.22	1	0.47	-
Total PAH-16MS	N/A	0.65	2.59	1.64	6.23	3.01	0.16

- Concentrations reported below laboratory method detection limit.

Table 13 –Summary of Reported PAH Concentrations in Soil Samples (mg/kg).

In summary, none of the reported concentrations of PAH compounds exceed the TSVs protective of human health receptors.

11.1.3 Total Petroleum Hydrocarbons (TPH)

Three soil samples were scheduled for banded TPH analysis, and four samples were scheduled for speciated TPH, MTBE and the BTEX compounds (Benzene, Toluene, Ethylbenzene, and Xylene). The results of the for TPH analysis are summarised in the tables below.

Determinant	TSV	WS01 0.10m	WS02 0.50m	WS06 0.30m
TPH >C8-C10	78	5	2	-
TPH >C10-C12	48	5	-	-
TPH >C12-C16	24	10	-	-
TPH >C16-C21	28,000	13	3	-
TPH >C21-C40	28,000	46	9	-

- Concentrations reported below laboratory method detection limit.

Table 14 –Summary of Banded TPH Concentrations in Soil Samples (mg/kg).

Determinant	TSV	BH01 0.50m	WS03 0.60m	WS04 1.00m	WS05 0.70m
Aliphatic >C10-C12	48	-	-	1	1
Aliphatic >C12-C16	24	-	-	-	-
Aliphatic >C16-C21	1,600,000	-	2	2	-
Aliphatic >C21-C35	1,600,000	-	3	26	-
Aromatic >C10-C12	364	-	-	-	-
Aromatic >C12-C16	169	-	2	-	-
Aromatic >C16-C21	28,000	-	20	5	-
Aromatic >C21-C35	28,000	-	103	18	-

- Concentrations reported below laboratory method detection limit.

Table 15 –Summary of Speciated TPH Concentrations in Soil Samples (mg/kg).

In addition to the above, concentrations of BTEX compounds (Benzene, Toluene, Ethylbenzene and Xylenes), aliphatic hydrocarbons in the >C5-C10 range, and aromatic hydrocarbons in the >C5-C10 range were all reported below the laboratory method detection limit.

In summary, reported hydrocarbon concentrations do not exceed the TSV's protective of human health receptors.

11.1.4 Asbestos

All seven samples were analysed for the presence of asbestos fibres by optical microscopy. None of the samples were reported to contain potential asbestos fibres.

11.1.5 Human Health GQRA Summary

The results of the investigation confirm that contaminant concentrations across the site do not exceed Pick Everards TSV's protective of human health receptors. Accordingly, the risk to human health is considered to be low, and specific remedial measures will not be necessary.

11.2 Plant Toxicity

Concentrations of the potentially phytotoxic metals (Zinc, Copper, Nickel) in all seven samples were compared against the characteristic concentrations in topsoil provided in BS3882:2015 [9]. Soil sampled from WS05 was compared against characteristic concentrations for soils with a pH of 6.0-7.0, whilst for the remaining six samples a pH of >7.0 was selected.

Concentrations of the potentially phytotoxic metals were reported below the published characteristic values. Additionally, significantly elevated hydrocarbon concentrations were not recorded across the site. Accordingly, the risk to vegetation is considered to be low.

It should be noted however that six of these samples have been obtained from the Made Ground, which may not be suitable as a growing medium due to other parameters outside of the scope of this assessment (coarse fragment content, electrical conductivity, plant nutrient content etc.).

11.3 Qualitative Controlled Waters Risk Assessment

No water samples were obtained as no significant groundwater body was encountered. One soil sample was obtained from WS03 at a depth of 2.00m bgl however, and analysed for the contaminants of concern. The sample contained no significantly elevated contaminants, and a total TPH of 105mg/kg showed a decrease in depth from 130mg/kg recorded in the same borehole at 0.60m bgl.

In assessing the risk to controlled waters beneath the site, consideration has been given to the following:

- A lack of significantly elevated contaminant concentrations recorded in soils beneath site
- A lack of encountered groundwater within the Kempton Park Gravel Member;
- A lack of groundwater abstraction points in the surrounding area;
- No significantly contaminative historical land use on-site; and
- Historic industrial land use in the surrounding areas present a more likely source of potential groundwater contamination than the site itself.

On the basis of the above, it is considered that the site presents no risk to controlled waters, and no further investigation is required.

11.4 Ground Gas Risk Assessment

Ground gas monitoring has been undertaken on six occasions over a seven-week period, in general accordance with BS8576:2013. Results are included as Appendix F and summarised in the table below.

Location ID	Maximum Steady State			Gas Screening Value
	CH_4 Concentration (%v/v)	CO_2 Concentration (%v/v)	Flow Rate (l/hr)	
WS01	0.1	6.2	0.1	0.0062
WS02	0.1	5.1	0.1	
WS05	0.1	3.2	0.1	

Negative flow rates converted to positive as a precaution, in accordance with BS8485:2015

Table 16 –Maximum steady state ground gas concentrations recorded by Pick Everard.

Atmospheric pressure over the monitoring period was recorded between 1001mbar and 1041mbar, and as such it is considered that the worst-case ground gas generating conditions have not been encountered (generally considered to be periods of low and falling pressure, <1000mbar). it is noted however, that gas flow rates remained consistently very low throughout the monitoring period. Additionally, no significant ground gas source has been identified beneath the site, and the primary risk is from offsite migration. On

this basis, it is considered that the values obtained are representative of the ground gas regime, and that additional monitoring is unnecessary.

Based on the information above, a Gas Screening Value (GSV) of 0.0062 has been calculated in accordance with BS8485:2015+A1:2019, using the highest CO_2 concentration and the highest flow rate recorded. Whilst this value would place the site within a Characteristic Situation 1, it is noted that maximum steady state concentrations of CO_2 were recorded in excess of 5% on multiple occasions throughout the monitoring period. As such, it is considered that the site should be placed within a Characteristic Situation 2 (Low Hazard Potential) in accordance with the recommendations of BS8485:2015+A1:2019. Accordingly, ground gas protection measures will be necessary.

12.0 Revised Conceptual Site Model

12.1 Introduction

On the basis of the information provided above, a revised Conceptual Site Model has been produced and is presented below.

12.2 Contamination Sources

12.2.1 On site

The following sources of contamination are considered based on the current and historic site uses;

- S1 – Potentially Contaminated Made Ground and Shallow Soils – associated with historic construction and demolition. Potential contaminants include TPH, PAH, heavy metals, and asbestos.
- S2 - Ground gas generated in Made Ground and nearby Alluvium deposits.

12.2.2 Off Site

- S3 – Current and historic industrial activities in the nearby area. Potential contaminants include TPH, PAH, and heavy metals.

12.3 Potential Pathways

The following pathways are considered likely at this site;

- P1 – Dermal contact with soils and/or dust;
- P2 – Accidental ingestion of soil or dust;
- P3 – Inhalation of gases, vapours, or dusts;
- P4 – Vertical and lateral migration through shallow soils or within groundwater;
- P5 – Exposure of plants to soil contaminants via root contact;
- P6 – Direct contact with buildings/infrastructure; and
- P7 – Accumulation within confined spaces.

12.4 Potential Receptors

There are a number of receptors that need to be considered as part of the redevelopment process. These are outlined below:

12.4.1 Human receptors

- R1 – Future Site Users – this will include future ground staff, plus visitors;
- R2 – Construction Workers; and
- R3 – Adjacent Land Users – this includes ground staff and visitors of Royal Botanical Gardens Kew.

12.4.2 Environmental

- R4 – Vegetation - this includes the existing and future landscaped areas of the site / proposed development;
- R5 – Controlled waters – Secondary A Aquifer and River Thames;

12.4.3 Other

- R6 – Buildings and buried services/infrastructure;

12.5 Conceptual Site Model

Source	Receptor	Severity	Pathway	Likelihood	Risk
S1 – Potentially Contaminated Made Ground and Shallow Soils – Potential contaminants include PAH, metals, asbestos.	R1 - Site User	Mild	P1 - Dermal Contact	Unlikely	Very Low
			P2 - Ingestion	Unlikely	Very Low
			P3 - Inhalation	Unlikely	Very Low
			P4 - Migration	Unlikely	Very Low
			P5 - Plant uptake	Unlikely	Very Low
	R2 - Construction	Mild	P1 - Dermal Contact	Low	Low
			P2 - Ingestion	Low	Low
			P3 - Inhalation	Low	Low
			P4 - Migration	Unlikely	Very Low
	R3 - Neighbours	Mild	P3 - Inhalation	Unlikely	Very Low
			P4 - Migration	Unlikely	Very Low
	R4 - Vegetation	Mild	P5 - Plant uptake	Unlikely	Very Low
	R5 – Controlled Waters	Medium	P4 - Migration	Unlikely	Low
	R6 - Building	Mild	P6 - Direct Contact	Unlikely	Very Low
S2 – Ground Gas	R1 - Site User	Medium	P7 - Accumulation	Low	Low/Moderate
	R2 - Construction	Medium	P7 - Accumulation	Unlikely	Low
S3 – Current and Historical nearby industrial land use.	R1 - Site User	Mild	P4 - Migration	Unlikely	Very Low
	R2 - Construction	Mild	P4 - Migration	Unlikely	Very Low
	R6 - Building	Mild	P4 - Migration	Unlikely	Very Low

Table 17 – Revised Conceptual Site Model

12.5.1 Future Site Users / Construction workers / Neighbouring Property

The results of the GQRA have confirmed that the risk to human health receptors is very low- low, and specific remedial measures are unnecessary. During groundworks, contractors will be exposed to Made

Ground. The exposure by dermal contact, inhalation, and ingestion of soil, is however likely to be of relatively short duration and exposure can be mitigated by the use of appropriate Personal Protective Equipment (PPE).

Ground gas accumulation has been determined to present a low to moderate risk to future site users, however this risk will be mitigated by the installation of ground gas protection measures as detailed in section 15.3.

12.5.2 Vegetation

While elevated concentrations of phytotoxic metals were not reported, it is noted that the Made ground may not be a suitable growing medium.

12.5.3 Controlled Waters

The risk to controlled waters is considered to be low based on the results of the qualitative assessment, and further investigation is not required.

12.5.4 Building Materials and Services

The results of the laboratory analysis suggest that the risk to buried services and structures is low.

13.0 Geotechnical Appraisal

13.1 General

An assessment of the geotechnical properties and ground conditions is given below with comments made relating to foundation, floor slab, pavement and earthworks design and other ground related development constraints.

13.2 Foundations

Due to the potential for unacceptably high total and differential settlement, it is considered that the underlying Made Ground deposits are unsuitable as a bearing stratum for the proposed development without further improvement. Foundations should therefore extend through any Made Ground deposits and found on the medium dense to dense sands beneath. It should be noted that Made Ground has been locally identified to a maximum depth of 2.60m bgl.

Should traditional strip, or trench fill, foundations be incorporated into the proposed development an allowable bearing capacity of at least 150kN/m^2 at a minimum depth of 1.20m bgl should be achievable, assuming 600mm wide foundations and limiting settlement to less than 25mm. Foundations will also need deepening locally to ensure that the Made Ground and any loose natural deposits have been fully penetrated, and the foundations bear on the medium dense sands and gravels.

If higher loads are required, then piled foundations may be necessary to provide an adequate bearing capacity for the proposed development. The safe working loads for a range of potential pile sizes and depths are provided in the table below, assuming Continuous Flight Augur (CFA) Piles are the preferred option. These are preliminary and will require confirmation based on the actual proposed loading schedule. Should the propose piling technique change, or greater depths required, this assessment should be revised.

CFA Pile Depth (m bgl)	CFA Pile Diameter		
	450mm	600mm	750mm
6.00	210kN	380kN	600kN
15.00	385kN	530kN	680kN
20.00	590kN	800kN	1010kN

Table 18 – Preliminary safe working loads according to CFA pile size and depth

Alternatively ground improvement options could be considered to avoid piling. Vibro-compaction/stone-columns could be utilised to provide a shallow founding horizon and could also be used to all for the construction of a ground bearing floor slab.

Another option would be to dig out the existing Made Ground and either replace with imported compacted granular material or if found to be suitable the Made Ground could be re-laid and compacted in layers to an engineering specification.

13.3 Ground Floor Slabs

Floor slabs should be designed considering the required performance criteria for the proposed structures. It should be noted that the thickness of sub floor Made Ground fill is likely to exceed 600mm, and a suspended floor slab would be recommended to reduce the effects of differential settlement from the Made Ground. Alternatively, the ground improvement options given in 13.2 above may allow for the use of a ground bearing floor slab.

13.4 Buried Concrete

Sulphate and pH testing was undertaken on 18 samples recovered from the Made Ground and natural deposits. The results of the testing are summarised in the table below:

Geology	pH	Water Soluble Sulphate (mg/l)	Total Potential Sulphate (%)
Made Ground	6.75	65	-
Kempton Park Gravel	5.25	71.5	-
London Clay	8.2	370	1.95

Table 19 – Characteristic pH and Sulphate Values based on BRE SD1

On the basis of the above it is recommended that buried concrete should be designed based on a Sulphate Class of DS-1 and an Aggressive Chemical environment for Concrete classification of AC-1 within the Made Ground, and to DS-1 and AC-2z within the Kempton Park Gravel Member.

The London Clay Formation is considered to be pyrite-bearing, and so the laboratory testing results were used to calculate oxidisable sulphates in accordance with the methodology of BRE SD1. The results of which indicated pyrite was present in all four samples tested from within the London Clay Formation, and as such the DS/AC classification was subsequently corrected to account for this. Accordingly, it is considered that buried concrete within the London Clay Formation should be designed to DS-4 and AC-4.

If foundations are proposed to extend below the groundwater table, it is recommended that pH and sulphate testing be undertaken on samples of the groundwater to confirm this design.

13.5 Soakaway Drainage

The results of the infiltration testing undertaken to date confirm that traditional soakaway drainage is appropriate for the proposed development.

13.6 Excavations

It is considered that excavation of the near surface Made Ground and natural soils within shallow foundations should be readily achievable using conventional hydraulic excavation techniques.

Whilst groundwater was not encountered during the investigative works, subsequent groundwater monitoring suggests that the resting groundwater level is below 2.65m bgl. It is considered that traditional

sumping and pumping techniques should be sufficient to deal with any groundwater ingress during foundation excavations.

Granular deposits of the Kempton Park Gravel Member were encountered across the site, and it is likely that any foundation excavations will be unstable. Consideration should therefore be given to the use of shoring/ supports during excavation works.

It is recommended that excavations should not be entered without appropriate support and a full risk assessment should be completed prior to entry. Mitigation measures to protect from accumulating ground gases should be implemented.

13.7 Pavement Design

It is likely that Made Ground will be identified at formation level. Average CBR values within Made Ground vary significantly. It is therefore recommended that these materials be removed to a depth of at least 500mm beneath formation, sorted and supplemented with thoroughly compacted suitable granular material, to provide a CBR value within the range of 2-5%.

Where natural soils are encountered at formation, the design CBR value should be restricted to 2%. It may be necessary to either; remove additional volumes of 'soft' cohesive material where encountered or incorporate geogrid reinforcement where appropriate.

Consideration should be given to the completion of in-situ CBR testing at finalised pavement formation levels to confirm design values.

15.0 Remedial Recommendations

15.1 Soils

The results of the GQRA have confirmed that the risk to human health receptors is low, and specific remedial measures are unnecessary.

It is noted however that a significant thickness of Made Ground is present across the site, and this may not provide an adequate growing medium for any areas of soft landscaping. It may therefore be prudent, where soft landscaping is proposed, to remove the top 150mm of Made Ground, and replace with clean, site-won or imported topsoil.

Any imported materials to be used in areas of soft landscaping should be validated to confirm that contaminant concentrations do not exceed the relevant assessment criteria for the site. The proposed chemical validation rates are shown in the table below, however this should be approved by the local authority EHO prior to confirming the testing regime.

Source and Validation Rate	Chemical Analysis Suite		
	Pick Everard Suite 2	Asbestos ID	TPH CWG
Greenfield/Manufactured Soils 1 per 250m³ (min 3)	X	X	
Brownfield/Screened Soils 1 per 100m³ (min 6)	X	X	X

Table 20 – Proposed Validation Schedule

Imported topsoil will also need to be tested for conformity with BS3882:2015.

15.2 Controlled Waters

Remediation of controlled waters is not considered necessary, and no further investigation is required.

15.3 Ground Gas

Ground gas protection measures are considered necessary to satisfy a CS2 scenario. It is understood that the development is likely to comprise a 'Type C' building. In a CS2 scenario these will require a gas protection score of 2.5 points.

The table below provides suggested combinations of floor slab, ventilation, and membrane that can achieve a suitable level of protection.

Building Type	Structural Slab	Ventilation	Membrane	Point Score
Type C - Commercial building with central building management. Small to large sized rooms with active or good passive ventilation.	Cast in-situ reinforced suspended slab*	Pressure relief pathway in accordance with Table 6 of BS8485:2015	Gas resistant membrane in accordance with Table 7 of BS8485:2015	4.0*
	Cast in-situ ground bearing floor slab (nominal reinforcement)			3.0
	Suspended beam and block flooring			2.5

* Cast in-situ slabs should be well reinforced to control cracking, with minimal penetrations cast in, or the points score should be reduced by 0.5.

Table 21 – Potential Ground Gas Protection Measures

Following installation of the gas protection membrane, a visual inspection by a suitably qualified Geo-Environmental Engineer will be required. A photographic record of the membrane installation, including detailing around service entries, should be produced as part of this inspection.

The findings of the membrane inspection (including photographic record) should be included in the validation report. If any non-conformities are identified during the site visit, the verification report should also include details of how these will be mitigated. Arrangements should also be included as to how the long-term integrity of the membrane is ensured.

The site lies within an area where it is estimated that less than 1% of properties exceed the Radon action level. Radon specific protection measures are not required.

15.4 Utilities

The results of the laboratory analysis suggest that standard utility pipes will be appropriate for the proposed development, however the results should be passed to the utility provider for confirmation.

15.5 Unexpected Contamination

In the event that unexpected contamination is encountered during the development, a competent geo-environmental consultant should be informed immediately. Further investigation of the identified contamination is likely to be required, and the local authority EHO will also need to be notified.

16.0 Waste

Any material which the developer intends to discard as part of the construction works would be classed as waste and must be appropriately handled and managed in accordance with current waste legislation. The developer should be aware of, and utilise, the waste hierarchy where possible. Where material cannot be retained onsite, and disposal is the only option the waste must be classified (in accordance with EA technical guidance note WM3) and subsequent Waste Acceptance Criteria testing would be required by the receiving waste facility prior to disposal. To support this, Pick Everard have provided a preliminary assessment of the likely classification of the waste soils onsite below.

16.1 Waste Classification

The soils have been assessed against the European Waste Catalogue using the 'HazWasteOnline™' software. This assesses the data against the threshold concentrations applicable to potential hazardous properties in order to assess classification. The classification certificates are presented in Appendix G.

All of the samples analysed were classified as 'non-hazardous' soil and stone and can be disposed of under EWC Code 17 05 04.

It should also be noted that uncontaminated natural soils are generally acceptable to be disposed of as 17 05 04, and subsequently inert waste without further testing.

16.2 Waste Acceptance Criteria

Landfill Waste Acceptance Criteria (WAC) testing was undertaken on one sample of the non-hazardous Made Ground (BH01 at 0.50m bgl). The sample failed the inert WAC criteria due to elevated concentrations of fluorene and lead. As such, it is considered that the majority of Made Ground beneath the site would be suitable for disposal to a landfill rated to accept 'Non-Hazardous' soil and stone.

Uncontaminated natural soils can be disposed of as inert waste without further testing.

This assessment should be considered as preliminary only, and additional testing (classification and WAC) may be required by the receiving landfill depending on the volume of material proposed for disposal. Any suspected contaminated material identified during the development will need to be tested prior to disposal, or risk being rejected by the receiving site. It should also be noted that landfilling is a private enterprise, and receiving sites are at liberty to set their own, more stringent, assessment criteria and may refuse waste that would otherwise meet their permit requirements. It is therefore recommended that early consultation with an appropriate waste management organisation be undertaken to reduce disposal costs.

16.3 Waste Management

Waste generated from the site that are destined for landfill must undergo pre-treatment to reduce to volume or hazardous nature of the waste, facilitate handling, or enhance recovery. Treatment may comprise thermal, chemical, biological, or physical processes, including sorting, that changes the characteristics of the waste. Exemptions to the regulations exist where treatment is not technically feasible,

or where feasible treatment techniques would not reduce the hazardous nature of the or volume of the material going to landfill.

It should also be noted that soils that fail the requirements for hazardous WAC cannot be disposed of to landfill without further treatment to bring them under the threshold concentrations.

In order to reduce the volume of material sent for disposal (and ultimately cost), consideration should also be given to the potential donation of surplus natural soil arisings to nearby developments utilising the CL:AIRE register of materials, or reuse on site as part of the development works.

Reuse of remediated, excavated or imported soils may require a Materials Management Plan and declaration under the CL:AIRE 'Definition of Waste Code of Practice' (DoW:CoP), a registered waste exemption and/or an environmental permit.

16.4 Stockpiling and Handling of Materials

Natural soils should be stockpiled separately from Made Ground. Suspected contaminated/hazardous materials should also be stockpiled separately (on a bunded, impermeable membrane or concrete hardstanding to prevent run-off) for subsequent analysis and, if necessary, off-site treatment/disposal. All stockpiles should be numbered and tracked with an appropriate source location and destination detailed recorded. Any proposed remedial works will require agreement with the regulators prior to implementation.

Appropriate precautionary methods should be adopted when handling the materials. Soils should be kept damp to minimise the potential for dust generation and visual vigilance maintained for suspect materials. Should suspected asbestos or other contamination be identified, works in that area should be halted and a competent geo-environmental consultant contacted for advice.

A Site Waste Management Plan (SWMP) should be produced by the main contractor, as best practice, prior to the commencement of the project. The SWMP should describe the volumes and types of waste that are likely to be produced during a project, and should set out the actions for recycling, re-use, and disposal for each waste stream.

17.0 Recommended Further Works

The following further works are recommended:

- If foundations extend below the groundwater table, consideration should be given to the collection of groundwater samples to assists in concrete design;
- If ground improvement works are considered as a replacement to piling then further investigation works may be required to support this; and
- A Site Waste Management Plan (SWMP) should be produced by the main contractor.

This report should be submitted to the local authority for comment and approval.

18.0 References

1. EA/DEFRA – Land Contamination: Risk Management;
2. BS 10175 (2011) 'Investigation of Potentially Contaminated Sites: Code of Practice', British Standards Institution, London;
3. BS 21365:2020 'Conceptual Site Models for Potentially Contaminated Sites', British Standards Institution, London;
4. BS 5930:2015 'Code of Practice for Site Investigations', British Standards Institution, London;
5. BRE Digest 365 Soakaway Design.
6. Kent County Council (2000) 'The Soakaway Design Guide';
7. LQM/CIEH S4ULs for Human Health Risk Assessment, 2015.
8. Chartered Institute of Environmental Health / CL:AIRE. May 2008. Guidance on Comparing Soil Contamination Data with a Critical Concentration.
9. BS 3882:2015 'Specification for Topsoil', British Standards Institution, London;
10. BS 8576:2013 'Guidance on investigations for Ground Gas – Permanent Gases and VOC's', British Standards Institution, London; and
11. BS 8485:2015+A1:2019 Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings' British Standards Institution, London.

Drawings

210699-PEV-ZZ-ZZ-DR-C-0501 – Proposed Development Plan

NO DIMENSIONS TO BE SCALED FROM THIS DRAWING

CDM - RESIDUAL HAZARDS The following are considered to be significant risks relevant to this drawing, which could not be fully mitigated or removed through design:

CDM - RESIDUAL HAZARDS	
1	Refer to Design Risk Assessment
2	
3	
	Further possible control measures have been identified within the Design Risk Assessments which may help to mitigate these and other identified risks further during the construction / maintenance process.

General Notes:

1. This drawing is to be read in conjunction with the relevant specifications, inc, risk assessments (see CDM notes) and all other related drawings issued by the engineer.
2. All dimensions shown on this drawing are in metres unless otherwise stated.
3. SVP and RWP locations have not been provided to the Engineer at RIBA Stage 2.

Drainage Notes:

1. All works carried out to Sector Guidance in relation to the adoption of sewerage assets by sewerage companies in England (V1 2019) and Building Regulations Part H
2. All abandoned manholes, gullies and associated pipework excavated and disposed of off-site, remaining void backfilled with compacted Type 1 granular material. Redundant connections to retained sewers made good.
5. All pipework has a Class S bed and surround unless minimum cover of 1200mm in road areas and 900mm cover in pedestrian areas is not achieved. In this case, pipes should be protected by a 150mm thick concrete slab.
6. Cover levels to be set to proposed external level details shown on external levels layout plan.
7. Rainwater downpipe and foul water below ground connections indicative only, coordinates to be confirmed by Architects.
8. All manhole and inspection cover and frames within proposed external block paved areas to be recessed and inlaid with proposed surface finishing.
9. Manhole cover and frames within landscaped areas and footpaths are B125 rated to BS EN 124:1994.
10. Manhole cover and frames within vehicular loaded areas are D400 rated to BS EN 124: 1994.
11. Drainage runs within proposed floor slab to be ductile iron pipework with flexible joints to BS EN 598.
12. Drainage runs below proposed floor slab to be uPVC in accordance with BS EN 1401.
13. All drains to be tested prior to backfilling, after backfilling and upon completion of hard landscaping. All drains to be CCTV surveyed prior to hard landscaping.
14. Where pipes are crossing, plastic membrane to be used for protection to eliminate any chances of cross contamination.
15. Pipes of different diameters entering manholes should be installed with soffits at the same level.
16. Proposed soakaway sizes have been calculated using MicroDrainage Quick Storage Calculation and calculations are based on the 1 in 100 year storm event plus 40% climate change. No allowance for void ratio has been made at this stage. Calculations are indicative only and subject to detailed design

Key:

- Proposed surface water drainage
- Proposed soakaway
- Proposed inspection chamber
- Existing surface water drainage to be retained
- Existing surface water drainage to be removed

P02	Updated following Client presentation	11/11/2021	JD	CJM
P01	First issue	20/10/2021	JD	CJM
Revision		**Date**	**Drn**	**Chk**

Client
Royal Botanic Gardens Kew

Project
RBGK Learning Centre

Drawing Title
Proposed Surface Water Strategy

Suitability Status
S2 - Suitable for Information

Job No.	Scale	Size	Rev
210699	**1 : 200**	**@ A1**	**P02**

Drawing Number
210699 - PEV - ZZ - ZZ - DR - C - 0501
Project Code - Originator - Zone - Level - Type - Role - Number

PICK EVERARD

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LEGEND

- Hand Dug Trial Pit
- Soakaway Test
- Window Sample Location (with Falling Head Test)
- Window Sample Location
- Cable Percussion Borehole

Drawing Title: Exploratory Hole Location Plan

Project Name: RBG Kew Learning Centre

Project ID: 210699

Client: Royal Botanic Gardens Kew

Drawing No:

Drawn By: RHG

Checked By: RHG/EBE

Date: 07/04/2022

Rev No:

Scale: 1:300

PICK EVERARD

PEV-SK-C-0002 – Exploratory Hole Location Plan

Groundsure INSIGHTS

Site Details:

WHITE PEAKS CAFE, ROYAL BOTANIC GARDENS, KEW GREEN, KEW, TW9 3AB

Client Ref: 92068
Report Ref: GS-8427492
Grid Ref: 518471, 177334

Map Name: 1056 Scale Town Plan

Map date: **1867**

Scale: 1:1,056

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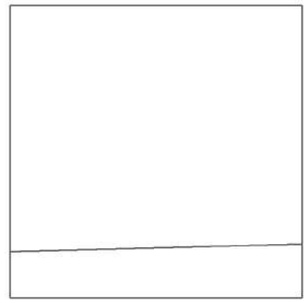

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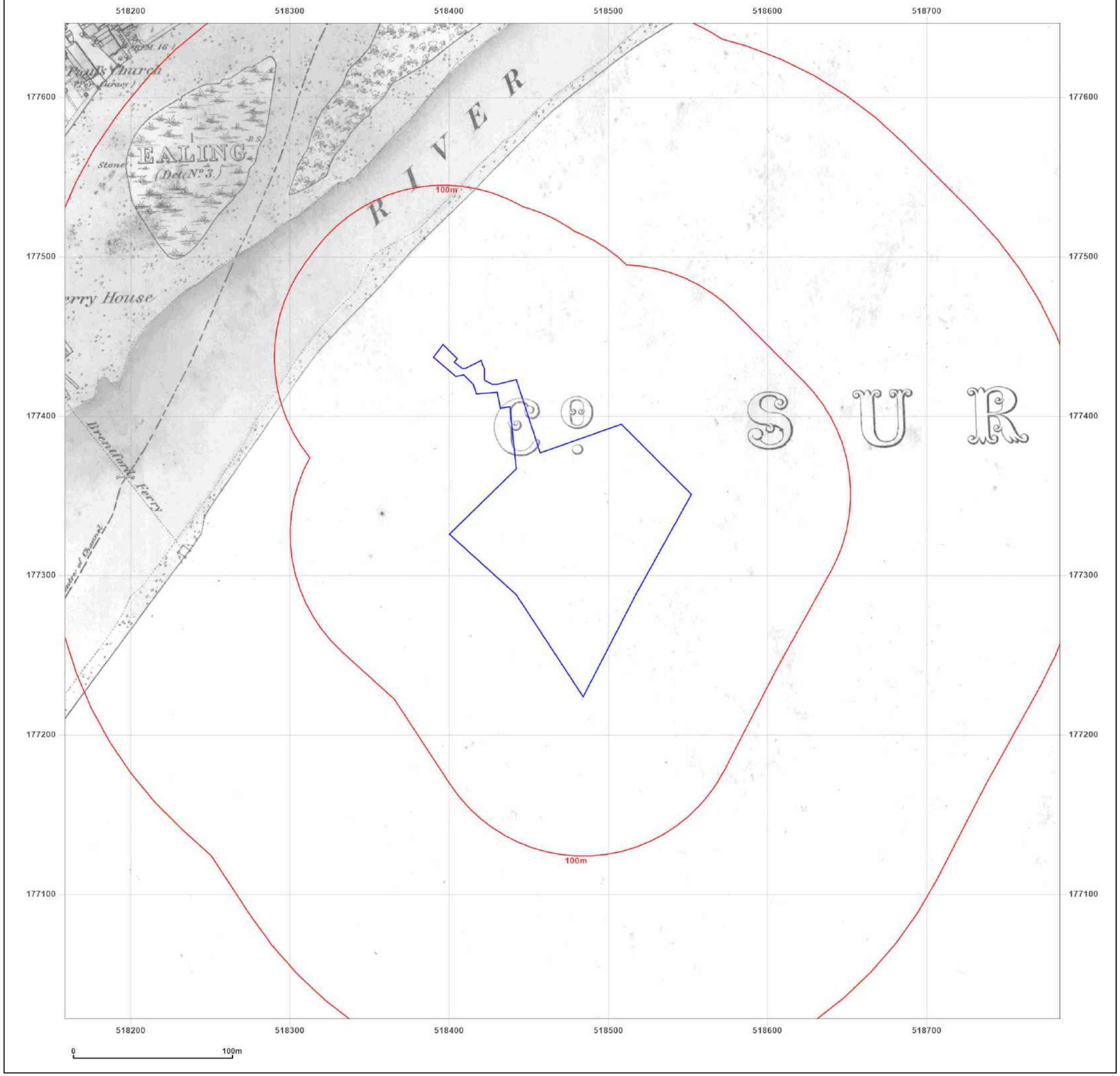

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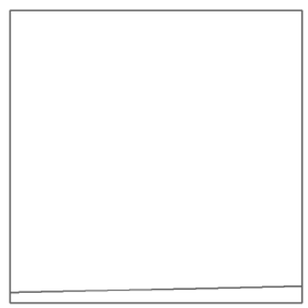

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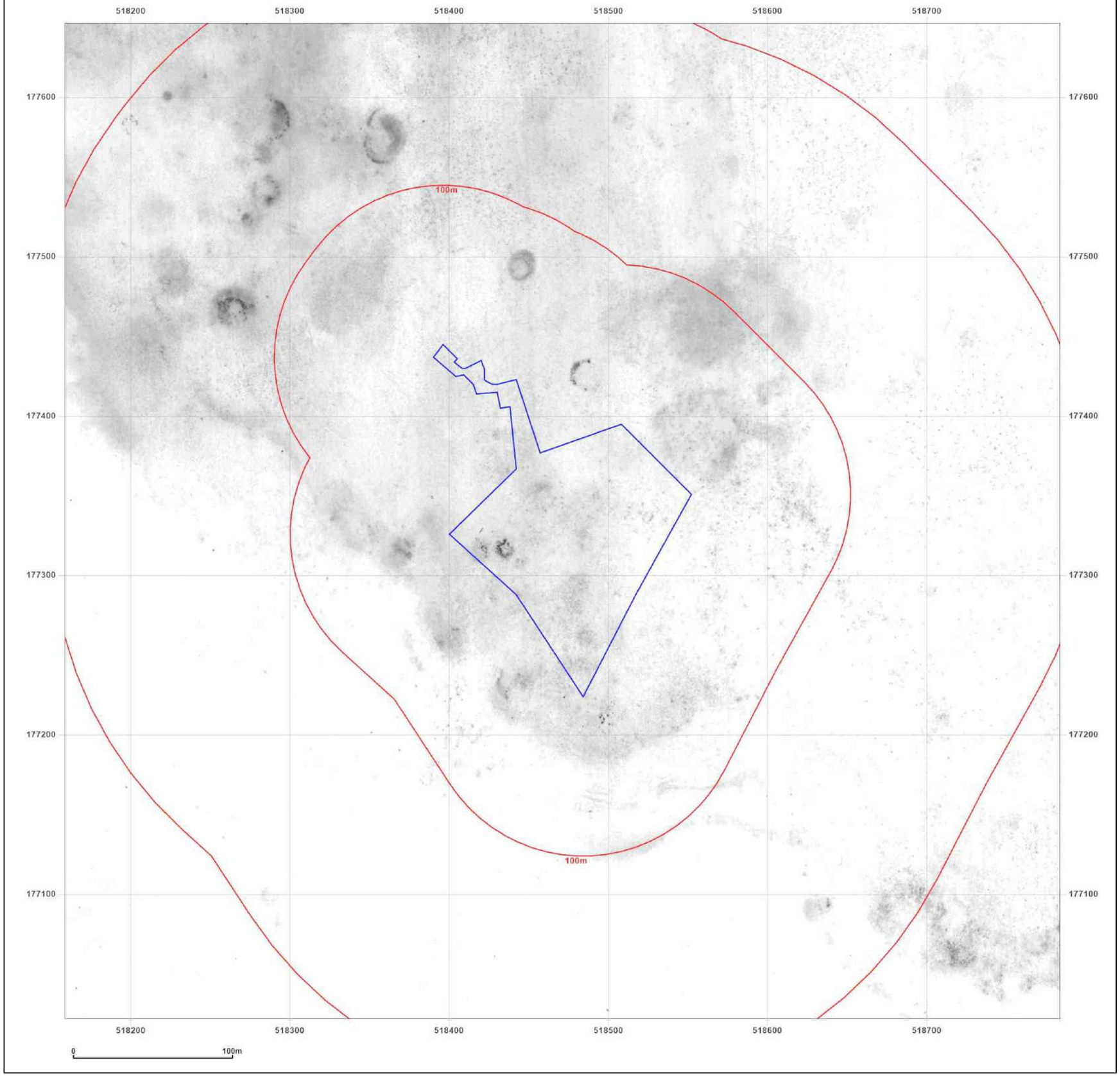

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Grid Ref: 518471, 177334

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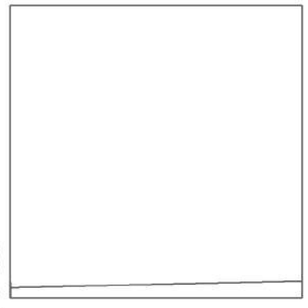

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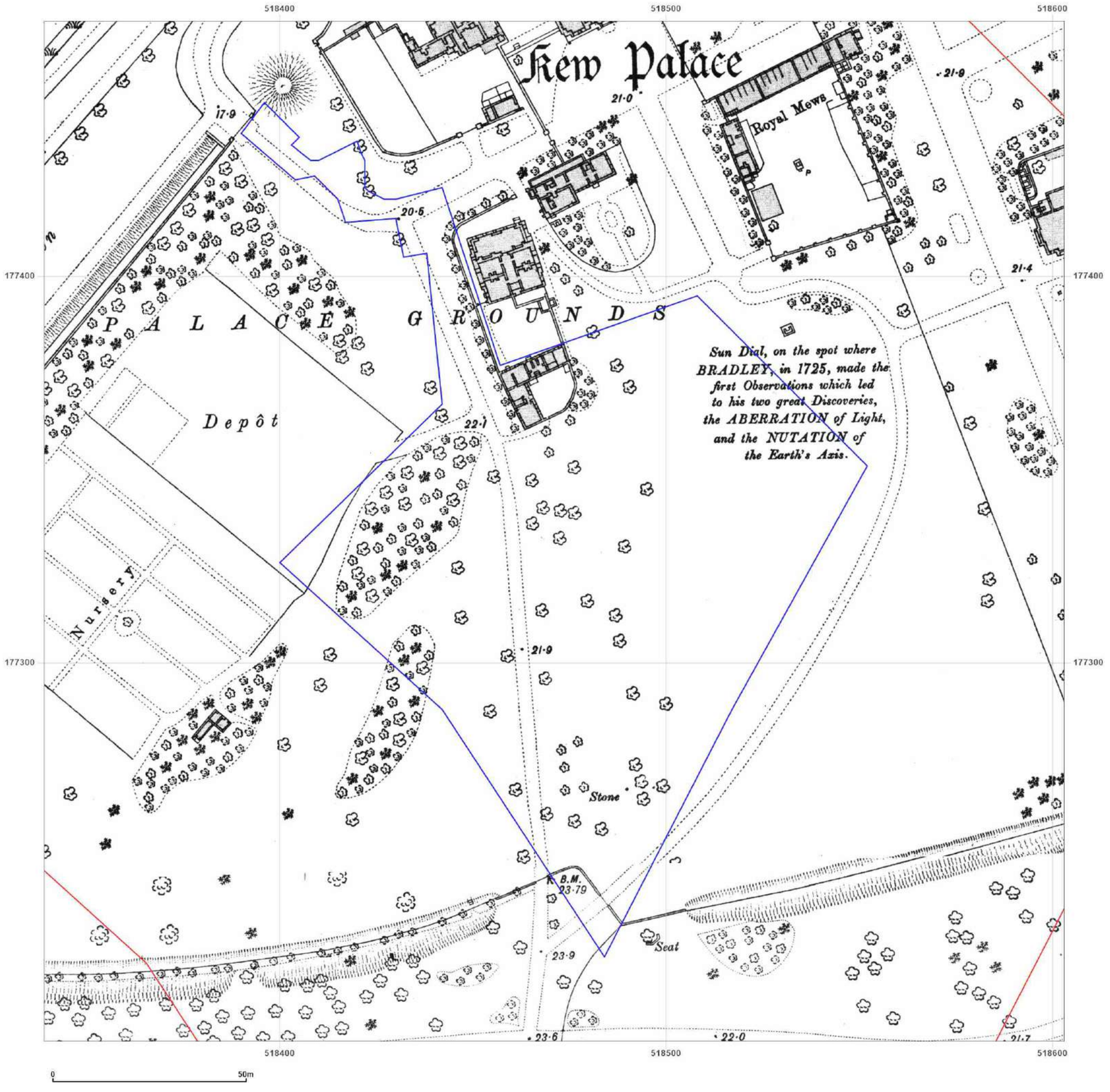

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Report Ref: GS-8427492
Grid Ref: 518471, 177334

Map Name: 1056 Scale Town Plan

Map date: **1896**

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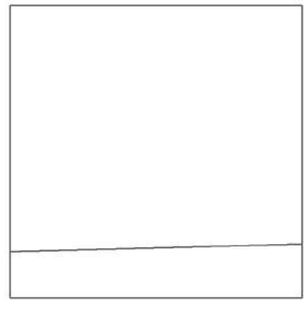

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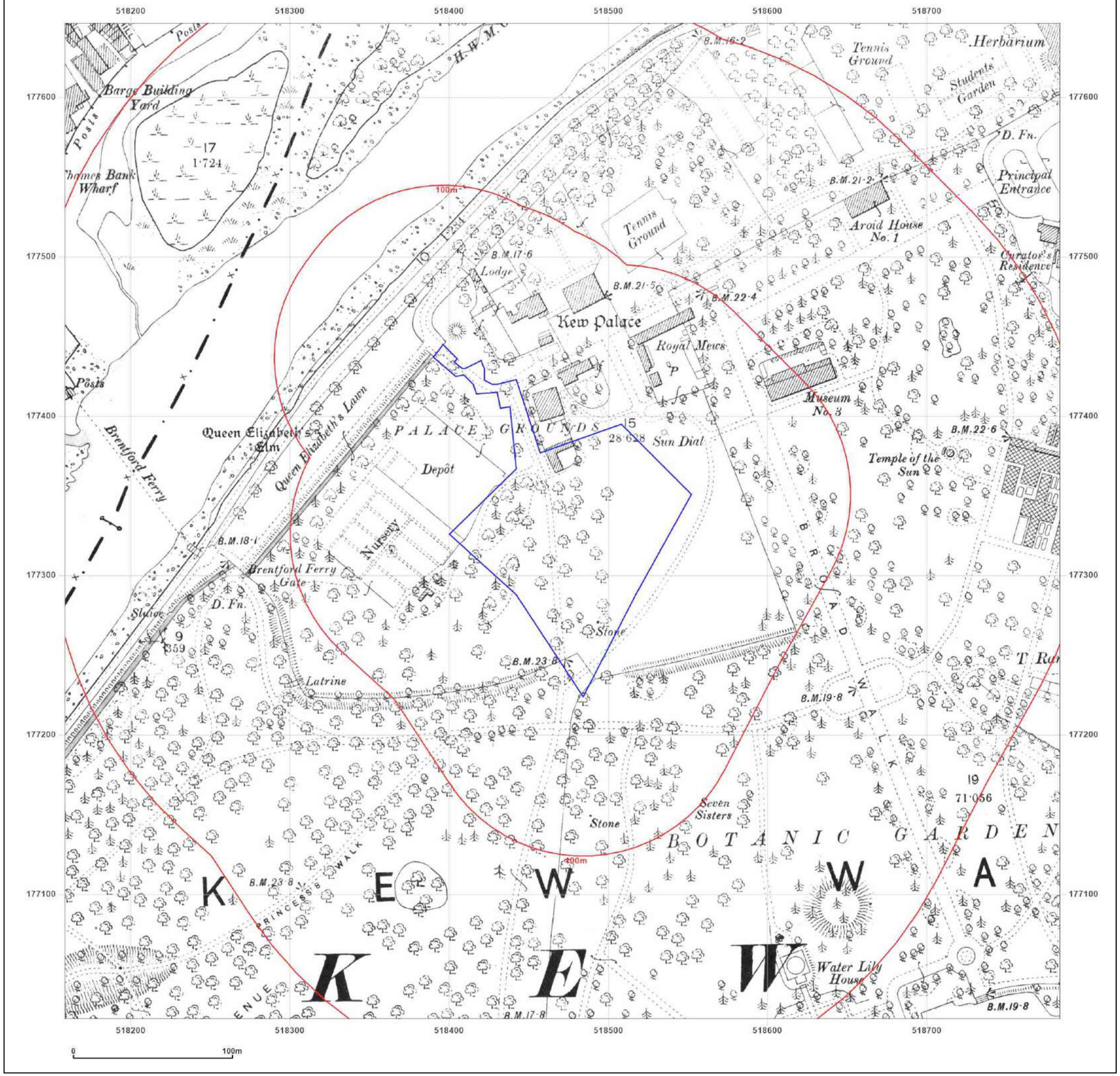

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Grid Ref: 518471, 177334

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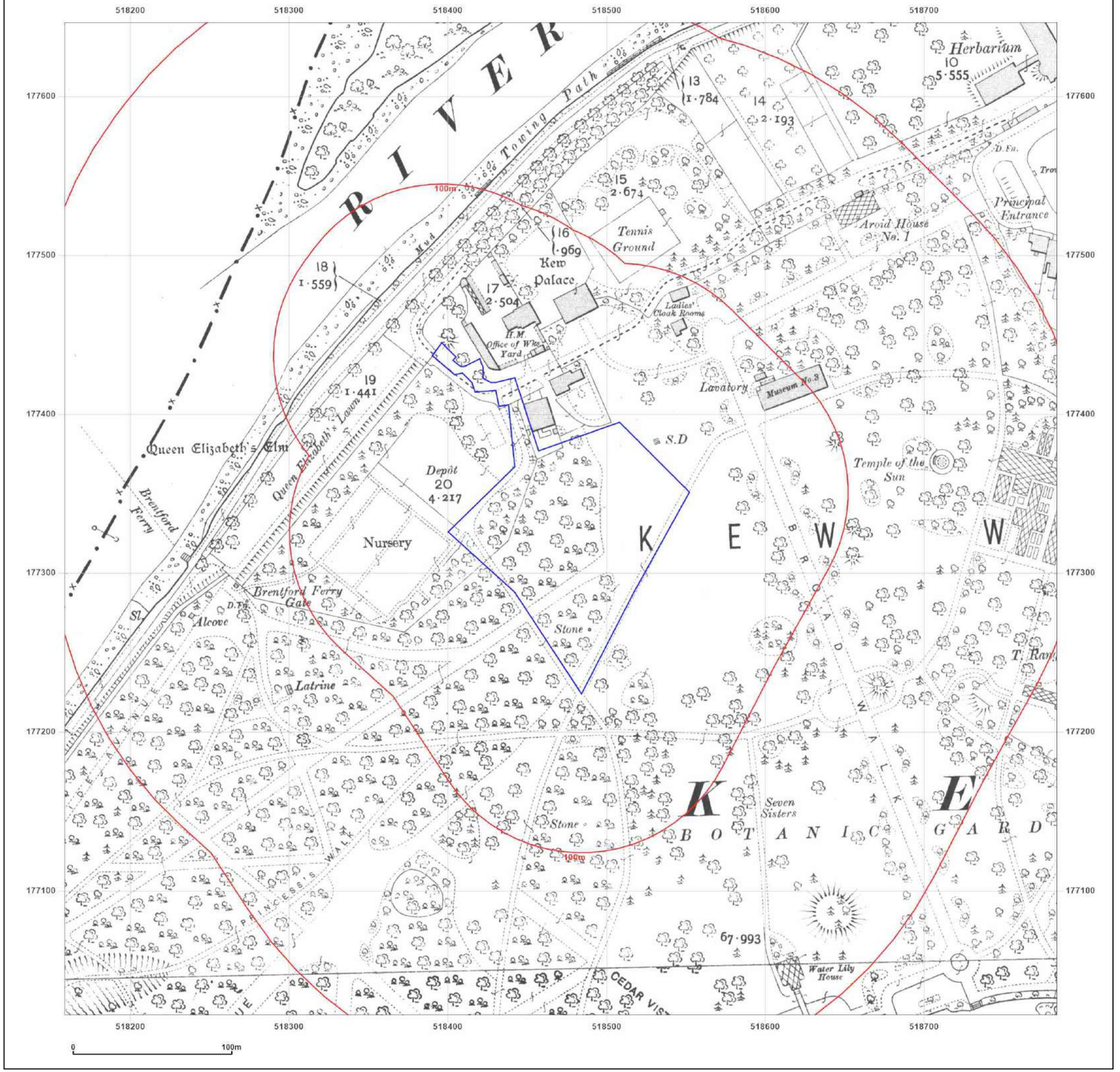

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Client Ref: 92068
Report Ref: GS-8427492
Grid Ref: 518471, 177334

Map Name: County Series

Map date: **1913**

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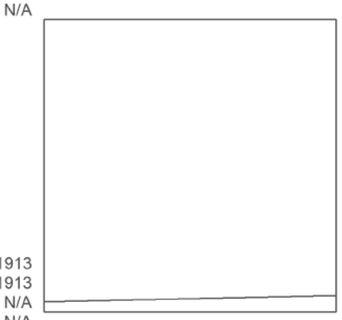

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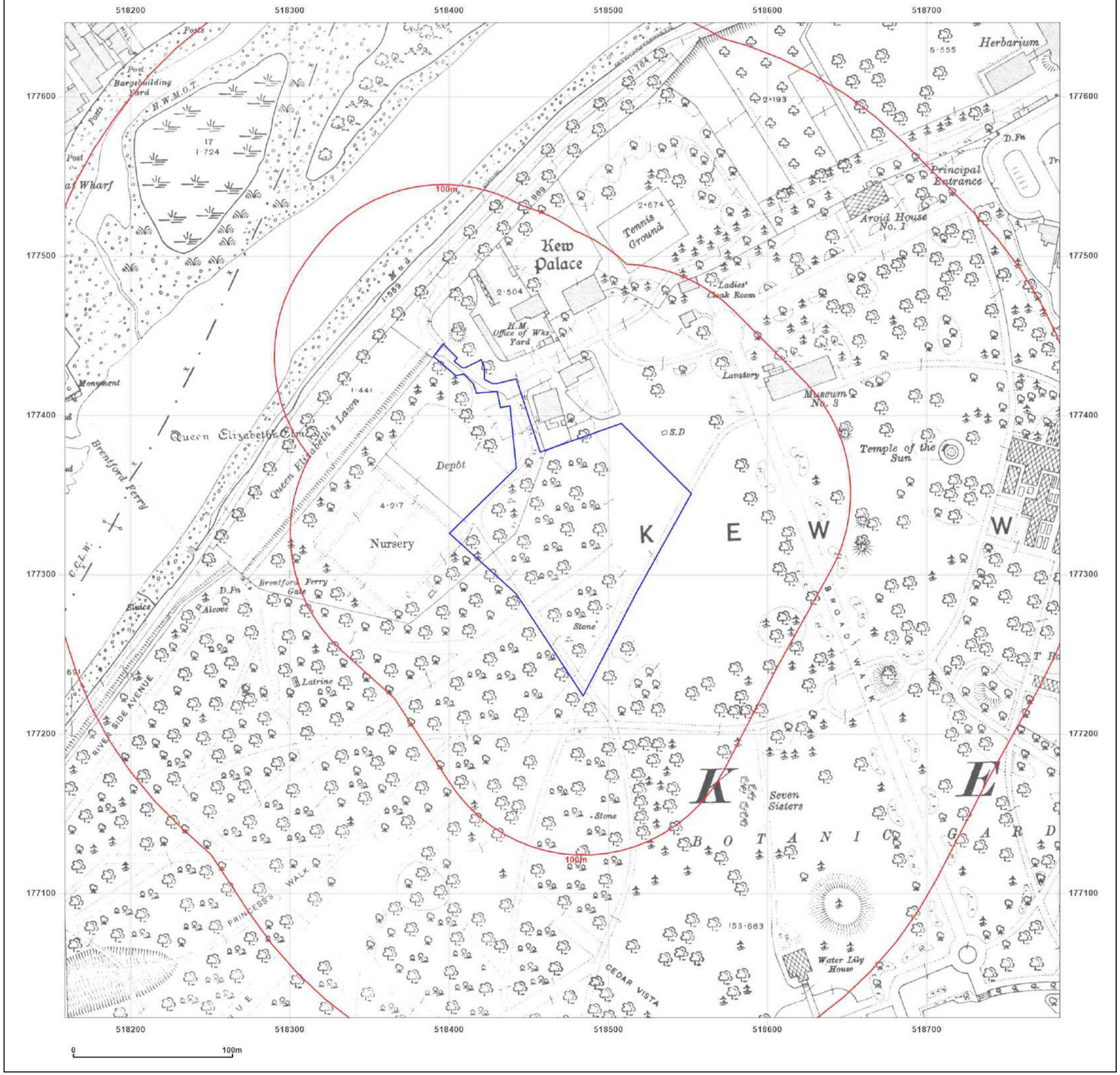

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Site Details:

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Client Ref: 92068
Report Ref: GS-8427492
Grid Ref: 518471, 177334

Map Name: County Series

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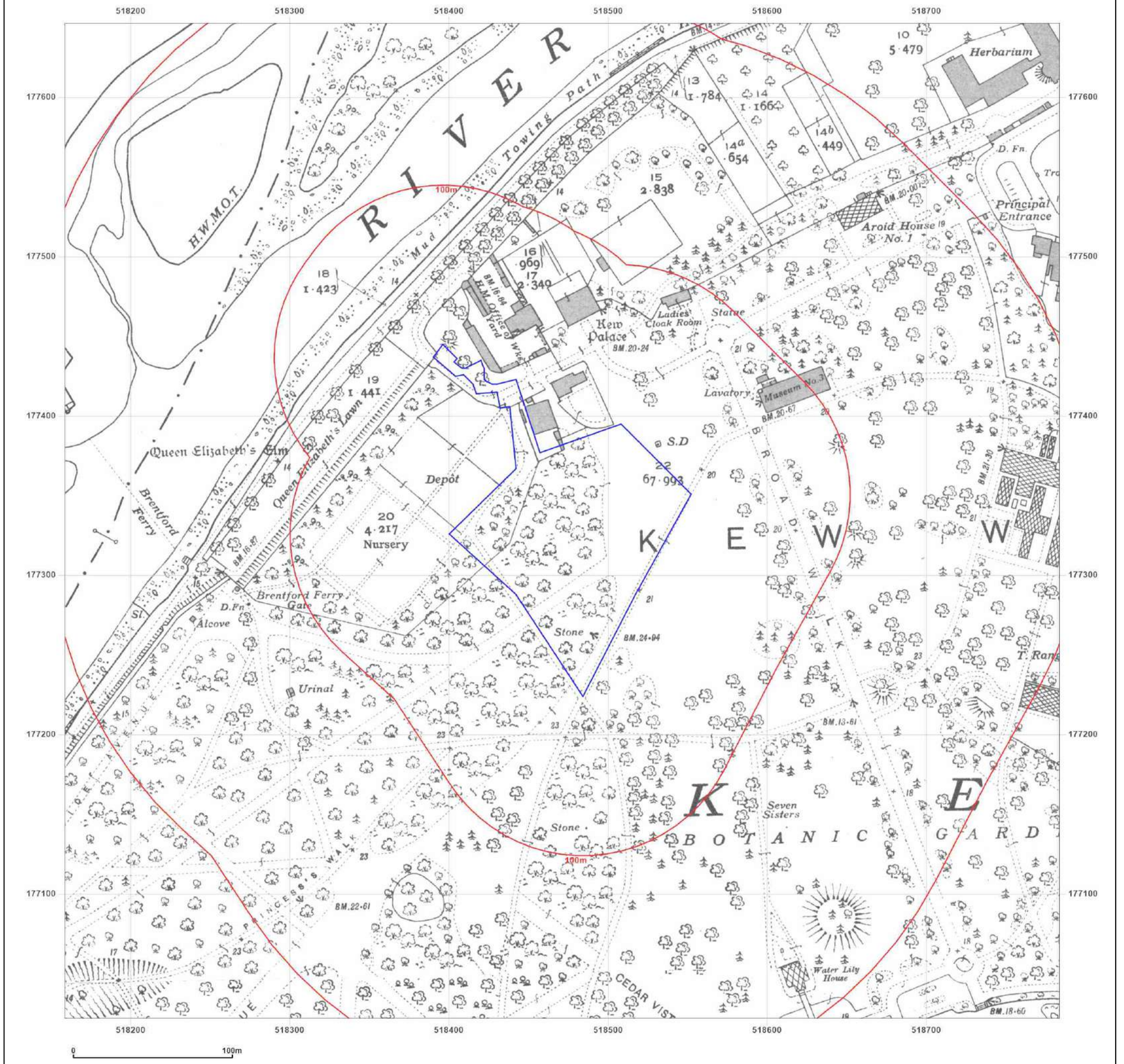

Groundsure INSIGHTS

Site Details:

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Client Ref: 92068
Report Ref: GS-8427492
Grid Ref: 518471, 177334

Map Name: County Series
Map date: **1933**
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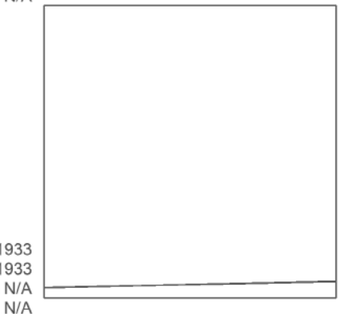

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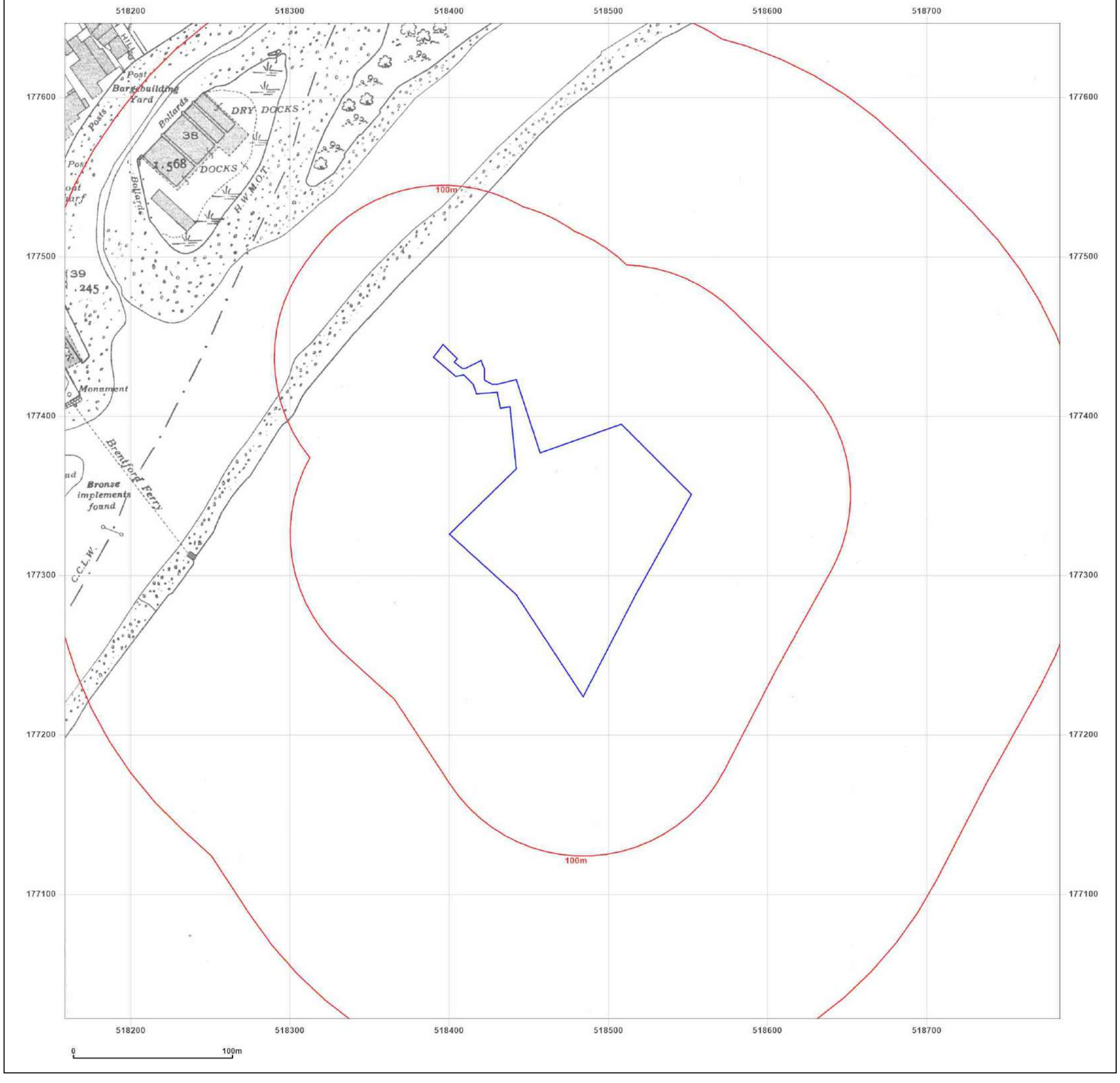

Groundsure INSIGHTS

Site Details:

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Client Ref: 92068
Report Ref: GS-8427492
Grid Ref: 518471, 177334

Map Name: County Series

Map date: **1935**

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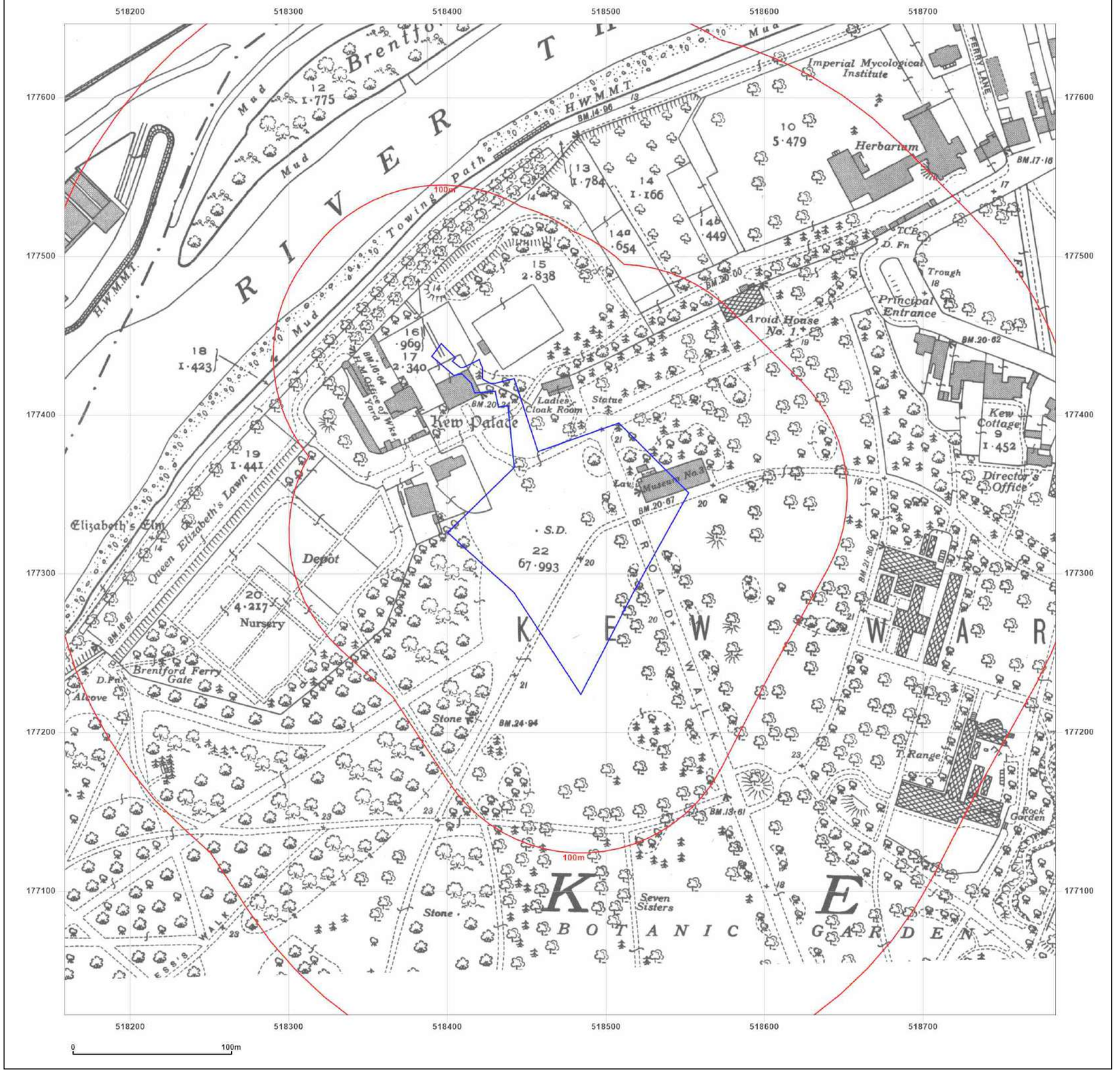
Production date: 06 January 2022

Map legend available at:
www.groundsure.com/sites/default/files/groundsure_legend.pdf



Groundsure INSIGHTS

Site Details:

WHITE PEAKS CAFE, ROYAL BOTANIC GARDENS, KEW GREEN, KEW, TW9 3AB

Client Ref: 92068
Report Ref: GS-8427492
Grid Ref: 518471, 177334

Map Name: County Series

Map date: **1940**

Scale: 1:2,500

Printed at: 1:2,500

N
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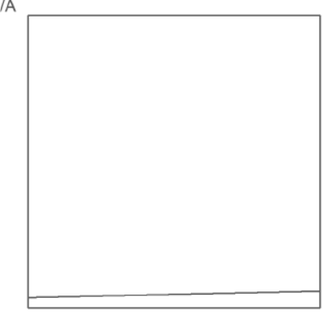
Surveyed 1940
Revised 1940
Edition N/A
Copyright N/A
Levelled N/A



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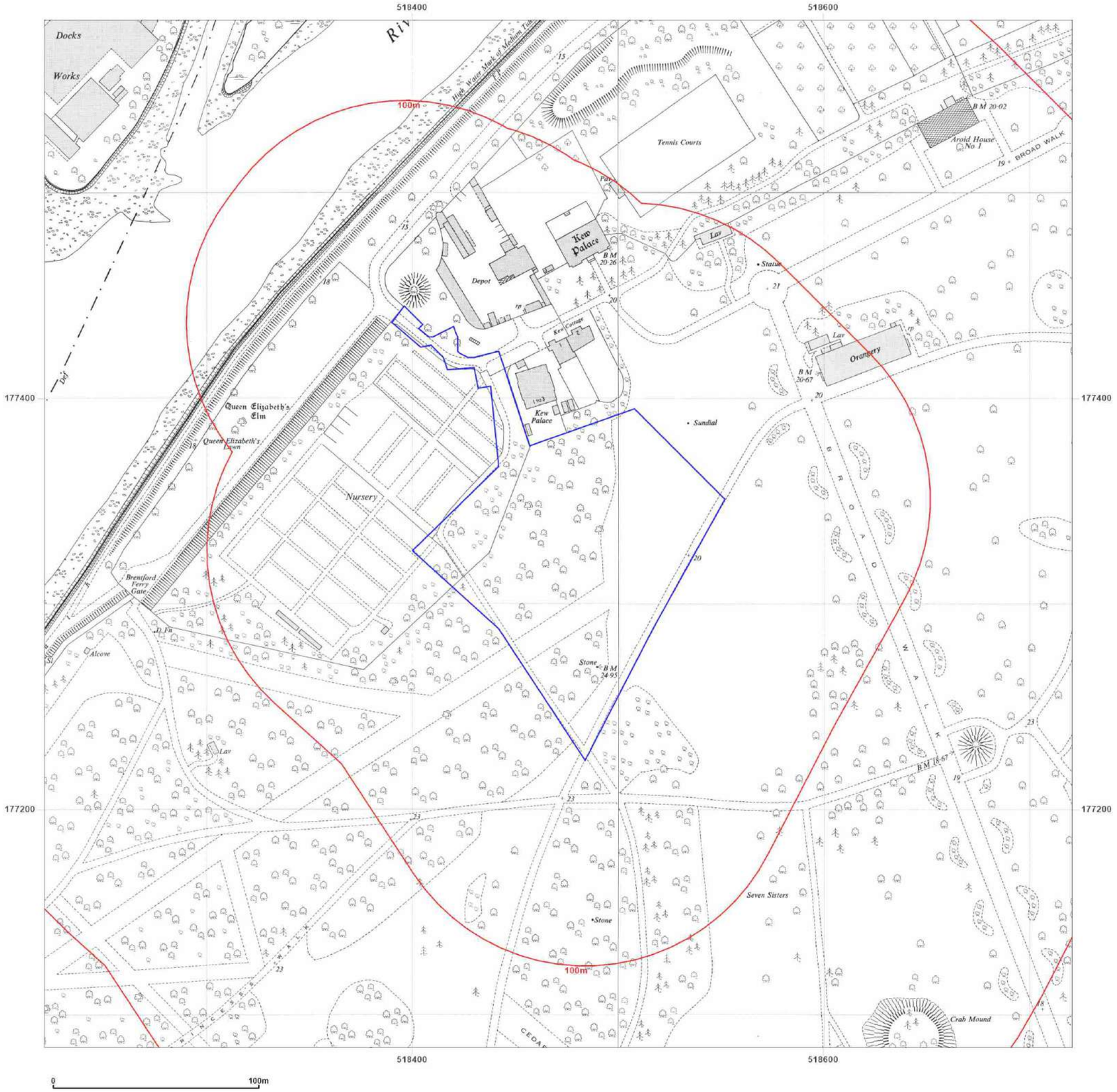

Groundsure INSIGHTS

Site Details:

WHITE PEAKS CAFE, ROYAL BOTANIC GARDENS, KEW GREEN, KEW, TW9 3AB

Client Ref: 92068
Report Ref: GS-8427492
Grid Ref: 518471, 177334

Map Name: National Grid

Map date: **1961**

Scale: 1:1,250

Printed at: 1:2,000

N
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Surveyed 1960
Revised 1960
Edition N/A
Copyright 1961
Levelled 1957

Surveyed 1960
Revised 1960
Edition N/A
Copyright 1961
Levelled 1947

Surveyed 1960
Revised 1960
Edition N/A
Copyright 1961
Levelled 1957

Surveyed 1959
Revised 1959
Edition N/A
Copyright 1961
Levelled 1957

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Production date: 06 January 2022

Map legend available at:
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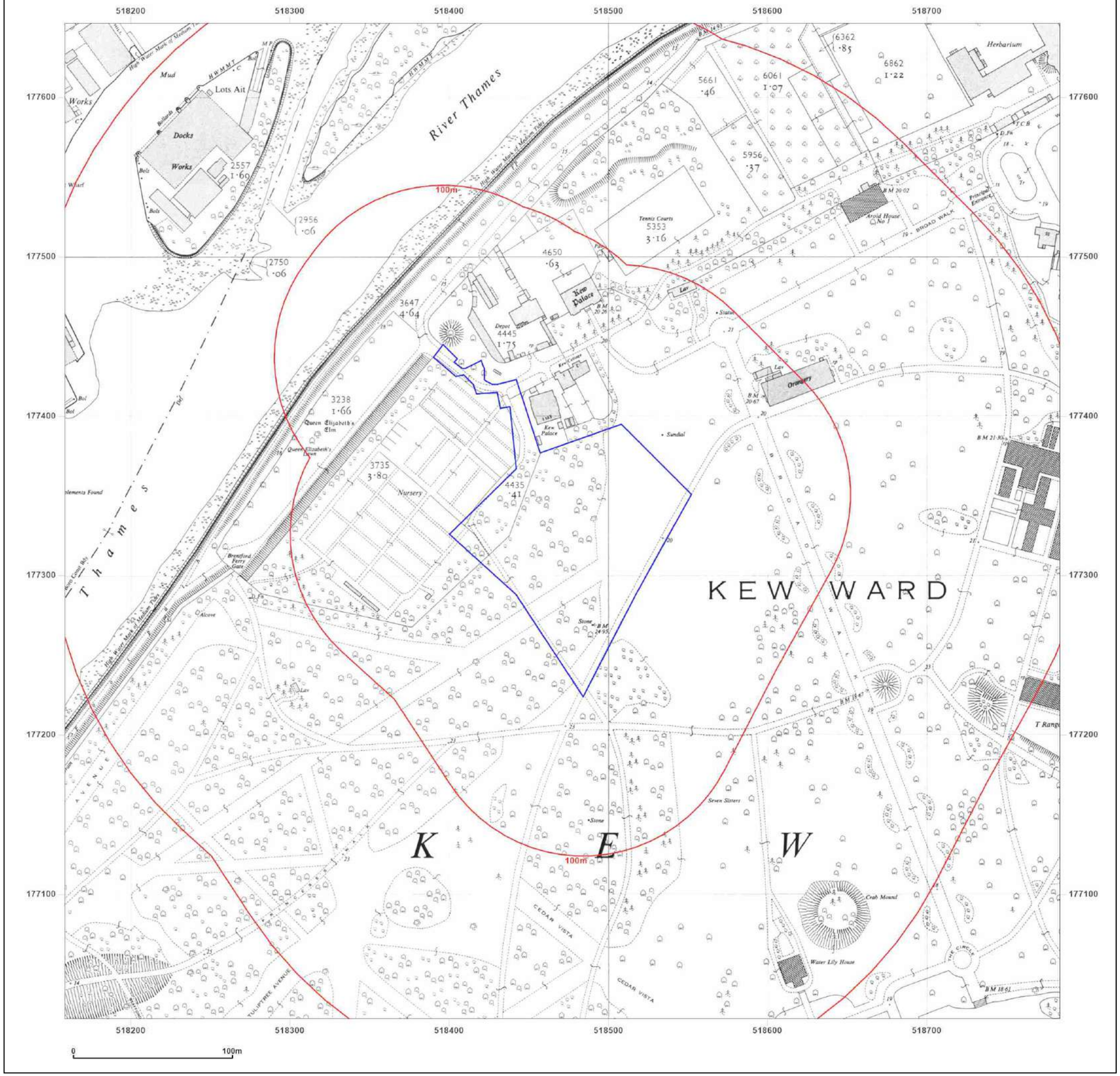

Groundsure INSIGHTS

Site Details:

WHITE PEAKS CAFE, ROYAL BOTANIC GARDENS, KEW GREEN, KEW, TW9 3AB

Client Ref: 92068
Report Ref: GS-8427492
Grid Ref: 518471, 177334

Map Name: National Grid

Map date: **1961**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1960
Revised 1960
Edition 1961
Copyright 1961
Levelled 1957

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Production date: 06 January 2022

Map legend available at:
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Groundsure INSIGHTS

Site Details:

WHITE PEAKS CAFE, ROYAL BOTANIC GARDENS, KEW GREEN, KEW, TW9 3AB

Client Ref: 92068
Report Ref: GS-8427492
Grid Ref: 518471, 177334

Map Name: National Grid

Map date: **1965**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1960
Revised 1965
Edition N/A
Copyright 1961
Levelled 1957

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Production date: 06 January 2022

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Groundsure INSIGHTS

Site Details:

WHITE PEAKS CAFE, ROYAL BOTANIC GARDENS, KEW GREEN, KEW, TW9 3AB

Client Ref: 92068
Report Ref: GS-8427492
Grid Ref: 518471, 177334

Map Name: National Grid

Map date: **1974-1977**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed N/A
Revised N/A
Edition N/A
Copyright 1974
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1977
Levelled N/A

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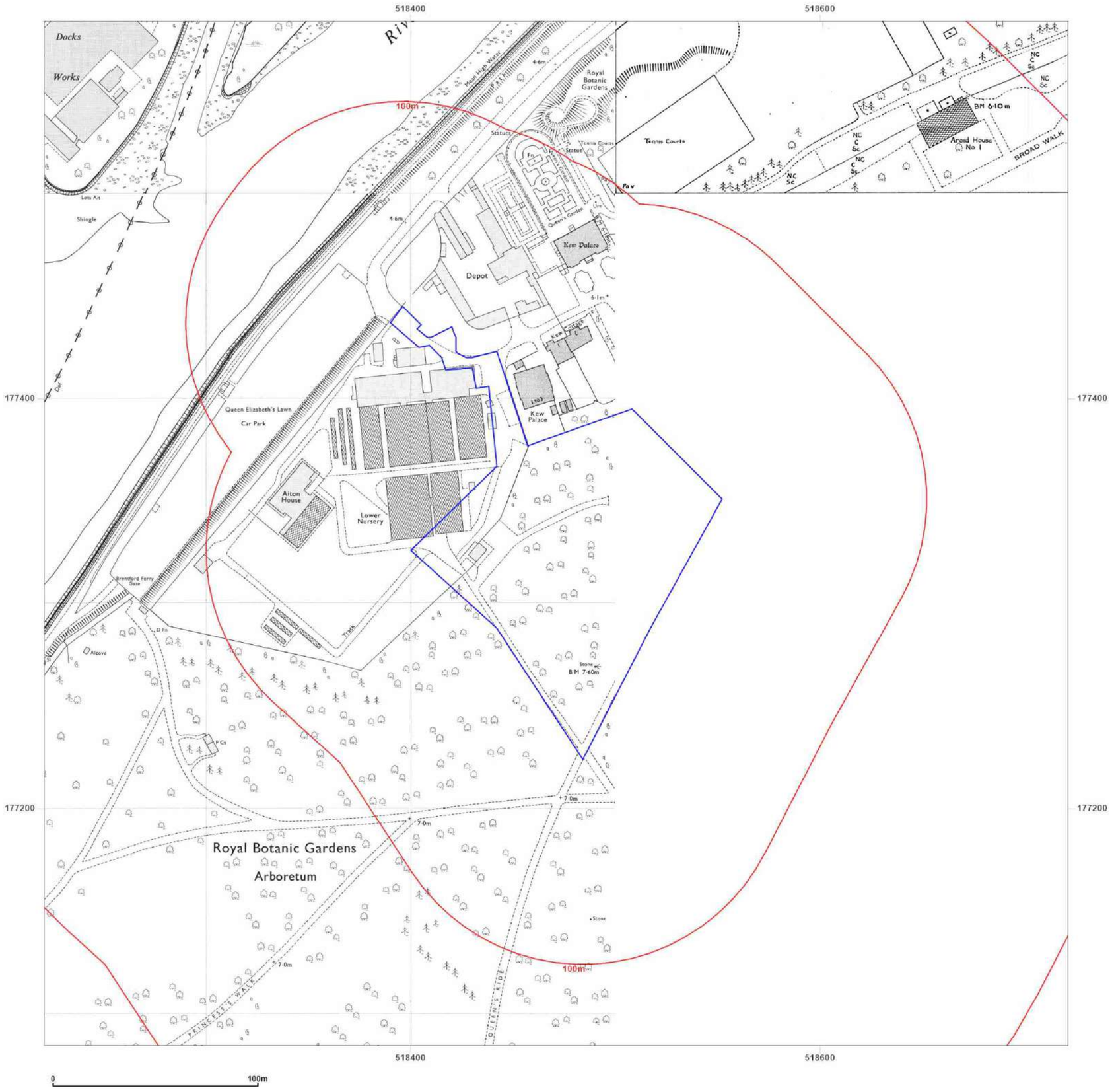

Groundsure INSIGHTS

Site Details:

WHITE PEAKS CAFE, ROYAL BOTANIC GARDENS, KEW GREEN, KEW, TW9 3AB

Client Ref: 92068
Report Ref: GS-8427492
Grid Ref: 518471, 177334

Map Name: National Grid

Map date: **1977-1980**

Scale: 1:1,250

Printed at: 1:2,000

N
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Surveyed 1960
Revised 1976
Edition N/A
Copyright 1977
Levelled 1957

Surveyed 1975
Revised 1980
Edition N/A
Copyright 1980
Levelled 1975

Surveyed 1960
Revised 1979
Edition N/A
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