Riverside Energy Park

Environmental Statement Technical Appendices

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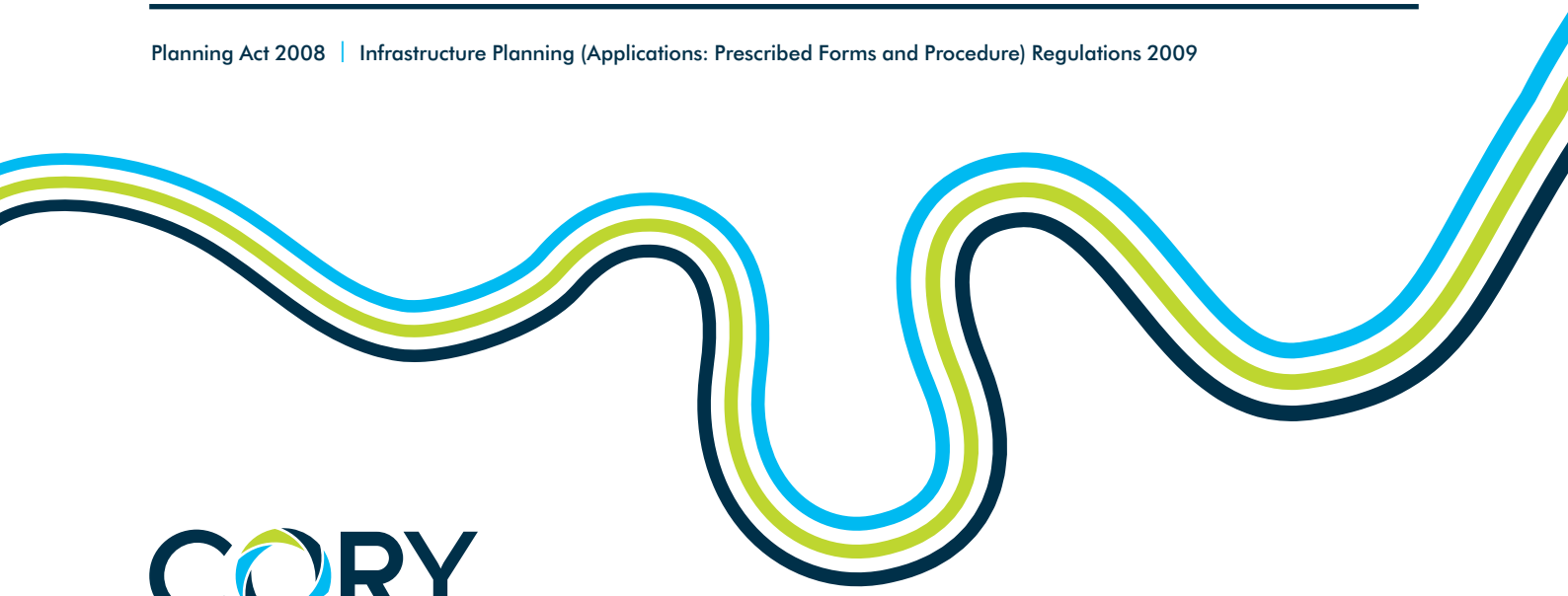

CORY
RIVERSIDE ENERGY

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1 Introduction

1.1 Preamble

1.1.1 This document is provided as part of the Riverside Energy Park Development Consent Order (DCO) application. Cory Environmental Holdings Limited (trading as Cory Riverside Energy (Cory)) is applying to the Secretary of State under the Planning Act 2008 (PA 2008) for powers to construct, operate and maintain an integrated Energy Park to be known as Riverside Energy Park (REP).

1.1.2 As the generating capacity of REP will be in excess of 50 MWe capacity it is classified as a Nationally Significant Infrastructure Project (NSIP) under the section 14 and 15 of the PA 2008, and therefore requires a DCO to authorise its construction and operation.

1.1.3 Cory must submit a DCO application to the Planning Inspectorate (PINS) who will first decide whether to accept the application. If accepted, PINS will examine the application in accordance with the relevant National Policy Statements (NPSs) which outline the need for energy infrastructure and the issues to be considered. The relevant NPSs include: NPS EN-1 (Overarching Energy Policy), NPS EN-3 (Renewable Energy Supply from Waste) and NPS EN-5 (Electricity Networks Infrastructure).

1.1.4 Following the examination, PINS will make a recommendation to the Secretary of State (SoS) as to whether or not the application should be approved. Should the SoS approve the application then the DCO will be made authorising the construction, commissioning and operation of REP.

The Applicant

1.1.5 Cory is registered in England (Company Number 05360864) and is the Applicant for the Proposed Development. Cory's registered address is 2 Coldbath Square, London, United Kingdom, EC1R 5HL.

1.1.6 Cory is a leading recycling, energy recovery and resource management company, with an extensive river logistics network in London. Cory secured consent for, constructed and now operates the existing Riverside Resource Recovery Facility (RRRF) in the London Borough of Bexley adjacent to the project site.

1.1.7 Cory is now progressing plans for the Riverside Energy Park (REP) to maximise the use of its existing infrastructure and land holding, and to further meet the needs for resource recovery and energy generation in UK and in London.

1.1.8 Further information on REP is provided on the dedicated project website at http://www.riversideenergypark.com.

1.1.9 Preparation of the Application has been managed by Cory with support from the following consultancy team:

- Ardent Management Ltd – land referencing;
- Camargue Group Ltd – community engagement services;
- Fichtner Consulting Engineers Limited – engineering services;
- Hitachi Zosen Inova AG – proposed technology provider and engineering, procurement and construction services;
- Marico Marine - marine navigation specialists;

- Peter Brett Associates LLP – environmental and planning services;
- Pinsent Masons LLP – legal services.

Note: Weedon Architects have provided architectural design services on behalf of Hitachi Zosen Inova AG

Project Description

1.1.10 REP would be constructed on land immediately adjacent to Cory's existing Riverside Resource Recovery Facility (RRRF), within the London Borough of Bexley and would complement the operation of the existing facility. It would comprise an integrated range of technologies including; waste energy recovery, anaerobic digestion, solar panels and battery storage. The main elements of REP would be as follows:

1.1.11 **Energy Recovery Facility (ERF)**: to provide thermal treatment of Commercial and Industrial (C&I) residual (non-recyclable) waste with the potential for treatment of (non-recyclable) Municipal Solid Waste (MSW);

1.1.12 **Anaerobic Digestion Facility**: to process food and green waste. Outputs from the anaerobic digestion facility would be transferred off-site for use in the agricultural sector as fertilizer or as an alternative, where appropriate, used as a fuel in the ERF to generate electricity;

1.1.13 **Solar Photovoltaic Installation**: to generate electricity. Installed across a wide extent of the roof of the Main REP Building;

1.1.14 **Battery Storage**: to store and supply additional power to the local distribution network at times of peak electrical demand. This facility would be integrated into the main REP building;

1.1.15 **On Site Combined Heat and Power ('CHP') Infrastructure**: to provide an opportunity for local district heating for nearby residential developments and businesses. REP would be CHP enabled with necessary on site infrastructure within the REP site included.

1.1.16 **The Electrical Connection Route**: REP would be connected to the electricity distribution network via a new 132 kilovolt (kV) underground electricity cable connection. The route options for the Electrical Connection are shown in the Works Plans (**Document Reference 2.4**). In consultation with UK Power Networks ('UKPN'), Cory is considering Electrical Connection route options to connect to the existing National Grid Littlebrook substation located south east of the REP site, in Dartford. The route options are located within the LBB and Dartford Borough, and would run from a new substation proposed to be constructed within the REP site.

1.1.17 **Delivery of waste to REP**: the majority of waste will be delivered to REP by barge from Waste Transfer Stations (WTS) along the River Thames, utilising the existing jetty which is located immediately to the north of RRRF and the REP site. The remainder would be delivered by road. Whilst CRE are a river-based operator, the application includes flexibility to allow deliveries by road where commercially and environmentally appropriate to do so, e.g. for local waste deliveries from the Bexley area or for food/green waste; and

1.1.18 **Removal of by-products from REP**: Incinerator Bottom Ash (IBA) would be transported by river to the existing IBA Facility at the Port of Tilbury for treatment/recycling, and then for onward use as secondary aggregate in the construction sector. Air Pollution Control Residues (APCR) would be taken off-site by road in sealed containers to be treated/recycled for use as a construction material.

1.2 Objectives

1.2.1 The primary aim of this assessment is to meet the requirements of the National Planning Policy Framework (NPPF) (MHCLG, 2018) Clauses 170 (e) & (f), 178 and 180. To support planning applications an appropriate risk assessment of contamination, ground and slope stability is required (NPPF Glossary Annex 2 Site Investigation Information). The Phase 1 Desk Study forms the first stage of this risk assessment process.

1.2.2 This report presents a Phase 1 Ground Condition Assessment (GCA) comprising a desk study, site walkover and Tier 1 preliminary qualitative contamination risk assessment and preliminary geotechnical assessment.

1.2.3 The objective of the Phase 1 GCA is to review readily available information to assess the likely ground conditions and environmental setting at the Application Site and in the immediate surrounding area in order to identify if there are potential geoenvironmental and geotechnical hazards and constraints that present a significant risk to the Proposed Development. The geoenvironmental element of the works will allow the assessment of any potential for impacts on human health, controlled waters, ecology and the buildings/services from the ground conditions as a result of REP. The geotechnical element will provide initial recommendations with respect to the design of REP and its associated infrastructure and ancillary development.

1.2.4 It should be noted that this Phase 1 assessment is a ground condition assessment and does not purport to be an ecological, flood risk or archaeological survey and additional specific surveys may be required to support the REP DCO. Guidance on the use of this report is provided in **Section 9**.

1.3 Scope of Work/Terms of Reference

1.3.1 As required by the NPPF, the assessment has been carried out in accordance with “established procedures” using current UK good practice and guidance such as that given in British Standard 10175:2011 + A2:2017 and Contaminated Land Report 11 (EA, 2004). and NHBC Standards Chapter 4.1 (NHBC, 2016).

1.3.2 In order to identify the current conditions and land use on the Application Site and in the surrounding area, readily available information in the public domain has been obtained and reviewed, and an Application Site reconnaissance walkover has been carried out. This report presents a review of the acquired information, together with the development of a Preliminary Conceptual Site Model (CSM) and the associated Tier 1 risk assessment. This report also presents a qualitative assessment of any hazards and constraints posed by the existing ground conditions to the Proposed Development and comments on any mitigation or remediation measures that may be required.

1.3.3 The geotechnical assessment includes a review of the readily available historical ground investigation information relating to the Application Site and published information relating to the geoenvironmental setting. The primary geotechnical objective of this study was to undertake an assessment of the geotechnical constraints present at the Application Site in order to assist with informing the DCO application for the Proposed Development.

1.3.4 The PBA Specification for Phase 1 Ground Condition Assessment is presented as **Appendix A**.

1.4 Methodology

Assessment of Ground Conditions - Contamination

1.4.1 UK legislation on contaminated land from historical activities is principally contained in Part 2A of the Environmental Protection Act, 1990 (which was inserted into the 1990 Act by section 57 of the Environment Act 1995).

1.4.2 The Regulations and Statutory Guidance that accompanied the Act, including the Contaminated Land (England) Regulations 2006, have been revised with the issue of the Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012/263) and the Contaminated Land Statutory Guidance for England 2012. Contaminated Land Report 11 (CLR 11) of the Model Procedures for the Management of Contaminated Land (EA 2004) provides references to established technical and procedural practice.

1.4.3 CLR 11 presents a three-stage process to the management of contaminated land:

Stage 1 = risk assessment

Stage 2 = options appraisal and

Stage 3 = implementation of remedial strategy

1.4.4 Risk assessment is undertaken in a phased manner with the three tiers being:

Tier 1 – "preliminary risk assessment" – a qualitative assessment forming part of a Phase 1 report,

Tier 2 – "generic risk assessment" - a quantitative assessment using published criteria to screen site specific ground condition data forming part of a Phase 2 report and

Tier 3 – "detailed risk assessment" – a quantitative assessment involving the generation of site specific assessment criteria (SSAC).

1.4.5 The PBA methodology for the assessment of potentially contaminated land is presented in **Appendix B**.

1.4.6 The underlying principle is the evaluation of pollutant linkages in order to assess whether the presence of a source of contamination could potentially lead to harmful consequences. A pollutant linkage consists of the following three elements:

- A source of contamination or hazard that has the potential to cause harm or pollution;
- A pathway for the hazard to move along / generate exposure; and
- A receptor which is affected by the hazard.

1.4.7 For each potential pollutant linkage identified the risk is estimated through consideration of the magnitude of the potential consequences and the likelihood or probability of an event occurring.

1.4.8 This report is divided into chapters identifying potential sources (hazard identification), potential pathways and receptor identification, risk estimation and assessment.

Assessment of Ground Conditions – Instability

1.4.9 The preliminary ground stability assessment methodology adopted by PBA follows the guidance on preliminary land stability assessment given in the Planning Practice Guidance for Land

Stability published by the Department for Communities and Local Government (DCLG 2014). The guidance requires, at least, a desk based study and a site inspection visit by an appropriately qualified person.

1.4.10 The desk-based study comprises a review of existing readily available published sources of geological, geomorphological, hydrogeological and /or mining information on the Application Site and its surroundings and a historical review including mapping and aerial imagery, if appropriate.

1.4.11 The preliminary stability assessment includes for example, where relevant, a review of geological hazards for the Application Site such as natural and man-made (mining) cavities, landslide, cambering and block movement, collapsible and compressible soils, running sand, and subsidence and heave due to volumetric change in the ground.

1.5 Sources of Information

1.5.1 Information provided by the Client (as listed in **Appendix C**), and that readily available in the public domain has been reviewed in order to identify the likely ground conditions at the Application Site and in the surrounding area.

1.5.2 The following additional sources of information were used in the preparation of this report: -

- Landmark Information Group (LIG) were commissioned to provide an Envirocheck report (2018) that includes historical maps, environmental datasets and sensitivity information for the Application Site and the surrounding area. The historical maps are presented as **Appendix D** and the Envirocheck report is presented as **Appendix E.**
- PBA walkover inspections on 8th September 2017 and 5th March 2018 – photographic plates are presented in **Appendix F.**
- Information published by the British Geological Survey (BGS) from 1:50,000 scale geological maps.
- Review of the National Artificial (non-coal mining) and Natural Cavities Databases managed and enhanced by Peter Brett Associates LLP.
- Environment Agency website 'What's in Your Back Yard?' accessed on the 10th October 2017.

2 Site Location and Description

2.1 Site Location

2.1.1 The REP site is located approximately 1.3 km to the north of Belvedere railway station, situated on the southern bank of the River Thames between Erith and Woolwich, in the London Borough of Bexley. The Electrical Connection route extends from the REP site in a south eastwards direction to join Littlebrook substation approximately 7.3 km to the south east of the REP site. The REP site is centred at approximate National Grid Reference TQ 496 806.

2.2 Site Description and Current Land Use

2.2.1 For simplicity and ease of reading, the description of the Application Site has been split into several sections, described below:

- The Riverside Energy Park Site
- The River Thames area
- Main Temporary Construction Compound and Data Centre site
- The Electrical Connection routes (later broken into sub-sections)

2.2.2 This section presents a summary of current land uses on and immediately adjacent to the various Application Site areas. Land use is used to inform the hazard identification element of the risk assessment.

2.2.3 The current land use information is based on walkover inspections undertaken by PBA on the 8th September 2017 and 5th March 2018. Photographs taken during the site walkover (Plates 1 to 30) are presented in **Appendix F**.

Riverside Energy Park (REP) Site

2.2.4 The REP site occupies an area of approximately 7.7 ha and comprises an area of land predominantly to the west of but also surrounding the existing RRRF plant. This area specifically **excludes** the existing RRRF plant. The current land use within the REP site includes the existing ancillary infrastructure (roads, security outbuildings, electrical substation area etc.) associated with the existing RRRF. In addition, the REP site area includes: ancillary soft-landscaped areas; wetland and “habitat areas”; and an ash container storage area. There are also two parcels of land currently used by a Portakabin hire firm and for vehicle/plant maintenance and a partially macadam surfaced former car parking area.

2.2.5 The northern boundary of this area is formed by the Thames Path.

2.2.6 The eastern boundary is formed by a fence line separating the REP site from the Isis Reach Industrial Park to the east.

2.2.7 The western boundary is formed by a fence line at the western edge of the former car parking area, with Crossness Nature Reserve immediately adjacent to the western boundary of the REP site and Crossness Sewage Treatment Works located approximately 200 m to the west of the REP site.

2.2.8 The southern boundary is formed by drainage ditches separating the REP site from grazing land to the south.

The Main Temporary Construction Compound and Data Centre site

2.2.9 The Data Centre site occupies an area of approximately 2.87 ha and is located circa 120 m to the south of the REP site. This area is currently unused, comprising open rough grassland. A tarmac access track for the Crossness Sewage Treatment Plant (located approximately 500 m to the west of the REP site) splits this area in two. This access track is excluded from the Data Centre site area. This area is currently consented for development as a Data Centre for the RRRF (see section 3.1.24 below).

2.2.10 This area is bounded to the east by Norman Road, and to the north, west and south west by open grassland. The southern boundary is formed by the northern half of the Main Temporary Construction Compound area, described below.

2.2.11 The Main Temporary Construction Compound area occupies an area of land approximately 2.7 ha in size. In the centre of this area a recently constructed warehouse/industrial unit is present with an adjacent area comprising of a concrete service yard. To the north and south of this area the land is currently unused and comprises rough open ground.

2.2.12 This area is bounded on all sides by fencing. Norman Road forms the eastern boundary and there is open grassland to the west and south. The land use surrounding this area comprises Crossness Nature Reserve to the north and west, with Norman Road and Isis Industrial Area to the east and the A2016 to the south.

River Thames Area

2.2.13 The River Thames area is an area within the Application Boundary that extends into the river to the north of the REP site, and comprises the shoreline area to the north of the Thames Path and part of the channel of the River Thames. Within this area is the current delivery/export jetty of the RRRF.

Electrical Connection Route

2.2.14 The Electrical Connection routes (ECRs) being considered are predominantly along the route of existing roads and paths between the REP site and the grid connection point at the Littlebrook substation in Dartford. The routes follow either the major A2016/A206 roads or minor roads to the east of the A206 through the industrial/residential areas closer to the River Thames.

2.2.15 The current land use along the majority of the ECR options is for highway use, with associated pavements or soft verges at the sides. There are short sections of the ECR potential routes that cross predominantly undeveloped areas of either open grassland or footpath as follows:

- A section at the start of Option 1 which follows an approximately 5m wide strip of land comprising an access trackway and public footpath along the western edge of the Crossness Nature Reserve between the REP site and the A2016.
- Land to the west side of Norman Road where the Application Boundary includes an approximately 3 m width of soft verge adjacent to the existing carriageway
- The southern end of Norman Road where it joins the A2016 where a surface water channel passes beneath Norman Road. Here, areas up to 20 m width, immediately east and west of the highway are included within the Application Boundary. These areas are either grassed or lightly wooded, adjacent to the channel which crosses beneath the road in an east-west alignment.
- A short section on the A206 between the roundabout with Crayford Way and the roundabout with Bob Dunn Way where a grassed area approximately 20 m wide is included to the south

of the highway. At the eastern end of this section a similar grassed and slightly wooded area approximately 15m wide is included to the north of the highway.

- An area up to approximately 30 m wide to the southwest of the A206 adjacent to Erith railway station. This area is partly wooded, partly hard surfaced (station car park and forecourt) and partly grassed/wooded (public access way to station).

- A short section on the A206 to the west of the railway bridge to the north of Thanet Road which comprises areas of tree coverage adjacent to a railway cutting.

- An approximately 700 m long section of the A206 (Bob Dunn Way) to the west of the roundabout with Green Lane where grassed/marshy areas up to approximately 75 m wide are included to both the north and south of the highway. This section includes the highway crossing of the River Darent where a proposed area of open trenching on the northern side of the highway is proposed. A section of the area to the south of the highway has historically been used as a landfill (Creek Works Landfill).

- An approximately 150 m long length to the north of University Way at the eastern end of the Electrical Connection route which follows an area of open grassed land, crossed by a trackway at the edge of a wooded area before re-joining established roads.

2.2.16 The land use adjacent to the ECR options is varied along the length, and comprises predominantly residential and/or industrial/commercial use, and open ground alongside areas of historical landfill.

2.2.17 At the end of the ECR is the Littlebrook substation, operated by National Grid. This existing substation is understood to comprise "*3x240MVA 400/132kV super grid transformers with a firm capacity of 553MW and 488MW in the winter and summer respectively*". These are housed within a part-one and part-two storey metal-clad shed, with the remaining external area being open and surfaced in gravel.

3 Historical Land Use & Relevant Planning History

Riverside Energy Park (REP) Site

3.1.1 The earliest available Ordnance Survey (OS) mapping dated 1869 - 1870 shows several buildings labelled as a Manure Works in the northeast of the REP site. These works are indicated to comprise a large building in the north eastern corner of the REP site, with smaller buildings adjacent to the main works, a small terrace of houses to the south of the main works area, and a small building (later labelled the New Marsh Tavern public house) located to the west of the works. The early maps indicate two piers and cranes are located adjacent to the manure works on the shore of the River Thames. The map indicates the presence of an embankment between the REP site and the River Thames, with sloping masonry on the river side.

3.1.2 The 1894-1895 OS map edition indicates that a Powder Magazine is present adjacent to the western boundary of this site, next to the River Thames.

3.1.3 By 1897, the manure works is no longer labelled on the OS mapping, and the former manure works buildings appear to have been redeveloped. There are three main buildings in the north east of the REP site and it is not clear if these were part of the Belvedere Mills that are indicated to be present adjacent to the eastern boundary (although shown as disused). The Thames Fish, Guano and Oil Works are indicated to have been developed in the north part of the REP site, with New Marsh Tavern between the fish works and the other main buildings. At this time, additional houses have been constructed on the terrace in the south-east part of the REP site and four piers/cranes are shown on the shore of the River Thames.

3.1.4 In the wider area, the 1898/1899 OS map indicates that a sewage works with associated infrastructure such as a gasometer and jetties/piers has been constructed approximately 200 m to the west of the REP site. The OS maps indicate the construction may have been placed on an area of raised ground.

3.1.5 The 1909 edition OS map indicates that the three buildings formerly labelled as the disused Belvedere Mills are now in use as a borax refinery. The borax production process involved the refining of borate ores to produce borax, but also generated significant volumes of production wastes which were stored on the land to the south of the REP site, (now the area consented for the Data Centre). In addition, as well as the single long shed sited approximately halfway along the northern boundary of the REP site, just west of the New Marsh Tavern, the Thames Fish, Guano and Oil Works also included two large trenches that (as indicated by an 1871 report by Dr. Ballard, the Medical Health Officer for Islington) were potentially used for storage/maturing of the manure.

3.1.6 A fire insurance plan dated 1908 provides additional detail regarding the specific processes of the businesses operating at the REP site. These processes have been described in detail for the individual businesses from east to west as shown on the plan and this information is presented in **Appendix G**. The buildings are all located along the northern boundary, accompanied by their own separate wooden jetties for loading/unloading raw/processed materials and goods.

3.1.7 The OS maps indicate that the borax refinery remained largely unchanged during the first half of the 20th Century. Additional houses were added to the terrace in the south east, and a small area to the west of the terrace was used as allotment gardens. An issue of The London Gazette dated 9th October 1934 describes the winding-up of the Belvedere Fish Guano Company, following which, in the 1950s the fish, guano and oil works building was redeveloped for use as a depot (the former trenches are no longer shown and are assumed to have been infilled). Historical aerial photography indicates that timber storage took place at the depot across the unbuilt areas during the 1950s.

3.1.8 The 1958 edition OS map indicates that a large depot building has been constructed to the south of the main depot building and the borax refinery (now labelled as a Mill) has been significantly expanded, with several of the earlier sheds being demolished and other sheds being joined together and extended together with the construction of new works buildings. The western side of the REP site is indicated to remain undeveloped. The terrace of housing has been demolished by this time.

3.1.9 In the 1960s a strip of the REP site adjacent to the western boundary is shown on the OS mapping to have been partitioned off. Anecdotal information provided by the Erith and Belvedere Local History Society suggests that this area was used as a car park for employees of a car factory (Ford) on the opposite side of the river, with a ferry service operated by Ford taking workers across the river.

3.1.10 In the wider area, the OS maps indicate that by the late 1960s there has been significant expansion of the sewage works to the west of the REP site. A spoil heap is indicated to be present approximately 50 m to the south of the REP site, at the location of the current consented area for the data centre. It is understood (Knight Piesold 2001 & 2003, AMEC 2009, WSP 2016), that this spoil is borax waste from the refinery. This is further described in the planning history section below. To the south of the spoil heap, an electricity substation is indicated to be present, on the southern half of the proposed Norman Road temporary construction laydown area.

3.1.11 By 1974 the OS mapping shows that a new building (understood to be the open-sided storage shed that remained, and was photographed, at the time of the remedial works undertaken by AMEC in 2008) has been constructed immediately to the west of the main depot building. Also at this time the southern 1950s depot shed was demolished.

3.1.12 The 1984 OS map edition indicates that whilst west and south west parts of the REP site appear to remain undeveloped, they have been split into separate land areas. The open land adjacent to the western boundary of the REP site is indicated to be sludge lagoons.

3.1.13 OS mapping dated 1991 shows the northern half of the main depot building to have been demolished. A tank is shown adjacent to the remaining section of building and a new electrical substation has been constructed. Four tanks are also shown to the west of the main 'Mill' shed in the north-eastern corner of the REP site. The 1992 and 1996 edition OS maps indicate the presence of individual depots in the separated land areas within the south part of the REP site.

3.1.14 The OS maps indicate that the majority of the buildings in the central, northern and eastern parts of the REP site have been demolished by the mid-late 1990s. Aerial photography from 1999 and 2003 shows the floor slabs to be still in place, alongside the depot storage shed. The separate strip of land within the western part of the REP site is shown to be in use as a car park.

3.1.15 Aerial photography from 2005 shows the western strip of land to no longer be in use as a car park, following (according to anecdotal information provided by the Erith and Belvedere Local History Society) the withdrawal of the ferry service to the car factory in 2004.

3.1.16 The 2018 OS mapping indicates the current site layout with the existing RRRF having been constructed between 2009 and 2011.

Relevant Planning History

3.1.17 In 1999 an application was submitted by Riverside Resource Recovery Limited (RRRL) to the Secretary of State for Trade and Industry under Section 36 of the Electricity Act 1989 (London Borough of Bexley [LBB] planning ref: 99/02388/CIRC) for "*consent under Section 36 of the Electricity Act 1989 for the construction and operation of a resource recovery plant of nominally rated output of 72MW gross*", this was subsequently approved, subject to the following relevant contaminated land condition (No. 25):

"Development hereby permitted shall not commence until a scheme to deal with contamination of the site has been submitted to and approved in writing by the Council, in consultation with the Environment Agency or other competent authority, the scheme shall include an investigation and assessment to identify the extent of contamination and the measures to be taken to avoid risk to the public, damage to buildings or harm to the environment when the site is developed, together with a timetable for the implementation of such measures. Development shall not commence until the measures approved in the scheme have been implemented unless the Council gives its prior written consent to any variation. This condition shall not be discharged until a validation (closure) report has been submitted to and approved in writing by the local planning authority. Details of any post contamination sampling and analysis to show the site condition shall be included in the closure report together with details of materials imported to or removed from the site in connection with any remedial works".

Data Centre site

3.1.18 The Data Centre site is first shown on OS mapping from 1870. At this time the access trackway running westwards off Picardy Manorway (later renamed Norman Road) that bisects the northern section, has been established.

3.1.19 OS mapping dated 1897 shows a building named Orient House to have been constructed adjacent to the access trackway and Norman Road along with two smaller outbuildings to the west. By 1909, additional outbuildings had been constructed and a section between these and the grounds of Orient House was used as an orchard.

3.1.20 At this time an area in the north western corner of the northern section is indicated to be a refuse heap. This is understood (Knight Piesold 2001 & 2003, AMEC 2009, WSP 2016) to represent the storage of borax refining wastes (described in Knight Piesold Report ref: 11396\R15014\ABD as "*solid boro-gypsum waste and boiler ash*") in this area, from the borax refinery to the north. Aerial photography from 1924 confirms this, showing stored material several metres high.

3.1.21 OS mapping from the first half of the 20th Century indicates continued use of this area as a refuse heap and based on OS mapping dated 1958, the entire area (minus the access trackway) is shown as such.

3.1.22 Knight Piesold report ref: 11396\R15014\ABD states that "*following decommissioning and closure of the [borax] plant in 1988 these heaps were removed in 1990 down to the surrounding ground level. However, the waste heaps had caused consolidation of the underlying geological strata such that waste had settled down to a level below the surrounding ground level. This waste below original ground level was not removed as part of the closure operations*".

3.1.23 Remedial works of the near-surface soils to remove the remaining borax processing wastes and to improve ground and surface water quality were undertaken between 2000 and 2016 by Knight Piesold/Scott Wilson and WSP, during which time the area was used as a construction compound for the construction of the RRRF and the improvement works to Norman Road.

Relevant Planning History

3.1.24 On 11th July 2016 outline planning permission (ref: 15/02926/OUTM) was granted by the London Borough of Bexley (LBB), allowing "*the construction of a data centre (Use Class B8), sub-stations, formation of new access, car parking and landscaping*". Subject to a contaminated land condition (Condition 4) requiring a) a desk study, b) subsequent site investigation and c) reporting and where necessary d) remediation and e) completion reporting.

3.1.25 In early 2017 WSP Parsons Brinckerhoff (WSP) undertook a ground investigation with the aim "*to present sufficient information to allow discharge of Condition 4a, b and c attached to Planning*

Permission 15/02926/OUTM". Their subsequent Ground Investigation Report (ref: 70031031 v2.3) and a Detailed Quantitative Risk Assessment (DQRA) was submitted to LBB and following acceptance by the Environment Agency (EA) were found adequate to discharge parts a) to c) of Condition 4, with parts d) and e) required only for the reporting of any previously undiscovered contamination.

Main Temporary Construction Compound

3.1.26 The southern section of the Main Temporary Construction Compound area appears to remain as undeveloped open land until the mid-1950s when a large substation associated with the nearby Belvedere Power Station is constructed.

3.1.27 Details provided in the 2008 RSK report (ref:36281-001) indicate that the 132/275kV substation, owned by National Grid and leased since the 1970s to EDF Energy (and its predecessors) who operated it until its closure in late 2005, consisted of a main switch house building that was approximately 180 m long by 25 m wide and approximately four storeys high and is understood to have had an additional storey of basement. To the west of the switch house were four shunt reactors (Deptford 1 and 2 and Sydenham 1 and 2) and to the east of the switch house were four 'station transformers' (1, 2A, 2B and 4), various smaller plant and four series reactors.

3.1.28 The RSK report further states that, following the closure of the substation in 2005 "*Significant, but localised, oil contamination of the ground has been identified near to the Deptford 1 and 2 shunt reactors and the Sydenham 1 shunt reactor in the western part of the site…which allowed oily water from the shunt reactor bunds to be pumped onto the adjacent ground. This practice has reportedly been taking place for approximately four or five years*".

3.1.29 Aerial photography shows the substation being demolished in late 2010 / early 2011.

3.1.30 In 2012 a Lustre Consulting report (ref: 1118/SO/06-12/087) notes that "*anecdotal evidence from the site owner has confirmed that localised remedial works, carried out by Site Remedial Services Limited in 2011, predominantly comprised the removal of the localised contaminated soils and any perched groundwater, validation sampling and groundwater monitoring for a period of one year. Upon completion of the remedial works, all excavations were backfilled with site won crushed concrete*".

3.1.31 In 2016 an industrial-type shed has been constructed on the central third of this area, with an associated concrete service yard. This building is understood to be a warehouse and office for an electrical contracting firm.

3.1.32 During the recent site walkover it was noted that a new electrical substation has been constructed in the southernmost corner of this area.

Relevant Planning History

3.1.33 In 2013 planning permission was granted by LBB (13/00918/FULM) for the construction of a "*building comprising 3 industrial units for mixed-use within Class B1 (business), Class B2 (general industrial) and B8 (storage/distribution), within associated ancillary works*" in the central third of this area (Site 3). The Lustre Consulting report was submitted prior to determination of the application and therefore the development was subject to contaminated land conditions requiring the inclusion of gas protection measures in the construction of the building, and for any unforeseen contamination to be assessed and appropriately remediated/mitigated. A verification report was required to be submitted. The verification report is not available for review.

River Thames Area

3.1.34 Several generations of piers and jetties have been constructed on the shoreline, facilitating the works on the REP site and adjacent sites (the receiving jetty for the former power station, the jetty for the former car factory ferry etc.) during the 19th and 20th Centuries.

3.1.35 The RRRF jetty was constructed in early 2010.

Electrical Connection Route

3.1.36 At the time of writing this report, there are various route options being considered and these have been described separately in the following sections. A brief history of the ECRs is as follows:

Route Option 1

3.1.37 The first section of this route follows a public footpath adjacent to the Great Breach Dyke along the boundary of the Crossness Sewage Treatment Works (STW) and the Crossness Nature Reserve, meeting the A2016 to the south. This area has remained as marshland since the earliest available OS mapping.

3.1.38 At the southern boundary of the Crossness Nature Reserve the route joins the A2016 (Eastern Way) that was constructed in the mid-1980s on previously undeveloped land, typically following the alignment of a pylon route connecting to the former Belvedere Power Station.

3.1.39 Moving eastwards, the next section of this route on the A2016 (Bronze Age Way) was constructed in the late 1990s, parallel to the route of a much earlier railway. This section re-used/widened some earlier roads, but for the large part was simply built through the built development (typically industrial works, but also including residential properties, a church, allotment gardens etc.) that previously occupied this area.

3.1.40 At the southern end of Bronze Age Way, the ECR joins the A206. The A206 was constructed in the 1930s over open ground in a generally industrial area, with many brick works, mills, chalk pits etc. present in the area. The A206 is indicated to be either adjacent to or slightly within the boundaries of a number of historical landfills (see **Section 6.2.2**)

3.1.41 Further east, this route follows the A206 onto Bob Dunn Way and University Way, both constructed over former marshland in the early 1990s. To the south of Bob Dunn Way is an area of historical landfill (Creek Works Landfill), indicated by the Environment Agency to have been in operation between 1993 and 1996 and to have received inert wastes.

3.1.42 This route then turns northwards just before meeting the M25 and the Dartford Tunnel, following smaller roads built in the mid-to-late 2000s on former scrub/marshland in conjunction with the adjacent Sainsbury's distribution centre before meeting the Littlebrook substation, constructed by 2015 to replace the adjacent electrical grid infrastructure that was demolished around this time.

Route Option 1A

3.1.43 Route Option 1A runs directly southwards from the REP site, following the long-established Norman Road (present since OS mapping dated 1870), to re-join Route Option 1at the A2016.

Route Option 2A

3.1.44 Route Option 2A leaves the A2016 where it joins Bronze Age Way and follows several smaller roads typically constructed in the first half of the 20th Century on undeveloped land indicated to be marshy before re-joining Route Option 1 at Thames Road. This section is characterised

generally by the earlier works and wharves to the north of this route along the shoreline of the River Thames, and the later residential properties to the south of this route.

Route Option 2B

3.1.45 Route Option 2B leaves the A206 at the roundabout in the middle of Bob Dunn Way and initially uses side roads constructed in the mid-2000s as part of a large residential development on a much older former hospital site before using roads constructed at a similar time on former marshland as part of the Sainsbury's distribution centre development, then meeting the Littlebrook substation.

3.2 Proposed Development

3.2.1 REP would be developed on land immediately adjacent to Cory's existing Riverside Resource Recovery Facility (RRRF), within the London Borough of Bexley and would complement the operation of the existing facility. It would comprise an integrated range of technologies including; waste energy recovery, waste anaerobic digestion, solar panels and battery storage. The main elements of REP are described below:

- **Energy Recovery Facility (ERF)**: to provide thermal treatment of Commercial and Industrial (C&I) residual waste (post-recycling) with the potential for treatment of municipal solid waste (MSW);
- **Anaerobic Digestion Facility**: outputs from the anaerobic digestion facility would be transferred off-site for use in the agricultural sector as fertilizer or as an alternative, where necessary, used as a fuel in the ERF to generate electricity;
- **Solar Photovoltaic Installation**: to be integrated across a wide extent of the roof;
- **Battery Storage**: to supply additional power to the local distribution network at times of peak electrical demand. This facility would be integrated into the main REP building;
- **Combined Heat and Power Connection ('CHP')**: REP would be CHP enabled with necessary infrastructure within the REP site included. The heat connection could service nearby residential developments such as the Thamesmead area;
- **The Electrical Connection Route**: REP would be connected to the existing National Electrical Transmission System ('NETS') via a new 132 kilovolt (kV) distribution network connection, within the London Borough of Bexley and Dartford Borough Council, and a new substation within the REP site. In consultation with UK Power Networks ('UKPN') Cory are currently considering Electrical Connection route options to connect to the existing National Grid Littlebrook substation located south east of REP. All Electrical Connection options have been included within the Application Boundary at this stage. A single Electrical Connection route will be confirmed through consultation with UKPN and included in the DCO application. The proposed excavations for the ECR are predominantly shallow excavations within existing highways and utility corridors and in these areas the cable trench is proposed to be 450mm wide and 900mm deep. Along parts of the ECR the proposals for the cable are either to strap the cable onto existing structures such as bridges and in a limited number of locations the proposals are for trenchless installation techniques below features such as rivers, or the provision of above ground cable supports. These areas are listed below;
    - Southern end of Norman Road – proposed cable support structure or use of trenchless installation techniques beneath the water channel

- The A206 to the west of the railway bridge to the north of Thanet Road - here it is proposed to attach the cable to the existing above ground infrastructure over the railway

- The A206 between the roundabout with Crayford Way and the roundabout with Bob Dunn Way – here trenchless installation techniques are proposed beneath the River Cray

- The A206 (Thames Road) to the west of the Bob Dunn Way roundabout, beneath the railway bridge – here trenchless installation techniques are proposed beneath the highway

- The A206 (Bob Dunn Way) at the crossing of the River Darent - here trenchless installation techniques are proposed beneath the river.

- **Delivery of waste to REP**: the majority of waste will be delivered to REP by barge from Waste Transfer Stations (WTS) along the River Thames, utilising the existing jetty as per the existing RRRF. The remainder would be delivered by road. The proportions of the total to be delivered by road and river will be determined through further assessment work and details included in the DCO application; and

- **Removal of by-products from REP**: Incinerator Bottom Ash (IBA) would be transported by river to the existing IBA Facility at the Port of Tilbury for treatment/recycling, and then onward use as secondary aggregate in the construction sector. Air Pollution Control Residues (APCR) would be taken off site by road in sealed containers to be treated/recycled for use as a construction material.

4 Geology and Ground Conditions

4.1 Geology

Geological Map and Regional Geology

4.1.1 According to the British Geological Survey (BGS) Geological Maps (1:50,000 Sheets 257 (1976) and 271 (1998)) the solid geology of the area generally consists of the following sequence of strata:

Superficial Deposits

- Alluvium (AL), comprising normally soft to firm consolidated, compressible silty clay, but can also contain layers of silt, sand, peat and basal gravel.
- River Terrace Gravel (RTD), comprising sand and gravel, locally with lenses of silt, clay or peat.

Bedrock Deposits

- The London Clay Formation (LC), comprising laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay. Commonly contains thin courses of carbonate concretions ('cementstone nodules') and disseminated pyrite.
- Harwich Formation (HF), comprising glauconitic silty or sandy clays, silts and fine- to coarse-grained glauconitic sands, some gravelly, varying to flint gravel beds.
- The Lambeth Group (LG) comprising 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.
- The Thanet Formation (TS) comprising pale yellow-brown, fine-grained sand that can be clayey and glauconitic. Rare calcareous or siliceous sandstones may also be present.
- The Lewes Nodular Chalk Formation (LNCK), comprising chalk with flints. The LNCK can contain discrete marl seams, nodular chalk, sponge-rich and flint seams throughout.

4.1.2 The table below describes the naturally occurring geological lithologies anticipated to be encountered in each area of the Application Site.

Table 4.1 – Expected Naturally Occurring Lithologies

Site Area	Expected Surface Lithology
REP site	Alluvium overlying River Terrace Gravel and London Clay
Main Temporary Construction Compound and Data Centre site	Alluvium overlying River Terrace Gravel and Lambeth Group, with potential for London Clay beneath the northern half
River Thames	Alluvium overlying River Terrace Gravel and London Clay

ECR	Alluvium overlying River Terrace Gravels, London Clay, Lambeth Group, Thanet Sand and Chalk

4.1.3 Given the historical land uses described in Section 3 above and based upon historical ground investigations at the REP site, significant and highly varying thicknesses of Made Ground should also be expected overlying the natural strata across the majority of the Application Site. This is described further in the following sections.

4.2 Site Specific Ground Conditions from Previous Ground Investigations

4.2.1 Information on the ground conditions at the Application Site has been taken from previous ground investigations in each of the individual site areas (where such information has been made available).

REP site

4.2.2 The following ground investigations have previously been undertaken at least partly within the REP site:

Table 4.2 – Ground Investigations at least partly within the REP site

Date	Originator	Client	Records Obtained?	Reference
1989	Terresearch	Greenham Construction Materials	Partial	Letter dated 26th September 1989
23/10/1992	Wilkinson Associates	Cory Environmental Ltd	Yes	87-01-01
11/12/1992	Wilkinson Associates	Cory Environmental Ltd	Yes	87-01-02
22/12/1992	Wilkinson Associates	Cory Environmental Ltd	Yes	87-01-03
24/09/2003	Applied Environmental Research Centre Ltd	Riverside Resource Recovery Ltd	Yes	C3477/R1384
11/2007	Soil Mechanics	Von Roll Environmental Technology	Yes	G7061

4.2.3 In addition to the above investigations, remediation is understood to have been carried out as a precursor to the development of the RRRF, which included parts of the current REP site as described (and reported) in the following reports:

Table 4.3 – Reports detailing remediation undertaken at the REP site

Date	Originator	Title	Report Obtained?	Reference
24/09/2003	Applied Environmental Research Centre Ltd	Site Investigation and Remediation Proposals	Yes	C3477/R1384
04/05/2007	Applied Environmental Research Centre Ltd	Contaminated Land Remediation Method Statement	Yes	C34129/R2489

11/06/2008	AMEC Earth and Environmental (UK) Ltd	Method Statement Zone 4 – Main RRRF Plant	Yes	7888001173/R3094
09/06/2008	AMEC Earth and Environmental (UK) Ltd	Validation Report of Contaminated Land Phase 1 – "Hotspots"	Yes	C34129/R2976
23/10/2010	Con-Form via AMEC Earth and Environmental (UK) Ltd	AMEC's Review of Con-Form's Report	Yes	Unreferenced
		Validation Report, Riverside Resource Recycling Facility, Belvedere	Yes	C1387/09/01

4.2.4 The various ground investigation reports carried out for the RRRF indicate that prior to the construction of the RRRF the ground conditions across the REP site typically comprised:

Table 4.4 – Anticipated Ground Conditions at the REP site

Stratum	Depth to Top of Strata (m bgl)	Elevation of Top of Strata (mOD)	Thickness (m)
Made Ground	Ground Level	1.32 to -1.82	0.6 – 5.95
Alluvium	0.6 to 5.95	1.75 to -1.39	3.1 to 11.1
River Terrace Gravels	4.0 to 15.6	-2.35 to -10.15	1.8 to 12.05
London Clay	12.8 to 19.0	-10.76 to -14.91	4.5 to 8.8
Harwich Formation	14.0 to 24.6	-11.16 to -21.65	0.7 to 10.5
Lambeth Group	20.3 to 30.0	-18.94 to -28.59	9.5 to 19.6
Thanet Sand	45.0 to 46.42	-44.39 to -44.33	Not Proven (+11.92)

4.2.5 The ground investigation information reviewed indicates that previous intrusive work has not been carried out within the western, south western and southern parts of the REP site.

4.2.6 Perched water was encountered at various depths within the Made Ground.

4.2.7 Groundwater strikes were recorded at the top of the River Terrace Gravels (approx. 10m to 13m depth) where the water was confined by the cohesive alluvial soils above. This water appeared to be subartesian as, following the initial strike, the water level rose rapidly over the next 20 minutes to within 5 m of the ground surface and in subsequent monitoring the standing water level was typically within 3 m of the surface, and appeared to vary tidally.

Main Temporary Construction Compound and Data Centre site

4.2.8 The following ground investigations are understood to have taken place within the area:

Table 4.5 – Ground Investigations within the Main Temporary Construction Compound and Data Centre site

Date	Originator	Client	Reference
2008	RSK	National Grid Property Ltd	36281-001
28/01/2009	AMEC	Riverside Resource Recovery Limited	C34129/R3332
07/2012	Cladir Ltd	Lustre Consulting Ltd	1118/SO/07-12/087
05/2017	WSP	Riverside Resource Recovery Limited	70031031 v2.3

4.2.9 The various ground investigation reports reviewed indicate that ground conditions in the area of the Data Centre site generally confirm the anticipated naturally occurring geology with the additional presence of Made Ground to between 1.60 m and 2.70 m depth overlying the natural strata.

4.2.10 The various ground investigation reports reviewed indicate that the ground conditions beneath the Main Temporary Construction Compound generally confirm the anticipated geology with the exception of the presence of Made Ground to between 0.30 m and 0.60 m depth overlying the natural strata.

4.2.11 It is noted that these areas appear to span the geological boundary between the London Clay and the Lambeth Group, with London Clay present in the Data Centre site only.

4.2.12 Groundwater strikes were recorded at the top of the River Terrace Gravels (between 7 m and 8 m depth) where the water was confined by the cohesive alluvial soils above. This water appears to be semi-artesian and was later monitored at approximately 1 m below ground level. Perched water was also noted within the Made Ground.

4.2.13 In addition to the above investigations, remediation is understood to have been carried out within these areas as described (and reported) in the following reports:

Table 4.6 – Reports detailing remediation undertaken in the Main Temporary Construction Compound/Data Centre site

Date	Originator	Title	Reference
08/2001	Knight Piesold	Construction Completion Report	11396\R15014\ABD
01/2003	Knight Piesold	Post-Completion Monitoring Report	D844435/OJR/ABD
08/03/2004	Scott Wilson	Certificate of Completion	D103828

4.2.14 Additionally, it is noted in the Cladir Ltd report that "*anecdotal evidence from the site owner has confirmed that localised remedial works were undertaken in order to remove the identified contamination. The remedial works, carried out by Site Remedial Services Ltd in 2011, predominantly comprised the removal of the localised contaminated soils and any perched groundwater, validation sampling and groundwater monitoring for a period of one year. Upon completion of the remedial works, all excavations were backfilled with site won crushed concrete*". No records of this remediation have been obtained.

River Thames Area

4.2.15 An investigation within the River Thames was undertaken in 2007 by Soil Mechanics for Riverside Resource Recovery Limited (ref: A7007) to provide geotechnical information for the design of the RRRF jetty.

4.2.16 The various ground investigation reports reviewed confirm the anticipated geology, showing superficial deposits to between 4.80 m and 15.00 m depth, overlying London Clay.

Electrical Connection Route

4.2.17 A brief overview of the geology, inferred from nearby BGS boreholes and available ground investigation data beneath or adjacent to the ECRs confirms the anticipated geology. It is likely that a limited thickness of Made Ground will be present beneath all areas of the ECR. However, in the localised areas where the ECR crosses areas of historical landfill a greater thickness of Made Ground may be anticipated.

5 Hydrogeology, Groundwater Vulnerability & Hydrology

5.1 Hydrogeology & Groundwater Vulnerability

5.1.1 The aquifer designation map for the Application Site provides the following aquifer classifications for the strata within the Application Site:

Table 5.1 – Aquifer Designations

Lithology	Aquifer Designation
Alluvium	Secondary Undifferentiated
River Terrace Deposits	Secondary A
London Clay	Unproductive Strata
Harwich Formation	Secondary A
Lambeth Group	Secondary A
Thanet Formation	Secondary A
Lewes Nodular Chalk	Principal

5.1.2 The Alluvium and River Terrace Deposits are indicated to have a High Leaching Potential, however this is an assumed worst case classification (until proven otherwise), based on fewer observations in this urban area than in other non-urban areas.

5.1.3 The Environment Agency (EA) are currently in the process of updating the groundwater vulnerability maps (to reflect improvements in data mapping and understanding of the factors affecting vulnerability) and these designations should therefore be re-assessed once the new mapping and information is available.

5.1.4 The Principal Aquifer in the Chalk and the overlying Secondary A aquifers are all separated from both any perched water in Made Ground, and from the Secondary Aquifers in the Superficial Deposits by the London Clay. The London Clay is considered to be relatively impermeable, forming an aquiclude that separates the aquifers above and below.

5.1.5 It is anticipated that groundwater flow across the site will be to the north and north-east, towards the River Thames.

5.1.6 The REP site is not located within any part of a groundwater source protection zone (SPZ).

5.1.7 The ECR passes through SPZ Zones 3, 2 and 1. These SPZs are associated with groundwater abstractions in Crayford approximately 320 m to the south of the ECR at its closest, and in Dartford, some 1.6 km to the south of the ECR at its closest.

5.1.8 Licensed groundwater abstractions have not been identified within 1 km of the REP site.

5.2 Hydrology

5.2.1 The River Thames forms the northern boundary of the REP site, and part of the Application Boundary extends into the river area.

5.2.2 A drainage ditch runs inside the REP site's eastern boundary before connecting into a series of artificial ponds which form the wetland habitat area.

5.2.3 Within the Crossness Nature Reserve are three large ponds/clusters of ponds and a longer, larger lagoon which runs NE/SW through the southern half of the nature reserve before connecting to the Great Breach Dyke.

5.2.4 The Great Breach Dyke runs along the boundary between the Crossness Nature Reserve and the Crossness Sewage Treatment Works. Several smaller local dykes and surface water bodies in the nature reserve area connect to this dyke. The dyke enters a culvert at a Thames Water pumping station, exiting to outflow directly into the River Thames.

5.2.5 Drainage ditches run on either side of Norman Road along its entire length. The ditch on the western side of Norman Road splits to encircle the Norman Road Area before reconnecting and re-joining Norman Road, before turning westwards to run along the southern boundary, and partially along the western boundary of the REP site. This does not appear to connect to either the River Thames, or the Great Breach Dyke.

5.2.6 Surface water ponding has been observed in the grazing land immediately south of the REP site.

5.2.1 The following table summarises the information recorded in the Envirocheck Report regarding hydrology.

Table 5.2 - Summary of Surface Water Related Information

Item	Description
Name	On-site: River Thames On-site: River Cray On-site: River Darent On-site: Surface water ditch on the eastern REP site boundary, and artificial ponds that form the wetland habitat area, to which the drainage ditch connects. Off site: Surface water ditches/dykes on REP site/Main Temporary Construction Compound and Data Centre site boundaries. Off site: Great Breach Dyke (adjacent to ECR and Crossness STW), various surface water ponds, drainage dykes and ditches within the Nature Reserve.
Quality	Not Provided.
Abstraction Permits	See Section 6.6
Discharge Consents	See Section 6.7
Pollution Incidents	See Section 6.8
River Flood Risk*	Site is within an EA Flood Zone 1
Groundwater Flood Risk*	Unknown
* The scope of this report does not include a flood risk assessment.	

6 Environmental Setting

6.1 Introduction

6.1.1 Information on the environmental setting is presented in this Section and the data is used to inform the Ground Stability Risk Assessment in **Section 9** and the Contamination Risk Assessment presented in **Section 8**.

6.2 Landfill Records

6.2.1 According to the Envirocheck Report and the EA What's in Your Back Yard (WIYBY) website the following historical landfills listed in **Table 6.1** are present within 1 km of the REP Site. It should be noted that these landfills are all located on the north side of the River Thames, and therefore separated from the Application Site by the river.

Table 6.1.1 - Landfills within 1km of the REP site

Name	Wastes Received	Distance (at closest point) from the REP Site	Waste Input Dates
Dagenham Dock	Industrial, Special	370m N	1939 to1990
Ex-City of London Site	Inert, Commercial, Household	380m N	Up to 1988
Manor Way	Unknown	~550m NE	Unknown

6.2.2 The Electrical Connection Route passes either within 50 m or through the following landfills

Table 6.1.2 - Landfills within 50m of the Electrical Connection Route

Name	Wastes Received	Distance (at closest point) from the Electrical Connection Route	Waste Input Dates
Myrtle Close	Inert, Industrial, Special	Within ECR	1933 - 1957
Colyers Lane	Inert, Industrial, Special	Within ECR	1961 - 1967
Chesworth Close	Inert, Special	40m west	1961 - 1975
Wessex Drive	Inert, Industrial, Special	Within ECR	1960 - 1967
Bridge Road	Inert, Industrial, Special	Immediately adjacent	1955 - 1965
Gascoyne Drive	Inert, Industrial	Within ECR	1960 - 1967
Leycroft Gardens	Inert, Industrial	35m east	1959 - 1965
Moat Lane	Inert	Immediately adjacent	1939 - 1952
Whitehall Lane	Unknown	Immediately adjacent	1936 - 1967
Dale View	Inert, Commercial, Household	Immediately adjacent	1955 - 1967
Kennett Road	Inert, Industrial	Immediately adjacent	1952 - 1960
Creek Works	Inert,	Within ECR	1993 - 1999
Littlebrook Substation	Inert, Industrial, Commercial	Within ECR	1956 - unknown

6.3 Waste Management, Treatment and Transfer

Licenced Waste Management Facilities

6.3.1 Five active Licenced Waste Management Facilities are present within 1 km of the REP site. Of these, one is located at the RRRF (licence 103887) licensed to Riverside Resource Recovery Limited for 'HCI Waste'. The remaining licenced facilities are as follows:

- Approx. 300 m east – Licence 104859, licensed to Highway United Ltd, for 'Physical Treatment Facilities'
- Approx. 620 m southeast – Licence 102921, licensed to JDT (South-East) Ltd, for 'Treatment of waste to produce soil <75,000 tpy
- Approx. 760 m west – Licence 400178, Crossness Sewage Treatment Works, licensed to Thames Water Utilities Ltd for a 'Landfill gas engine (<3 mW).
- Approx. 860 m south – Licence 83425, licensed to Meridian Technical Services Ltd, under category 'Physical Treatment Facilities'

6.3.2 No other waste transfer, treatment or disposal facilities are present within 1 km of the REP site.

6.4 Pollution Prevention and Control

Local Authority Integrated Pollution Prevention and Controls (IPPCs)

6.4.1 Seven active IPPCs are present within 1 km of the REP site as follows:

- On site – Permit Ref: VP3230WG, operated by Riverside Resource Recovery Limited permitting "*The incineration of non-hazardous waste in an incineration or co-incineration plant with a capacity exceeding 3 tonnes per hour"*.
- Approx. 270 m west (note: licence is located approx. 700 m west at an address stated as the sludge powered generator, however the location used here is not that of the licence but the known location of the generator building) – Permit Ref: Up3737pq, operated by Thames Water Utilities Limited permitting "*The incineration of Non Hazardous waste greater than 1 T/hr)".*
- Approx. 470 m east – Permit Ref: PP/10/50.0, operated by JDT Services Southeast Ltd, permitting "*mobile screening and crushing processes*".
- Approx. 710 m southeast – Permit Ref: PP/92/13, operated by Henkel Ltd, permitting "*coating manufacturing*".
- Approx. 840 m southeast – Permit Ref: PP/92/9, operated by Young & Partner, permitting the "*manufacture of timber and wood-based products*".
- Approx. 940 m southeast – Permit Ref: PP/03/1.0, operated by Lafarge Readymix Ltd, permitting the "*blending, packing, loading and use of bulk cement*".
- Approx. 940 m southeast – Permit Ref: PP/92/3.2, operated by Tarmac Southern Ltd, permitting "*mineral drying and roadstone coating processes"*.

IPPC Enforcements

6.4.2 A single Integrated Pollution Prevention Control (IPPC) enforcement (type: air pollution control enforcement notice) is present within 1 km, issued in August 1999, and is located approximately 800 m to the southeast at Fishers Way, ref: PP/91/10.1.

6.5 Hazardous Substances

Control of Major Accident Hazards (COMAH) Sites

6.5.1 The Envirocheck Report records two COMAH sites within 1 km of the REP site as follows:

- Approx. 520 m southeast, Nufarm UK Ltd., located at Crabtree Manorway North, Ref: 1029845, type: Upper Tier.
- Approx. 710 m southeast, Henkel UK Ltd., located at Mulberry Way, no reference supplied, type: Lower Tier.

6.5.2 It is noted that the Nufarm site, previously an agrochemicals plant, is understood (Card Geotechnics, 2010) to have ceased operation and have been demolished in 2010. Recently parts of this site have been developed with warehouse type units.

Explosive Sites

6.5.3 The Envirocheck report has not identified any explosive sites within 1 km of the REP site.

Notification of Installations Handling Hazardous Substances (NIHHS) Sites

6.5.4 The Envirocheck report has not identified any active NIHHS sites within 1 km. Two '*Not Active*' sites are listed at the same locations as the COMAH sites above.

Planning Hazardous Substance Consents

6.5.5 The Envirocheck report has identified eight Planning Hazardous Substance Consents within 1 km of the REP site as follows:

- Approx. 380 m to the east, allowing Calor Gas Limited to hold a maximum quantity of 49.9 (no units provided) of "l*iquid extremely flammable gas (including LPG) and natural gas (whether liquefied or not)*", Ref: 07/01814/HAZ
- Approx. 520 m to the east, 3x consents allowing Nufarm UK Ltd to store maximum quantities of 0, 822 and 822 (no units provided) of "*chlorine*", "*combination of dangerous substances*" and "*unknown at time of report*", Refs: 02/01358/HAZ and 06/01154/HAZ
- Approx. 560 m to the southeast, allowing Rhone Poulenc Ltd. to hold a maximum quantity of 200 (no units provided) of "*Part A, Toxic Substance, Chlorine, where amount held is greater than or equal to 10 tonnes"*, Ref: TP/X/92/47
- Approx. 720 m to the southeast, allowing Henkel Ltd. to hold a maximum quantity of 20 (no units provided) of "*Part A, Toxic Substance, Hydrogen Fluoride, where amount held is greater than or equal to 10 tonnes",* Ref: TP/A/93/9
- Approx. 900 m to the west, allowing Thames Water Ltd. to hold a maximum quantity of 28 (no units provided) of "*Part C, Flammable Substance (not in parts A and B), Gas or gases flammable in air, when held as a gas, where amount held is >= 15 tonnes"*, Ref: TP/X/92/50
- Approx. 980 m to the southeast, allowing Henkel Chemicals Ltd. to hold a maximum quantity of 462.25 (no units provided) of "*unknown at time of report"*, Ref: 04/04472haz

6.5.6 It is noted that Nufarm UK Ltd. (and its predecessor, Rhone Poulenc Ltd.) no longer operate at their sites at this location and that these sites have been, or are soon to be, redeveloped.

Unexploded Ordnance

6.5.7 A review of the Zetica Unexploded Ordnance map for southeast London shows the site to be at **Low** risk from Unexploded Ordnance based upon the density of bombs dropped per square kilometre.

6.6 Abstraction Permits

6.6.1 The Envirocheck report records two abstraction permits (surface waters) within 1 km of the REP Site as follows:

- On site at "*Belvedere Energy Plant*", operated by Cory Environmental Developments Ltd. Licence No. 28/39/44/0028 allowing for abstraction of tidal waters for "*Additional Purpose(s) – Cooling Evaporate*" at a rate no greater than 173,800,000 m^3 per year.
- 220 m to the west of the site at the Great Breach Dyke, operated by Thames Water Utilities Ltd. Licence No. 28/39/44/0041 (version 2 of earlier permit) allowing for abstraction of surface waters for "Public Water Supply: General Use (High Loss)". A Freedom of Information Request was subsequently made to the Environment Agency who responded that "*due to national security considerations…we cannot at this time provide information that can be used to directly or indirectly identify where public water supply sources are located*". Clarification has subsequently been provided by Thames Water that this abstraction of is not for public water supply, but to redistribute water around Crossness Nature Reserve to top up wetland meadows, wader scrape and ponds/reed beds.

6.6.2 No groundwater abstractions are indicated within 1km of the REP site. However, parts of the ECR are located within groundwater SPZs and therefore groundwater abstraction is inferred in these surrounding areas.

6.7 Discharge Consents

6.7.1 The Envirocheck report records five active discharge consents to surface water within 1 km of the REP site as follows:

- On site, ref: CHME.0052, operated by Cory Environmental Developments Ltd, allowing discharge of "Trade Discharge – Cooling Water Authorised by Hmip" to "Freshwater Stream/River".
- Approx. 400 m to the west (Ref Cssa.0362) at Crossness Sewage Treatment Works, operated by Thames Water Utilities Ltd allowing "Sewage Discharges" to "Saline Estuary".
- Approx. 560 m to the east at Lidl UK GMBH Distribution Warehouse, DA17 6BS, ref: Casm.0331, operated by Lidl UK GMBH, allowing discharge of "Trade Effluent Discharge-Site Drainage" to "Saline Estuary".
- Approx. 810 m to the southeast at a Thames Water pumping station on Crabtree Manorway, ref: Temp.0770, operated by Thames Water Utilities Ltd. allowing discharge of "Freshwater Stream/River" to the River Thames.
- Approx. 910 m to the northwest at Crossness Sewage Treatment Works, ref: Cssa.0362, operated by Thames Water Utilities Ltd, allowing discharge of "Sewage Discharges STW Storm Overflow/Storm Tank – Water Company" into "Saline Estuary".
- Approx. 910 m to the southeast at Crabtree Manorway North, ref: T00382, operated by Henkel Chemicals Ltd., allowing discharge of "Freshwater Stream/River" into the Green Level dyke.

6.8 Pollution Incidents to Controlled Waters

6.8.1 The Envirocheck report and Freedom of Information (FOI) response record 46 pollution incidents to controlled waters within 1 km of the REP site. The majority of these were classed as Minor Incidents, however the following twelve, located to the south of the River Thames were classed as Significant or Major Incidents with respect to their impact to controlled waters.

- Approx. 190 m west at Dyke-North, Great Breach – Significant Incident (Category 2), dated 1997, spillage of "*General"*, no receiving water supplied. Ref: THSE1997028954

- Approx. 310m west within the Crossness STW. Major Incident (Category 1), a pipe failure below ground on 16/12/2017 allowed the discharge of sewage sludges. This is assumed to be the pollution incident related to the remedial works being undertaken by Thames Water within the Great Breach Dyke, observed during the site walkover visit on 05/03/18.
- Approx. 470 m northwest at Storm Outfall, Crossness Sewage Treatment Works – Significant Incident (Category 2), dated October 1998, spillage of "*Storm sewage"*, no receiving water supplied. Ref: THSE1998040918
- Approx. 470 m northwest at the Crossness STW outfall, Major Incident (Category 1) a containment control failure on 21/06/2005 allowed the spillage of Final Effluent materials into the River Thames.
- Approx. 590 m southeast at Tuffnells Parcels – Significant Incident (Category 2), dated 1993, spillage of "*Oils – Unknown"*, no receiving water supplied. Ref: SE930283
- Approx. 710 m west at Eastern Way, 2x Significant Incidents (Category 2), dated December 1994 and 15/04/2005, spillages of "*Chemicals – Unknown"* and "*Organic Chemicals/Products"*, no receiving water supplied. Ref: SE940406
- Approx. 720m east at Jenningtree Point, Significant Incident (Category 2) x3, on 30/03/2005,15/04/2005 and 21/04/2005 storm tanks to overflowed and discharged "*Other Sewage Material*" and "*Storm Sewage"* into the River Thames.
- Approx. 890 m southeast at Anderson Way – Significant Incident (Category 2), dated November 1992, spillage of "*Unknown Sewage"*, no receiving water supplied. Ref: SE920335
- Approx. 950 m southeast at Crabtree Manorway South – Significant Incident (Category 2), dated January 1997, spillage of "*Unknown Sewage"*, no receiving water supplied. Ref: THSE1997031808.

6.9 Entries to the Substantiated Pollution Incident Register

6.9.1 The Envirocheck report records ten entries to the Substantiated Pollution Incident Register within 1 km of the REP site, and where classed as having had a Major impact (to Water, Air, or Land) are described below.

- Approx. 320 m northwest – Pollutant "*Sewage Materials: Final Effluent",* dated June 2005, Ref: 322163 – Classed as Major Incident (Water Impact)

6.10 Sensitive Land Uses

6.10.1 Crossness Local Nature Reserve (LNR) is located immediately adjacent to the western and southern boundaries of the REP site and is the closest LNR to the Application Boundary. Crossness LNR forms part of a wider Site of Metropolitan Importance for Nature Conservation (SINC) (Erith Marshes) and is owned and managed by Thames Water. Combined, these designated areas form one of the last remaining areas of grazing marsh in Greater London, and the largest reed bed in Bexley.

6.10.2 The Thames Estuary is designated as a Marine Conservation Area.

6.10.3 The Abbeywood SSSI is located approximately 1.5 km to the southwest of the REP site and Norman Road area. The SSSI designation relates to the geological interest at the site with reference to the fossil beds present. The wider Abbey Woods, including the SSSI element, is also designated as a Local Nature Reserve (LNR) (i.e. Lesnes Abbey Woods LNR).

7 Review of Ground Conditions encountered based upon Previous Reports

7.1 Introduction

7.1.1 This chapter provides a summary review of the soil and groundwater conditions at each of the Application Site areas in turn, based upon ground investigation and remediation works undertaken to date, based upon available third party reports.

7.2 REP Site

7.2.1 Several historical ground investigations have previously been undertaken at least partly within the REP site. The information below has been compiled from AERC's 2003 Site Investigation and Remediation Proposals Report (Ref: C3477/R1384) which describes both AERC's investigation and the results of earlier investigation work by others and AERC's 2007 Contaminated Land Remediation Method Statement (Ref: C34129/R2489) which describes additional investigation undertaken by AERC in 2006.

Ground Conditions – AERC, 2003 & 2006

7.2.2 Investigations carried out by AERC in 2003 and 2006, at least partly within the REP site identified elevated concentrations of arsenic and water soluble boron across the area, and hotspots of cadmium, lead, mercury, nickel, copper, zinc, sulphide, sulphate, total petroleum hydrocarbons (TPH) and total polycyclic aromatic hydrocarbons (PAHs) when compared to the screening criteria for a residential end use. Asbestos Containing Materials (ACMs) were also encountered within the soils. Hotspots of elevated Lead and TPH concentrations were also identified when compared to screening criteria for an industrial end use. The arsenic and boron were identified as being present in a mobile form that could present a potential risk to surface water.

7.2.3 The site investigations also identified elevated concentrations of lead, nickel, arsenic, boron, sulphate and TPH in groundwater when compared to the screening criteria current at the time. (UK Drinking Water Standards (DWS) and Environmental Quality Standards (EQS) for freshwater).

Remediation

7.2.4 Remediation proposals were outlined by AERC in 2003 and formalised in 2007 with the aims of 1) reducing the potential for leaching of metals, particularly arsenic, into surface waters and 2) providing a 'clean' seed bed for areas of planting. These proposals split the area investigated (the wider RRRF construction area), which included part of the REP site, into five areas as follows:

- Zone 1 – Proposed wetland habitat and landscaping
- Zone 2 – Areas of landscaping
- Zone 3 – Proposed wasteland habitat
- Zone 4 – Main RRRF plant
- Zone 5 – Areas of hardstanding (i.e. roads, car parks etc.)

7.2.5 No remediation was proposed (by AERC) in Zones 3 and 5 given that Zone 3 was to be raised by some 0.5 m and the coverage of Zone 5 by buildings and hardstanding was deemed by AERC to provide a barrier between receptors and the underlying ground. Zones 1, 2 and 4 were taken forward for remediation, together with an initial phase comprising the removal of 14 hotspots of TPH (designated based upon a TPH concentration of greater than 1000 mg/kg) by excavation and validation testing of the remaining material.

7.2.6 The remediation of the hotspots is described in AMEC's 2008 Validation Report: Phase 1 – Hotspots (ref: C34129/R2976). A threshold criteria of 500 mg/kg was adopted as acceptably remediated. The validation samples were all below the threshold criteria in four of the fourteen hotspots. In the remaining ten hotspots, the "*vast majority*" of the validation samples identified TPH concentrations below the threshold criteria. The validation samples that exceeded the threshold criteria were described as generally only "*marginally elevated"*.

7.2.7 The remediation report identifies that 19 exceedances of the 500 mg/kg threshold were recorded, with values typically between 500 mg/kg and 900 mg/kg, and a maximum concentration of 1263 mg/kg. The assessment in the report concluded that these exceedances did not pose a significant risk to human health on the basis of the proposed clean capping layer and the proposed lining in the wetland area water body.

7.2.8 The general remediation proposals for Zone 4 following removal of the TPH hotspots, included the excavation and removal of contaminated soils from site and the provision of a clean cover system in all areas of soft-landscaping of a minimum thickness of 0.45 m, for the protection of human health.

7.2.9 The details of the remediation and validation works undertaken in Zone 1 and Zone 2 have at the time of reporting not been provided or made available.

7.2.10 The reports reviewed did not identify a significant risk to controlled waters. It is understood that there were no groundwater remediation requirements and it is noted that in correspondence from the EA's Contaminated Land Technical Specialist dated 14/01/2007 (EA ref: Bex017), providing comment on a draft of the 2007 AERC Remediation Method Statement it is stated that the EA "*concur with the general conclusions of the risk assessment that mobile contaminants in the Made Ground, principally arsenic, boron and hydrocarbons, are unlikely to pose and unacceptable risk to the underlying minor aquifer (Terrace Gravels) or the River Thames*".

7.2.11 Further to the remediation and validation in Zone 4 described above, a further phase of investigation and remediation was undertaken in 2010. Con-Form's 01/2010 Validation Report (ref: C1387/09/01) describes that 24,750 m^3 of excavated materials were screened to recover 4,270 m^3 of aggregate and 20,480 m^3 of fines. Validation testing of the screened fines indicated that the materials were unsuitable for use in a commercial/industrial end-use and subsequently were treated off-site prior to being disposed of as non-hazardous fill.

7.3 Main Temporary Construction Compound and Data Centre site

7.3.1 Several historical ground investigations have previously been undertaken in these areas. Given the differing historical uses and thus the differing levels of remediation, the sections are discussed independently. The information is compiled from Knight Piesold's (later Scott Wilson's) Construction Completion Report (August 2001, ref: 11396\R15014\ABD), Post-Completion Monitoring Report (January 2003, ref: D844435/OJR/ABD), AMEC's Report on Ground Investigation (January 2009, ref: C34129/R3332) and WSP's Ground Investigation Report (March 2017, ref: 70031031 v2.3).

Data Centre site

Ground Conditions - Knight Piesold, 2001

7.3.2 Knight Piesold were commissioned in 2001 to investigate the alleged contaminant migration and to manage the removal of the remaining borax processing waste materials.

7.3.3 Following an initial investigation to prove the depth of the waste deposits, baseline surveys of groundwater and surface water quality were undertaken by Knight Piesold in 2001. Concentrations of boron, (the principal contaminant of concern based on the site history of this area), in surface waters beneath and downstream of the Data Centre site were in general found

to vary between 2 mg/l and 8 mg/l, although elevated concentrations up to 205.6 mg/l were recorded. It was also identified that elevated concentrations (up to 32.5 mg/l) were recorded at the control point upstream.

7.3.4 Concentrations of boron within the River Terrace Deposits groundwater at approximately 6 m depth beneath the Data Centre site were found to vary between approximately 2 mg/l and 20 mg/l, with occasional concentrations up to 120 mg/l recorded. Groundwater concentrations of Boron upstream of the Data Centre site were typically below 3 mg/l, with concentrations up to a maximum of 13.2 mg/l recorded. This information was used to prepare a Remediation Method Statement and Risk Assessment which was subsequently agreed with LBB and the EA (letter dated 9th August 1999, ref: 11396.101 PJF/PSP).

Remediation – Knight Piesold, 2001-2003

7.3.5 Scott Wilson's Post-Completion Monitoring Report (ref: D844435/OJR/ABD) states "*As agreed with [the regulators] prior to commencement of works... remediation of the site shall be deemed to be complete when the laboratory analysis results from ground and surface waters around the site indicate that the water quality is within an order of magnitude of that obtained from the control sampling points*". The adopted control points were the River Thames for groundwater and a point located in the surface water dyke to the south (upstream) for surface water.

7.3.6 Remedial works were carried out by Knight Piesold, comprising the following:

- *"The clearance and rehabilitation of surface water courses surrounding the site;*
- *Excavation of 37,119m3 of waste materials, to an approximate average depth of 2.0m below original ground levels*
- *Importation… of 34, 501m3 approved inert backfill material*
- *Placement, spreading and compaction of backfill material to the void created by waste excavation. Including provision of bunding adjacent to the fencing along Norman Road to improve site security"*

7.3.7 Monitoring was continued until October 2002 when it was considered that for groundwater "*all concentrations of boron at all of the boreholes monitored are within an order of magnitude of the concentration of boron found in the River Thames*". Surface water concentrations at the control point were typically within an order of magnitude of those observed on the northern half of the Norman Road area for the duration of the monitoring period.

Ground Conditions – AMEC, 2009

7.3.8 In 2009 AMEC were commissioned by RRRL to undertake additional investigation to "*provide advice on the current contaminative status"* of this area.

7.3.9 The results of the investigation identified site-wide elevated concentrations of water soluble boron (determine based on values greater than 3.0 mg/kg).

7.3.10 Samples of surface water from the drainage ditches surrounding the site were submitted for laboratory analysis. When the results were compared to both the DWS and EQS screening criteria, elevated concentrations of arsenic, sulphate, nickel, selenium and sulphide were identified. No conclusions or recommendations for further work were made.

Ground Conditions – WSP, 2016

7.3.11 A further ground investigation in 2016 by WSP included the analysis of 14 soil samples. No exceedances of the adopted assessment criteria (SGVs/C4SL/self-derived Generic Assessment Criteria [GAC] using CLEA V1.071) for a commercial end-use were noted.

7.3.12 Sulphate concentrations up to 494mg/kg and bromide concentrations up to 8.82 mg/kg (there are no GAC screening criteria for either) were noted.

7.3.13 Two of the asbestos screenings on samples of the previously imported inert fill recorded the presence of asbestos (amosite & chrysotile in one and crocidolite in the other). These samples were both subsequently quantified, with the asbestos representing less than 0.001%/wt.

7.3.14 WSP concluded that the risk to human health was Low to Moderate, though in the absence of disturbance or removal of the Made Ground, could be reduced to Low, and recommended further work to investigate the presence of asbestos within the imported fill material.

7.3.15 Eight samples of groundwater (two being perched water from the Made Ground, three from within the Alluvium and three from the River Terrace Deposits) as well as three surface water samples from the drainage ditches (one upstream, one adjacent and one downstream) at the boundaries of this area were collected and submitted for laboratory testing.

7.3.16 When compared with the adopted assessment threshold criteria DWS, EQS and World Health Organisation (WHO) standards) exceedances of the criteria for metals, PAHs and TPHs were identified within the Made Ground, the Alluvium and the River Terrace Deposits.

7.3.17 WSP concluded that, given the presence of metals, boron, sodium, sulphate, TPH and PAHs within the groundwater and surface water the risks to controlled waters including the on and off-site aquifers, the surrounding watercourses and the River Thames was Moderate but given the presence the London Clay, vertical migration to the deeper aquifers was not considered to represent a significant risk. They further concluded that the elevated concentrations identified within the surface water and underlying groundwater may not currently be acceptable and will need to be confirmed by the EA and a Detailed Quantitative Risk Assessment (DQRA) for Controlled Waters may be required.

7.3.18 Four rounds of gas monitoring were undertaken which, within the Made Ground and Alluvial deposits, identified elevated carbon dioxide concentrations with a maximum of 11.2%, elevated methane concentrations with a maximum 54.8% and a maximum flow of 8.6 l/hr. WSP subsequently identified the risk to human health associated with elevated ground gases as Moderate and classified the Data Centre site as Characteristic Situation 4, requiring ground gas protection measures in the construction of new buildings.

7.3.19 Further to the Ground Investigation Report, WSP produced a DQRA (ref: 70031031-L05, dated November 2017). A copy of this report has not been provided or made available for review at the time of reporting.

Main Temporary Construction Compound

7.3.20 Ground investigations were undertaken within this area by Dames and Moore in 2000 (no copy of this report has been provided or is publicly available at the time of reporting), in 2006 by RSK and reported in their 2008 report ref: 36281-001 (only partial sections of this report have been available) and by Lustre Consulting as described in their July 2012 Site Investigation Report (ref: 1118/SO/06-12/087).

Ground Conditions – RSK, 2008

7.3.21 The RSK investigation in 2008 identified three visually oil impacted areas which exhibited significant oil staining and strong hydrocarbon odour through the Made Ground and into the underlying alluvium to approximately 1.0 m depth.

7.3.22 Only summary tables of the chemical analyses undertaken as part of the 2008 investigation are available. Non-speciated TPH testing was undertaken and as such it is not possible to compare the results directly to current screening criteria. However it can be seen that, within the soils,

elevated concentrations of heavier fraction hydrocarbons are present, and that >C10 bands greatly outweigh the <C10 bands by orders of magnitude.

7.3.23 Almost 140 soil samples were tested for PCBs, with only one exceedance of the limit of detection in four of the congeners (101, 138, 153, 180).

7.3.24 Within the groundwater, concentrations of water soluble boron were well within the baseline of upstream background levels defined in the assessment of the Data Centre site. Additionally, no PCBs, TPHs or PAHs were detected. Only the first 23 pages of this report have been made available and thus it is not known what (if any) remedial recommendations were given.

Remediation and Validation – National Grid

7.3.25 The Lustre Consulting report states that "*anecdotal evidence from the site owner has confirmed that localised remedial works, carried out by Site Remedial Services Limited in 2011, predominantly comprised the removal of the localised contaminated soils and any perched groundwater, validation sampling and groundwater monitoring for a period of one year. Upon completion of the remedial works, all excavations were backfilled with site won crushed concrete*". No records of this remediation have been provided or are publicly available.

Ground Conditions – Lustre Consulting, 2012

7.3.26 The Lustre Consulting investigation was limited to the area, now occupied by the electrical contracting firm warehouse/office and service yard. Within the twelve samples analysed, only a single exceedance of the adopted soils assessment criteria (LQM CIEH GACs for commercial/industrial development, Internal TPH screening values and Dutch Intervention Values) was recorded. A value of 601.6 mg/kg of EPH (C10-C40), and a PID reading from a sample taken at the same depth and in the same location gave the highest observed reading of 3.3ppm.

7.3.27 No asbestos was detected within any of the samples.

7.3.28 A total of four groundwater samples were analysed. All concentrations of heavy metals and PAHs were found to be below the laboratory detection limits. No exceedances of the EQS or DWS were recorded.

7.3.29 A single round of ground gas monitoring was undertaken on standpipes with response zones within the River Terrace Gravels and Alluvium. This visit recorded a peak methane concentration of 2.4% (the log for this visit states "*immediately recorded 2.4% and then rapidly decreased to 0.0%*") and a steady-state methane of 0.0%. Carbon dioxide levels of less than 2% were recorded. A peak flow of 0.1 l/hr was recorded.

7.3.30 On the basis of the peak values obtained during the single round of monitoring undertaken and the presence of alluvial soils, the decision was taken to classify the area as Characteristic Situation 2 (CS2), requiring ground gas protection measures in the construction of new buildings.

7.3.31 Lustre concluded "*no risk of significant pollution to occur at the site has been established with the soils or groundwater within the area of investigation*" and found that it was unlikely that the site would be designated as statutory contaminated land under Part 2A of the Environmental Protection Act (1990). Additionally, Lustre recommended the inclusion of gas protection measures commensurate with the requirements of a CS2 site. Recommendations for further investigation work were not made.

7.4 River Thames

Ground Conditions – Soil Mechanics 2007

7.4.1 As part of the investigation undertaken by Soil Mechanics in 2007 (Factual Report on Ground Investigation, Ref: A7007) for the construction of the RRRF, several soil (sediment) samples were retrieved from the river and submitted for chemical laboratory testing. An interpretative report for the RRRF development has not been provided and is not publicly available.

7.4.2 Concentrations of TPHs (up to 2050 mg/kg) and PAHs (up to almost 35 mg/kg) were detected within the top 2 m of sediment. Concentrations of PCBs, MTBE and BTEX above the laboratory limit of detection were not identified.

Remediation

7.4.3 The planning consent for the development of the RRRF (of which the application site included a similar area of the River Thames) made no requirements for remediation within the River Thames.

8 Tier 1 Preliminary Risk Assessment

8.1 Introduction

8.1.1 The methodology developed and adopted by PBA for the assessment of ground conditions is presented in **Appendix B**. In accordance with guidance presented in CLR 11 (EA Model Procedures for the Management of Land Contamination) we adopt a staged approach to risk assessment and this report presents a Tier 1 Preliminary Risk Assessment.

8.1.2 The underlying principle to ground condition assessment is the identification of pollutant linkages in order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences.

8.2 Conceptual Site Model

8.2.1 The Tier 1 Preliminary Risk Assessment includes the development of a conceptual site model (CSM). The CSM describes the types and locations of potential contamination sources, the identification of potential receptors and the identification of potential transport/migration pathways.

8.2.2 For a pollutant linkage to be identified a connection between all three elements (source-pathway-receptor) is required. A pictorial representation of the preliminary CSM is presented as **Figure 4**.

8.3 Geoenvironmental Hazard Identification

REP Site

8.3.1 This study has identified potentially contaminative historical land uses at the REP site, and the presence of geological strata that could present a ground gas risk.

8.3.2 This study has also identified the historical presence of elevated concentrations of metals and hydrocarbons across parts of the REP site, alongside the presence of asbestos. Although some remediation has been undertaken in some parts of the REP site, the validation information available for review is limited, and there have been changes in screening criteria since the remediation was undertaken.

8.3.3 During the site walkover, the above-ground fuel storage tanks within the REP site were observed to be in good, clean condition, with barrels/tanks being kept within well maintained bunds.

8.3.4 The site reconnaissance visits have identified current land uses that present a low to moderate potential for localised contamination.

8.3.5 Therefore, the potential for a significant source of contamination hazard to be present in this area of the site is considered to be Moderate, and the contaminants of concern include hydrocarbons, metals and asbestos.

Main Temporary Construction Compound and Data Centre site

8.3.6 The Data Centre site is indicated to have been remediated and consented for new development, with its earlier contaminated land conditions signed off as previously described.

8.3.7 Similarly, the Main Temporary Construction Compound is indicated to have been remediated (outside of the planning system) and subsequently consented for development.

8.3.8 However, on the basis of the information reviewed in this study, the remaining potential hazards in this area are asbestos within the imported fill material used in the earlier remediation of the Data Centre site, and also potentially within the Main Temporary Construction Compound, and potentially elevated concentrations of ground gases associated with the underlying alluvium and peat (with methane concentrations previously recorded up to nearly 55%), and the Data Centre site assessed as CS4.

8.3.9 Therefore, it is considered that the potential for a significant source of contamination hazard to be present is Moderate, and the potential contaminants of concern include asbestos, boron and ground gases.

River Thames Area

8.3.10 This area is within the Application Boundary due to the intention to use the existing Jetty as part of the Proposed Development. There are no intrusive works proposed within the River Thames. On that basis, this area is not taken forward through the Tier 1 Preliminary Risk Assessment, although the River Thames is considered as a receptor in the risk assessment in later sections.

Electrical Connection Route

8.3.11 The ECR is located predominantly along the alignment of existing roads. The historical land uses along the ECR prior to construction of the roads are varied and include residential and industrial uses, together with historical landfill areas and also previously undeveloped land.

8.3.12 In the areas that have not previously been developed, or where the historical land uses are residential or industrial, or where there are historical landfilled areas that have subsequently been redeveloped, the potential for significant contamination to be present is considered to be Moderate, and the potential contaminants of concern include ground gases from the geological strata, and metals and hydrocarbons largely associated with any residual contamination within Made Ground used in the construction of the current infrastructure.

8.3.13 Where areas of historical landfill are present within the extent of the ECR which have not subsequently been redeveloped, the potential for significant contamination to be present within these limited areas of the ECR is considered to be High, and the potential contaminants of concern include metals, heavy metals, hydrocarbons (PAHs, TPHs), asbestos and landfill gases associated with the waste materials in the historical landfilled areas. However, this applies to only one area (to the south of Bob Dunn Way) where intrusive works are not proposed to disturb the historical landfill.

Potential Off-Site Sources (Hazards) and Contaminants of Concern

8.3.14 The information reviewed in this study indicates that the adjacent RRRF site has been subject to site-specific remediation, including the removal of hotspots of contamination and creation of barriers (to break the pathway) between human receptors and potential sources of contamination within the underlying soils. These “barriers” comprise either the built development itself, or the provision of a clean cover system in soft landscaped areas. However, the assessment at the time did not include a groundwater vapour risk assessment, and the threshold criteria used at that time would not considered to be suitably protective of human health at the current time.

8.3.15 The current site reconnaissance visits undertaken as part of this study, which included the RRRF, indicate that the RRRF site appeared to be clean and orderly at the time of the walkover, and that any potentially contaminative elements such as above ground fuel tanks were appropriately bunded and there was no visual evidence of any spills or localised leaks.

8.3.16 The Crossness Sewage Treatment Works is located approximately 200 m to the west of the REP site.

8.3.17 The ECR is aligned along existing roads, passes through industrial, residential and commercial areas, and passes historical landfills and close to railways.

8.3.18 It is therefore considered that the worst-case risk to the Application Site associated with potential off-site contamination generation based on the historical and current land uses is Moderate to High and the potential contaminants of concern will include, metals, hydrocarbons, organics, solvents.

Summary

8.3.19 **Table 8.1** summarises the potential on-site sources of contamination (PSC) and contaminants of concern (COC)

Table 8.1 - Summary of Potential On-Site Sources of Contamination (PSC) and Contaminants of Concern (COC)

PSC Reference	Area	Description	COC
1	REP, Main Temporary Construction Compound and Data Centre site, ECR	Alluvium and peat	Hazardous ground gases including methane and carbon dioxide
2	REP, ECR	Made Ground and impacted natural strata and groundwater.	Hydrocarbons (TPH and PAH) including vapours and metals
3	Main Temporary Construction Compound and Data Centre site	Remnant Made Ground and impacted natural strata and groundwater. Imported fill material.	Asbestos, Boron
4	REP, ECR	Asbestos within the Made Ground due to demolition of earlier structures	Asbestos
5	ECR (section passing through the former Creek Works landfill)	“Inert” Waste Materials	Whilst described as being “inert” there is a residual risk that waste materials could contain fractions of materials which could lead to hazardous ground gases including methane and carbon dioxide. Metals, heavy metals, hydrocarbons (TPH and PAH) including vapours and asbestos.

8.3.20 **Table 8.2** summarises the potential off-site sources of contamination (PSC) and contaminants of concern (COC)

Table 8.2 - Summary of Potential Off-Site Sources of Contamination (PSC) and Contaminants of Concern (COC)

PSC Reference	Area	Description	COC
1	RRRF	Made Ground and impacted natural strata and groundwater	Hydrocarbons, including vapours
2	Crossness STW	Sewage discharges	Organics, nitrates
3	Areas adjacent to the ECR	Industrial areas, roads, railways, landfills	Metals, hydrocarbons, solvents, hazardous ground gases, organics, inorganics

Potential Receptors and Sensitivity Score

8.3.21 The receptors considered as part of this land contamination assessment are summarised in **Tables 8.3 to 8.5** below and based on the information reviewed either eliminated from further consideration or allocated a sensitivity score in accordance with the PBA Methodology **(Appendix A)**. The sensitivity score informs the consequence element of the risk estimation process.

Table 8.3 – Potential Receptors - REP

Item	Comment	Receptor/Sensitivity
Human Health – Current	RRRF Workers/Visitors	Yes – 4
Human Health – Future	Commercial/Industrial	Yes – 4
Human Health – Off-site	Workers at adjacent industrial park, users of Thames Path	Yes – 4
Human Health – Construction	Construction Activities Expected	Yes – 4
Groundwater (shallow)	Secondary A aquifer present	Yes – 3
Surface Water	River Thames and surface drainage ditches/dykes	Yes – 4
Property - Buildings	Requires DCO	Yes – 4
Property - Animal or Crop Effect	Horses are grazed adjacent to this site area	Yes – 2
Ecological Systems	On-site wetland and wasteland habitat areas Crossness Local Nature Reserve is located adjacent to this site area	Yes – 3

Table 8.4 – Potential Receptors – Main Temporary Construction Compound and Data Centre site

Item	Comment	Receptor/Sensitivity
Human Health – Current	Users of warehouse/office building	Yes – 4
Human Health – Future	Commercial /Industrial	Yes – 4
Human Health – Off-site	Users of adjacent nature reserve	Yes – 4
Human Health –	Limited Construction Activities Expected	Yes – 4

Item	Comment	Receptor/Sensitivity
Construction		
Groundwater (shallow)	Secondary A Aquifer Present	Yes – 3
Surface Water	Surface drainage ditches/dykes	Yes – 2
Property - Buildings	Existing industrial type building, no new structures proposed – area for construction lay-down	Yes – 1
Property - Animal or Crop Effect	Horses are grazed adjacent to this site area	Yes - 2
Ecological Systems	Crossness Local Nature Reserve is located adjacent to this site area	Yes - 3

Table 8.5 – Potential Receptors - ECR

Item	Comment	Receptor/Sensitivity
Human Health – Current	Users are transient in cars or walking along surfaced footpaths	Eliminated
Human Health – Future	Users will be transient in cars or walking along surfaced footpaths	Eliminated
Human Health – Off-site	Residents of adjacent properties, workers at adjacent businesses.	Yes – 4
Human Health – Construction	Limited Construction (excavation) Activities Expected	Yes – 4
Groundwater (Deep and Shallow)	For the most part the proposed EC will be in shallow excavation no greater than 900 mm depth. However, in four locations trenchless installation techniques may be utilised in areas underlain by Principal Aquifer.	Yes – 4
Surface Water	The proposed EC excavations are predominantly within existing road/carriageway construction, however where historical landfill is present there is potential for waste materials to be exposed during construction works and therefore for direct run off into surface waters.,	Yes – 3
Property - Buildings	The proposed EC excavations are predominantly within existing road/carriageway construction.	Eliminated
Property - Animal or Crop Effect	The proposed EC excavations are predominantly within existing road/carriageway construction.	Eliminated
Ecological Systems	The proposed ECR includes a section along a path within Crossness Nature Reserve	Yes – 3

Potential Exposure Pathways

8.3.22 Table 2 in the PBA methodology (**Appendix B**) describes possible exposure pathways for each receptor type. Each of these possible pathways is then identified as viable or not when assessing the probability of the source of contamination causing a consequence to a defined receptor.

8.4 Risk Estimation

8.4.1 When there is a pollutant linkage (and therefore some measure of risk) it is necessary to determine whether the risk is significant and therefore whether further action is required.

8.4.2 Risk estimation involves predicting the likely consequence (what degree of harm might result) and the probability that the consequences will arise (how likely the outcome is).

8.4.3 Based on the information available, the estimated risks have been designated with further comments in the sections below. The outcomes of the risk assessment are presented in **Appendix H** giving an assessment of consequence and probability.

8.4.4 A summary of the worst-case risk estimation for the various site areas is presented in **Tables 8.6 to 8.8** below.

Table 8.6 - Worst-Case Risk Estimation - REP

Receptor	Risk Estimation
Human Health (Current Users)	Low to Moderate
Human Health (Future Users)	Low to Moderate
Human Health – Off-site	Low to Moderate
Human Health (Construction Workers)	Low to High
Groundwater	Low
Surface Water	Moderate
Property (Buildings/Structures)	Moderate
Property (Animal/Crop)	Very Low to Low
Ecological Systems	Very Low to Low

Table 8.7 - Worst-Case Risk Estimation – Main Temporary Construction Compound and Data Centre site

Receptor	Risk Estimation
Human Health (Current Users)	Low to Moderate
Human Health (Future Users)	Low to Moderate
Human Health – Off-site	Low to Moderate
Human Health (Construction Workers)	Low to Moderate
Groundwater	Low
Surface Water	Low
Property (Buildings/Structures)	Low
Property (Animal/Crop)	Very Low to Low
Ecological Systems	Very Low to Low

Table 8.8 - Worst-Case Risk Estimation - ECR

Receptor	Risk Estimation
Human Health (Current Users)	Eliminated
Human Health (Future Users)	Eliminated
Human Health – Off-site	Low
Human Health (Construction Workers)	Low to High*
Groundwater (Deep and Shallow)	Moderate
Surface Water	Moderate
Property (Buildings/Structures)	Eliminated
Property (Animal/Crop)	Eliminated
Ecological Systems	Very Low

Further Comments – Human Health (Construction Workers)

8.4.5 Risk to Human Health (Construction Workers) has been assessed initially as **Low to High** across the different areas on the basis of construction workers encountering potentially contaminated soils during construction activities, and an associated risk of ingestion/inhalation/dermal contact with these soils. It is envisaged however that with the adoption of appropriate hygiene, working methods and PPE (based on further investigation and assessment) that this can be reduced to **Low** for all areas.

8.5 Risk Evaluation

8.5.1 Possible pollutant linkages are determined using professional judgement. If a linkage is considered possible, it is considered that this represents a potentially 'unacceptable risk' and therefore requires further consideration. This may be through remediation or mitigation or through further tiers of assessment.

8.5.2 Possible pollutant linkages have been identified for human health, groundwater, surface water, property and ecological features and the level of risk is generally **Low to Moderate**.

8.5.3 The worst-case risk estimation of **Moderate** (for human health, surface water and buildings) is described as follows 'It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term'.

8.6 Data Gaps and Uncertainty

8.6.1 The assessment presented herein is based on both publicly available information on land use and third party reports on intrusive investigations. Whilst the third-party reports provide some comfort that parts of the site have been remediated, further site-specific data from appropriate intrusive ground investigation will be required across the site, particularly in areas not previously investigated or where remediation validation reports have not been available. This information will be required prior to commencement of development to confirm the risk estimation.

9 Preliminary Ground Stability Risk Assessment

9.1 Introduction

9.1.1 In accordance with the requirements of the National Planning Policy Framework (MHCLG, 2018), the potential for the Proposed Development to contribute to or to be adversely affected by land instability has been assessed.

9.2 Naturally Occurring Geological Hazards

9.2.1 An assessment of potential geological hazards that may give rise to instability or adverse foundation or construction conditions as supplied by the British Geological Survey (BGS) from their National Geoscience Information Service (NGIS) are presented in the Envirocheck Report reproduced in **Appendix E**. The generic assessment is generated automatically based on digital geological maps and the scope and the accuracy is limited by the methods used to create the dataset and the excavations and landform modifications undertaken at the specific site. The BGS dataset is therefore only relevant for the search area.

9.2.2 The information contained in the Envirocheck Report has been reviewed and where considered necessary reassessed considering the specific information available for the Application Site. The modified assessment of the potential for geological hazards to be present within the REP site is summarised in Table 9.1 below.

Table 9.1 - Summary of Geological Hazards from Envirocheck Report

Hazard	BGS-NGIS Assessed Hazard Potential	PBA Assessment
Coal Mining Affected Areas	No Hazard	Agree
Collapsible Ground Stability Hazards	No Hazard	Agree
Compressible Ground Stability Hazards	Very Low to Moderate	Agree – see below
Dissolution Hazard	No Hazard	Agree
Landslide Ground Stability	Very Low	Agree
Running Sand	Very Low	Disagree – see below
Shrinking or Swelling Clay	Low	Disagree – see below

9.2.3 PBA would generally agree with the above assessments indicating that the Application Site generally has a Low or Very Low potential for being affected by the majority of geological hazards.

9.2.4 The exceptions to this are hazards associated with running sand and shrinking and swelling clay which, should be raised to Moderate, related to the presence of Alluvium, River Terrace Deposits and London Clay within the Application Site.

9.2.5 Compressible ground stability hazards are identified as locally Moderate related to the presence of both Alluvium; including peat layers, and to any Made Ground present within the Application Site. It should be noted that limited sections of the ECR run adjacent to, or within the boundaries of areas of historical landfill. Within these areas where significant thicknesses of Made Ground have the potential to be present, the potential for Compressible Ground Stability Hazards should locally be raised to High.

9.3 Natural and Mining Cavities

9.3.1 The National Natural and Mining Cavities Database maintained and updated by PBA has been searched for relevant natural and mining cavity records.

9.3.2 No records were found of natural cavities within a 1 km radius of points at the centre of the REP site, Main Temporary Construction Compound, Data Centre site and River Thames area.

9.3.3 The ECRs were analysed as a series of points at approximately 2 km intervals and revealed at least 20 natural cavities within 1 km, of which the majority are located within 2 km of the A206 section between the Queens Road/South Road railway bridge, and the end of Thames Road. The nearest cavity is a swallow hole located at 111 Northend Road, located within 40 m of the carriageway edge.

9.3.4 No mining cavity records are recorded within a 1 km radius of points at the centre of the REP Site, Main Temporary Construction Compound, Data Centre site and River Thames areas.

9.3.5 Upwards of 16 mining cavities are recorded in the vicinity of the ECR, again with the majority located within 2 km of the A206 section between the Queens Road/South Road railway bridge, and the end of Thames Road. The nearest of these is a former brickfield located off Kennet Road, approximately 200 m to the northeast of the ECR.

9.3.6 A further record is noted (though details are scarce) of a tunnel in the chalk beneath Littlebrook substation (it is unknown which of Littlebrook A-D this record refers).

9.3.7 Whilst the REP Site, Main Temporary Construction Compound and Data Centre site are underlain by chalk, this is at considerable depth (upwards of 40 m) and as such these areas are considered to be at lower risk. However, the geology and geomorphological setting of the ECR is such that the potential for such features to be present is considered to be High.

9.4 Radon

9.4.1 The Envirocheck Report indicates the REP site is in both a lower probability radon area where less than 1% of homes are estimated to be above the 200 bqm^{-3} action level area and an intermediate probability radon area where between 1% and 3% of homes are estimated to be above the 200 bqm^{-3} action level, and that no radon protective measures are necessary in the construction of new dwellings or extensions. It should be noted that the Radon mapping is being continuously updated and consequently the risk may change in the future.

9.5 Foundation Conditions

9.5.1 It is considered likely that there will be relatively significant thicknesses of Made Ground and/or Alluvium present below much of the Application Site. Both of these deposits are likely to be soft/weak, highly compressible and unlikely to prove suitable as a founding stratum due to the potential for significant (and unacceptably high) total and differential settlements. This is especially true for the limited sections of the ECR which run either adjacent to or within the boundaries of historical landfills where there is a high potential for differential settlements.

9.5.2 Consideration could be given to the use of the River Terrace Deposits or London Clay as suitable founding stratum, however the River Terrace Gravels in particular are likely to be variable in both thickness and density and this will need to be taken into consideration as part of the detailed design of foundations.

9.5.3 Structure specific geotechnical ground investigations will be needed, and particular attention should be given to structures that span or cross from one strata to another, and appropriate design mitigation measures adopted to minimise the potential for cross contamination of aquifers.

9.5.4 Consideration should also be given to the exiting river wall frontage and the construction of any existing retaining structures or tie backs which may be present at the site, and measures taken during design and construction to ensure that the integrity of the stability of any existing structures are not compromised.

9.6 Shrinkage and Swelling of Clay Soils

9.6.1 Most clay soils exhibit volume change when subjected to changes in moisture content. This causes shrinkage or swelling of the soil and such movements can cause foundations to move resulting in structural damage. Seasonal changes in moisture content can affect the near surface soils, and foundations in clay soils adopt a minimum depth to avoid such movements. Advice on the design of foundations in clay soils is given in NHBC Standards, and BRE Digests 241, 242, and 298, which can be applied as equally as appropriate to industrial buildings as houses.

9.7 Floor Slabs, Roads and Pavements

9.7.1 Roads and pavements constructed in areas where natural soft/weak materials are present at formation level may require capping layers, or alternatively stabilisation with lime or cement to minimise the requirement for granular materials. Soft/weak materials are likely in areas where Alluvium is present. Roads in areas of Made Ground will require investigation prior to construction to determine the nature and thickness of the fill materials and its properties including the appropriateness of lime/cement treatment techniques. Any heavily loaded floor slabs will either need to be suspended on to piles or the ground will require improvement before the slabs are cast.

9.7.2 Proof rolling of the formation should be undertaken and any soft or loose spots excavated and replaced with suitable clean general fill, and compacted in accordance with the Highways Agency Specification for Highway Works.

9.8 Excavations

9.8.1 Excavations are likely to encounter groundwater inflow at shallow depth and are likely to require significant groundwater controls. Excavations are unlikely to remain open unsupported for any duration, due to the soft nature of the near surface soils and the anticipated shallow groundwater, and will require support.

9.9 Hydraulic Uplift

9.9.1 When the piezometric pressure in a relatively permeable stratum exceeds the confining overburden pressure of the lower permeability strata overlying it, then there is a theoretical risk of heave or hydraulic uplift. Therefore, with lower permeability deposits of Alluvium overlying higher permeability River Terrace Deposits, and with anticipated high groundwater levels across the REP site, there might be a risk that hydraulic uplift may occur in the base of deeper excavations where the thickness of the overlying less permeable deposits has been reduced by excavations and overburden pressures are therefore reduced.

9.9.2 The proposals include construction of a waste bunker within the Main REP Building. In order to form this bunker, significant excavations within the underlying deposits will be required. Excavation of the anticipated geological sequence should be feasible using conventional tracked excavators. Measures to support the excavation sides and to control groundwater entries into the excavation to allow construction in dry conditions will be required. Several methods of construction may be considered for the retaining wall including sheet piled, contiguous and secant piled walls. In addition to controlling groundwater inflow from the excavation sides, measures may be required to limit or control inflows of groundwater into the base of the excavation. Additional ground investigation works will be required to provide

information on the groundwater conditions to enable the most appropriate groundwater control measures to be identified.

9.9.3 It is possible that the weight of the bunker will be lower than the hydrostatic uplift forces. If so, design measures will be required to ensure an acceptable factor of safety against floatation. It is recommended that the piezometric groundwater levels are confirmed as part of future ground investigations and the assessments are reviewed once the plan dimensions and depth of the waste bunker have been finalised.

9.9.4 Given that the proposed waste bunker will extend below groundwater level, allowance should be made to ensure the bunker is watertight. Similar considerations with regard to floatation and water tightness will need to be given to any other deep excavations such as the ash bunker.

10 Conclusions and Recommendations

10.1 Conclusions

10.1.1 The Application Site comprises two main packages of land (the REP Site and the Main Temporary Construction Compound/Data Centre site area) connected by a longer corridor of land (the Electrical Connection Route) which runs along; for the most part, existing roads between the REP site to the Littlebrook 132 kV substation in Dartford, some 7.8 km to the southeast. It also includes an area of the River Thames to the north of the REP site.

10.1.2 Evidence from historical maps indicates a variety of land uses in the different site areas. The REP site has been used in different areas as a manure factory, a borax processing works, a car factory car park, the depot of a portable buildings company, the depot of a plant hire firm and currently as the ancillary infrastructure (e.g. container storage, access roads, car parking, habitat areas) around the existing RRRF. The Data Centre site has been historically used as a storage area for borax processing wastes and the Main Temporary Construction Compound as a substation associated with a former power station. The Electrical Connection route is located on land that has historically been used for both industrial, residential and commercial purposes.

10.1.3 From a review of the available desk based information it is likely that the REP site is underlain by up to 6.0 m of Made Ground, beneath which are superficial deposits of Alluvium (including Peat) and River Terrace Gravels, to a depth of up to almost 16 m. Beneath the superficial deposits, bedrock of the London Clay formation is present. Geoenvironmental testing data from within the REP site indicates that the Made Ground (which is currently capped by either the built environment or, as part of earlier remedial works, a clean-capping layer) may present a potential source of contamination to both human health and controlled waters. The underlying alluvial soils also present a potential ground gas source. A worst case **Moderate** estimated risk (of potential contamination at the Application Site affecting a sensitive receptor) is assigned to this area.

10.1.4 From a review of the available desk based information it is likely that the Main Temporary Construction Compound and Data Centre site is underlain by Made Ground to up to 2.7 m depth. This Made Ground is an imported fill associated with the earlier remediation by removal of contaminative materials of this area. Geoenvironmental testing data from within the area indicates that the Made Ground is impacted with asbestos and may present a potential source of contamination. An earlier Detailed Quantitative Risk Assessment for Controlled Waters carried out by WSP at this site, which was subsequently agreed with the Local Authority and EA, confirms that the site does not pose a risk to controlled waters. The underlying alluvial soils also present a ground gas source. A worst case **Moderate** estimated risk (of potential contamination at the Application Site affecting a sensitive receptor) is assigned to this area.

10.1.5 With regard to the Electrical Connection route, there are not expected to be any new receptors introduced aside from the construction workers who will be excavating the cable route, and off-site users (i.e. the general public) walking alongside the shallow excavations through any Made Ground present. A **Low to Moderate** estimated risk (of potential contamination at the Application Site affecting a sensitive receptor) is assigned to this area, on the basis of the adoption of appropriate hygiene, working methods and PPE by construction workers.

10.1.6 The preliminary ground stability risk assessment has identified that for the Proposed Development, a piled foundation solution is likely to be required.

10.1.7 It is considered that this study has not revealed any widespread significant geoenvironmental or ground stability risks that would preclude development for the proposed end uses.

10.1.8 It is therefore considered that the Application Site is unlikely to be designated as “contaminated land” under Part IIA of the Environmental Protection Act (1990).

10.2 Recommendations

10.2.1 It is recommended that a Phase 2 Geotechnical and Geoenvironmental Ground Investigation is carried out to confirm the preliminary conceptual site model, investigate the identified on-site PSCs and inform a quantitative Tier 2 risk assessment, and also to inform the detailed design of the proposed development. The objectives of the intrusive ground investigation should be to provide information on the baseline soil, groundwater and surface water conditions within this area. As part of this investigation it will be necessary to install groundwater/gas monitoring standpipes which should be followed up by a robust groundwater/gas monitoring programme.

11 Essential Guidance for Report Readers

This report has been prepared within an agreed timeframe and to an agreed budget that will necessarily apply some constraints on its content and usage. The remarks below are presented to assist the reader in understanding the context of this report and any general limitations or constraints. If there are any specific limitations and constraints, they are described in the report text.

1. The opinions and recommendations expressed in this report are based on statute, guidance, and appropriate practice current at the date of its preparation. Peter Brett Associates LLP (PBA) does not accept any liability whatsoever for the consequences of any future legislative changes or the release of subsequent guidance documentation, etc. Such changes may render some of the opinions and advice in this report inappropriate or incorrect and we will be pleased to advise if any report requires revision due to changing circumstances, especially those over one-year-old. Following delivery of any report PBA has no obligation to advise the Client or any other party of such changes or their repercussions.

2. Some of the conclusions in this report may be based on third party data. No guarantee can be given for the accuracy or completeness of any of the third-party data used. Historical maps and aerial photographs provide a “snap shot” in time about conditions or activities at the site and cannot be relied upon as indicators of any events or activities that may have taken place at other times.

3. The conclusions and recommendations made in this report and the opinions expressed are based on the information reviewed and/or the ground conditions encountered in exploratory holes and the results of any field or laboratory testing undertaken. There may be ground conditions at the site that have not been disclosed by the information reviewed or by the investigative work undertaken. Such undisclosed conditions cannot be taken into account in any analysis and reporting.

4. Unless specifically stated to the contrary, this report does not purport to be a “Geotechnical Design Report” as defined in Clause 2.8 of Eurocode 7 (Geotechnical Design BS EN 1997-1:2004). Some of the data contained herein and used to support any geotechnical assessment presented in this report may be historical or for other reasons not fully compliant with the requirements of that code.

5. It should be noted that groundwater levels, groundwater chemistry, surface water levels, surface water chemistry, soil gas concentrations and soil gas flow rates can vary due to seasonal, climatic, tidal and man-made effects.

6. If the report indicates that asbestos has been identified within the ground, any work that involves, or is likely to involve, contact with asbestos must be undertaken in accordance with the Control of Asbestos Regulations 2012, particularly in regard to risk assessment, licencing and training. Risk assessment should be carried out prior to any activities that could lead to the disturbance of asbestos materials, either buried or on the ground surface and should include appropriate mitigation measures, such as damping down to prevent the spread of asbestos, air monitoring and minimum PPE and/or RPE requirements for the work proposed.

7. This report has been written for the sole use of the Client stated at the front of the report in relation to a specific development or scheme. The conclusions and recommendations presented herein are only relevant to the scheme or the phase of project under consideration. This report shall not be relied upon or transferred to any other party without the express written authorisation of PBA. Any such party relies upon the report at its own risk.

8. The interpretation carried out in this report is based on scientific and engineering appraisal carried out by suitably experienced and qualified technical consultants based on the scope of our engagement. We have not taken into account the perceptions of, for example, banks, insurers, other funders, lay people, etc, unless the report has been prepared specifically for that purpose.

Advice from other specialists may be required such as the legal, planning and architecture professions, whether specifically recommended in our report or not.

9. Public or legal consultations or enquiries, or consultation with any Regulatory Bodies (such as the Environment Agency, Natural England or Local Authority) have taken place only as part of this work where specifically stated.

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[1] An intrusive ground investigation is understood to have been undertaken in 1989 by Terresearch, for Greenham Construction Materials, detailed in a report titled "Site Investigation Report at Norman Road, Belvedere", but at the time of writing this has not been received.

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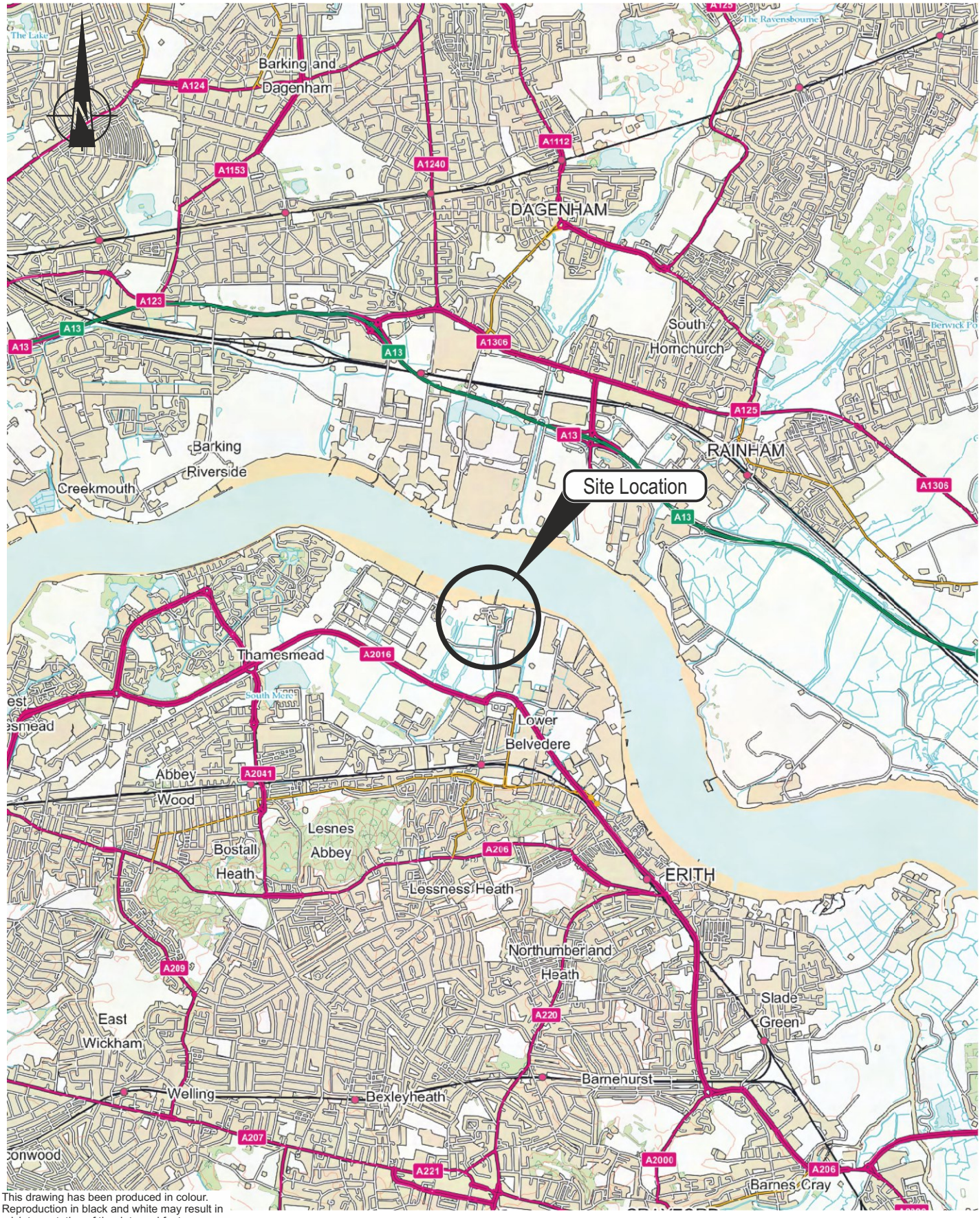
Figures



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Site Grid Ref: TQ 497 806

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RIVERSIDE ENERGY PARK

SITE LOCATION PLAN

Date	29.03.2018
A4 Scale	1:50 000
Drawn by	davco
Checked by	NH
Revision	0

FIGURE 1

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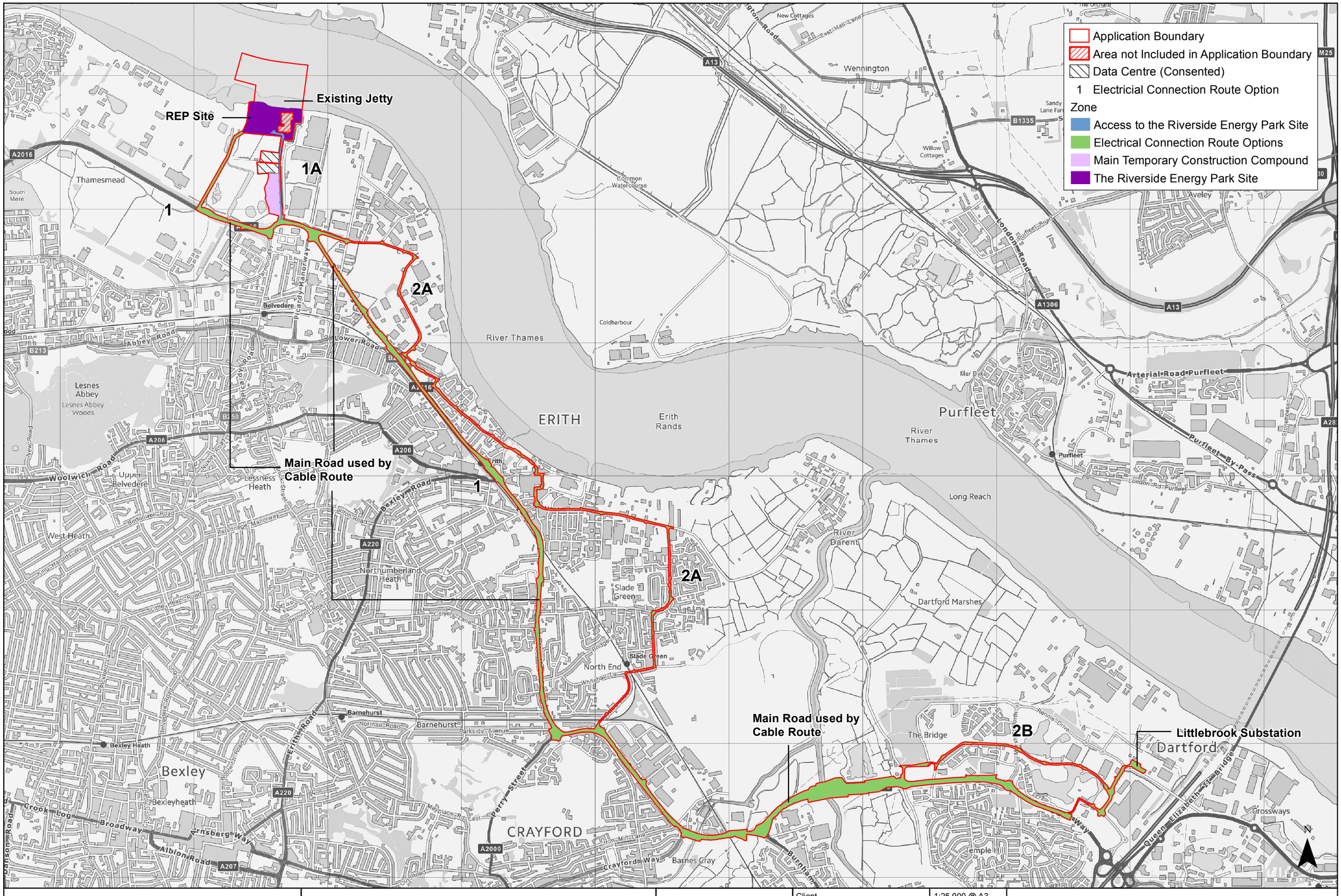

RIVERSIDE ENERGY PARK

0 0.5 1 km

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Based on Babcock/EDF plan - RRRL Cable Route Landowners - 2-01-2010 - Drawing NO. Cable Route Plan

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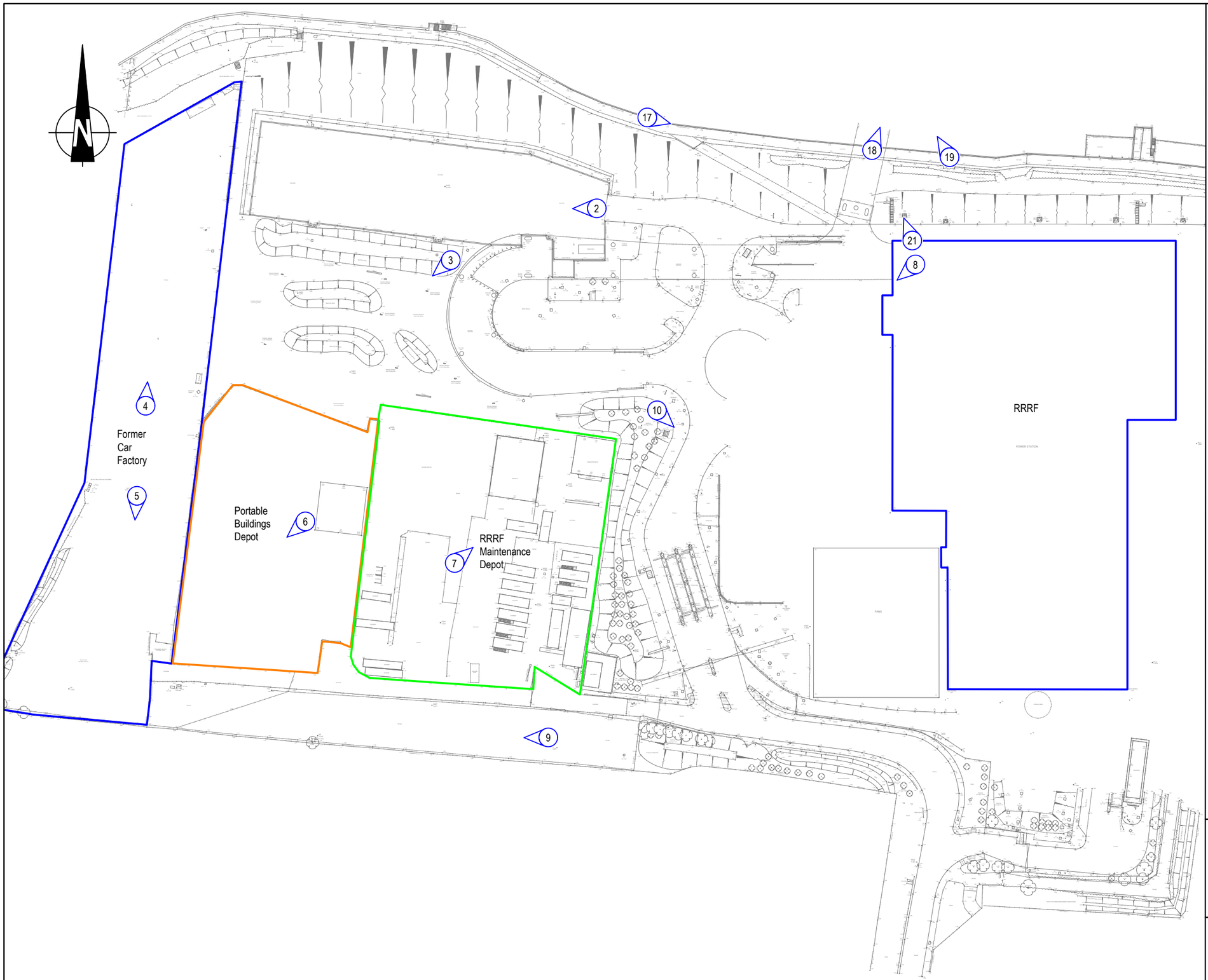
1:25,000 @ A3	
08/11/18	
Drawn: HG/CM	
Checked: JM	

Application Boundary

Figure 2 | Rev 0

Document Path: Z:\Projects\42166\02_mxd\ESPlans\42166_ApplicationBoundary_AssessmentBoundary.mxd



Key

2 Photograph Location

RIVERSIDE ENERGY PARK

SITE LAYOUT PLAN - REP SITE

Client

Cory Riverside Environmental Holdings Ltd

Date of 1st Issue	Drawn by
29.03.2018	davco
A3 Scale	Checked by
1:1250	NH

Figure Number

3

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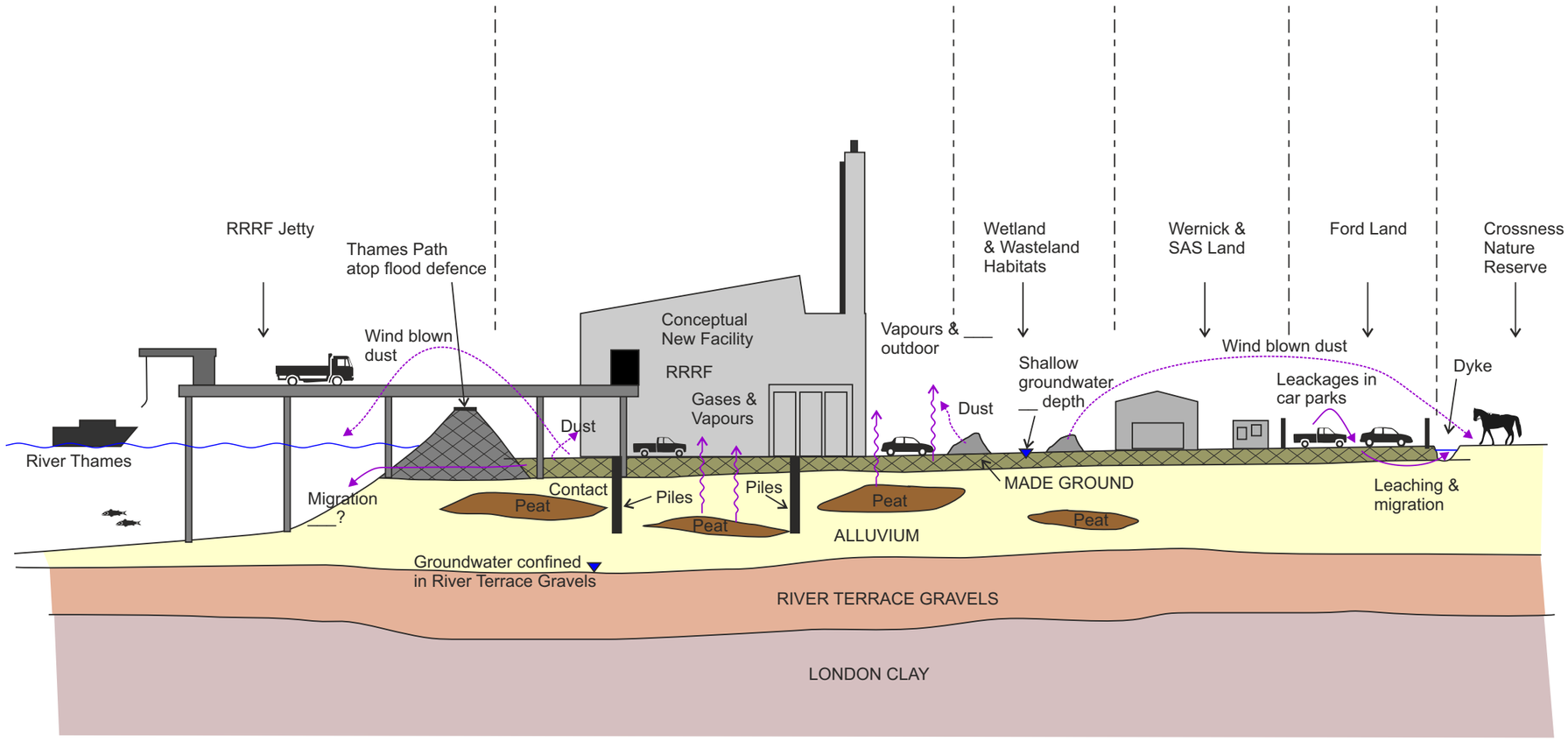

Sources

- Hazardous ground gases including methane and carbon dioxide originating in the Alluvium and Peat deposits Present beneath REP, Norman Road area and ECR
- Hydrocarbons (TPH and PAH) including vapours originating in the Made ground and impacted natural strata and groundwater. Present beneath REP and ECR.
- Asbestos and Boron within remnant made ground and impacted natural strata and groundwater as well as within the imported fill material. Present beneath Norman Road area.
- Asbestos within the made ground due to demolition of earlier structures. Present beneath REP and the ECR.

Pathways

- Ingestion of soil/dust indoors.
- Ingestion of soil/dust outdoors.
- Inhalation of particles (dust/Soil) Indoor and outdoor.
- Inhalation of vapours/gases outdoor.
- Inhalation of vapours/gases indoor.
- Dermal absorption via direct contact with soil.
- Leaching of soils to groundwater (Shallow).
- Migration of shallow groundwater via natural or anthropogenic pathways.
- Indirect via recharge of surface water from groundwater (hydraulic flow).
- Deposition of wind-blown dust.
- Direct contact between built environment and soil.
- Explosion due to gas migration via natural or anthropogenic pathways.
- Direct deposition of particles/dust. Windblown of flood.
- Indirect - through watering.
- Inhalation of gases/vapours or particulates/dust by animals.
- Ingestion of vegetation/water/soil by animals.

Receptors

- Human Health (Current Users)
- Human Health (Future Users)
- Human Health (Off- site)
- Human Health (Construction workers)
- Groundwater in secondary aquifer
- Surface Water (ditches/dykes, River Thames)
- Property - buildings/structures
- Property - Animal/crop (animals grazed on adjacent land)
- Ecological systems (River Thames, Crossness Nature Reserve)

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RIVERSIDE ENERGY PARK

CONCEPTUAL SCHEMATIC SITE MODEL

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nts	NH

Figure Number: FIGURE 4

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Appendix A PBA Specification for Phase 1 Ground Condition Assessment

Specification for a Phase 1 Ground Condition Assessment (Contamination and Land Stability)

1 Introduction

The Phase 1 Ground Condition Assessment comprises a desk study and site reconnaissance that identifies the likely ground conditions and environmental setting of a defined site and assesses the information to identify potential contamination issues / environmental liabilities or land stability hazards that could affect the site.

When prepared in a planning context the primary aim is to meet the requirements of the National Planning Policy Framework (NPPF, 2018). A Phase 1 is generally considered to be the minimum requirement to support any planning application on a site that might be affected by potential contamination, ground instability and/or slope stability. Further information is given in the Planning Practice Guidance Notes on "Land affected by contamination" and "Land stability" (accessed on the 20.08.18 from https://www.gov.uk/guidance/).

The Land affected by Contamination Guidance states:
"Developers should provide proportionate but sufficient site investigation information (a risk assessment) to determine the existence or otherwise of contamination, its nature and extent, the risks it may pose and to whom/what (the 'receptors') so that these risks can be assessed and satisfactorily reduced to an acceptable level.

The risk assessment should also identify the potential sources, pathways and receptors ('pollutant linkages') and evaluate the risks. This information will enable the local planning authority to determine whether further more detailed investigation is required, or whether any proposed remediation is satisfactory.

At this stage, an applicant may be required to provide at least the report of a desk study and site walk-over. This may be sufficient to develop a conceptual model of the source of contamination, the pathways by which it might reach vulnerable receptors and options to show how the identified pollutant linkages can be broken.

Unless this initial assessment clearly demonstrates that the risk from contamination can be satisfactorily reduced to an acceptable level, further site investigations and risk assessment will be needed before the application can be determined."

The Land Stability Guidance states:
"A preliminary assessment of ground instability should be carried out at the earliest possible stage before a detailed planning application is prepared. Developers should ensure that any necessary investigations are undertaken to ascertain that their sites are and will remain stable or can be made so as part of the development of the site. A site needs to be assessed in the context of surrounding areas where subsidence, landslides and land compression could threaten the development within its anticipated life or damage neighbouring land or property.

Such information could be provided to the planning authority in the form of a land stability or slope stability risk assessment report. Developers may choose to adopt phased reporting, e.g. desk study results followed by ground investigation results."

The data gathering stages of each assessment have many aspects in common and it is usually very cost effective to prepare a single combined report covering both contamination and instability requirements. The assessments are an important first step in the investigation of ground conditions at most sites, and can provide an early indication of geo-hazards, environmental liabilities, constraints and opportunities to feed into the master-planning process and development budgets. They are usually a pre-requisite for the planning application.

2 Scope of Works

The following sources of information will be included in the Phase 1 data search:

- A site reconnaissance visit to verify the current condition of the site and its immediate surroundings.
- Purchase and review of Historical Ordnance Survey maps.
- Database search to obtain environmental information in the public domain (commissioned from a third party).
- Review of readily available published geological borehole records, maps and memoirs, and technical papers or reports relating to the geology, geomorphology or geotechnics e.g. mineral assessment reports.
- Review of PBA's national natural and mining cavities (non-coal) databases, and PBA's internal database of ground investigation reports and surveys.
- Review of current guidance on the potential for radon to be present
- A search of the planning portal for development applications on or immediately adjacent to the site.
- An internet search (Google or similar) using the site address and post code.
- Web based information on ecological sites with international and national designations using a search radius of 1, 2 or 5km depending on the site specific circumstances.
- Review of the interactive Coal Authority mapapps2.bgs.ac.uk/coalauthority/home.html
- Review of UXB map for the site http://www.zetica.com/uxb_downloads.htm

The factual data will be presented in a report that will include: a preliminary conceptual site model (CSM) based on a source-pathway-receptor model to identify potential pollutant linkages and a Tier 1 Qualitative Risk Assessment.

The anticipated ground conditions and geology will be reviewed in respect of possible geological and other factors that could give rise to a risk of land instability, and a preliminary hazard assessment will be carried out. This will include the risk of natural and man-made (mining) cavities, slope stability issues, compressible soils, subsidence and heave due to volume change.

Outline recommendations for further work such as specialist surveys or intrusive ground investigation will be included as required and a preliminary review of potential liabilities and constraints that might affect the development.

3 Clarifications and Limitations

- Some of the searches will be undertaken using computerised database facilities. All databases have the limitation that they may not be up to date because they are only periodically updated. No guarantee can be given for the accuracy or completeness of third party information.
- Based on a review of the initial data the collection of further information, e.g. via formal requests to the relevant authorities, may be recommended. Any additional costs will be notified and approval sought.
- The absence of cavity records in the PBA natural and mining cavities (non-coal) databases is not considered as conclusive as to their absence.
- Information presented on maps / photographs represents the situation as surveyed at a given time. It is possible for developments to have occurred between surveys that are not shown or for the map record to have been censored for military security.
- The comments and the opinions expressed will be based on the information obtained from the specified sources. However, there may be conditions pertaining to the site, which are not disclosed by this information and, therefore, cannot be taken into consideration.
- Any interpretation is carried out based on a scientific and engineering appraisal and does not take into account the perceptions of, for example banks, insurers, lay people etc.
- When data is insufficient or inadequate to support a robust assessment, we will state that any conclusions are provisional and recommend further works.
- It should be noted that NPPF requires that *"planning policies and decisions should ensure that,… adequate site investigation information, prepared by a competent person, is available"*. A Phase 1 assessment may not be sufficient to enable the authority to grant planning permission. An intrusive ground investigation may be required to confirm the actual site conditions.

  It should be noted that additional surveys for ecological, flood risk or archaeological survey may be required to support a planning application.

Appendix B PBA Methodology for Assessing Land Contamination in England

1 Introduction

This document defines the approach adopted by PBA in relation to the assessment of land contamination in England. The aim is for the approach to (i) be systematic and objective, (ii) provide for the assessment of uncertainty and (iii) provide a rational, consistent, transparent framework.

When preparing our methodology, we have made reference to various technical guidance documents and legislation referenced in Section 7 of which the principal documents are (i) Contaminated Land Statutory Guidance (Defra 2012), (ii) the Model Procedures for the Management of Contamination (CLR 11) (EA 2004), (iii) Contaminated land risk assessment: A guide to good practice (C552) (CIRIA 2001) (iv) National Planning Policy Framework (NPPF, 2012 and 2018) and (v) BS 10175 Investigation of potentially contaminated sites - Code of Practice (BSI 2017).

2 Dealing with Land Contamination

Government policy on land contamination aims to prevent new contaminated land from being created and promotes a risk based approach to addressing historical contamination. With regard to historical contamination, regulatory intervention is held in reserve for land that meets the legal definition and cannot be dealt with through any other means, including through planning. Land is only considered to be "contaminated land" in the legal sense if it poses an unacceptable risk.

UK legislation on contaminated land is principally contained in Part 2A of the Environmental Protection Act, 1990 (which was inserted into the 1990 Act by section 57 of the Environment Act 1995). Part 2A was introduced in England on 1 April 2000 and provides a risk-based approach to the identification and remediation of land where contamination poses an unacceptable risk to human health or the environment. In 2004 the Model Procedures for the Management of Contamination (CLR 11) were published providing guidance on how the statutory requirements were to be delivered. The approach, concepts and principles for land contamination management promoted by CLR 11 are applied to the determination of planning applications.

Other legislative regimes may also provide a means of dealing with land contamination issues, such as the regimes for waste, water, environmental permitting, and environmental damage. Further, the law of statutory nuisance may result in contaminants being unacceptable to third parties whilst not attracting action under Part 2A or other environmental legislation.

2.1 Part 2A

The Regulations and Statutory Guidance that accompanied the Act, including the Contaminated Land (England) Regulations 2006, has been revised with the issue of The Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012/263) and the Contaminated Land Statutory Guidance for England 2012.

Part 2A defines contaminated land as "*land which appears to the Local Authority in whose area it is situated to be in such a condition that, by reason of substances in, on or under the land that significant harm is being caused, or there is a significant possibility that such significant harm (SPOSH) could be caused, or significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution (SPOSP) being caused*".

Harm is defined as "*harm to the health of living organisms or other interference with the ecological systems of which they form part, and in the case of man, includes harm to his property*".

Part 2A provides a means of dealing with unacceptable risks posed by land contamination to human health and the environment, and under the guidance enforcing authorities should seek to find and deal with such land. It states that "*under Part 2A the starting point should be that land is not contaminated land unless there is reason to consider otherwise. Only land where unacceptable risks are clearly identified, after a risk assessment has been undertaken in accordance with the Guidance, should be considered as meeting the Part 2A definition of contaminated land"*. Further, the guidance makes it clear that *"regulatory decisions should be based on what is reasonably likely, not what is hypothetically possible".*

The overarching objectives of the Government's policy on contaminated land and the Part 2A regime are:

"(a) To identify and remove unacceptable risks to human health and the environment.
(a) To seek to ensure that contaminated land is made suitable for its current use.
(b) To ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development".

The enforcing authority may need to decide whether and how to act in situations where decisions are not straight forward, and where there is uncertainty. "*In so doing, the authority should use its judgement to strike a reasonable balance between: (a) dealing with risks raised by contaminants in land and the benefits of remediating land to remove or reduce those risks; and (b) the potential impacts of regulatory intervention including financial costs to whoever will pay for remediation, health and environmental impacts of taking action, property blight, and burdens on affected people".* The authority is required to "*take a precautionary approach to the risks raised by contamination, whilst avoiding a disproportionate approach given the circumstances of each case".* The aim is "*that the regime produces net benefits, taking account of local circumstances*".

The guidance recognises that *"normal levels of contaminants in soils should not be considered to cause land to qualify as contaminated land, unless there is a particular reason to consider otherwise".*

Normal levels are quoted as:

"a) natural presence of contaminants' such as from underlying geology *'that have not been shown to pose an unacceptable risk to health and the environment*
b) …low level diffuse pollution, and common human activity…"

Similarly the guidance states that significant pollution or significant possibility of significant pollution of controlled waters is required for land to be considered contaminated and the "*fact that substances are merely entering water"* or "*where discharge from land is not discernible at a location immediately downstream"* does not constitute contaminated land.

To help achieve a more targeted approach to identifying and managing contaminated land in relation to the risk (or possibility) of harm to human health, the revised Statutory Guidance presented a new four category system for considering land under Part 2A, ranging from Category 4, where there is no risk that land poses a significant possibility of significant harm (SPOSH), or the level of risk is low, to Category 1, where the risk that land poses a significant possibility of significant harm (SPOSH) is unacceptably high.

For land that cannot be readily placed into Categories 1 or 4 further assessment is required. If there is a sufficiently strong case that the risks are of sufficient concern to cause significant harm or have the significant possibility of significant harm the land is to be placed into Category 2. If the concern is not met land is considered Category 3.

The technical guidance clearly states that the currently published SGV and GAC's represent *"cautious estimates of level of contaminants in soils"* which should be considered *"no risk to health or, at most, a minimal risk"*. These values do not represent the boundary between categories 3 and 4 and "*should be considered to be comfortably within Category 4".*

At the end of 2013 technical guidance in support of Defra's revised Statutory Guidance (SG) was published and then revised in 2014 (CL:AIRE 2014) which provided:
• A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
• A demonstration of the methodology, via the derivation of C4SLs for six substances – arsenic, benzene, benzo(a)pyrene, cadmium, chromium (VI) and lead.

With regards controlled waters the revised Statutory Guidance states that the following types of pollution should be considered to constitute significant pollution of controlled waters:

"(a) Pollution equivalent to "environmental damage" to surface water or groundwater as defined by The Environmental Damage (Prevention and Remediation) Regulations 2009, but which cannot be dealt with under those Regulations.
(b) Inputs resulting in deterioration of the quality of water abstracted, or intended to be used in the future, for human consumption such that additional treatment would be required to enable that use.
(c) A breach of a statutory surface water Environment Quality Standard, either directly or via a groundwater pathway.
(d) Input of a substance into groundwater resulting in a significant and sustained upward trend in concentration of contaminants (as defined in Article 2(3) of the Groundwater Daughter Directive (2006/118/EC)".

The guidance also states that, in some circumstances, significant concentrations at a compliance point (in groundwater or surface water) may constitute pollution of controlled waters.

As with SPOSH for human health the revised Statutory Guidance presents a four category system for SPOSP for controlled waters. Category 1 covers land where there is a strong and compelling case for SPOSH, for example where significant pollution would almost certainly occur if no action was taken to avoid it. Category 4 covers land where there is no risk or the risk is low, for example, where the land contamination is having no discernible impact on groundwater or surface water quality. Category 2 is for land where the risks posed to controlled waters are not high enough to consider the land as Category 1 but nonetheless are of sufficient concern to constitute SPOSP, Category 3 is for land where the risks posed to controlled waters are higher than low but not of sufficient concern to constitute SPOSP.

2.2 Planning

The Local Planning Authority (LPA) is responsible for the control of development, and in doing so it has a duty to take account of all material considerations, including contamination.

The principal planning objective is to ensure that any unacceptable risks to human health, buildings and other property and the natural and historical environment from the contaminated condition of the land are identified so that appropriate action can be considered and taken to address those risks.

The National Planning Policy Framework (NPPF, 2012) has been revised in July 2018 (NPPF, 2018).

Paragraph 118 states that planning policies and decisions should "*(c) give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land*."

Paragraph 179 states "*Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner*".

Paragraph 170 states "*planning policies and decisions should contribute to and enhance the natural and local environment by:*

> *e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans*; *and*
>
> *f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate."*

Paragraph 178 describes the policy considerations the Government expects LPA's to have in regard to land

affected by contamination when preparing policies for development plans and in taking decisions on applications. have been replaced by paragraphs 178 and 180 respectively.

Paragraph 178 states "*planning policies and decisions should ensure that:*

> *a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);*
>
> *b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
>
> *c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.*"

Paragraph 183 states "*The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.*"

The Glossary in Annex 2 provides the following:

***Brownfield land registers**: Registers of previously developed land that local planning authorities consider to be appropriate for residential development, having regard to criteria in the Town and Country Planning (Brownfield Land Registers) Regulations 2017. Local planning authorities will be able to trigger a grant of permission in principle for residential development on suitable sites in their registers where they follow the required procedures.*

***Competent person (to prepare site investigation information)**: A person with a recognised relevant qualification, sufficient experience in dealing with the type(s) of pollution or land instability, and membership of a relevant professional organisation.*

***Previously developed land**: Land which is or was occupied by a permanent structure, including the curtilage of the developed land (although it should not be assumed that the whole of the curtilage should be developed) and any associated fixed surface infrastructure. This excludes: land that is or was last occupied by agricultural or forestry buildings; land that has been developed for minerals extraction or waste disposal by landfill, where provision for restoration has been made through development management procedures; land in built-up areas such as residential gardens, parks, recreation grounds and allotments; and land that was previously developed but where the remains of the permanent structure or fixed surface structure have blended into the landscape.*

***Site investigation information**: Includes a risk assessment of land potentially affected by contamination, or ground stability and slope stability reports, as appropriate. All investigations of land potentially affected by contamination should be carried out in accordance with established procedures (such as BS10175 Investigation of Potentially Contaminated Sites – Code of Practice).* This in turn links to procedures in CLR11 which PBA adopt.

PBA adopt the principle that a Phase 1 desk study is the minimum assessment requirement for planning applications.

The level at which contamination is deemed to be unacceptable, or, gives rise to adverse effects under a planning context has not been identified but is envisaged to be more precautionary than the level required to detrmine land as contaminated under Part 2A.

2.3 Building Control

The building control department of the local authority or private sector approved inspectors are responsible for the operation and enforcement of the Building Regulations (DCLG 2010) to protect the health, safety and welfare of people in and around buildings. Approved Document C requires the protection of buildings and associated land from the effects of contamination, to be applied (non-exclusively) in all changes of use from commercial or industrial premises, to residential property.

3 Approach

CLR 11 recommends a phased or tiered approach to risk assessment with the three tiers being:-

- Tier 1 - preliminary – a qualitative assessment forming part of a Phase 1 report,
- Tier 2 - generic - a quantitative assessment using published criteria to screen site specific ground condition data forming part of a Phase 2 report
- Tier 3 - detailed – a quantitative assessment involving the generation of site specific assessment criteria

Each tier of risk assessment comprises the following four stages:-

1. Hazard Identification – identifying potential contaminant sources on and off site;
2. Hazard Assessment – assessing the potential for unacceptable risks by identifying what pathways and receptors could be present, and what pollutant linkages could result (forming the Conceptual Site Model (CSM));
3. Risk Estimation – estimating the magnitude and probability of the possible consequences (what degree of harm might result to a defined receptor and how likely); and
4. Risk Evaluation – evaluating whether the risk needs to be, and can be, managed.

A PBA Phase 1 report normally comprises a desk study, walkover and Tier 1 risk assessment (the project specific proposal defines the actual scope of work). At Tier 1 the PBA approach to risk estimation involves identifying the magnitude of the potential consequence

(taking into account both the potential severity of the hazard and the sensitivity of the receptor) and the magnitude of the likelihood i.e. the probability (taking into account the presence of the hazard and the receptor and the integrity of the pathway). This approach is promoted in current guidance such as R&D 66 (NHBC 2008).

The PBA approach is that if a pollution linkage is identified then it represents a potential risk which requires further consideration and either (1) remediation / direct risk management or (2) further tiers of assessment.

A PBA preliminary Phase 2 report comprises an intrusive investigation to collect site specific information, a Tier 2 quantitative generic risk assessment and a refinement of the CSM using the site specific data. Depending on the findings further investigation and/or progression to Tier 3 risk assessment and the generation of site specific assessment criteria may be required.

4 Identification of Pollutant Linkages and Conceptual Site Model (CSM)

For all Tiers of Risk Assessment the underlying principle to ground condition assessment is the identification of *pollutant linkages* in order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences. A pollutant linkage consists of the following three elements:-

- A source/hazard – a substance or situation which has the potential to cause harm or pollution;
- A pathway – a means by which the hazard moves along / generates exposure; and
- A receptor/target – an entity which is vulnerable to the potential adverse effects of the hazard.

The *Conceptual Site Model* identifies the types and locations of potential contaminant sources/hazards and potential receptors and potential migration/transportation pathway(s). The CSM is refined as the assessment progresses through the Tiers.

4.1 Hazard Identification

A hazard is a substance or situation that has the potential to cause harm. Hazards may be chemical, biological or physical.

At Tier 1 the potential for hazards to be present is determined from consideration of the previous or ongoing activities on or near to the site in accordance with the criteria presented in the **Table 1**.

Based on the land use information Contaminants of Potential Concern (COPC) are identified. The COPC direct the scope of the collection of site specific data and the analytical testing selected for subsequent Tiers.

At Tier 2 the site specific data is screened using appropriate published assessment criteria (refer to PBA document entitled Rationale for the Selection of Tier 2 Assessment Criteria). In general, published criteria have been developed using highly conservative assumptions and therefore if the screening criterion is not exceeded (and assuming that sufficient samples from appropriate locations have been analysed) then the COPC is eliminated as a potential Hazard. It should be noted that exceedance does not necessarily indicate that a site is contaminated and/or unsuitable for use only that the COPC is retained as a potential Hazard. Published criteria are generated using models based on numerous and complex assumptions. Whether or not these assumptions are appropriate in a site-specific context requires confirmation on a project by project basis and would normally form part of a Tier 3 assessment.

When reviewing or assessing site specific data PBA utilise published guidance on comparing contamination data with a critical concentration (CL:AIRE/CIEH 2008) which presents a structured process for employing statistical techniques for data assessment purposes. The benefit of the statistical tool is uncertainty in estimating the representative exposure/source concentration) is quantified and decisions are made knowing the strength of the evidence. Correct decision probability is a function of sample size, difference in the mean and the critical concentration, variation in measured values and the significance level.

4.2 Receptor and Pathway Identification

For all Tiers the potential receptors (for both on site and adjoining land) that will be considered are:

- Human Health – including current and future occupiers, construction and future maintenance workers, and neighbouring properties/third parties;
- Ecological Systems; *1
- Controlled Waters *2 – including surface water and groundwater;
- Property - Animal or Crop (including timber; produce grown domestically, or on allotments, for consumption; livestock; other owned or domesticated animals; wild animals which are the subject of shooting or fishing rights); and
- Property - Buildings (including archaeological sites and ancient monuments).

*1 International or nationally designated sites (as defined in the statutory guidance (Defra Circular 04/12)) "in the local area" will be identified as potential ecological receptors. A search radius of 1, 2 or 5km will be utilised depending on the site specific circumstances (see also pathway identification). The Environment Agency has published an ecological risk assessment framework (EA 2008) which promotes (as opposed to statutorily enforces) consideration of additional receptors to include locally protected sites and protected or notable species. These additional potential receptors will only be considered if a Phase 1 habitat survey, undertaken in accordance with guidance (JNCC 1993), is commissioned and the data provided to PBA. It should be noted that without such a survey the Tier 1 risk assessment may conclude that the identification of potential ecological receptors is inconclusive (refer to PBA Specification for Phase 1).

*2 the definition of "pollution of controlled water" was amended by the introduction of Section 86 of the Water Act 2003. For the purposes of Part 2A groundwater does not include waters above the saturated zone and our assessment does not therefore address perched water other than where development causes a pathway to develop.

If a receptor is taken forward for further assessment it will be classified in terms of its sensitivity, the criteria for which are presented in **Table 2**. Table 2 has been generated using descriptions of environmental receptor

importance/value given in various guidance documents including R&D 66 (NHBC 2008) and Transport Analysis Guidance (based on DETR 2000). Human health and buildings classifications have been generated by PBA using the attribute description for each class.

The exposure pathway and modes of transport that will be considered are presented in **Table 3**.

4.3 Note regarding Ecological Systems

The Environment Agency (EA) has developed an ecological risk assessment framework which aims to provide a structured approach for assessing the risks to ecology from chemical contaminants in soils (EA 2008). In circumstances where contaminants in water represent a potential risk to aquatic ecosystems then risk assessors will need to consider this separately.

The framework consists of a three tiered process:-

- Tier 1 is a screening step where the site soils chemical data is compared to a soil screening value (SSV)
- Tier 2 uses various tools (including surveys and biological testing) to gather evidence for any harm to the ecological receptors
- Tier 3 seeks to attribute the harm to the chemical contamination

Tier 1 is preceded by a desk study to collate information about the site and the nature of the contamination to assess whether pollutant linkages are feasible. The framework presents ten steps for ecological desk studies and development of a conceptual site model as follows.

1 Establish Regulatory Context
2 Collate and Assess Documentary Information
3 Summarise Documentary Information
4 Identify Contaminants of Potential Concern
5 Identify Likely Fate Transport of Contaminants
6 Identify Potential Receptors of Concern
7 Identify Potential Pathways of Concern
8 Create a Conceptual Site Model
9 Identify Assessment and Measurement Endpoints
10 Identify Gaps and Uncertainties

The information in a standard PBA Phase 1 report covers Steps 1 to 4 inclusive. Step 5 considers fate and transport of contaminants and it should be noted that our standard report adopts a simplified approach considering only transport mechanisms. A simplified approach has also been adopted in respect of Steps 6 and 7 receptors (a detailed review of the ecological attributes has not been undertaken) and pathways (a food chain assessment has not been undertaken). Step 9 is outside the scope of our standard Phase 1 report.

It should be noted that the Tier 1 assessment for ecological systems (i.e. where designated sites are identified) as part of a Phase 1 report will assess the viability of the mode of transport given the site specific circumstances and not specific pathways.

The Tier 1 risk assessment may conclude that the risk to potential ecological receptors is inconclusive (see PBA Specification for Phase 1).

4.4 Note regarding Controlled Waters

Controlled Waters are rivers, estuaries, coastal waters, lakes and groundwaters, but not perched waters.

The EU Water Framework Directive (WFD) 2000/60/EC provides for the protection of sub-surface, surface, coastal and territorial waters through a framework of river basin management. The EU Updated Water Framework Standards Directive 2014/101/EU amended the EU WFD to update the international standards therein; it entered into force on 20 November 2014 with the requirements for its provisions to be transposed in Member State law by 20 May 2016. Other EU Directives in the European water management framework include:

- the EU Priority Substances Directive 2013/39/EU;
- EU Groundwater Pollutants Threshold Values Directive 2014/80/EU amending the EU Groundwater Directive 2006/118/EC; and
- EU Biological Monitoring Directive 2014/101/EU.

The Ground Water Daughter Directive (GWDD) was enacted by the Groundwater Regulations (2009), which were subsumed by the Environmental Permitting Regulations (2010) which provide essential clarification including on the four objectives specifically for groundwater quality in the WFD: -

- Achieve ‘Good’ groundwater chemical status by 2015, commonly referred to as ‘status objective’;
- Achieve Drinking Water Protected Area Objectives;
- Implement measures to reverse any significant and sustained upward trend in groundwater quality, referred to as ‘trend objective’; and
- Prevent or limit the inputs of pollutants into groundwater, commonly referred to as ‘prevent or limit’ objectives

The Water Act 2003 (Commencement No.11) Order 2012 amends the test for 'contaminated land' which relates to water pollution so that pollution of controlled waters must now be "significant" to meet the definition of contaminated land.

River Basin Management Plans (RBMP) have been developed for the 11 River Basin Districts in England and Wales. These were released by Defra in 2009 (Defra 2009) and these were updated in 2015.

These RBMP’s establish the current status of waters within the catchments of the respective Districts and the current status of adjoining waters identified. As part of a Tier 2 risk assessment water quality data is screened against the WFD assessment criteria. Comparison with the RBMP’s current status of waters for the catchment under consideration would form part of a Tier 3 assessment.

5 Risk Estimation

Risk estimation classifies what degree of harm might result to a receptor (defined as consequence) and how likely it is that such harm might arise (probability).

At Tier 1 the consequence classification is generated by multiplying the hazard classification score and the receptor sensitivity score. This approach follows that presented in the republished R&D 66 (NHBC 2008).

The criteria for classifying probability are set out in **Table 4** and have been taken directly from Table 6.4 CIRIA C552 (CIRIA 2001). Probability considers the integrity of the exposure pathway.

The consequence classifications detailed in **Table 5** have been adapted from Table 6.3 presented in C552 and R&D 66 (Annex 4 Table A4.3).

The Tier 1 risk classification is estimated for each pollutant linkage using the matrix given in **Table 6** which is taken directly from C552 (Table 6.5).
Subsequent Tiers refine the CSM through retention or elimination of potential hazards and pollutant linkages.

6 Risk Evaluation

Risk evaluation is used to determine whether the risk is acceptable or not. It includes consideration of the risk estimation and associated uncertainties.

The PBA Tier 1 methodology provides an estimate of the level of risk, but does not identify a risk level at which the risk is considered "significant" and/or "unacceptable" as this is dependent on the view of the individual / stakeholder. For example; to a risk adverse stakeholder even a risk level of "very low" may be considered unacceptable and as such this stakeholder may require risk management options to be implemented.

In order to put the Tier 1 risk classification into context the likely actions are described in **Table 7** which is taken directly from C552 (Table 6.6). Subsequent Tiers identify potential risk management options through remediation and/or mitigation measures.

7 References

BSI 2007 BS 8485 Code of Practice for characterisation and remediation from ground gas in affected developments.
BSI 2017 BS 10175:2011+A2:2017 Investigation of potentially contaminated sites - Code of Practice

CIRIA 2001: Contaminated land risk assessment – a guide to good practice C552.

CIRIA 2008: Assessing risks posed by hazardous ground gases to buildings C655

CL:AIRE/EIH 2008 Guidance on Company Soil Contamination Data with a Critical Concentration. Published by Contaminated Land: Applications in Real Environments (CL:AIRE)

CL:AIRE 2013 SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Final Project Report published by Contaminated Land: Applications in Real Environments (CL:AIRE) 20th December 2013

DCLG 2010 Building Regulations 2010 Approved Document C Site preparation and resistance to contaminants and moisture.

NPPF, 2012 National Planning Policy Framework. (2012). 1st ed. [ebook] London: Department for Communities and Local Government.

NPPF 2018 National Planning Policy Framework (2018). 2nd ed. London: Ministry of Housing, Communities and Local Government.

DETR 2000 Methodology for Multi Modal Studies. Volume 2 Section 4. The Environmental Objective.

Defra Circular 01/2006

Defra Circular 04/2012 Environmental Protection Act 1990: Part 2A. Contaminated Land Statutory Guidance.

DEFRA, 2006 The Contaminated Land (England) Regulations 2006.

DEFRA, 2012 The Contaminated Land (England) (Amendment) Regulations 2012 (SI2012/263).

DEFRA, 2012 Environmental Protection Act 1990: Part 2A. Contaminated Land Statuary Guidance. April 2012.

DEFRA, 2013 Environmental Damage (Prevention and Remediation) Regulations 2009: Guidance for England and Wales

Defra '2009 Water for Life and Livelihoods. River Basin Management Plan. (11 Districts: Anglia, Dee, Humber, Northumbria, Northwest, Severn, Solway and Tweed, Southeast, Thames, Western Wales) December 2009

EA 2004: The Model Procedures for the Management of Land Contamination CRL 11 published by the Environment Agency (EA).

EA 2008 Ecological Risk Assessment Science Report Series SC070009 published by the Environment Agency (EA).

JNCC 1993 Handbook for Phase 1 Habitat Survey – A Technical for Environmental Audit prepared by the Joint Nature Conservancy Council (JNCC)

NHBC/EA/CIEH 2008: R&D Publication 66 Guidance for the safe development of housing on land affected by contamination.

Table 1: Criteria for Classifying Hazards / Potential for Generating Contamination

Classification/Score	Potential for generating contamination/gas based on land use
Very Low 1	Land Use: Greenfield Contamination: None. Gas generation potential : Inert Made Ground
Low 2	Land Use: Residential, retail or office use, recent small scale industrial. Contamination: None or locally slightly elevated concentrations. Gas generation potential : Shallow thickness of alluvium
Moderate 3	Land Use: Railway yards, collieries, scrap yards, light industry, engineering works. Contamination: Locally elevated concentrations. Gas generation potential : Dock silt and substantial thickness of organic alluvium/peat
High 4	Land Use: Gas works, chemical works, heavy industry, non-hazardous landfills. Contamination: Possible widespread elevated concentrations. Gas generation potential : Shallow mine workings Pre 1960's landfill
Very High 5	Land Use: Hazardous waste landfills. Contamination: Likely widespread elevated concentrations. Gas generation potential: Domestic landfill post 1960

"Greenfield" is land which has not been developed.. This can include land only used for agriculture but it should be recognised there is a potential for localised contamination of buried animal pits and diffuse pollution and this possibility should be considered in the risk assessment.

Table 2: Criteria for Classifying Receptor Sensitivity/Value

Classification/Score	Definition
Very Low 1	Receptor of limited importance Groundwater: Non aquifer Surface water: Water body within 25m or eliminate Ecology: No local designation Buildings: Replaceable Human health: Unoccupied/limited access
Low 2	Receptor of local or county importance with potential for replacement Groundwater: Secondary B aquifer or Secondary Undifferentiated Surface water: Tertiary water body immediately adjacent Ecology: local habitat resources Buildings: Local value Human health: Minimum score 4 where human health identified as potential receptor
Moderate 3	Receptor of local or county importance with potential for replacement Groundwater: Secondary A aquifer Surface water: Secondary water body immediately adjacent Ecology: County wildlife sites, Areas of Outstanding Natural Beauty (AONB) Buildings: Area of Historic Character Human health: Minimum score 4 where human health identified as potential receptor
High 4	Receptor of county or regional importance with limited potential for replacement Groundwater: Principal aquifer Surface water: Primary water body immediately adjacent Ecology: SSSI, National or Marine Nature Reserve (NNR or MNR) Buildings: Conservation Area Human health: Minimum score 4 where human health identified as potential receptor
Very High 5	Receptor of national or international importance Groundwater: Source Protection Zone Surface water: Primary water body on site Ecology: Special Areas of Conservation (SAC and candidates), Special Protection Areas (SPA and potentials) or wetlands of international importance (RAMSAR) Buildings: World Heritage site Human health: Residential, open spaces and uses where children are present

Table 3: Exposure Pathway and Modes of Transport

Receptor	Pathway	Mode of transport
Human health	Ingestion	Fruit or vegetable leaf or roots
		Contaminated water
		Soil/dust indoors
		Soil/dust outdoors
	Inhalation	Particles (dust / soil) – outdoor
		Particles (dust / soil) - indoor
		Vapours – outdoor - migration via natural or anthropogenic pathways
		Vapours - indoor - migration via natural or anthropogenic pathways
	Dermal absorption	Direct contact with soil
		Direct contact with waters (swimming / showering)
		Irradiation
Groundwater	Leaching	Gravity / permeation
	Migration	Natural – groundwater as pathway Anthropogenic (e.g. boreholes, culverts, pipelines etc.)
Surface Water	Direct	Runoff or discharges from pipes
	Indirect	Recharge from groundwater
	Indirect	Deposition of wind blown dust
Buildings	Direct contact	Sulphate attack on concrete, hydrocarbon corrosion of plastics
	Gas ingress	Migration via natural or anthropogenic paths
Ecological systems	See Notes	Runoff/discharge to surface water body
	See Notes	Windblown dust
	See Notes	Groundwater migration
	See Notes	At point of contaminant source
Animal and crop	Direct	Wind blown or flood deposited particles / dust / sediments
	Indirect	Plants via root up take or irrigation. Animals through watering
	Inhalation	By livestock / fish - gas / vapour / particulates / dust
	Ingestion	Consumption of vegetation / water / soil by animals

Table 4: Classification of Probability

Classification	Definition
High likelihood	There is a pollution linkage and an event either appears very likely in the short-term and almost inevitable over the long-term, or there is already evidence at the receptor of harm / pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter-term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

Table 5: Classification of Consequence (score = magnitude of hazard Table 1 and sensitivity of receptor Table 2)

Classification / Score	Examples
Severe **17-25** **(3 out of 25 outcomes)**	Human health effect - exposure likely to result in "significant harm" as defined in the Defra (2012) Part 2A Statutory Guidance [1]. Controlled water effect - short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Equivalent to EA Category 1 incident (persistent and/or extensive effects on water quality leading to closure of potable abstraction point or loss of amenity, agriculture or commercial value. Major fish kill. Ecological effect - short-term exposure likely to result in a substantial adverse effect. Catastrophic damage to crops, buildings or property
Medium **10-16** **(7 out of 25 outcomes)**	Human health effect - exposure could result in "significant harm" [1]. Controlled water effect - equivalent to EA Category 2 incident requiring notification of abstractor Ecological effect - short-term exposure may result in a substantial adverse effect. Damage to crops, buildings or property
Mild **5-9** **(7 out of 25 outcomes)**	Human health effect - exposure may result in "significant harm" [1]. Controlled water effect - equivalent to EA Category 3 incident (short lived and/or minimal effects on water quality). Ecological effect - unlikely to result in a substantial adverse effect. Minor damage to crops, buildings or property. Damage to building rendering it unsafe to occupy (for example foundation damage resulting in instability).
Minor **1-4** **(8 out of 25 outcomes)**	No measurable effect on humans. Protective equipment is not required during site works. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects to crops, buildings or property. The loss of plants in a landscaping scheme. Discolouration of concrete.

Note: 1. Significant harm includes death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. The local authority may also consider other health effects to constitute significant harm such as physical injury; gastrointestinal disturbances; respiratory tract effects; cardio-vascular effects; central nervous system effects; skin ailments; effects on organs such as the liver or kidneys; or a wide range of other health impacts. Whether or not these would constitute significant harm would depend on the seriousness of harm including impact on health, quality of life and scale of impact.

Table 6: Classification of Risk (Combination of Consequence Table 5 and Probability Table 4)

	Consequence			
Probability	***Severe***	***Medium***	***Mild***	***Minor***
High likelihood	Very high	High	Moderate	Low
Likely	High	Moderate	Moderate/	Low
Low likelihood	Moderate	Moderate	Low	Very low
Unlikely	Low	Low	Very low	Very low

Table 7: Description of Risks and Likely Action Required

Risk Classification	Description
Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation is likely to be required in the short term.
High risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short-term and are likely over the longer-term.
Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer-term.
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

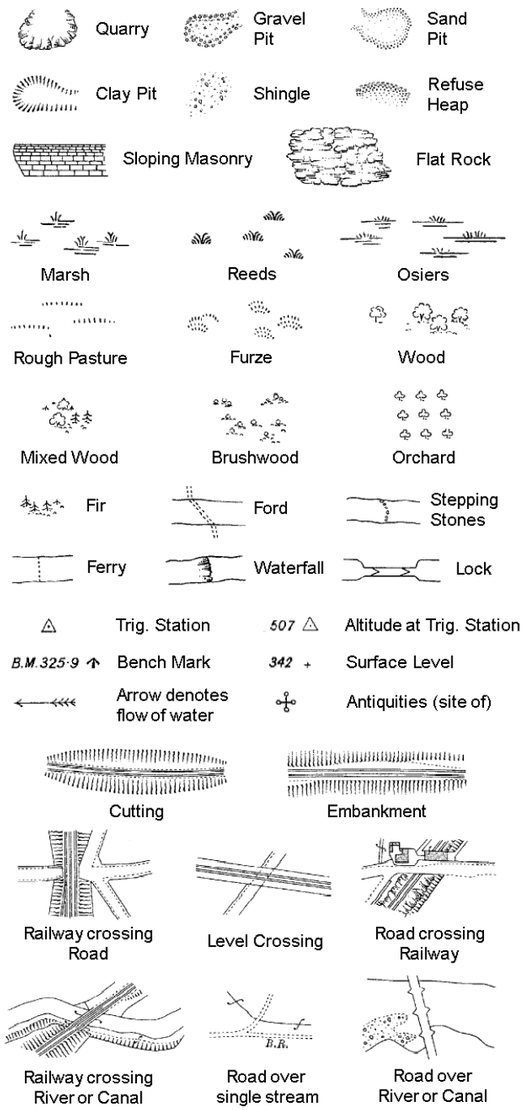
Appendix C List of Information Provided by the Client

- September 1999, Environmental Statement by Environmental Resource Management
- August 2001, Former Waste Heaps Site Remediation, Belvedere, Kent. Construction Completion Report by Knight Piesold Ltd, ref: 11396\R15014\ABD
- June 2002, Consolidated Environmental Statement by Environmental Resource Management
- January 2003, Former Waste Heaps Site Remediation, Belvedere, Kent. Post-Completion Monitoring Report by Scott Wilson (formerly Knight Piesold), ref: D844435/OJR/ABD
- September 2003, Site Investigation and Remediation Proposals by Applied Environmental Research Centre Ltd (AERC), ref: C3477/R1384
- April 2007, Factual Report on Ground Investigation by Soil Mechanics, ref: A7007
- May 2007, Contaminated Land Remediation Method Statement by Applied Environmental Research Centre Ltd (AERC), ref: C34129/R2489
- November 2007, Factual Report on Ground Investigation by Soil Mechanics, ref: G7061
- December 2007, Site Protection and Monitoring Programme by Fichtner Consulting Engineers Ltd, ref: S0768-0420-0012SMO
- June 2008, Method Statement Zone 4 - Main RRRF by AMEC, ref: 7888001173/R3094
- June 2008, Validation of Contaminated Land: Phase 1 - 'hotspots' by AMEC, ref: C34129/R2976
- January 2009, Former Borax Storage Area, Report on Ground Investigation by AMEC, ref: 34129/R3332

Appendix D Historical Maps

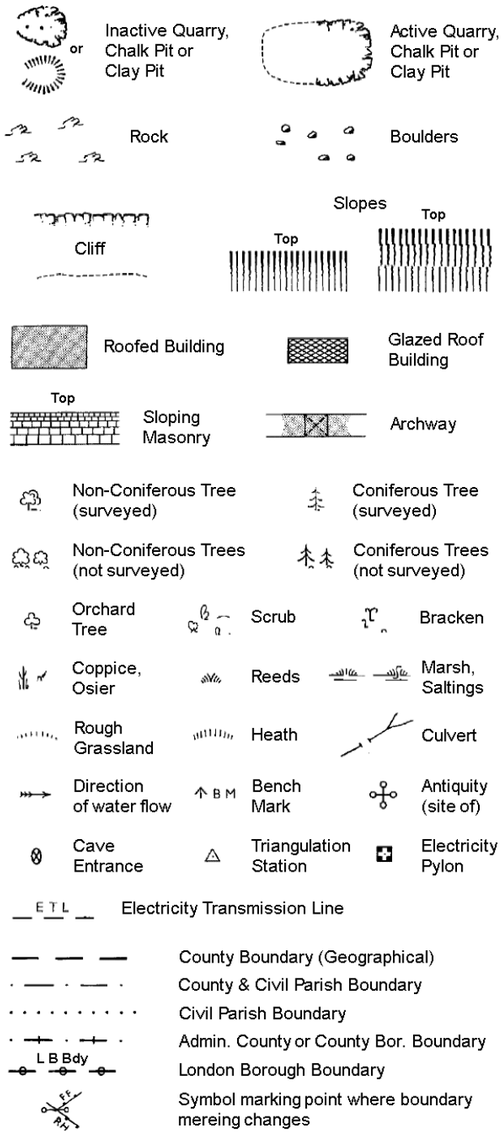
Historical Mapping Legends

Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



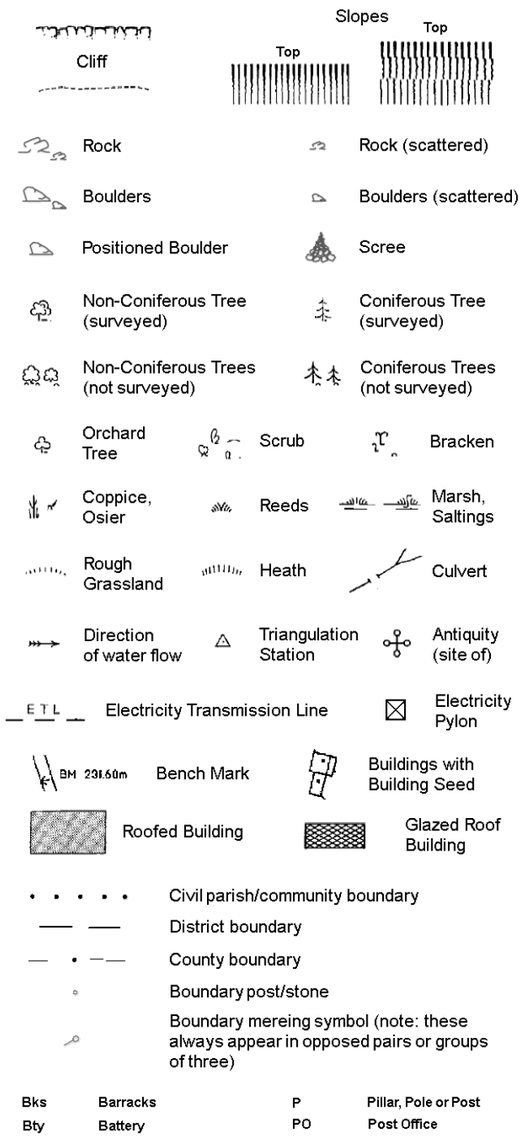
B P B S	Boundary Post or Stone	P.C.B	Police Call Box
B.R.	Bridle Road	P	Pump
E.P	Electricity Pylon	S.P	Signal Post
F.B.	Foot Bridge	St.	Sluice
F.P.	Foot Path	Sp.	Spring
G.P	Guide Post or Board	T.C.B	Telephone Call Box
M.S	Mile Stone	Tr.	Trough
M.P M.R	Mooring Post or Ring	W	Well

Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250



BH	Beer House	P	Pillar, Pole or Post
BP, BS	Boundary Post or Stone	PO	Post Office
Cn, C	Capstan, Crane	PC	Public Convenience
Chy	Chimney	PH	Public House
D Fn	Drinking Fountain	Pp	Pump
El P	Electricity Pillar or Post	SB, S Br	Signal Box or Bridge
FAP	Fire Alarm Pillar	SP, SL	Signal Post or Light
FB	Foot Bridge	Spr	Spring
GP	Guide Post	Tk	Tank or Track
H	Hydrant or Hydraulic	TCB	Telephone Call Box
LC	Level Crossing	TCP	Telephone Call Post
MH	Manhole	Tr	Trough
MP	Mile Post or Mooring Post	Wr Pt, Wr T	Water Point, Water Tap
MS	Mile Stone	W	Well
NTL	Normal Tidal Limit	Wd Pp	Wind Pump

Large-Scale National Grid Data 1:2,500 and 1:1,250



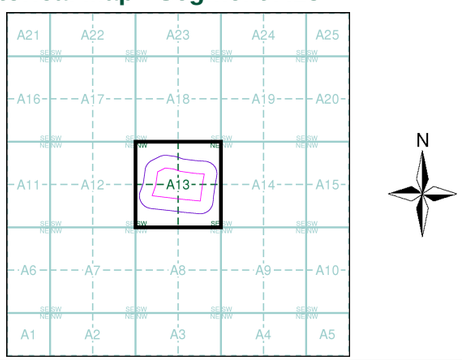
Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity Pole, Pillar	SB, S Br	Signal Box or Bridge
El Sub Sta	Electricity Sub Station	SP, SL	Signal Post or Light
FB	Filter Bed	Spr	Spring
Fn / D Fn	Fountain / Drinking Ftn.	Tk	Tank or Track
Gas Gov	Gas Valve Compound	Tr	Trough
GVC	Gas Governer	Wd Pp	Wind Pump
GP	Guide Post	Wr Pt, Wr T	Water Point, Water Tap
MH	Manhole	Wks	Works (building or area)
MP, MS	Mile Post or Mile Stone	W	Well

pba peterbrett

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Essex	1:2,500	1864	2
Essex	1:2,500	1867	3
Essex	1:2,500	1867	4
Kent	1:2,500	1894 - 1895	5
Kent	1:2,500	1897	6
Essex	1:2,500	1897	7
Kent	1:2,500	1909	8
London	1:2,500	1916	9
Essex	1:2,500	1916 - 1920	10
Kent	1:2,500	1933	11
Essex	1:2,500	1939 - 1940	12
Ordnance Survey Plan	1:1,250	1958	13
Ordnance Survey Plan	1:2,500	1958	14
Additional SIMs	1:2,500	1958	15
Ordnance Survey Plan	1:1,250	1963 - 1969	16
Ordnance Survey Plan	1:2,500	1970	17
Supply of Unpublished Survey Information	1:1,250	1974	18
Additional SIMs	1:1,250	1983 - 1984	19
Large-Scale National Grid Data	1:1,250	1991	20
Large-Scale National Grid Data	1:1,250	1992	21
Large-Scale National Grid Data	1:1,250	1996	22
Historical Aerial Photography	1:2,500	1999	23

Historical Map - Segment A13



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Search Buffer (m):	100

Site Details

Smaller extent, Belvedere, DA17 6JY

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Essex

Published 1864

Source map scale - 1:2,500

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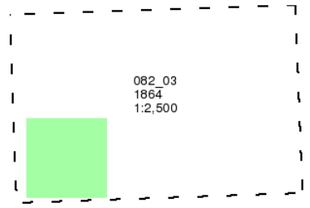
Map Name(s) and Date(s)



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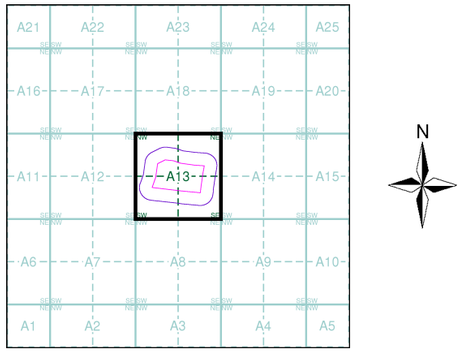

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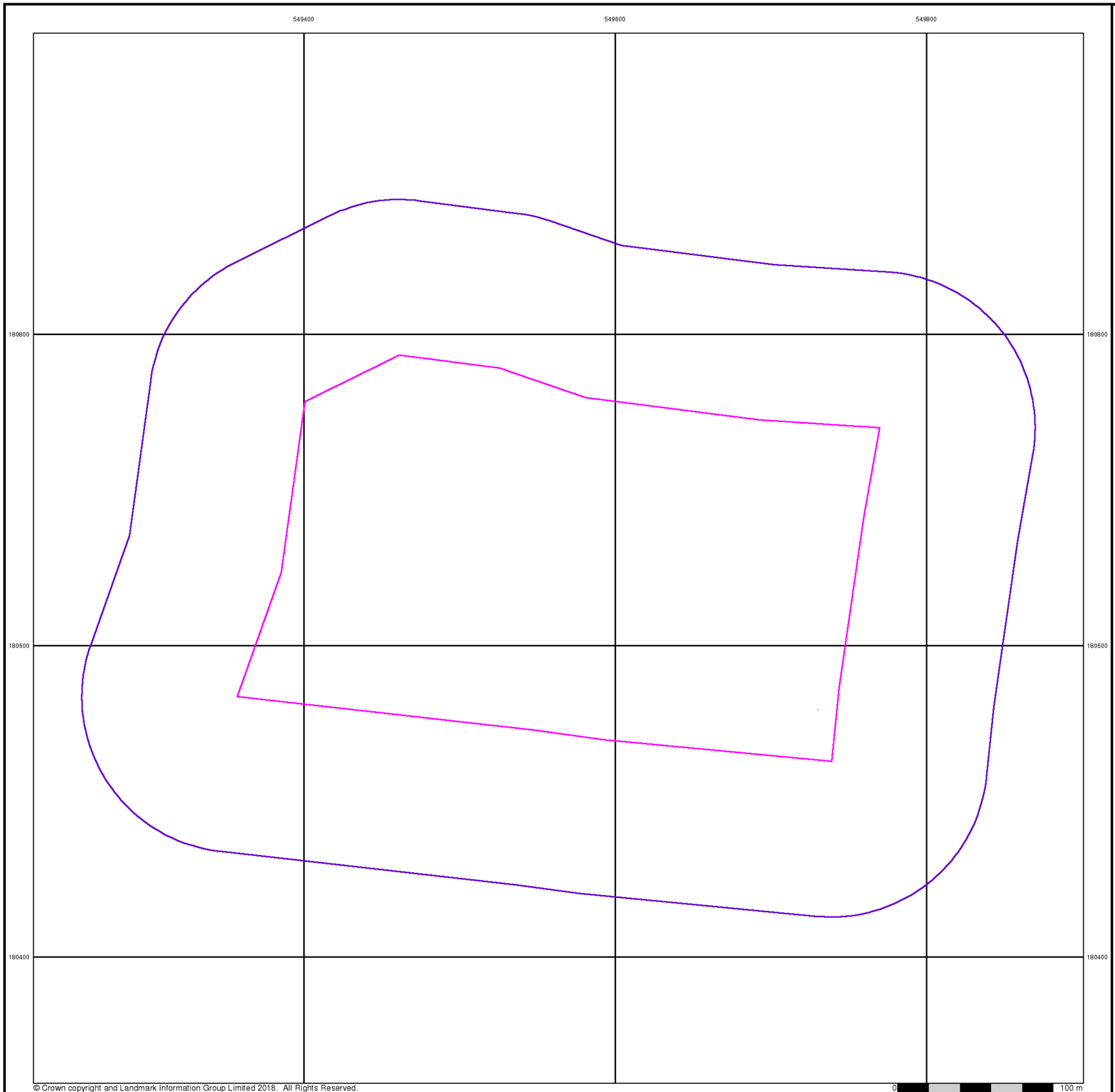

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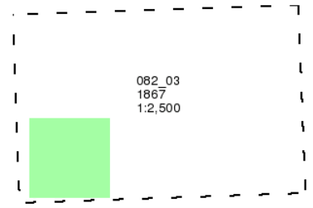
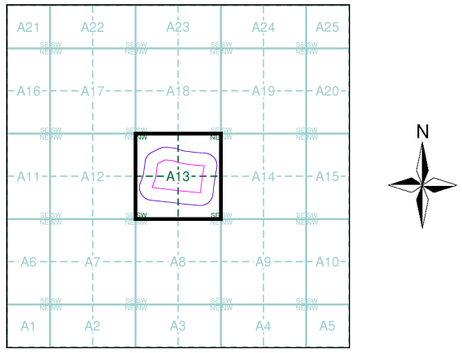


Historical Map - Segment A13



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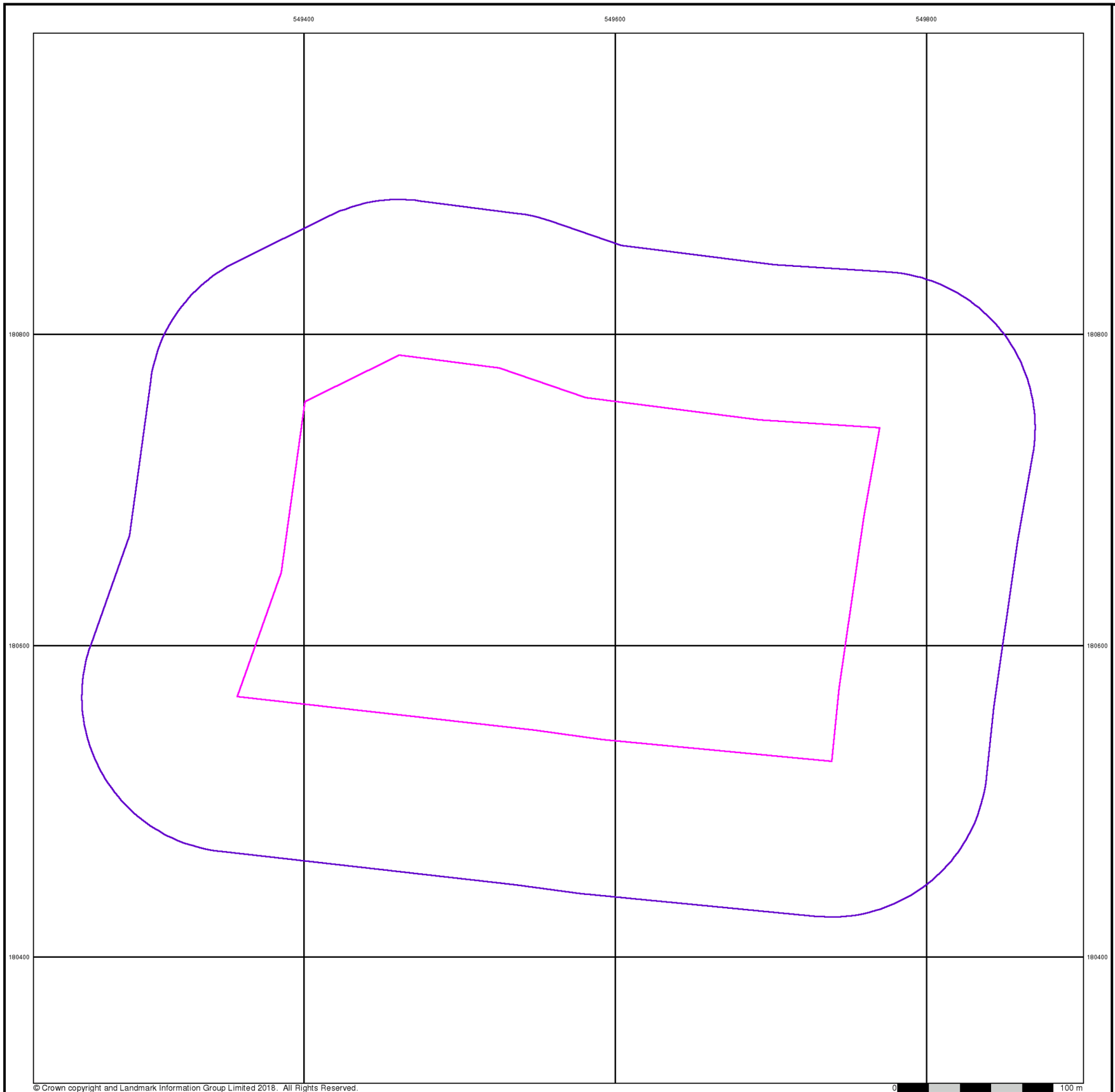

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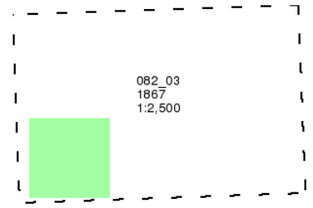
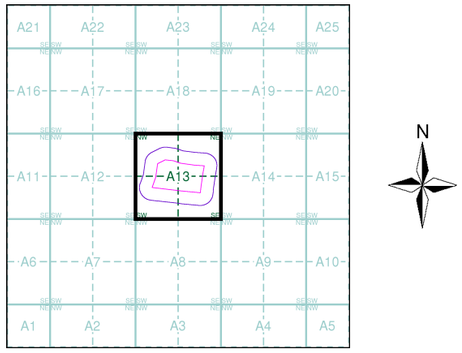
Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	100

Site Details

Smaller extent, Belvedere, DA17 6JY

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Kent

Published 1894 - 1895

Source map scale - 1:2,500

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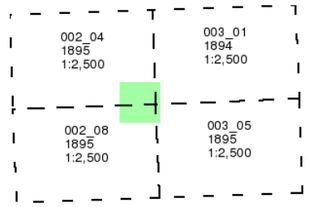
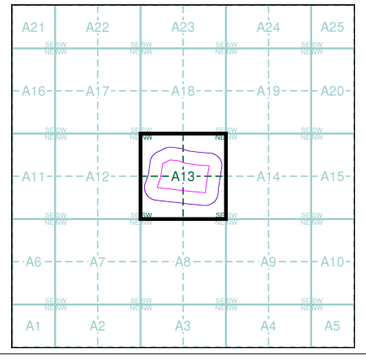
Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

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Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	100

Site Details

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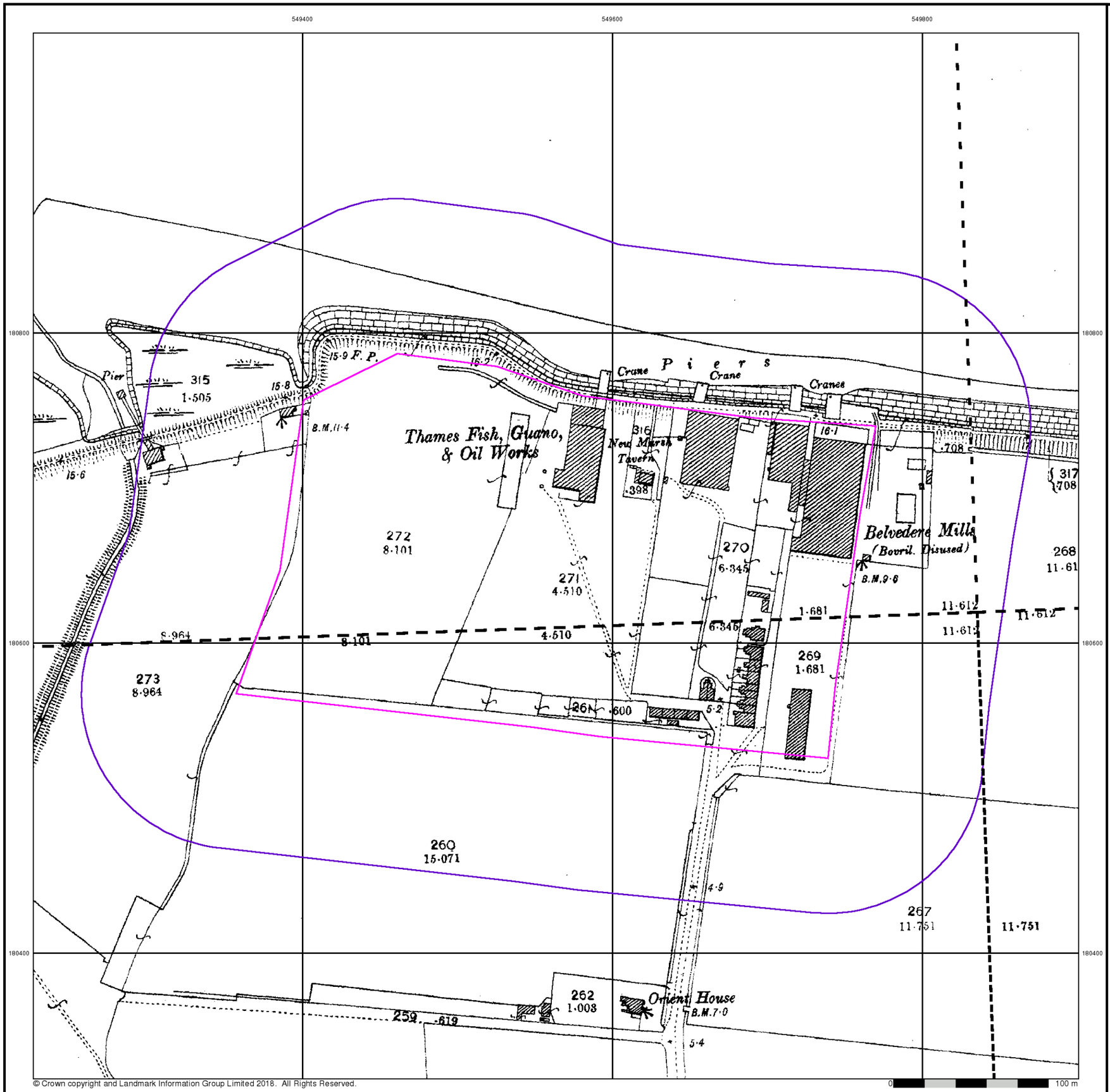

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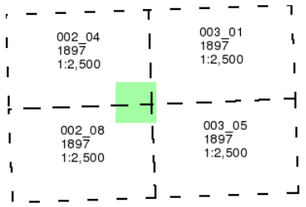
Kent

Published 1897

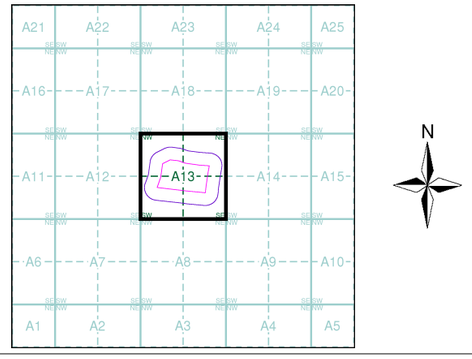
Source map scale - 1:2,500

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 and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below 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.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	100

Site Details

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0 100 m

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Essex

Published 1897

Source map scale - 1:2,500

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 and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below 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.

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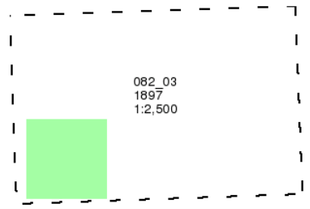
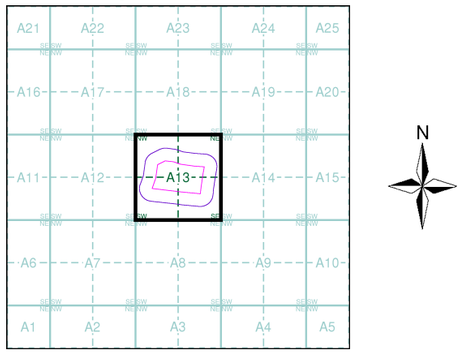


Historical Map - Segment A13



Order Details

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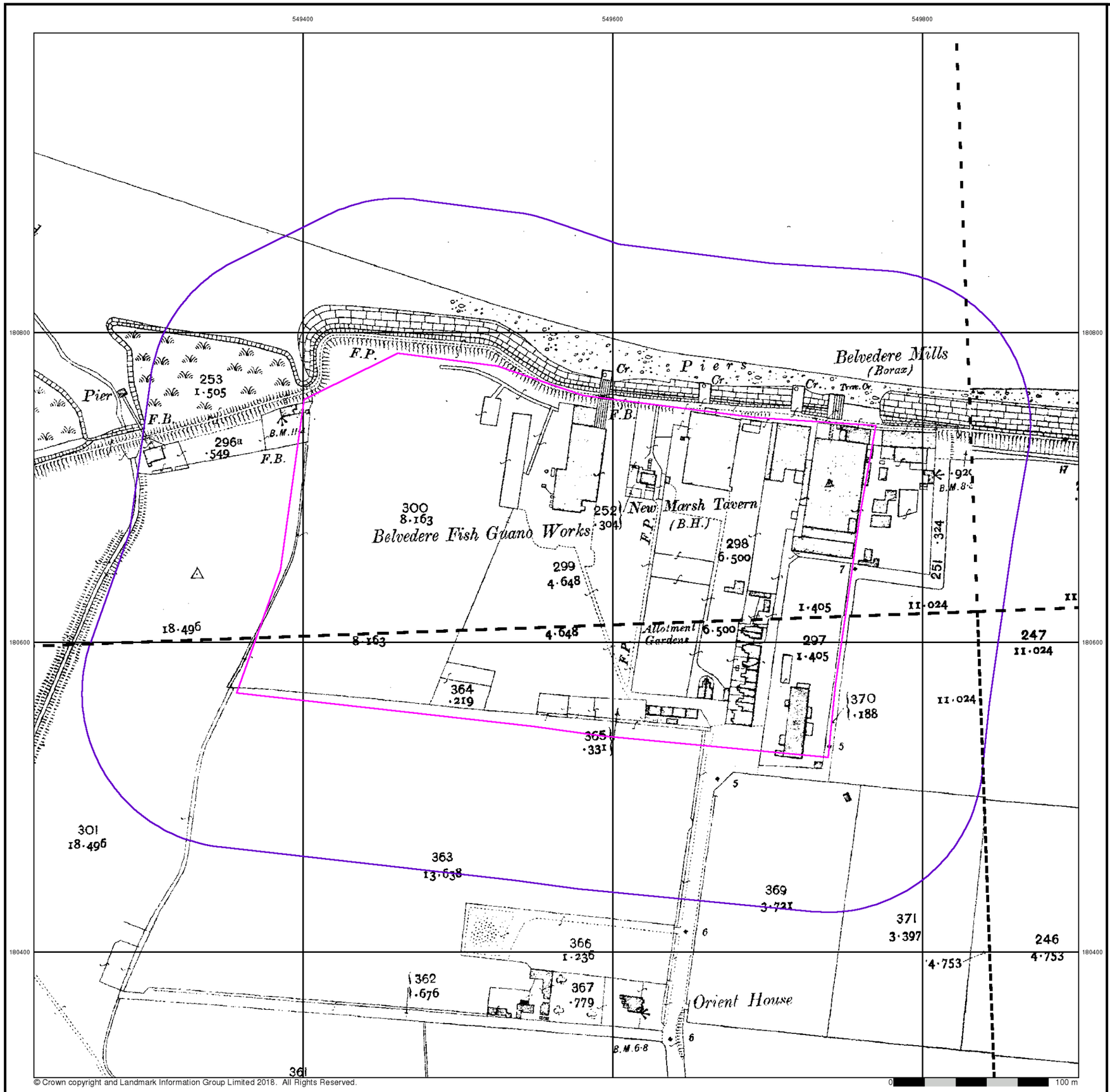

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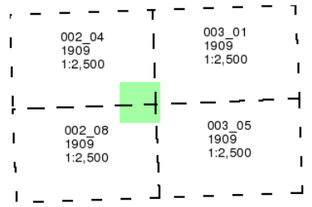
Kent

Published 1909

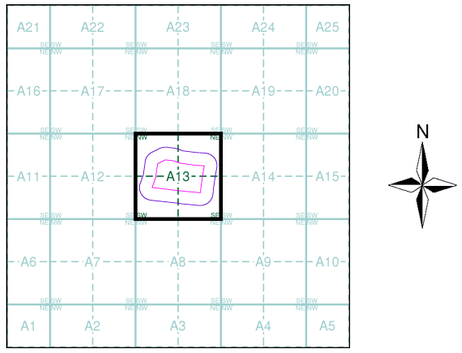
Source map scale - 1:2,500

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 and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below 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.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

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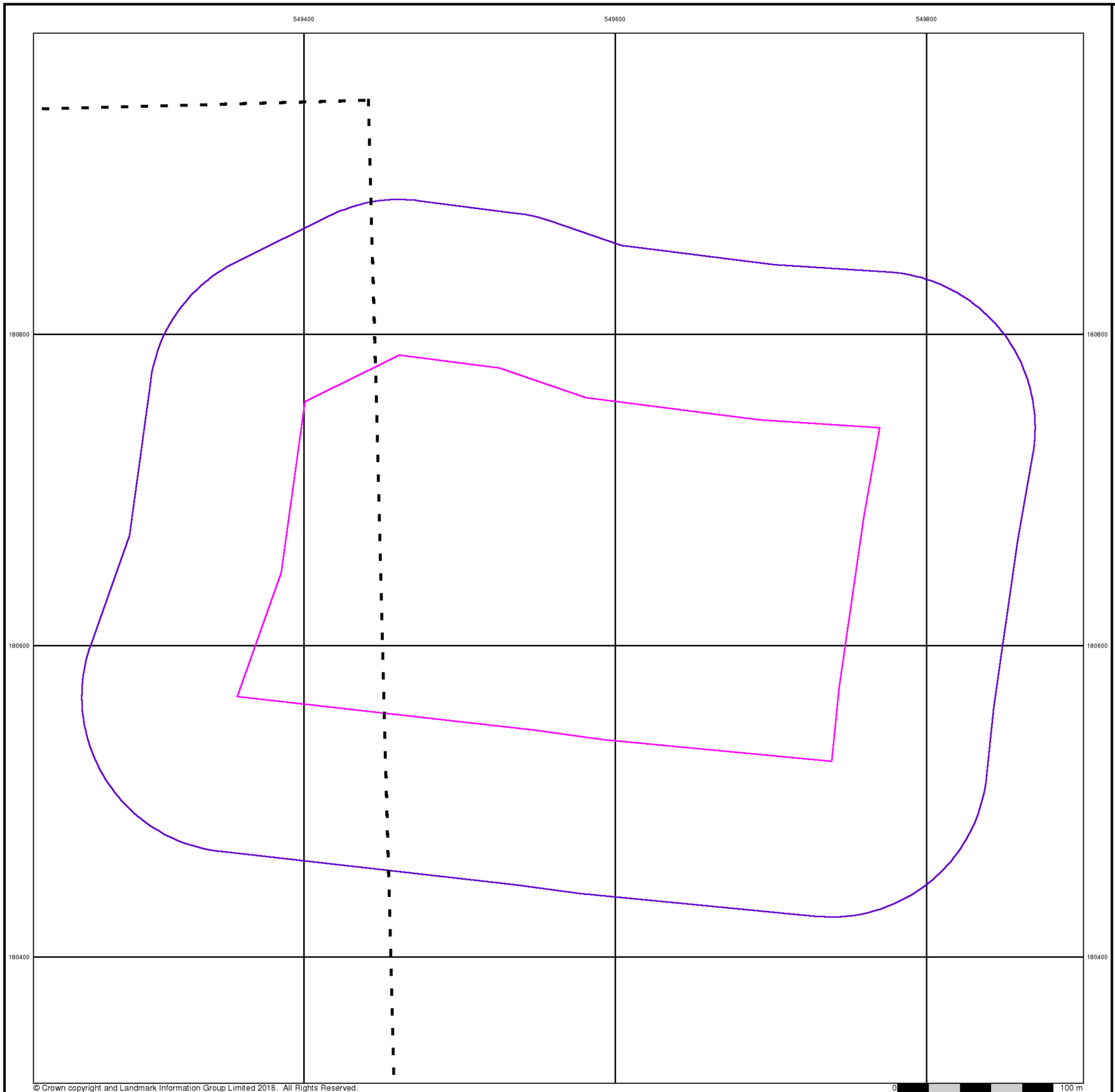


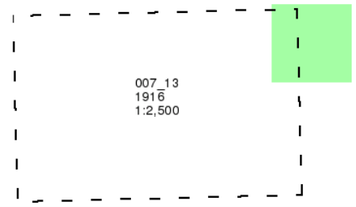
London

Published 1916

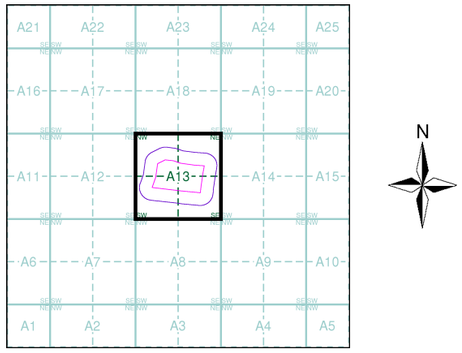
Source map scale - 1:2,500

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 and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below 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.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	100

Site Details

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Essex

Published 1916 - 1920

Source map scale - 1:2,500

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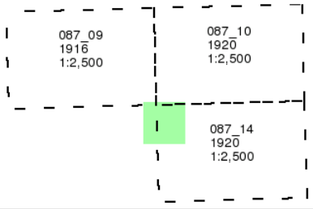
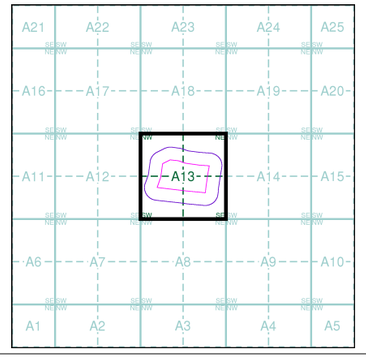
Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
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Site Details

Smaller extent, Belvedere, DA17 6JY

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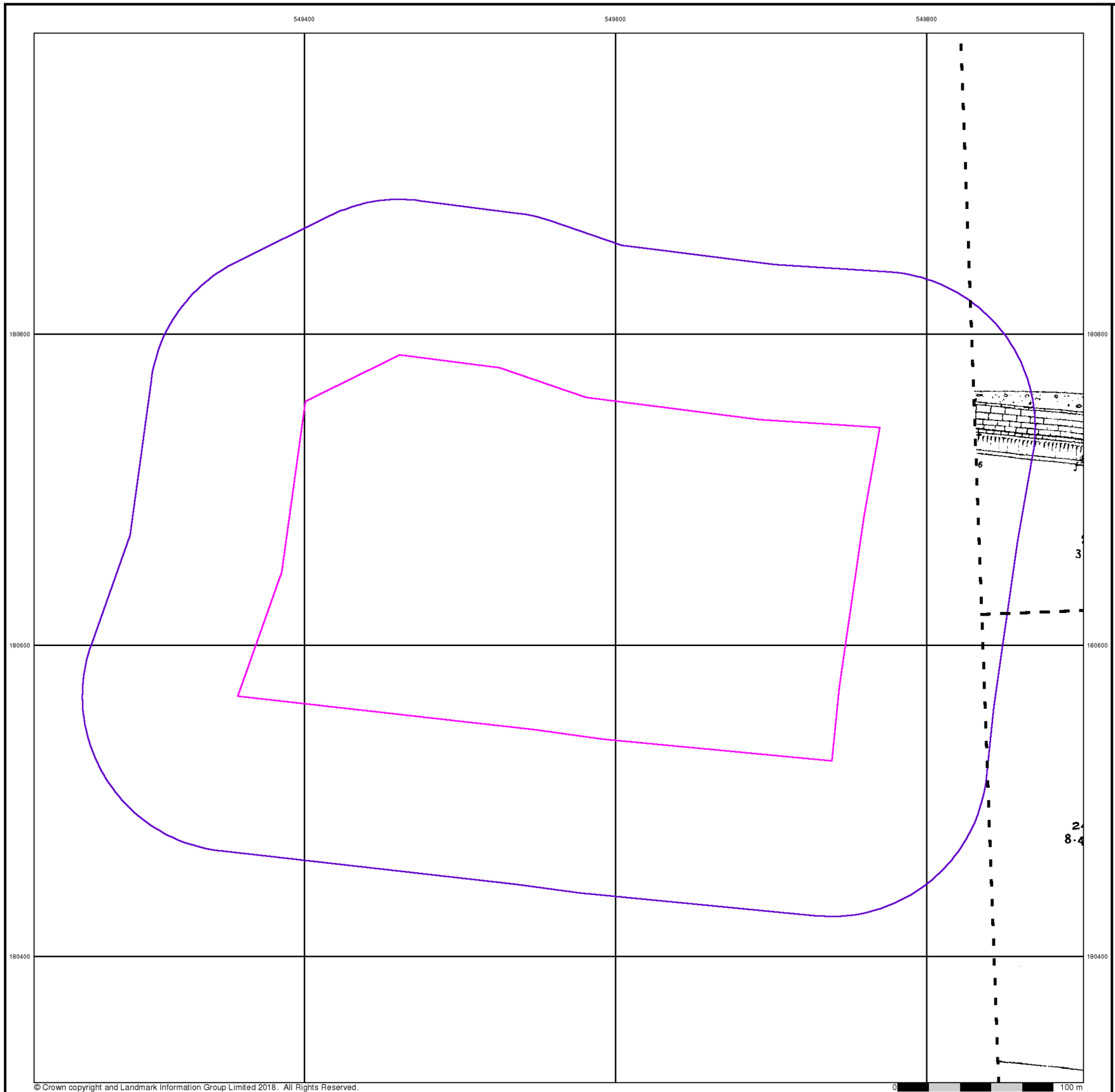


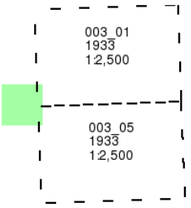
Kent

Published 1933

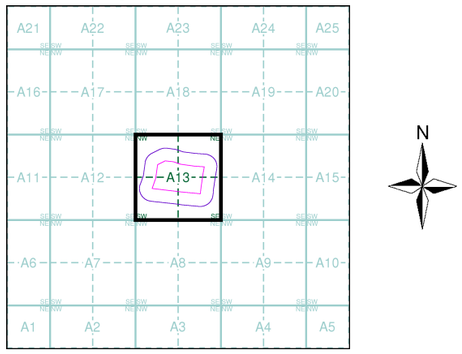
Source map scale - 1:2,500

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 and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below 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.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	100

Site Details

Smaller extent, Belvedere, DA17 6JY

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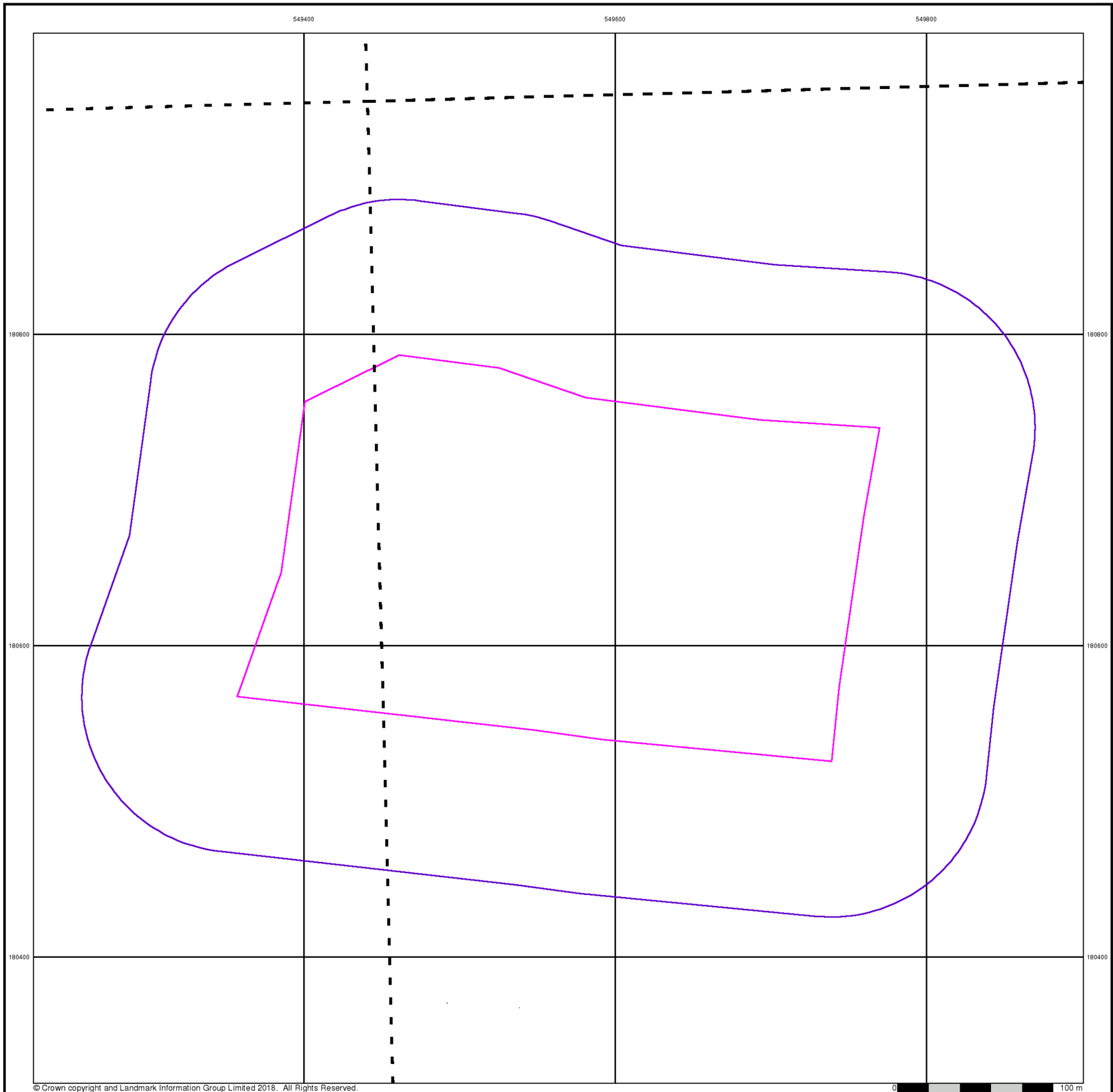

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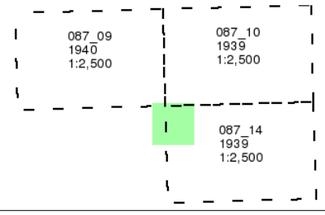
Essex

Published 1939 - 1940

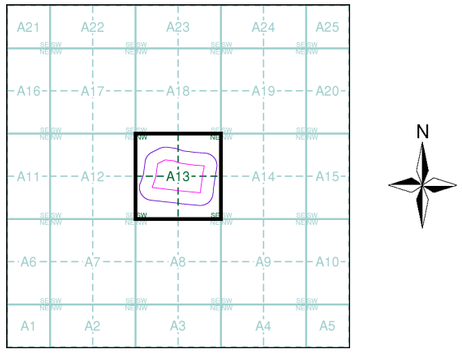
Source map scale - 1:2,500

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 and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below 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.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	158764613_1_1
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National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	100

Site Details

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Ordnance Survey Plan

Published 1958

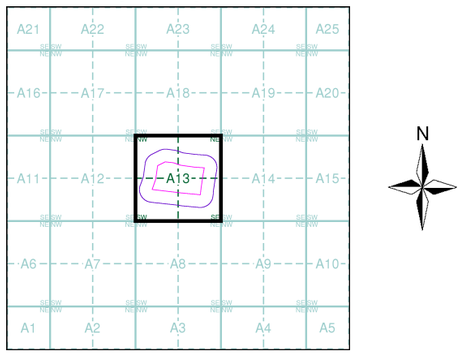
Source map scale - 1:1,250

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 and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below 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.

Map Name(s) and Date(s)

TQ4980NW 1958 1:1,250	TQ4980NE 1958 1:1,250
TQ4980SW 1958 1:1,250	TQ4980SE 1958 1:1,250

Historical Map - Segment A13



Order Details

Order Number:	158764613_1_1
Customer Ref:	42230
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Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	100

Site Details

Smaller extent, Belvedere, DA17 6JY

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Ordnance Survey Plan

Published 1958

Source map scale - 1:2,500

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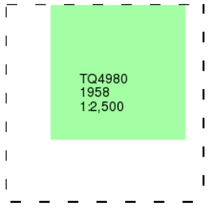
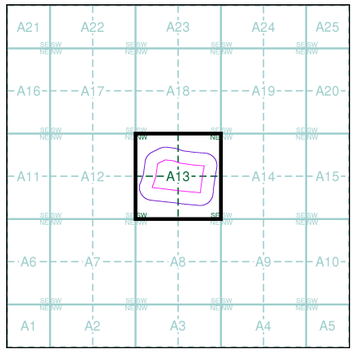
Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
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Site Details

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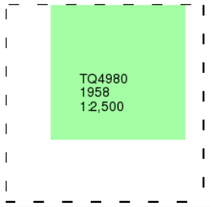
Additional SIMs

Published 1958

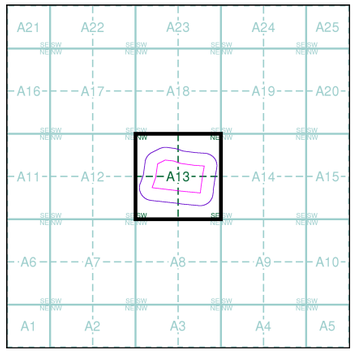
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

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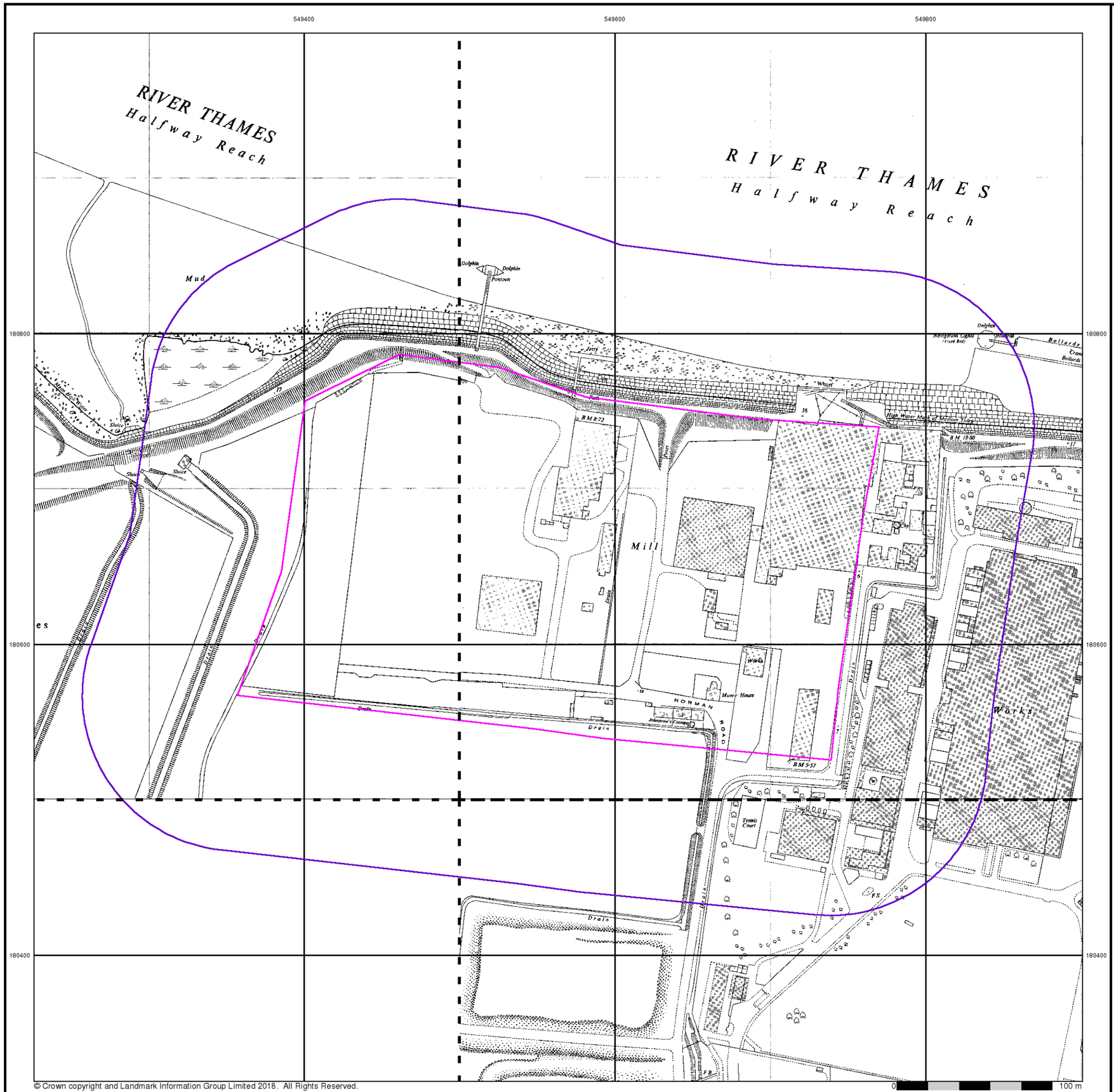

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Ordnance Survey Plan

Published 1963 - 1969

Source map scale - 1:1,250

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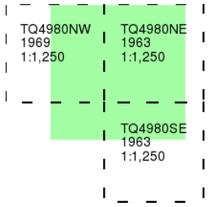
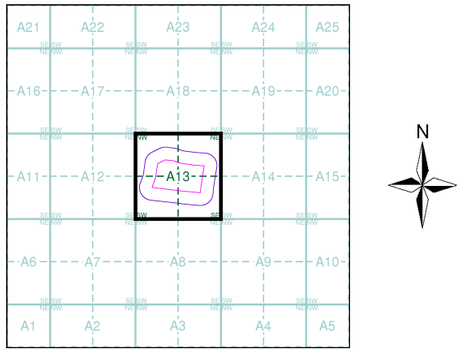
Map Name(s) and Date(s)



Historical Map - Segment A13



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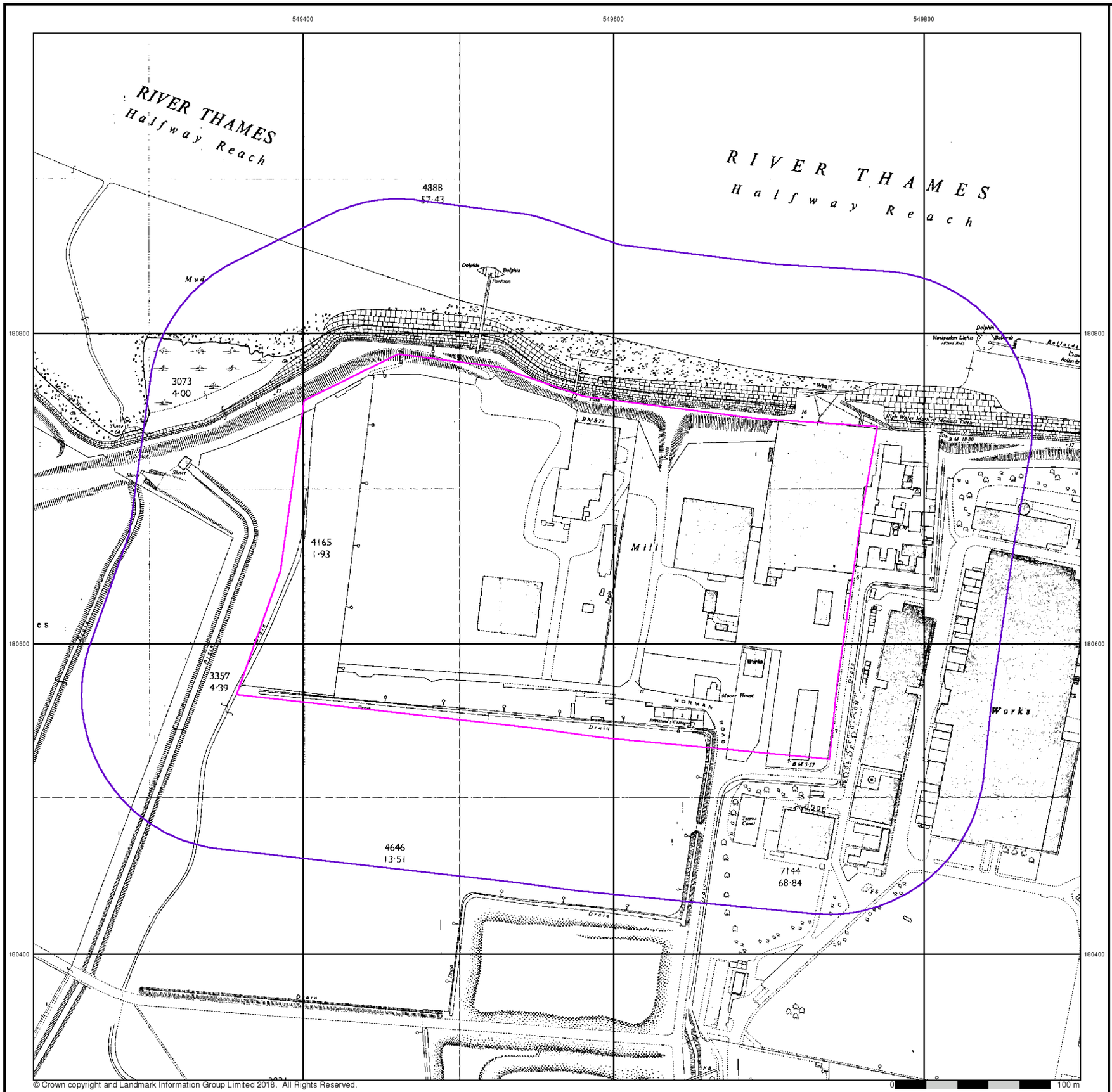

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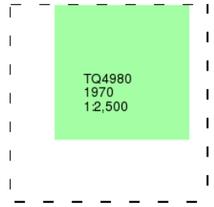
Ordnance Survey Plan

Published 1970

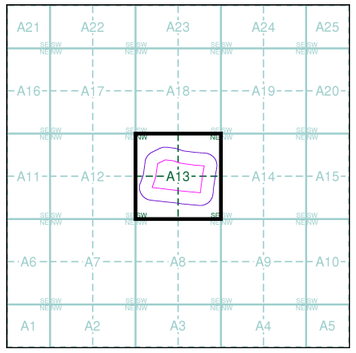
Source map scale - 1:2,500

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 and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below 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.

Map Name(s) and Date(s)



Historical Map - Segment A13



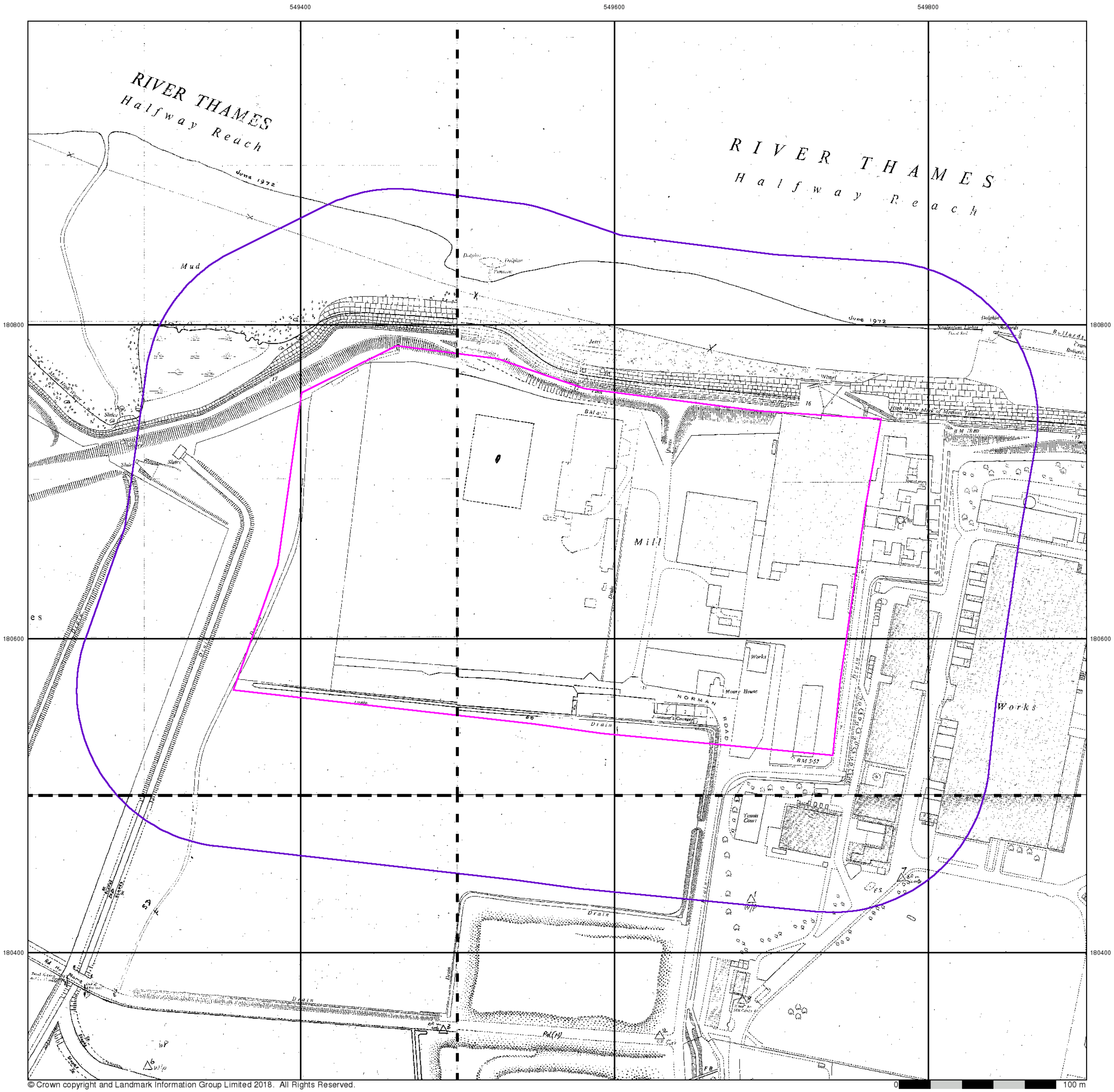
Order Details

Order Number:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	100

Site Details

Smaller extent, Belvedere, DA17 6JY

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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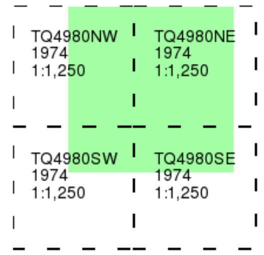
Supply of Unpublished Survey Information

Published 1974

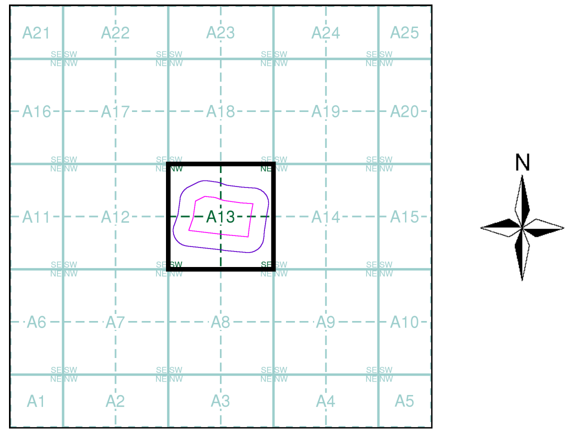
Source map scale - 1:1,250

SUSI maps (Supply of Unpublished Survey Information) were produced between 1972 and 1977, mainly for internal use at Ordnance Survey. These were more of a `work-in-progress' plan as they showed updates of individual areas on a map. These maps were unpublished, and they do not represent a single moment in time. They were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 158764613_1_1
Customer Ref: 42230
National Grid Reference: 549570, 180650
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Search Buffer (m): 100

Site Details

Smaller extent, Belvedere, DA17 6JY

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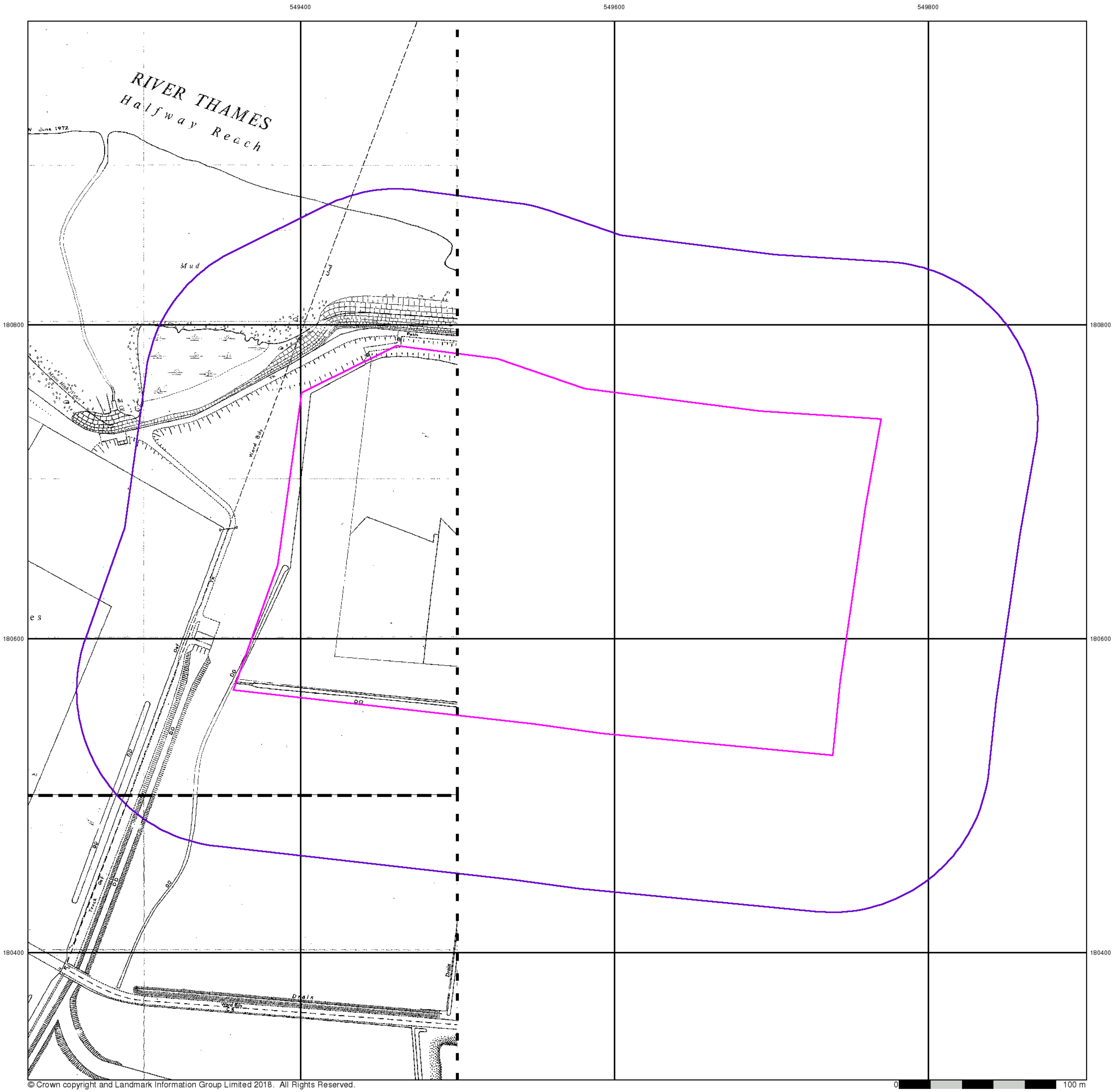

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0 100 m

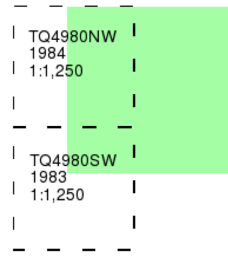
Additional SIMs

Published 1983 - 1984

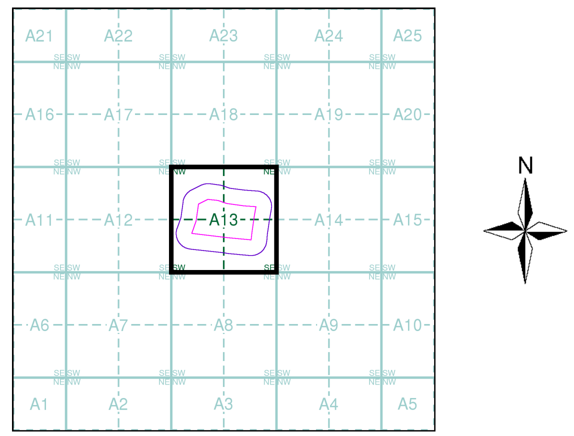
Source map scale - 1:1,250

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 158764613_1_1
Customer Ref: 42230
National Grid Reference: 549570, 180650
Slice: A
Site Area (Ha): 8.07
Search Buffer (m): 100

Site Details

Smaller extent, Belvedere, DA17 6JY

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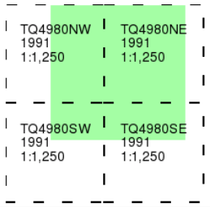
Large-Scale National Grid Data

Published 1991

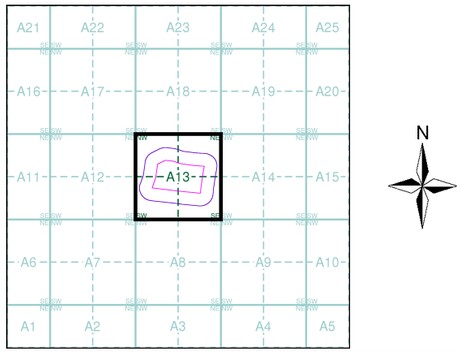
Source map scale - 1:1,250

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



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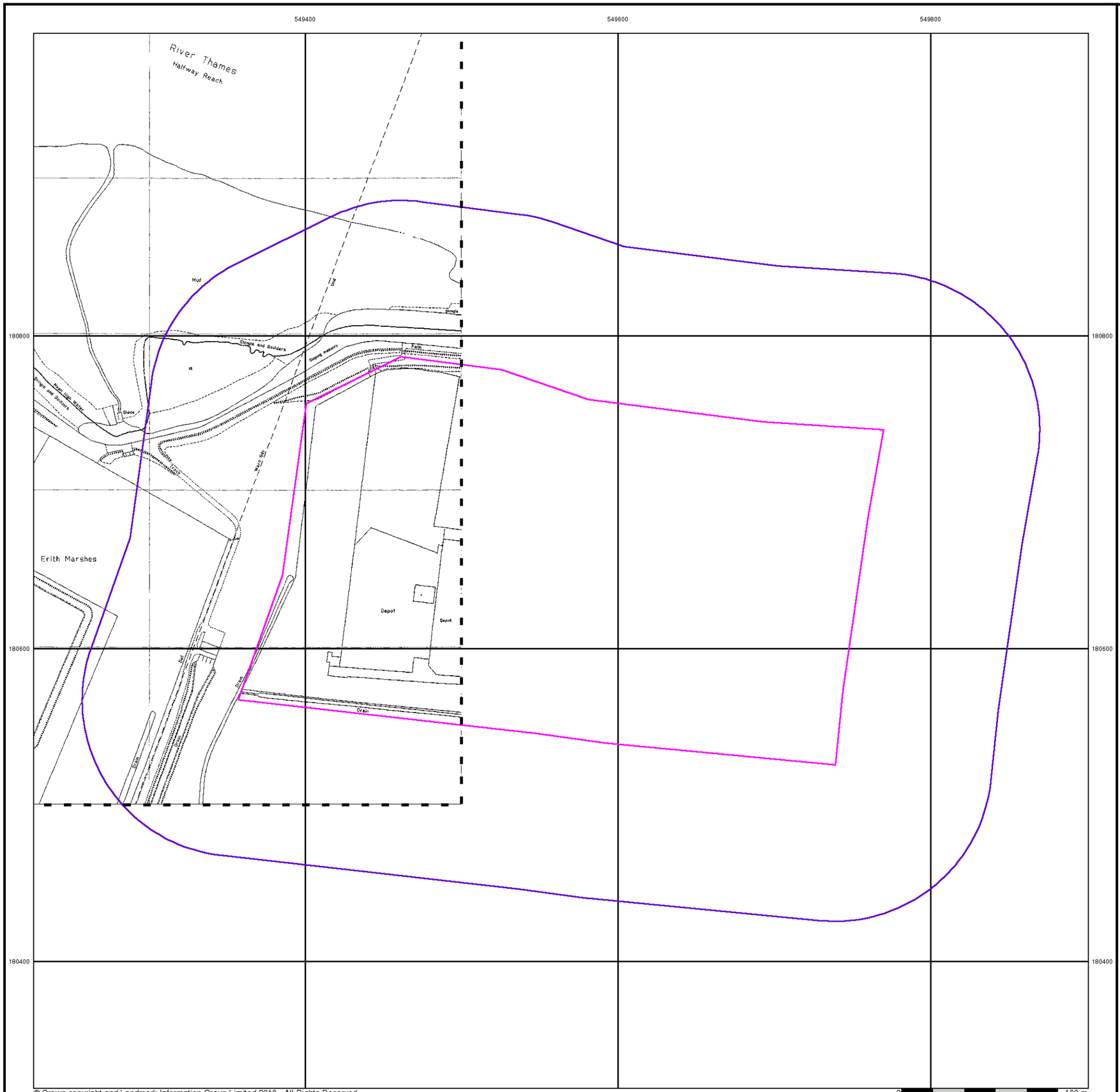

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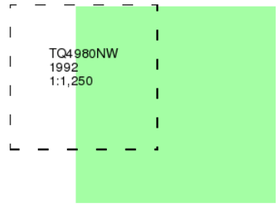
Large-Scale National Grid Data

Published 1992

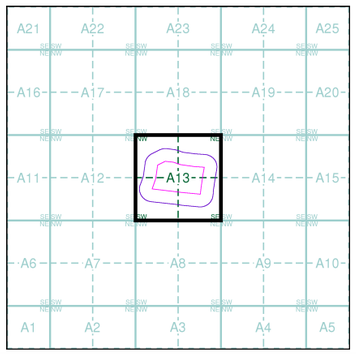
Source map scale - 1:1,250

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



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Large-Scale National Grid Data

Published 1996

Source map scale - 1:1,250

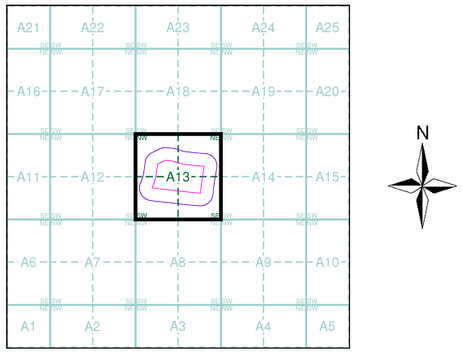
'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)

TQ4980NE
1996
1:1,250

TQ4980SE
1996
1:1,250

Historical Map - Segment A13



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Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	100

Site Details

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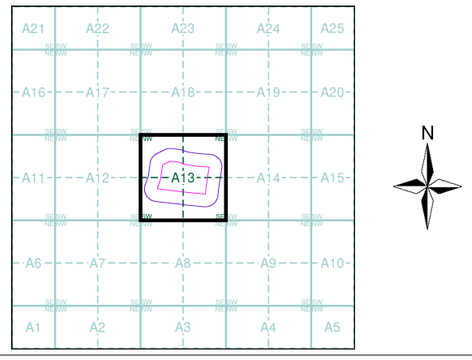
Historical Aerial Photography

Published 1999

This aerial photography was produced by Getmapping, these vertical aerial photographs provide a seamless, full colour survey of the whole of Great Britain

Historical Aerial Photography - Segment A13



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National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	100

Site Details

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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
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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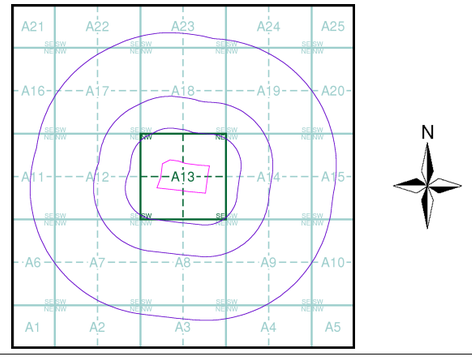
Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Kent	1:10,560	1869 - 1870	3
Essex	1:10,560	1873 - 1875	4
Essex	1:10,560	1898 - 1899	5
Kent	1:10,560	1898 - 1899	6
Kent	1:10,560	1910	7
Kent	1:10,560	1910	8
London	1:10,560	1920	9
Essex	1:10,560	1921	10
Kent	1:10,560	1931	11
Kent	1:10,560	1938	12
Essex	1:10,560	1938	13
London	1:10,560	1938	14
Ordnance Survey Plan	1:10,000	1940 - 1950	15
Kent	1:10,560	1951	16
Ordnance Survey Plan	1:10,000	1961 - 1969	17
Ordnance Survey Plan	1:10,000	1967	18
Ordnance Survey Plan	1:10,000	1975 - 1976	19
Gravesend	1:10,000	1977	20
Ordnance Survey Plan	1:10,000	1984 - 1988	21
London	1:25,000	1985	22
Ordnance Survey Plan	1:10,000	1993 - 1996	23
10K Raster Mapping	1:10,000	1999	24
10K Raster Mapping	1:10,000	2006	25
VectorMap Local	1:10,000	2018	26

Historical Map - Slice A



Order Details

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Site Details

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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

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 (бум.)
- Factory or Mill without Chimney (скип.)
- Mine or Open Pit Mine (медн.)
- Operating Shaft or Mine (кам. уг.)
- Non-Operating Shaft or Mine
- Salt Mine (сол.)
- Tailings Pile
- Pit (– 1.7)
- Stone Quarry (гл. пес. кам.)
- Gas Pump or Service Station
- Fuel Storage or Natural Gas Tank
- Oil or Natural Gas Derrick
- Small Hydroelectric Power Station
- Power Station
- Transformer Station (б.тр.)
- Cemetery
- Burial Mound (height in metres) (+ 8.1)
- Triangulation Point on Burial Mound (95.7)
- Triangulation Point (92.6)
- Bench Mark (52.1)
- Bench Mark (monumented) (71.1)
- Telegraph Office
- Telephone Station
- Radio Station
- Radio Tower
- Airfield or Seaplane Base
- Landing Strip
- Main Highway (Cut, Fill, Km Post, Plantings, Telegraph/Telephone Lines)
- Highway under Construction
- Improved Dirt Road (former truck road) (Width of Road, Steep Grade)
- Double-track Railroad with First Class Station (Small Bridge, Pipe (Culvert), Tunnel)
- Dismantled Railroad
- Railroad Under Construction
- Shore Embankment
- River or Ditch with Embankment (+ 2.4)
- Direction and velocity of current (Water Gauge, Water Level Mark)
- Well (К. 125.0 гл.8м (г.-сол.))
- Water Reservoir or Rain Water Pit (вдхр.)
- Spring (156.2 кл.)
- Isobath with value (20)
- Heavy (Index) Contour Line
- Contour Line and Value (20)
- Half Contour Line
- Spot Elevation Value (347.1)
- Coniferous
- Deciduous
- Mixed
- Scrub

Key to Numbers on Mapping

TQ48_London

No.	Description
192	Chemical Plant
275	Storage (Flammable And Lubricant Materials)
367	Power Station (Thermo-Electric)

TQ58_London

No.	Description
140	Factories (Instruments And Chemicals)

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Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Kent	1:10,560	1869 - 1870	3
Essex	1:10,560	1873 - 1875	4
Essex	1:10,560	1898 - 1899	5
Kent	1:10,560	1898 - 1899	6
Kent	1:10,560	1910	7
Kent	1:10,560	1910	8
London	1:10,560	1920	9
Essex	1:10,560	1921	10
Kent	1:10,560	1931	11
Kent	1:10,560	1938	12
Essex	1:10,560	1938	13
London	1:10,560	1938	14
Ordnance Survey Plan	1:10,000	1940 - 1950	15
Kent	1:10,560	1951	16
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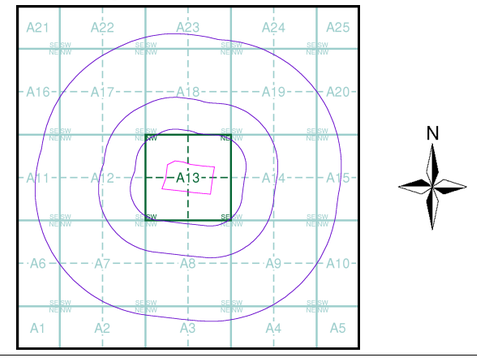
Ordnance Survey Plan	1:10,000	1993 - 1996	23
10K Raster Mapping	1:10,000	1999	24
10K Raster Mapping	1:10,000	2006	25
VectorMap Local	1:10,000	2018	26

Russian Map - Slice A



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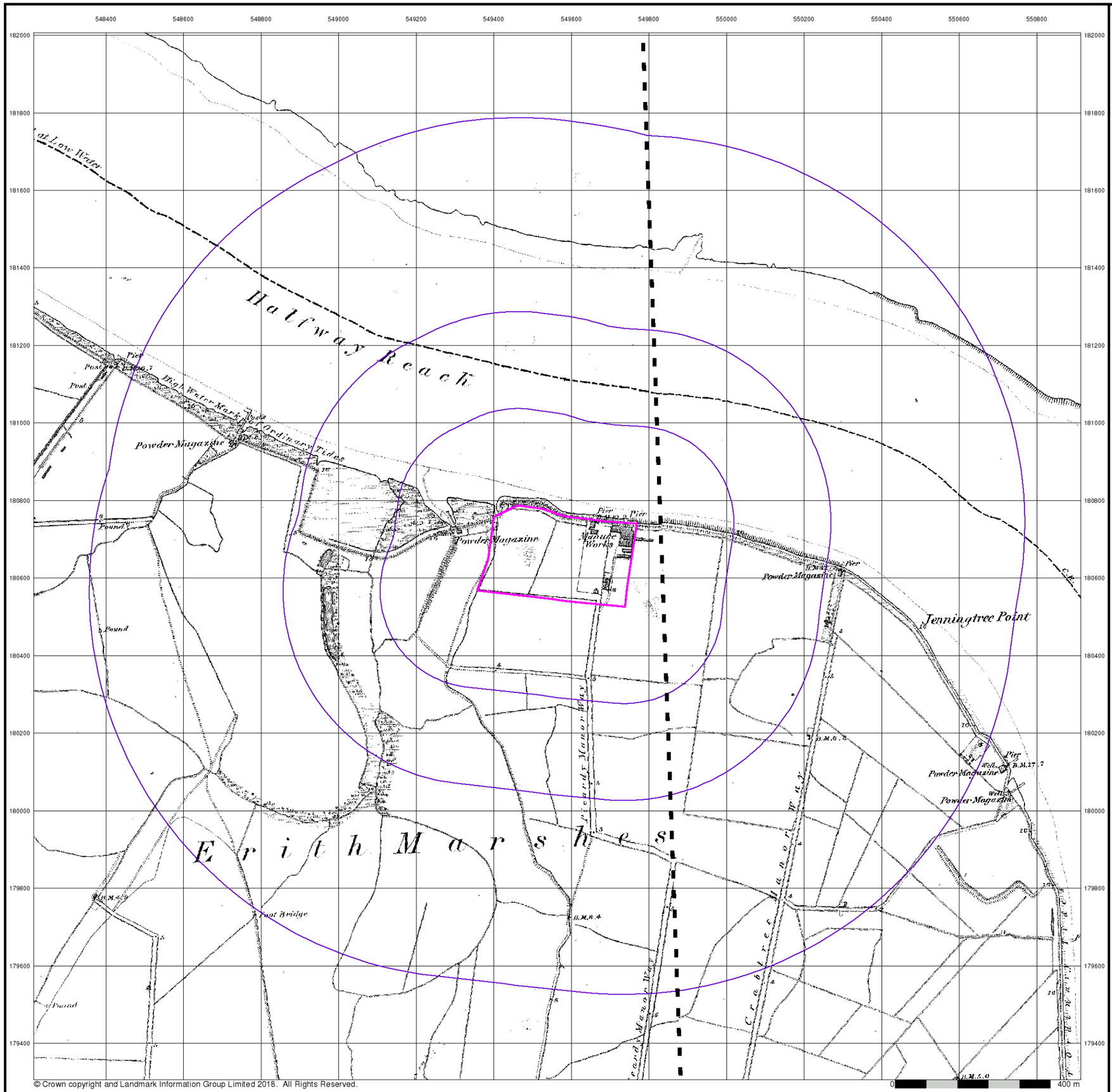

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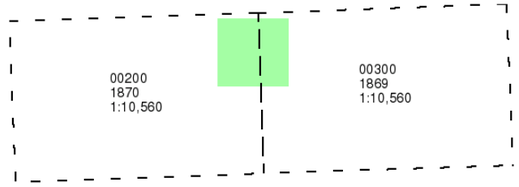
Kent

Published 1869 - 1870

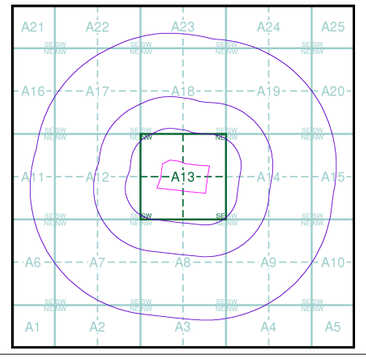
Source map scale - 1:10,560

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:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	1000

Site Details

Smaller extent, Belvedere, DA17 6JY

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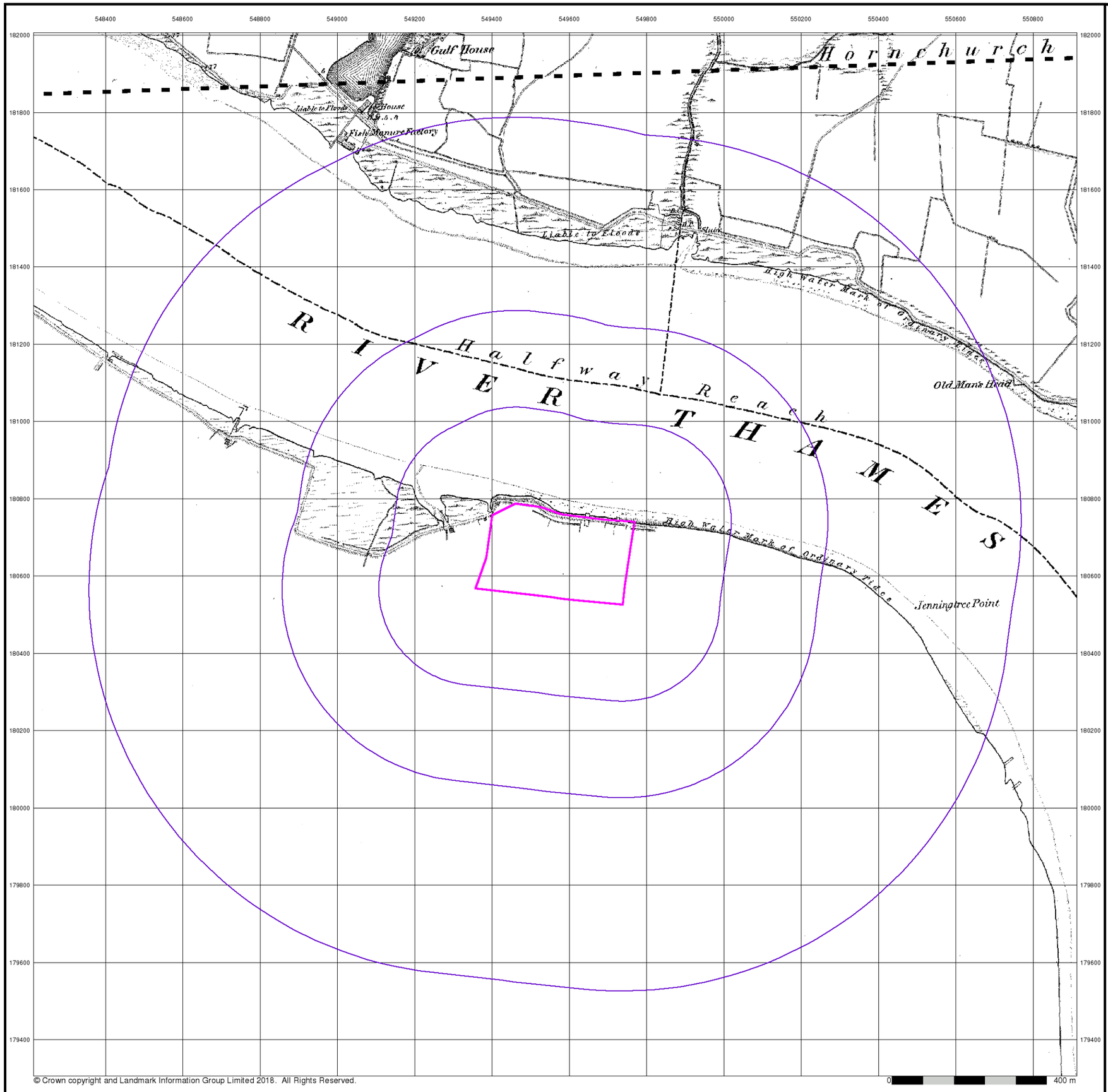

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pba peterbrett

Essex

Published 1873 - 1875

Source map scale - 1:10,560

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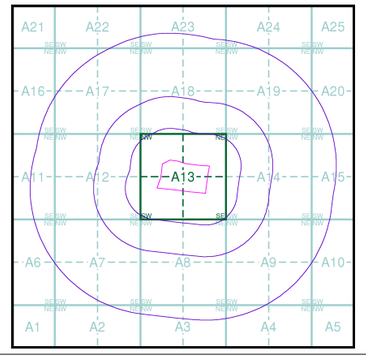
Map Name(s) and Date(s)

07400
1875
1:10,560

08200
1873
1:10,560

Historical Map - Slice A



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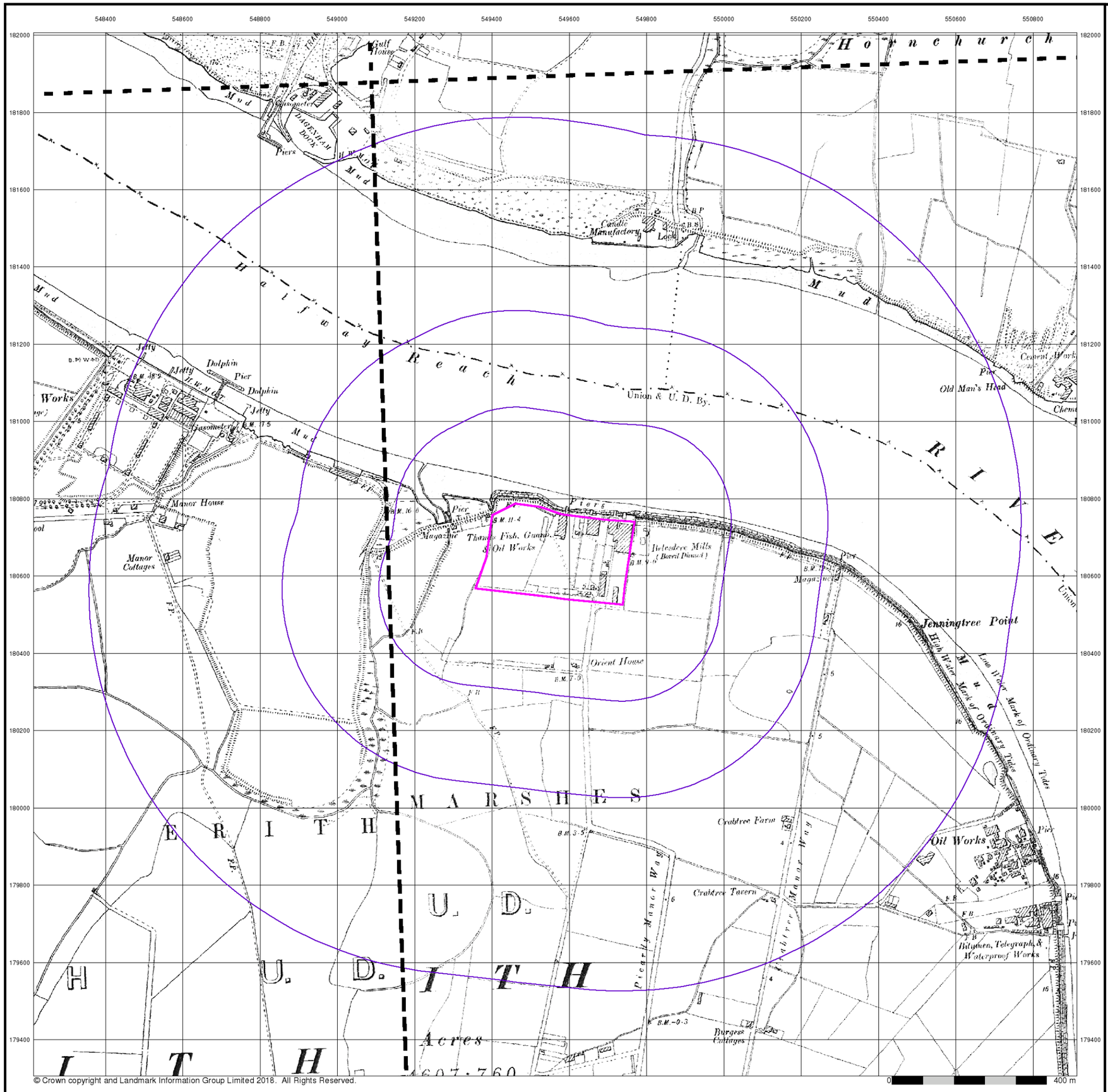

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Essex

Published 1898 - 1899

Source map scale - 1:10,560

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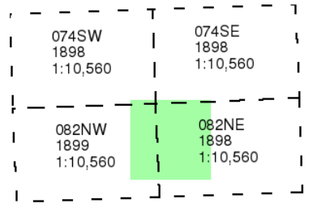
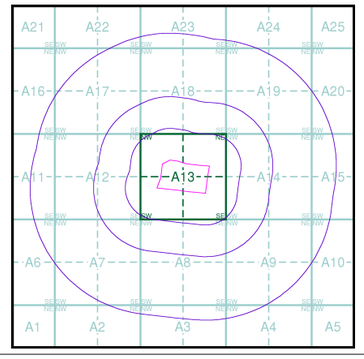
Map Name(s) and Date(s)



Historical Map - Slice A



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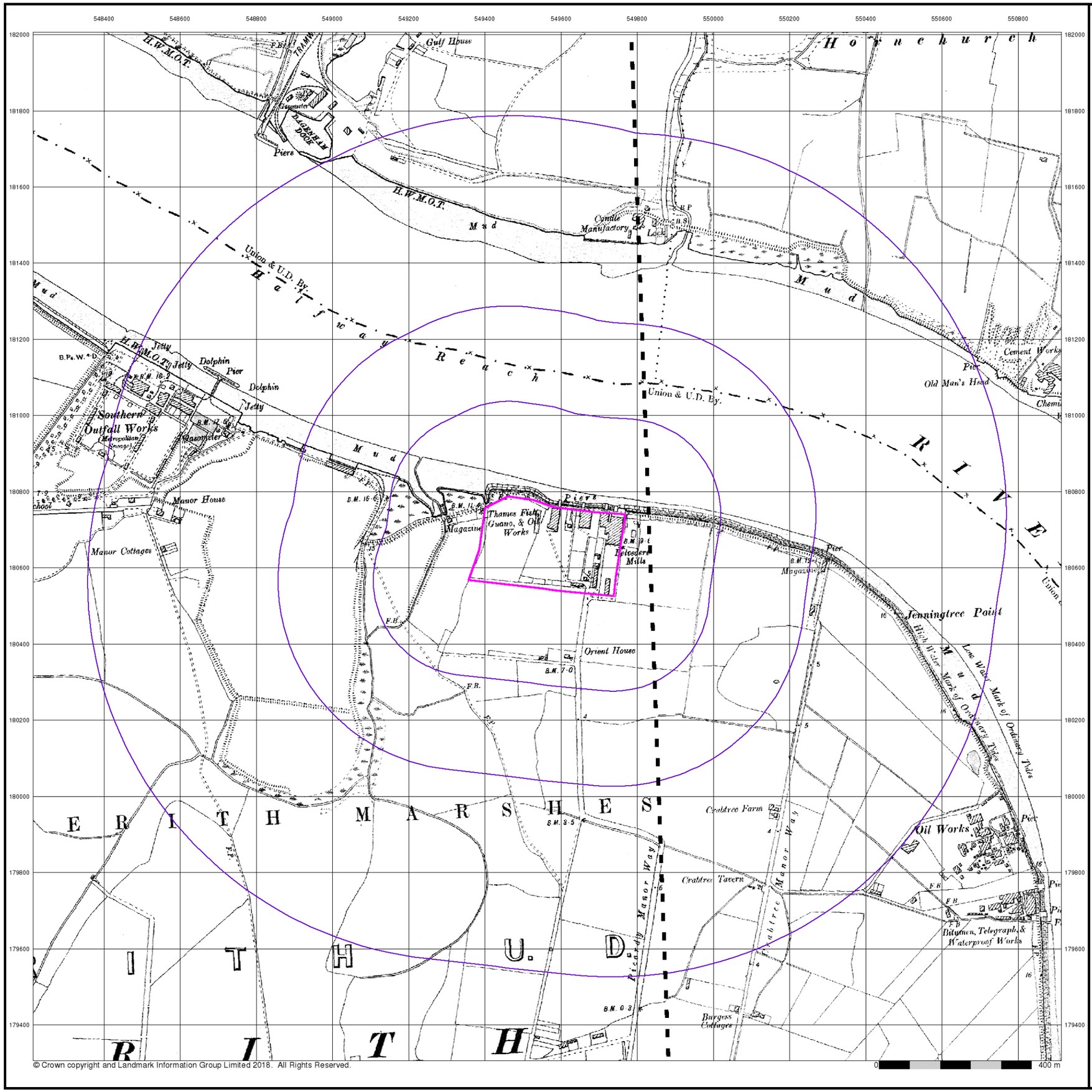

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pba peterbrett

Kent

Published 1898 - 1899

Source map scale - 1:10,560

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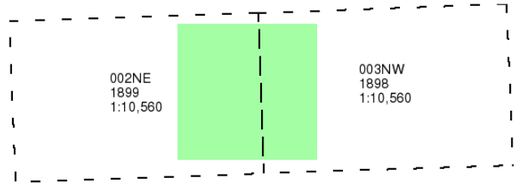
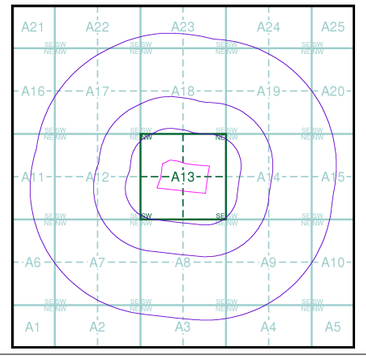


Historical Map - Slice A



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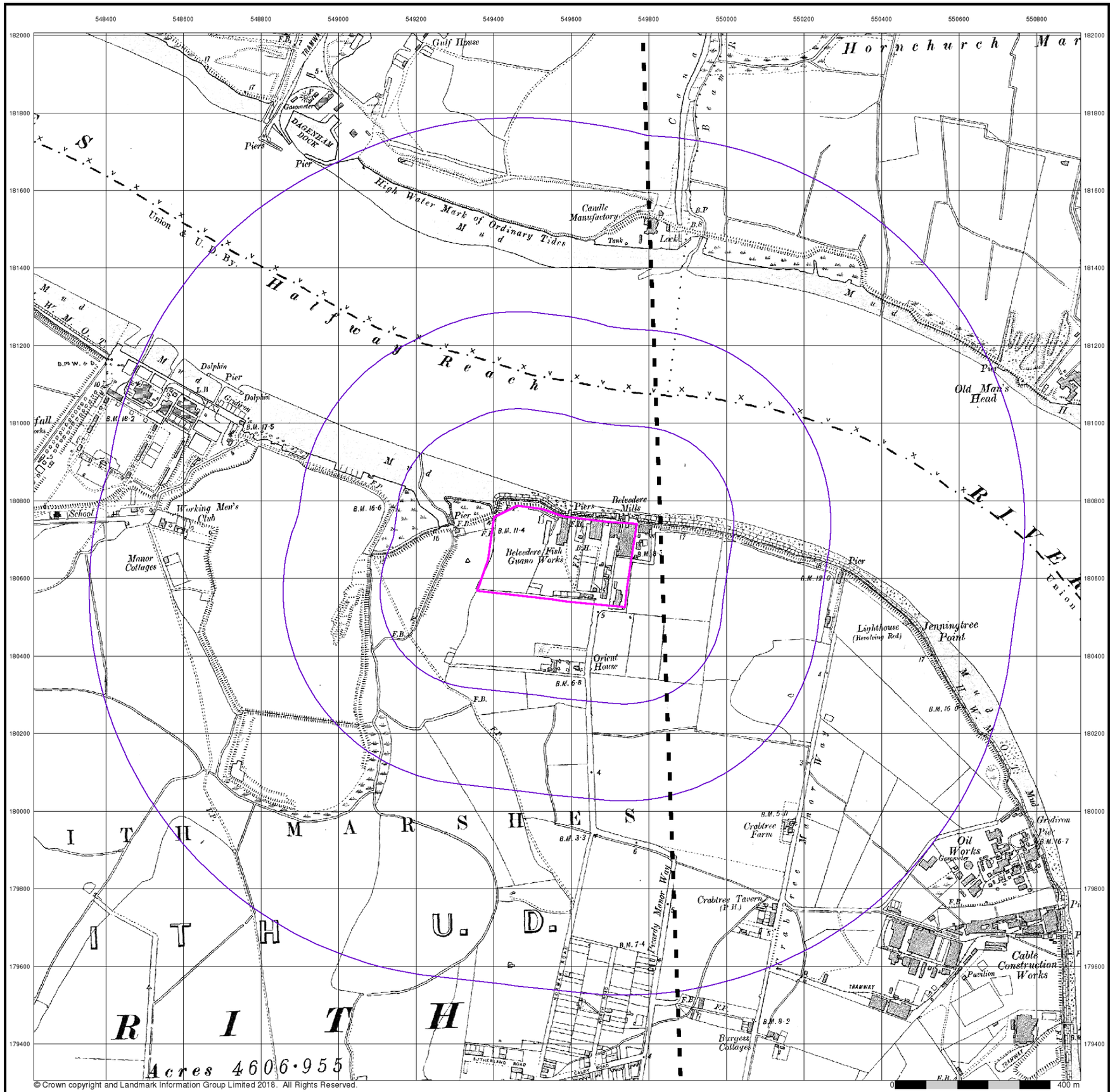

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Kent

Published 1910

Source map scale - 1:10,560

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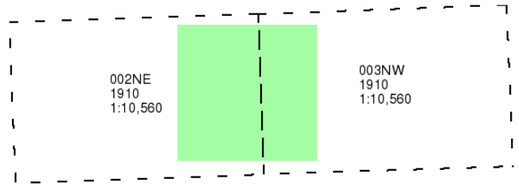
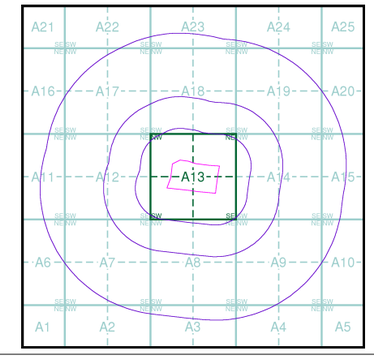
Map Name(s) and Date(s)



Historical Map - Slice A



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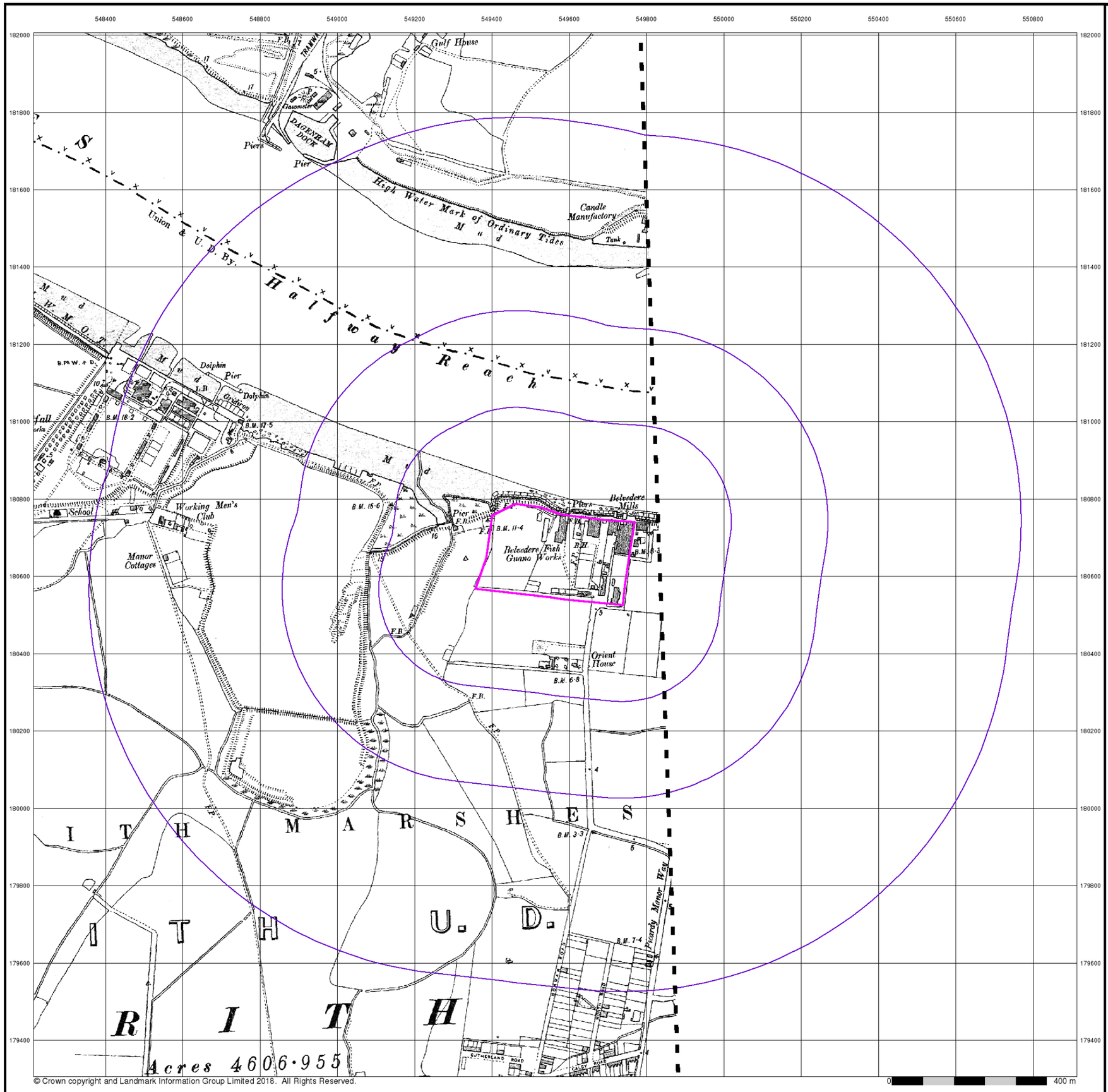

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pba peterbrett

Kent

Published 1910

Source map scale - 1:10,560

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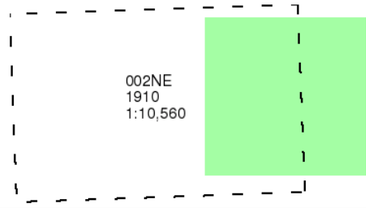
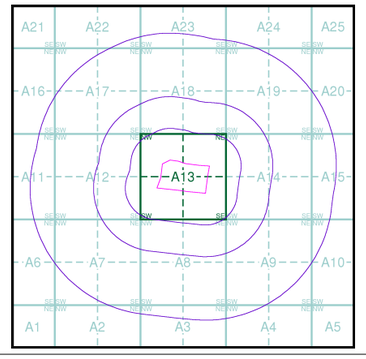


Historical Map - Slice A



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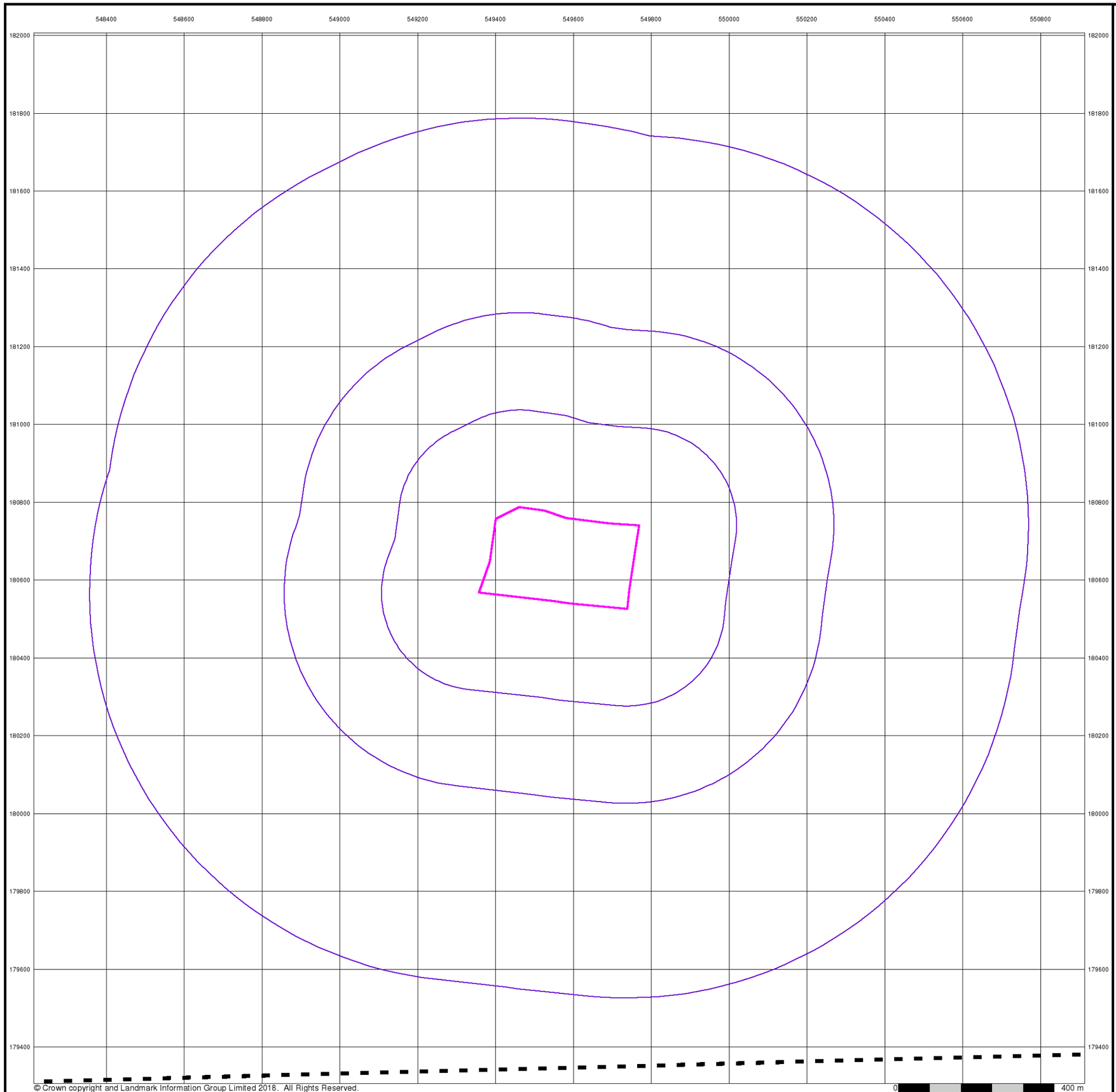

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London

Published 1920

Source map scale - 1:10,560

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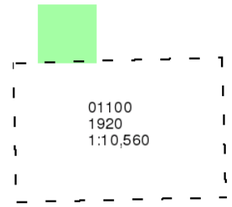
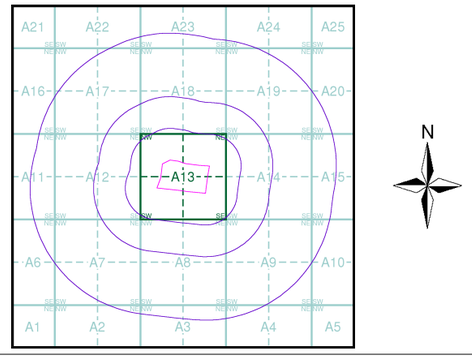
Map Name(s) and Date(s)



Historical Map - Slice A



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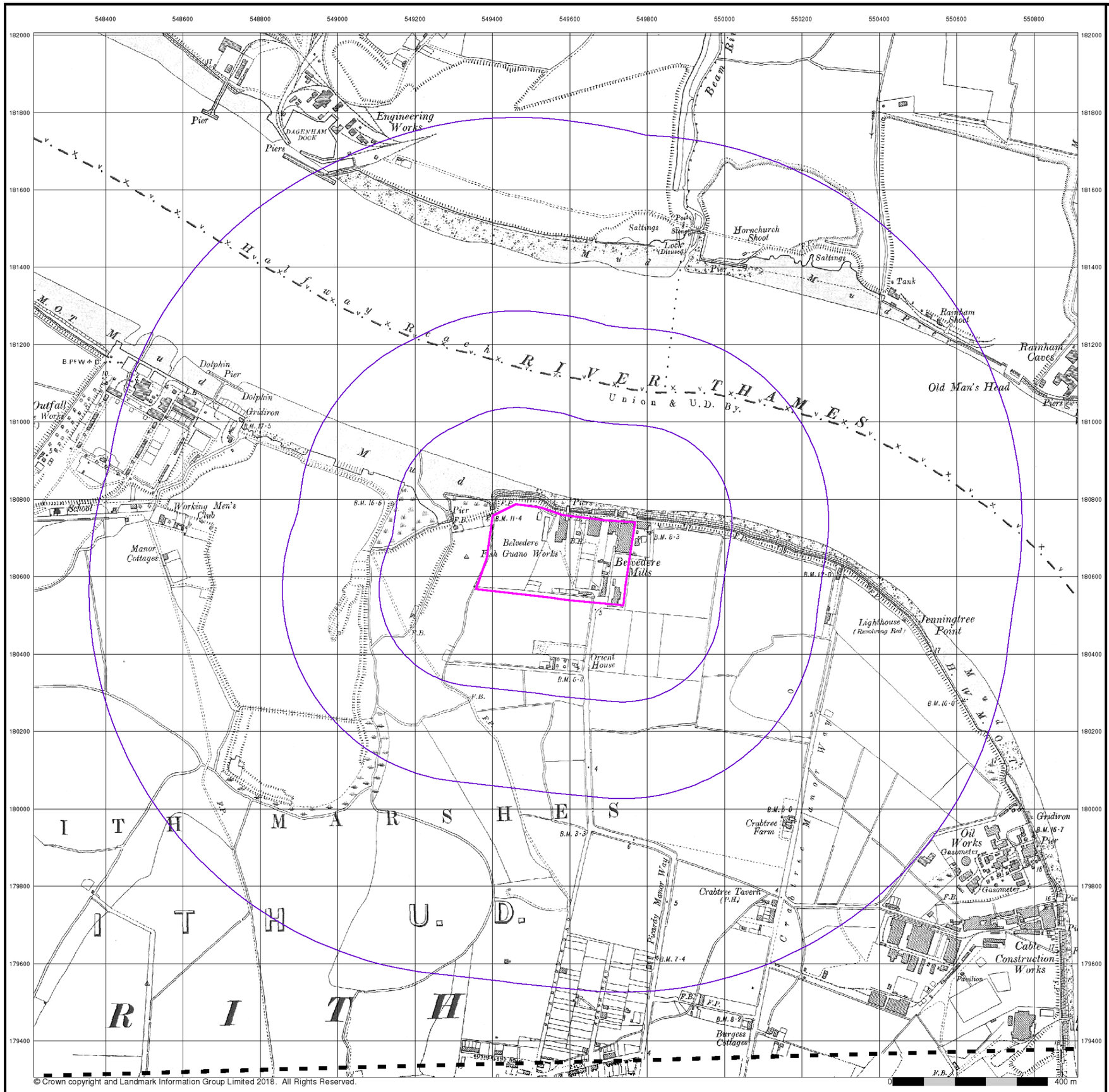

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pba peterbrett

Essex

Published 1921

Source map scale - 1:10,560

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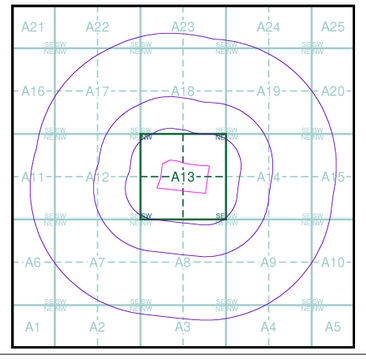
Map Name(s) and Date(s)

087SW
1921
1:10,560

09400
1921
1:10,560

Historical Map - Slice A



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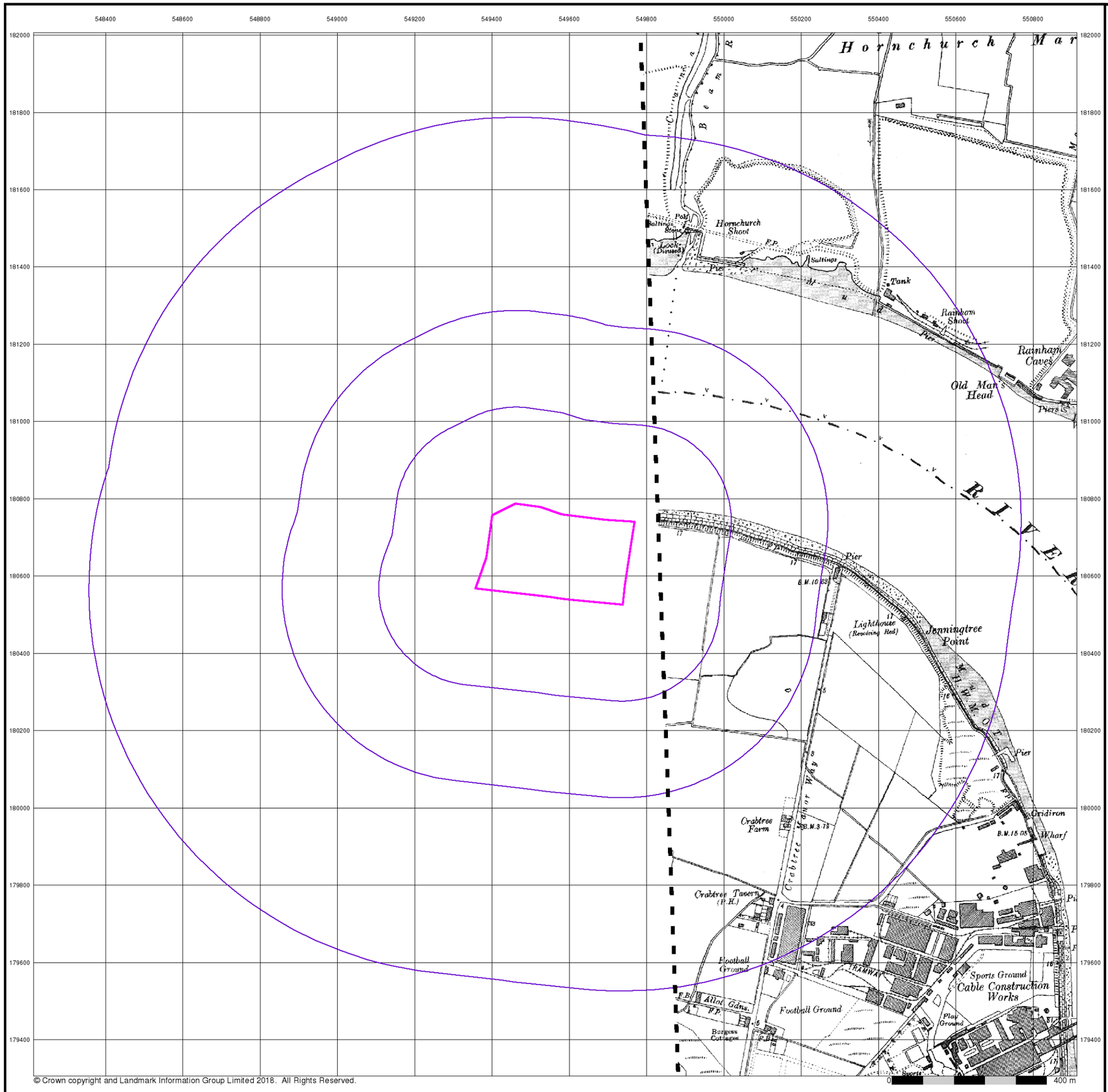

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peterbrett

Kent

Published 1931

Source map scale - 1:10,560

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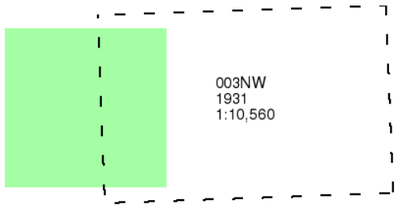
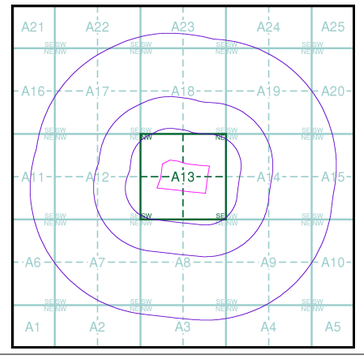
Map Name(s) and Date(s)



Historical Map - Slice A



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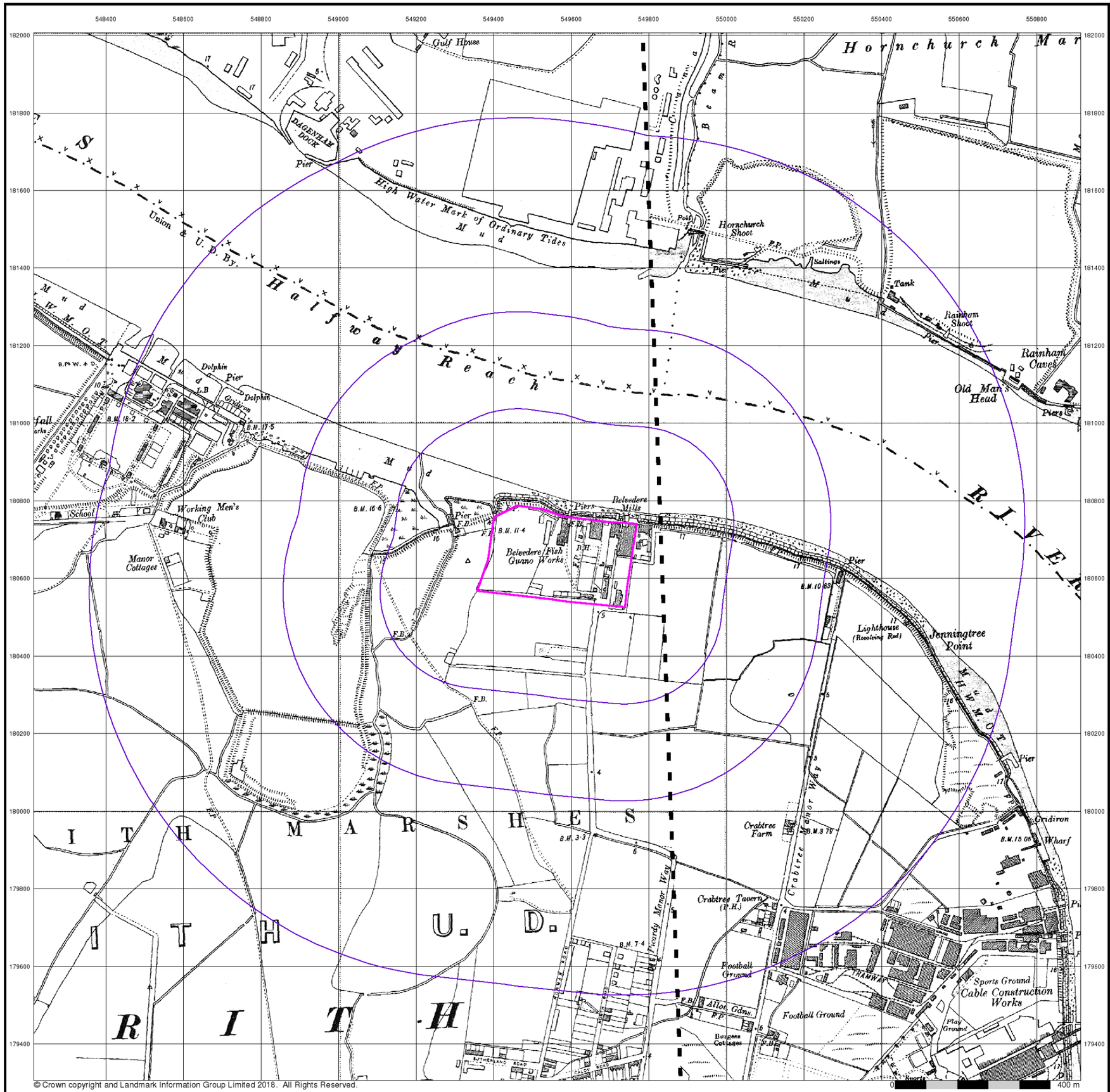

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Kent

Published 1938

Source map scale - 1:10,560

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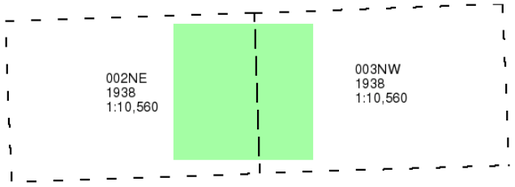
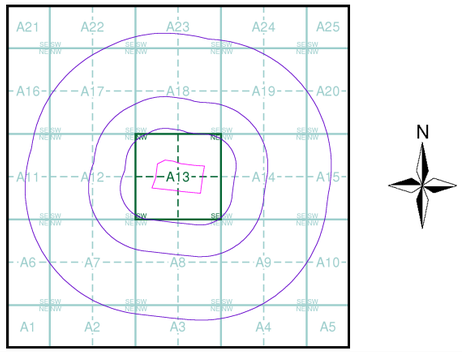
Map Name(s) and Date(s)



Historical Map - Slice A



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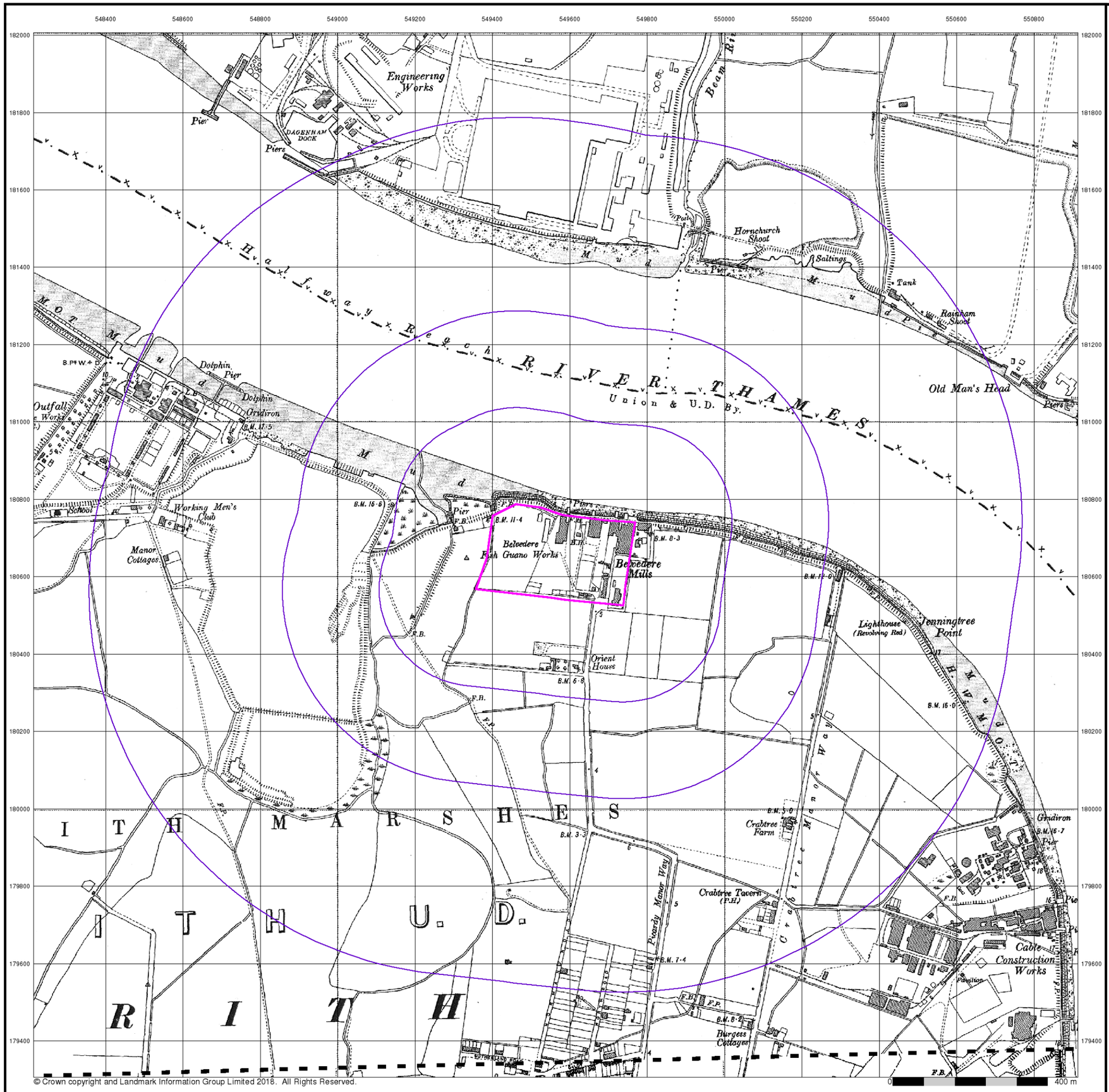

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Essex

Published 1938

Source map scale - 1:10,560

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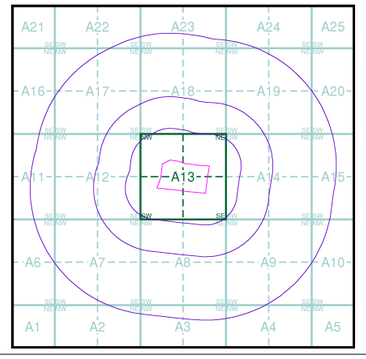
Map Name(s) and Date(s)

087SW
1938
1:10,560

09400
1938
1:10,560

Historical Map - Slice A



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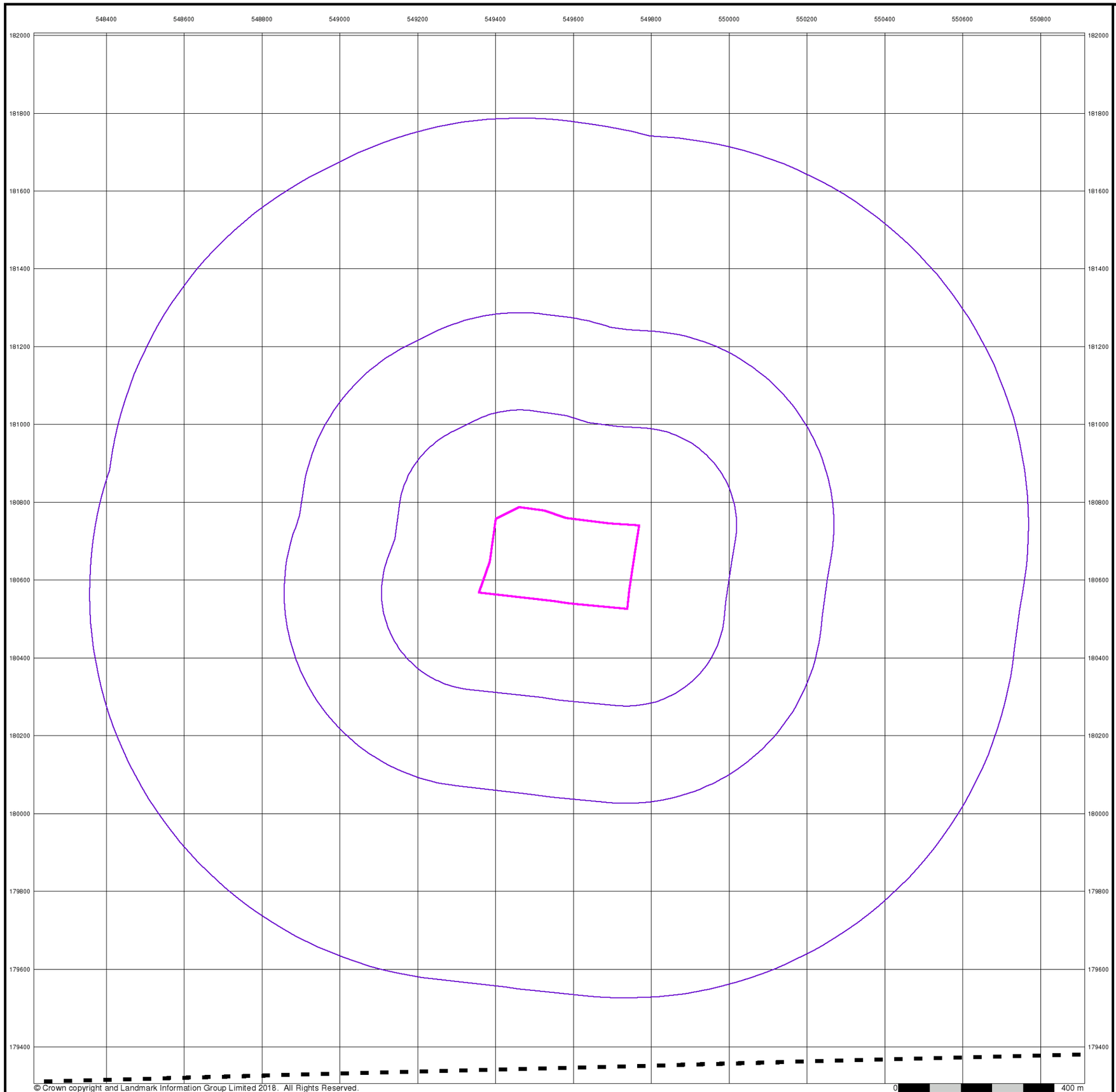

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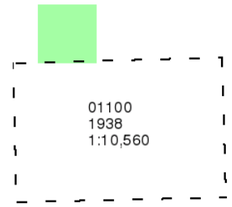
London

Published 1938

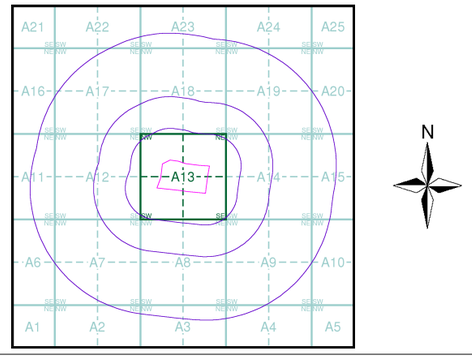
Source map scale - 1:10,560

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:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	1000

Site Details

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Ordnance Survey Plan

Published 1940 - 1950

Source map scale - 1:10,000

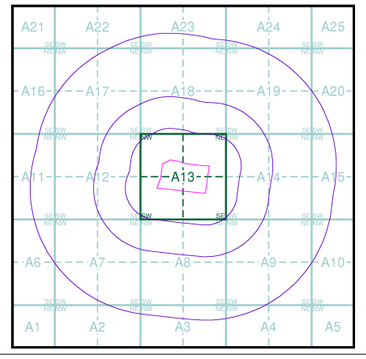
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some 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)

TQ48SE
1950
1:10,560

TQ47NE
1940
1:10,560

Historical Map - Slice A



Order Details

Order Number:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	1000

Site Details

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Kent

Published 1951

Source map scale - 1:10,560

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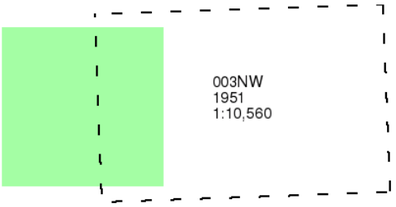
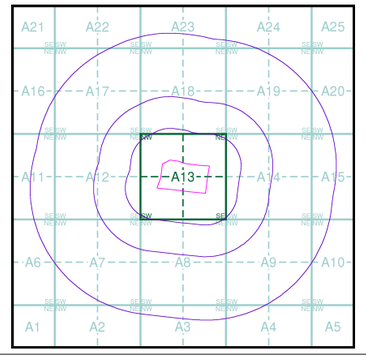
Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	1000

Site Details

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Ordnance Survey Plan

Published 1961 - 1969

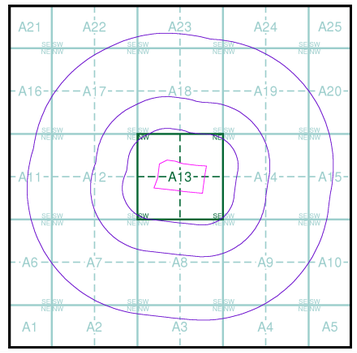
Source map scale - 1:10,000

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)

TQ48SE 1969 1:10,560	TQ58SW 1961 1:10,560
TQ47NE 1966 1:10,560	TQ57NW 1961 1:10,560

Historical Map - Slice A



Order Details

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Site Area (Ha):	8.07
Search Buffer (m):	1000

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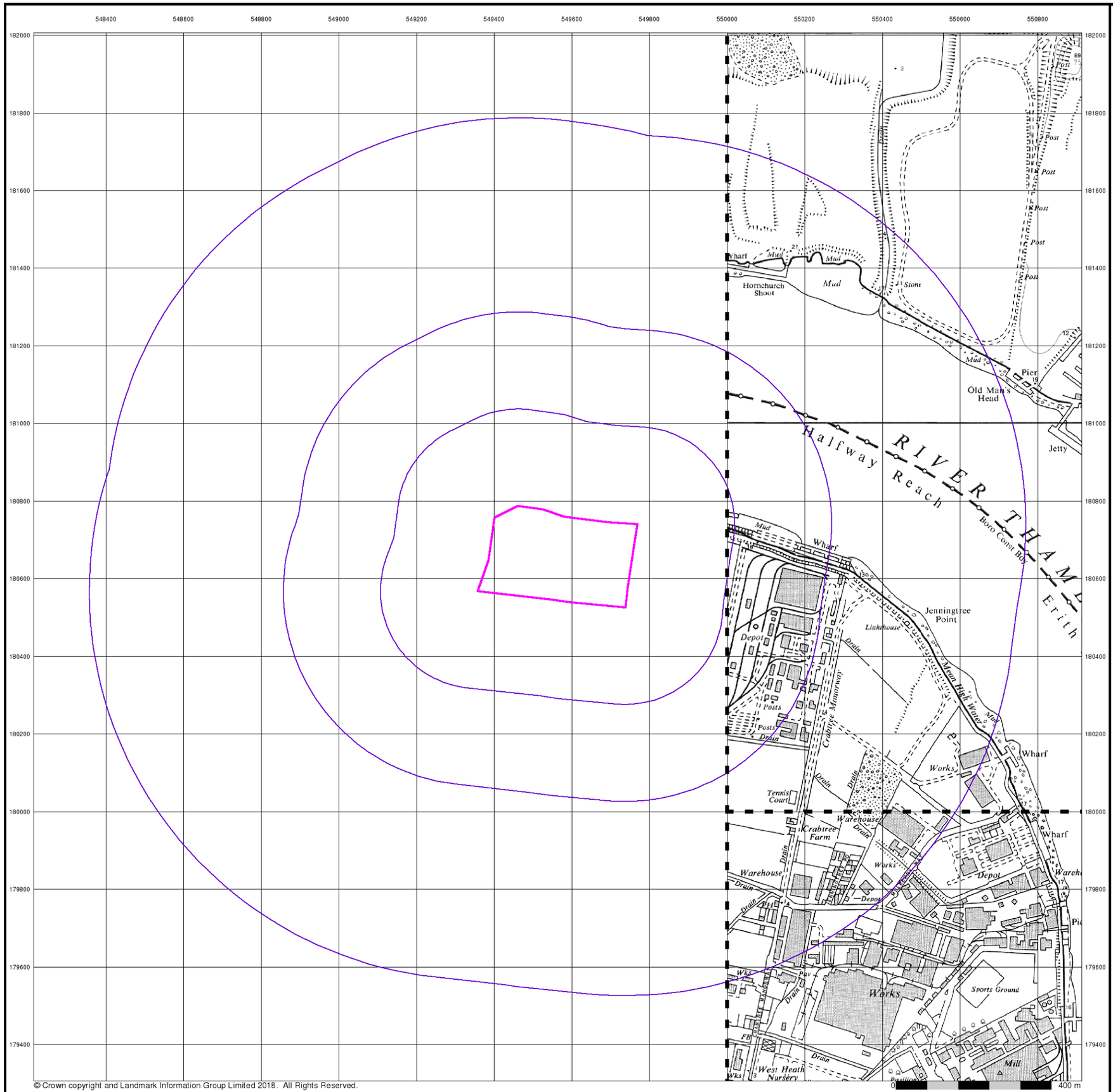

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Ordnance Survey Plan

Published 1967

Source map scale - 1:10,000

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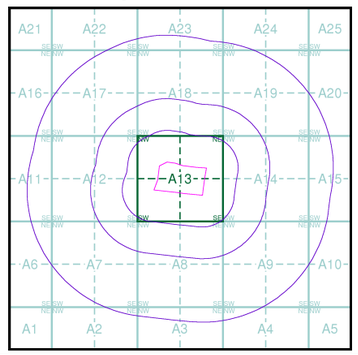
Map Name(s) and Date(s)

TQ58SW
1967
1:10,560

TQ57NW
1967
1:10,560

Historical Map - Slice A



Order Details

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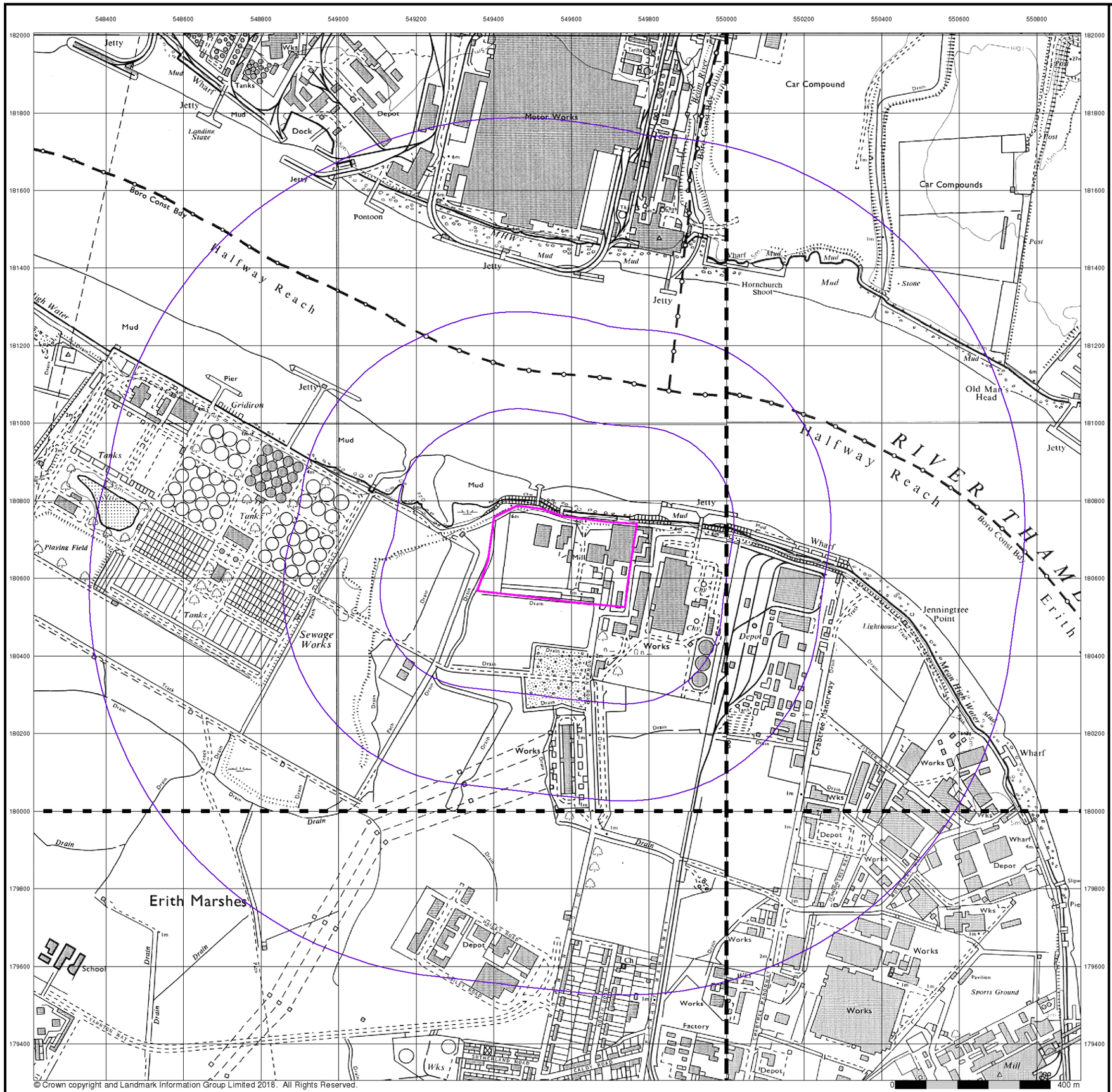

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Ordnance Survey Plan

Published 1975 - 1976

Source map scale - 1:10,000

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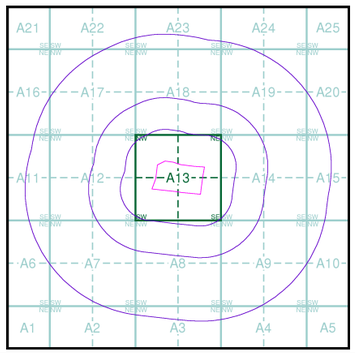
Map Name(s) and Date(s)

TQ48SE 1975 1:10,000	TQ58SW 1976 1:10,000
TQ47NE 1975 1:10,000	TQ57NW 1975 1:10,000

Historical Map - Slice A



Order Details

Order Number:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
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Site Area (Ha):	8.07
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Site Details

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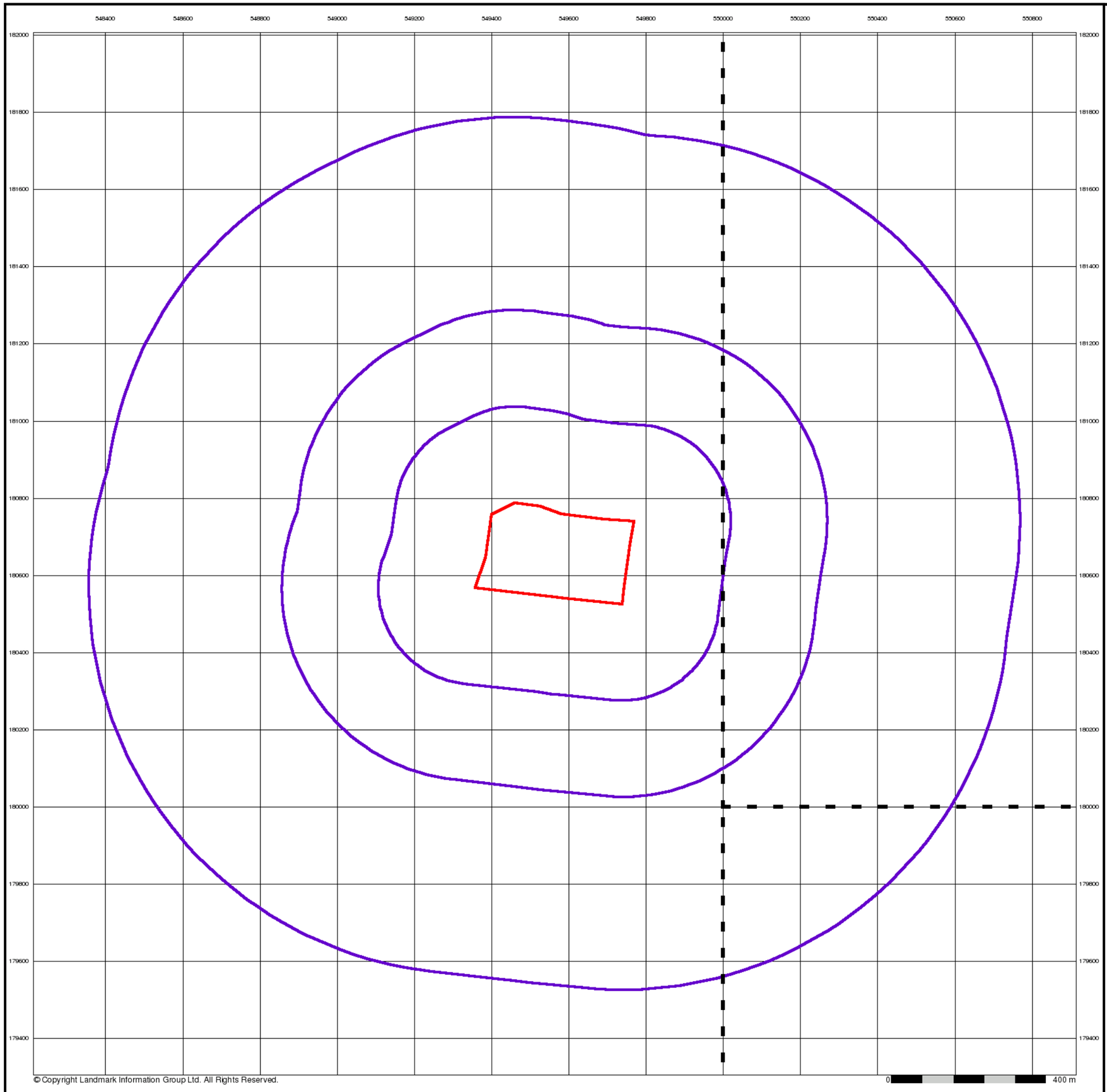

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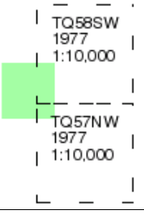
Gravesend

Published 1977

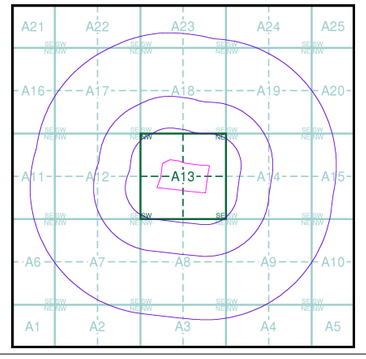
Source map scale - 1:10,000

These maps were produced by the Russian military during the Cold War between 1950 and 1997, and cover 103 towns and cities throughout the U.K. The maps are produced at 1:25,000, 1:10,000 and 1:5,000 scale, and show detailed land use, with colour-coded areas for development, green areas, and non-developed areas. Buildings are coloured black and important building uses (such as hospitals, post offices, factories etc.) are numbered, with a numbered key describing their use.
They were produced by the Russians for the benefit of navigation, as well as strategic military sites and transport hubs, for use if they were to have invaded the U.K. The detailed information provided indicates that the areas were surveyed using land-based personnel, on the ground, in the cities that are mapped.

Map Name(s) and Date(s)



Russian Map - Slice A



Order Details

Order Number:	158764613_1_1
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Ordnance Survey Plan

Published 1984 - 1988

Source map scale - 1:10,000

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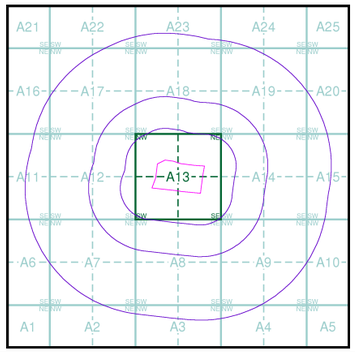
Map Name(s) and Date(s)

TQ48SE
1984
1:10,000

TQ47NE
1988
1:10,000

TQ57NW
1987
1:10,000

Historical Map - Slice A



Order Details

Order Number:	158764613_1_1
Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
Search Buffer (m):	1000

Site Details

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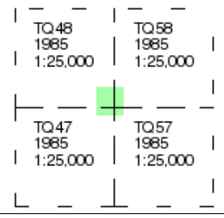
London

Published 1985

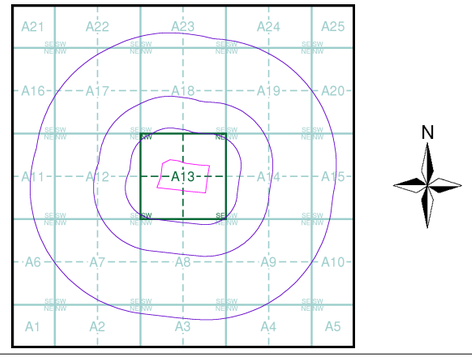
Source map scale - 1:25,000

These maps were produced by the Russian military during the Cold War between 1950 and 1997, and cover 103 towns and cities throughout the U.K. The maps are produced at 1:25,000, 1:10,000 and 1:5,000 scale, and show detailed land use, with colour-coded areas for development, green areas, and non-developed areas. Buildings are coloured black and important building uses (such as hospitals, post offices, factories etc.) are numbered, with a numbered key describing their use.
They were produced by the Russians for the benefit of navigation, as well as strategic military sites and transport hubs, for use if they were to have invaded the U.K. The detailed information provided indicates that the areas were surveyed using land-based personnel, on the ground, in the cities that are mapped.

Map Name(s) and Date(s)



Russian Map - Slice A



Order Details

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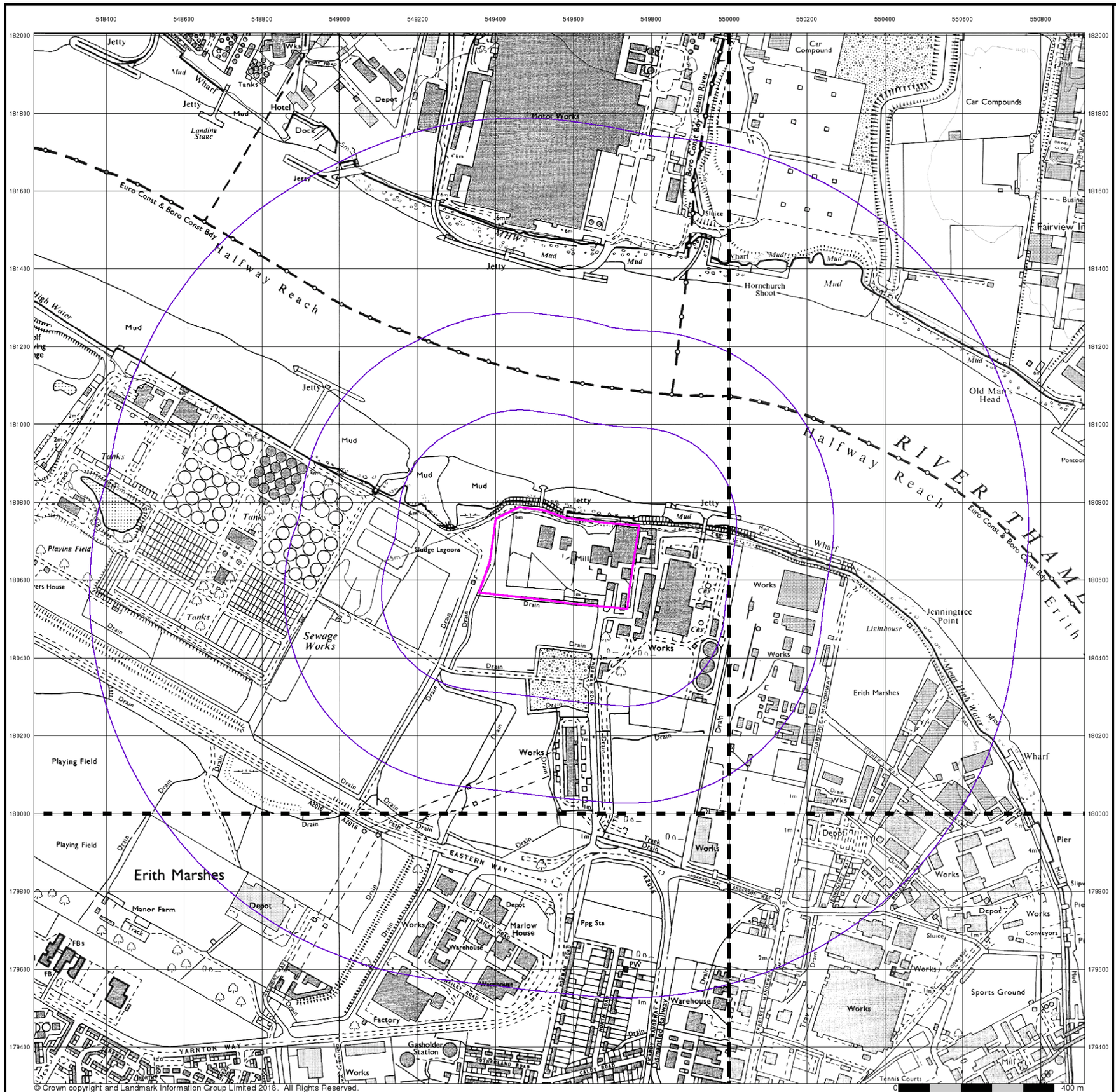

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Ordnance Survey Plan

Published 1993 - 1996

Source map scale - 1:10,000

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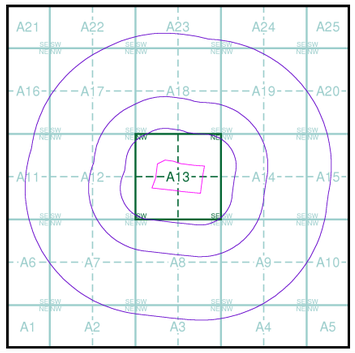
Map Name(s) and Date(s)

TQ48SE 1996 1:10,000	TQ58SW 1993 1:10,000
TQ47NE 1996 1:10,000	TQ57NW 1996 1:10,000

Historical Map - Slice A



Order Details

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Customer Ref:	42230
National Grid Reference:	549570, 180650
Slice:	A
Site Area (Ha):	8.07
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Site Details

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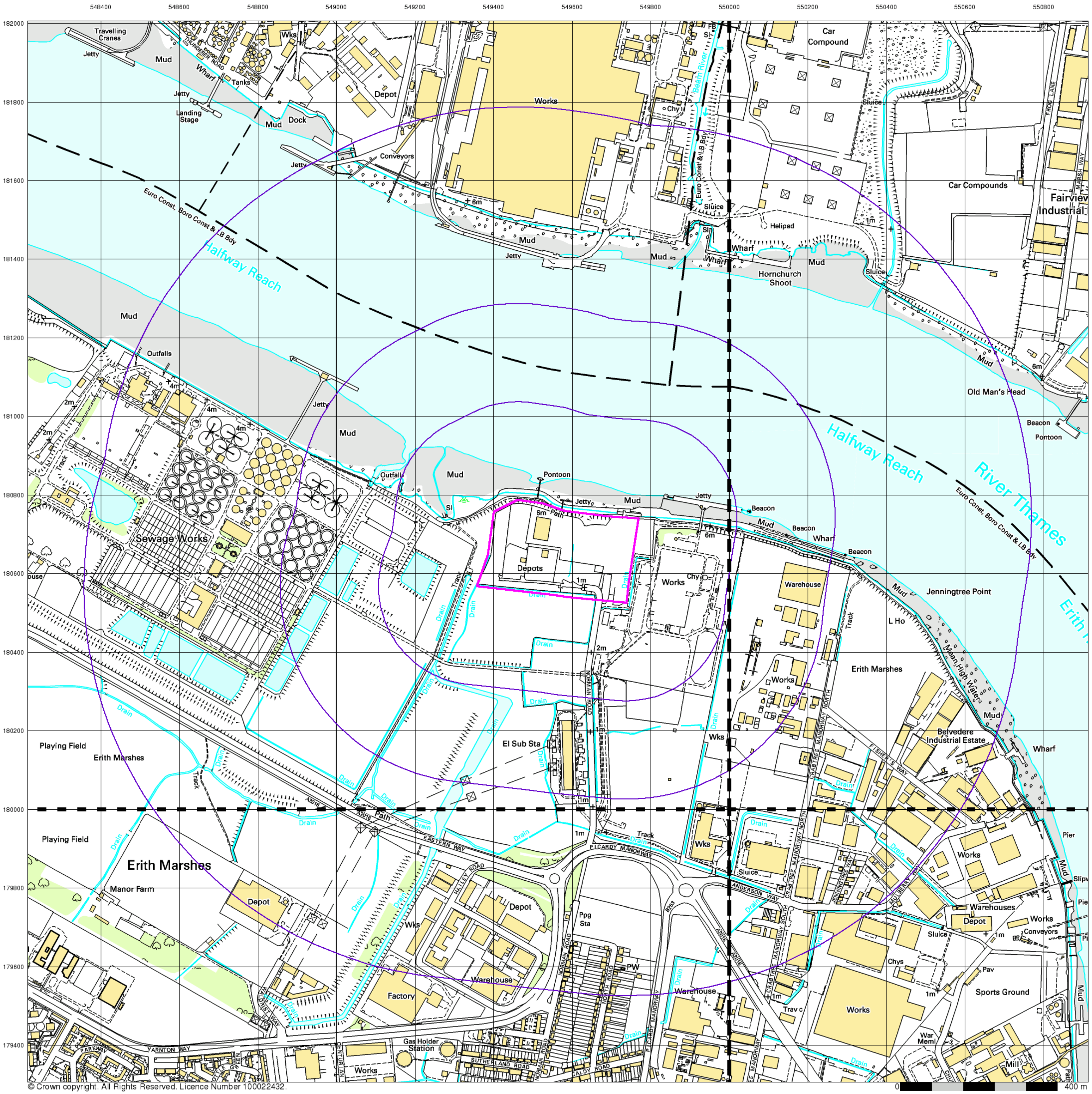

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0 400 m

10k Raster Mapping

Published 1999

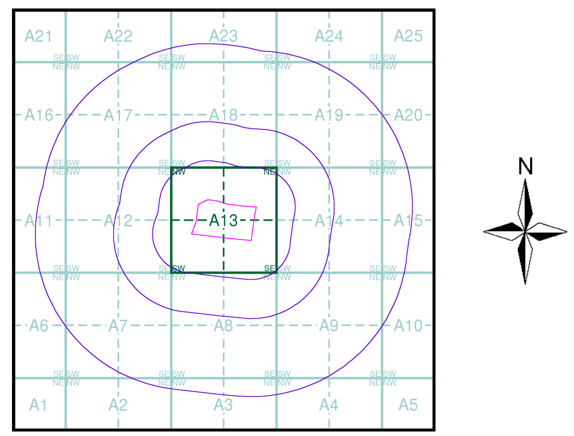
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey`s 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)

TQ48SE 1999 1:10,000	TQ58SW 1999 1:10,000
TQ47NE 1999 1:10,000	TQ57NW 1999 1:10,000

Historical Map - Slice A



Order Details

Order Number: 158764613_1_1
Customer Ref: 42230
National Grid Reference: 549570, 180650
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Site Details

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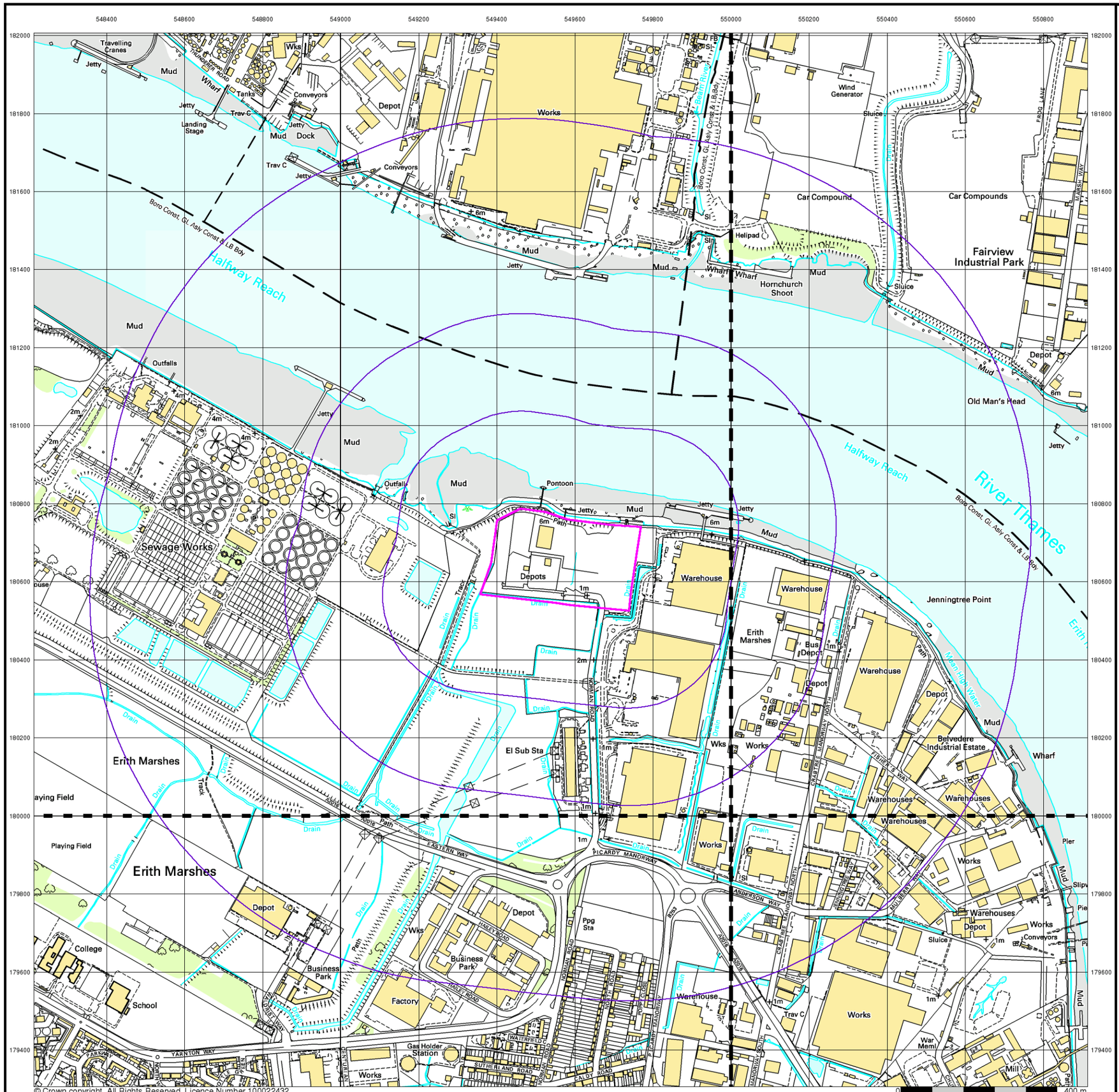


10k Raster Mapping

Published 2006

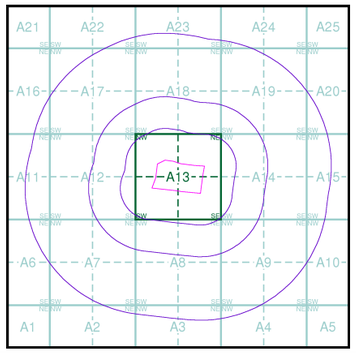
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey`s 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)

TQ48SE 2006 1:10,000	TQ58SW 2006 1:10,000
TQ47NE 2006 1:10,000	TQ57NW 2006 1:10,000

Historical Map - Slice A



Order Details

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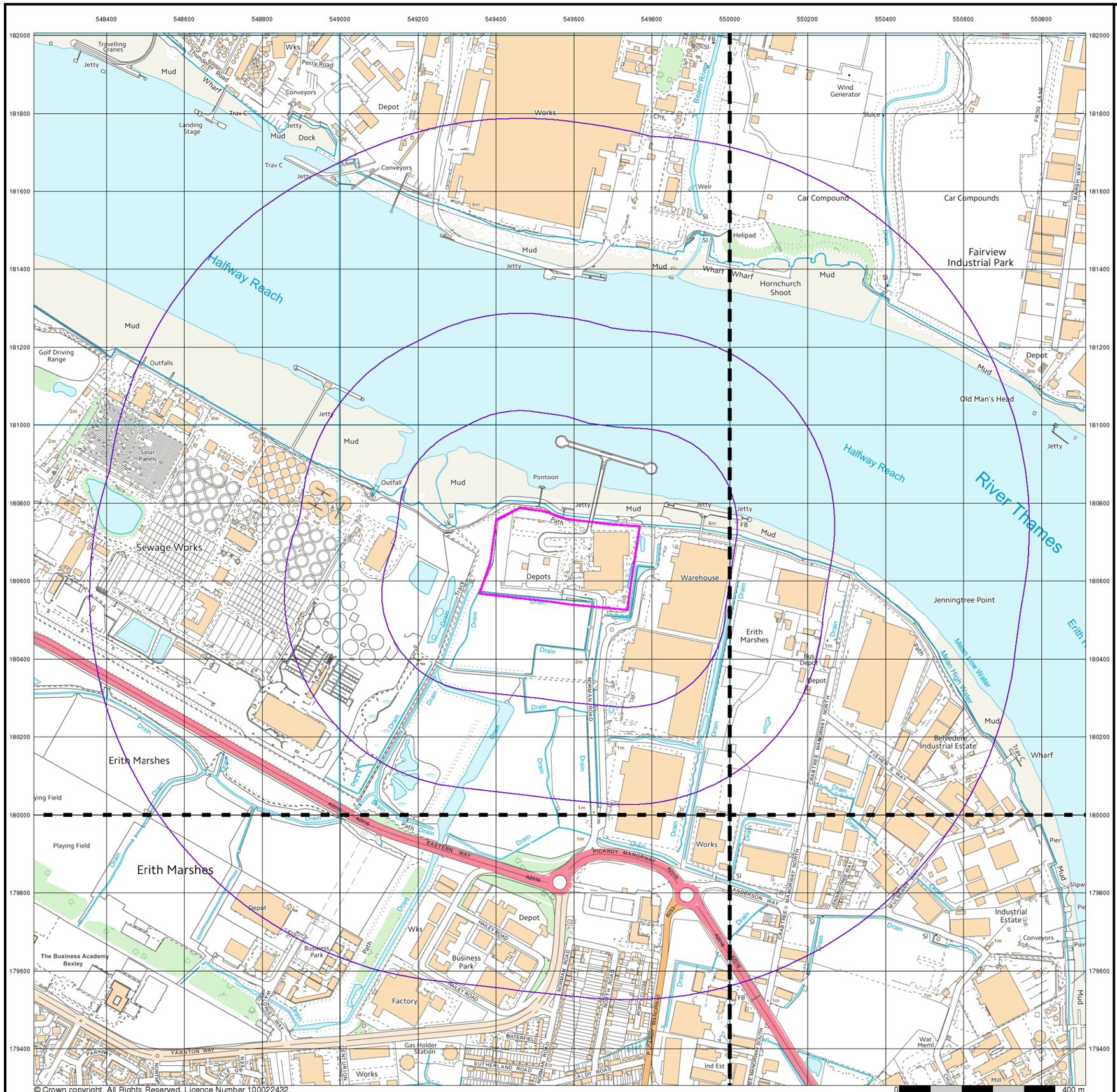

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VectorMap Local

Published 2018

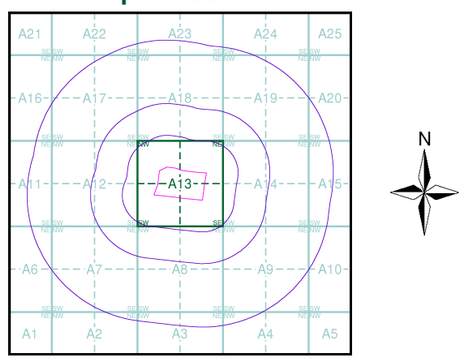
Source map scale - 1:10,000

VectorMap Local (Raster) is Ordnance Survey's highest detailed 'backdrop' mapping product. These maps are produced from OS's VectorMap Local, a simple vector dataset at a nominal scale of 1:10,000, covering the whole of Great Britain, that has been designed for creating graphical mapping. OS VectorMap Local is derived from large-scale information surveyed at 1:1250 scale (covering major towns and cities),1:2500 scale (smaller towns, villages and developed rural areas), and 1:10 000 scale (mountain, moorland and river estuary areas).

Map Name(s) and Date(s)

TQ48SE 2018 Variable	TQ58SW 2018 Variable
TQ47NE 2018 Variable	TQ57NW 2018 Variable

Historical Map - Slice A



Order Details

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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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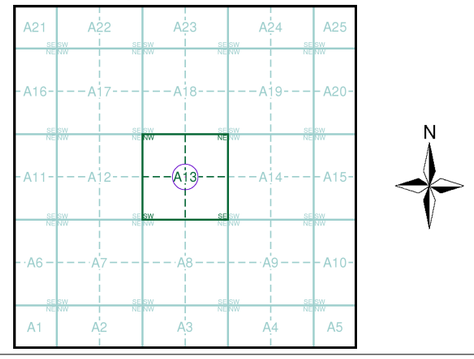
Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Kent	1:10,560	1869	3
Essex	1:10,560	1873	4
Kent	1:10,560	1898	5
Essex	1:10,560	1898 - 1899	6
Kent	1:10,560	1910	7
London	1:10,560	1920	8
Essex	1:10,560	1921	9
Kent	1:10,560	1931	10
Kent	1:10,560	1938	11
Essex	1:10,560	1938	12
London	1:10,560	1938	13
Historical Aerial Photography	1:10,560	1948	14
Kent	1:10,560	1950	15
Ordnance Survey Plan	1:10,000	1961	16
Ordnance Survey Plan	1:10,000	1967	17
Ordnance Survey Plan	1:10,000	1975	18
Gravesend	1:10,000	1977	19
London	1:25,000	1985	20
Ordnance Survey Plan	1:10,000	1987	21
Ordnance Survey Plan	1:10,000	1996	22
10K Raster Mapping	1:10,000	1999	23
10K Raster Mapping	1:10,000	2006	24
VectorMap Local	1:10,000	2018	25

Historical Map - Slice A



Order Details

Order Number:	159410216_1_1
Customer Ref:	42230
National Grid Reference:	551940, 177490
Slice:	A
Site Area (Ha):	0.01
Search Buffer (m):	1000

Site Details

Larger Extent

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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

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
- 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:

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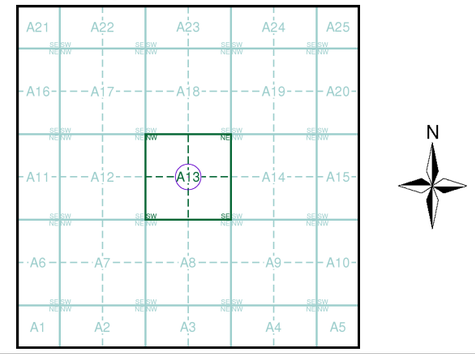
Ordnance Survey Plan	1:10,000	1996	22
10K Raster Mapping	1:10,000	1999	23
10K Raster Mapping	1:10,000	2006	24
VectorMap Local	1:10,000	2018	25

Russian Map - Slice A



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Site Details

Larger Extent

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Kent

Published 1869

Source map scale - 1:10,560

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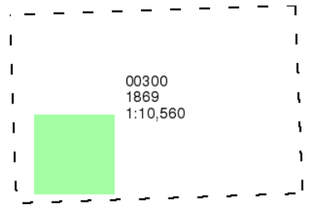
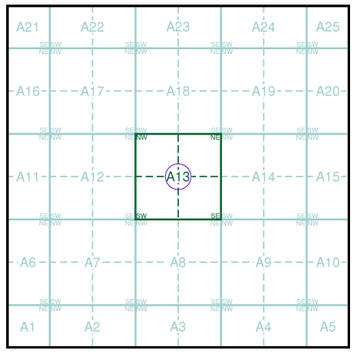
Map Name(s) and Date(s)



Historical Map - Slice A



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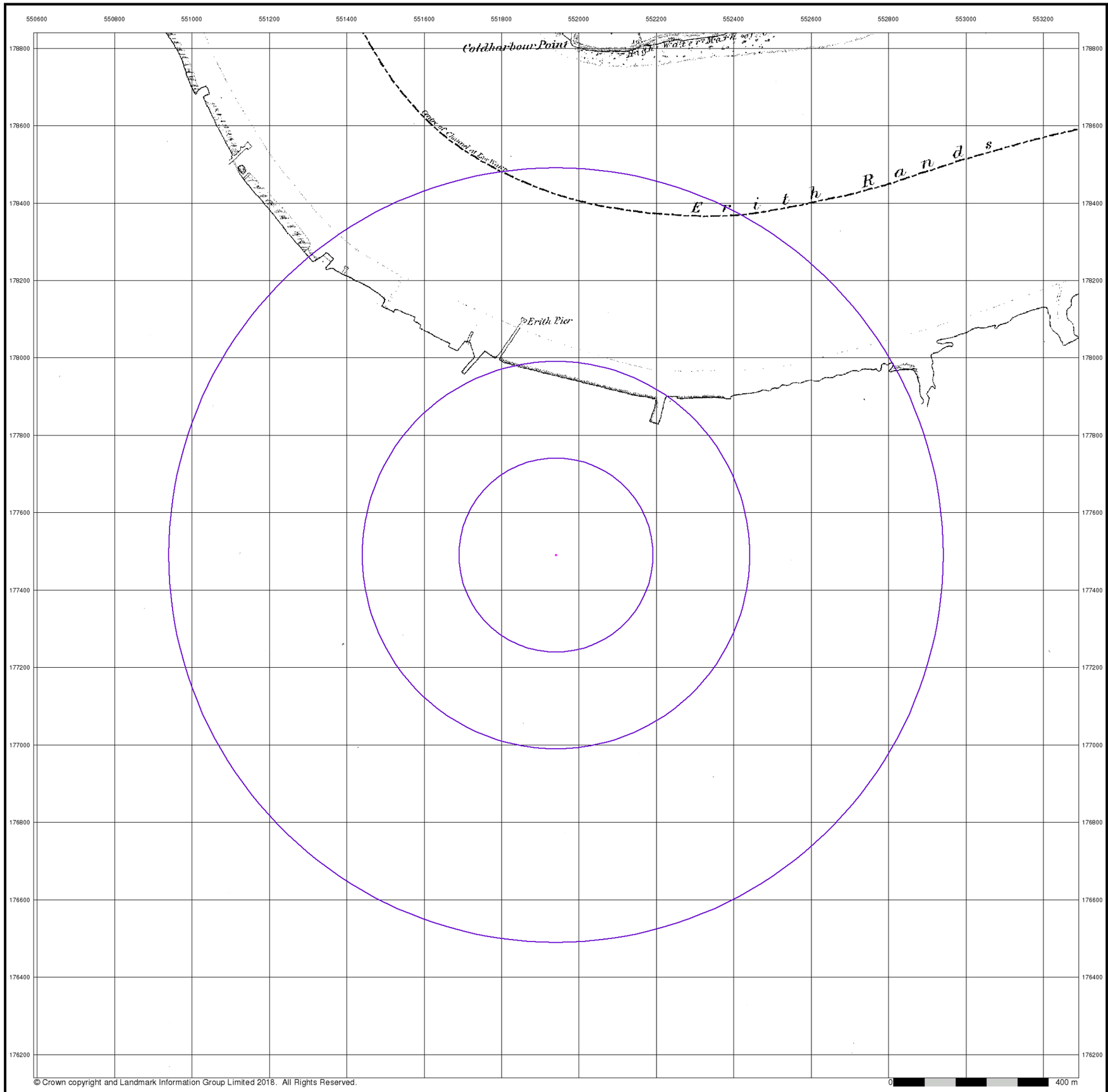

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Essex

Published 1873

Source map scale - 1:10,560

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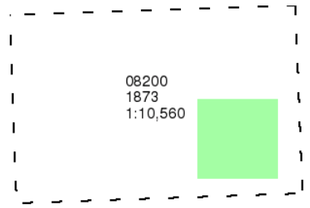
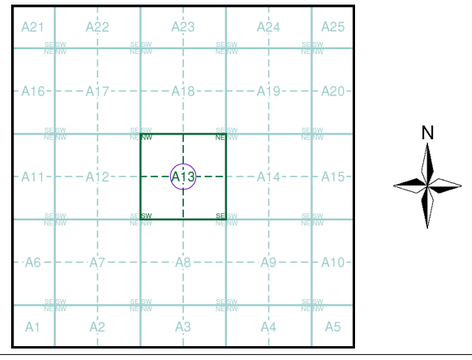


Historical Map - Slice A



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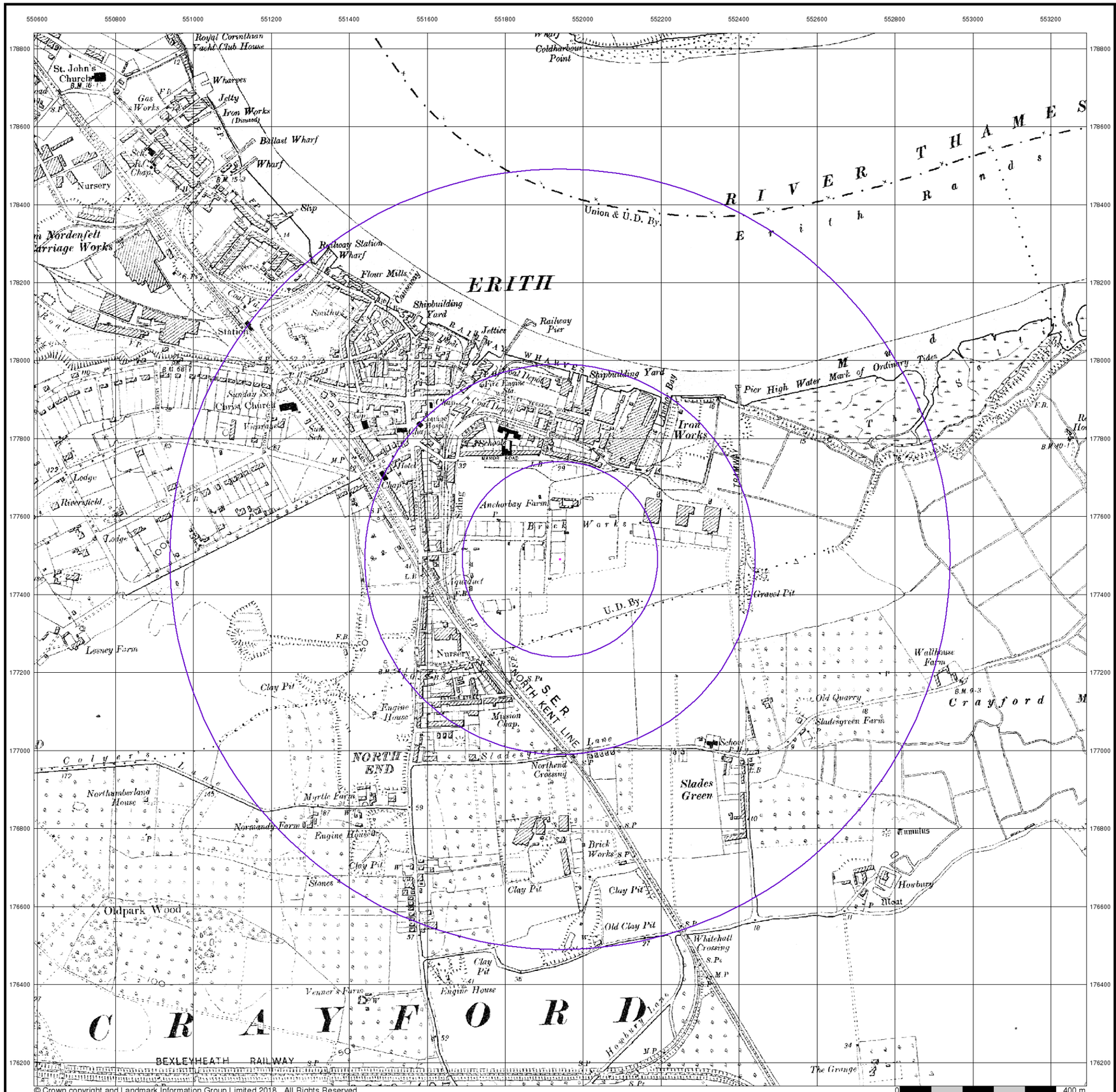

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Kent

Published 1898

Source map scale - 1:10,560

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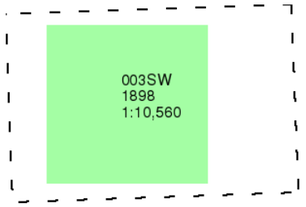
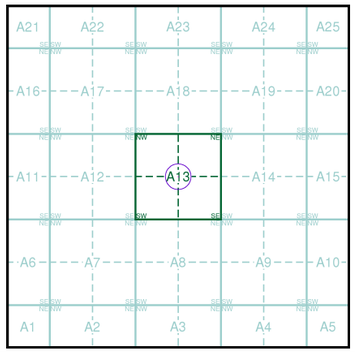
Map Name(s) and Date(s)



Historical Map - Slice A



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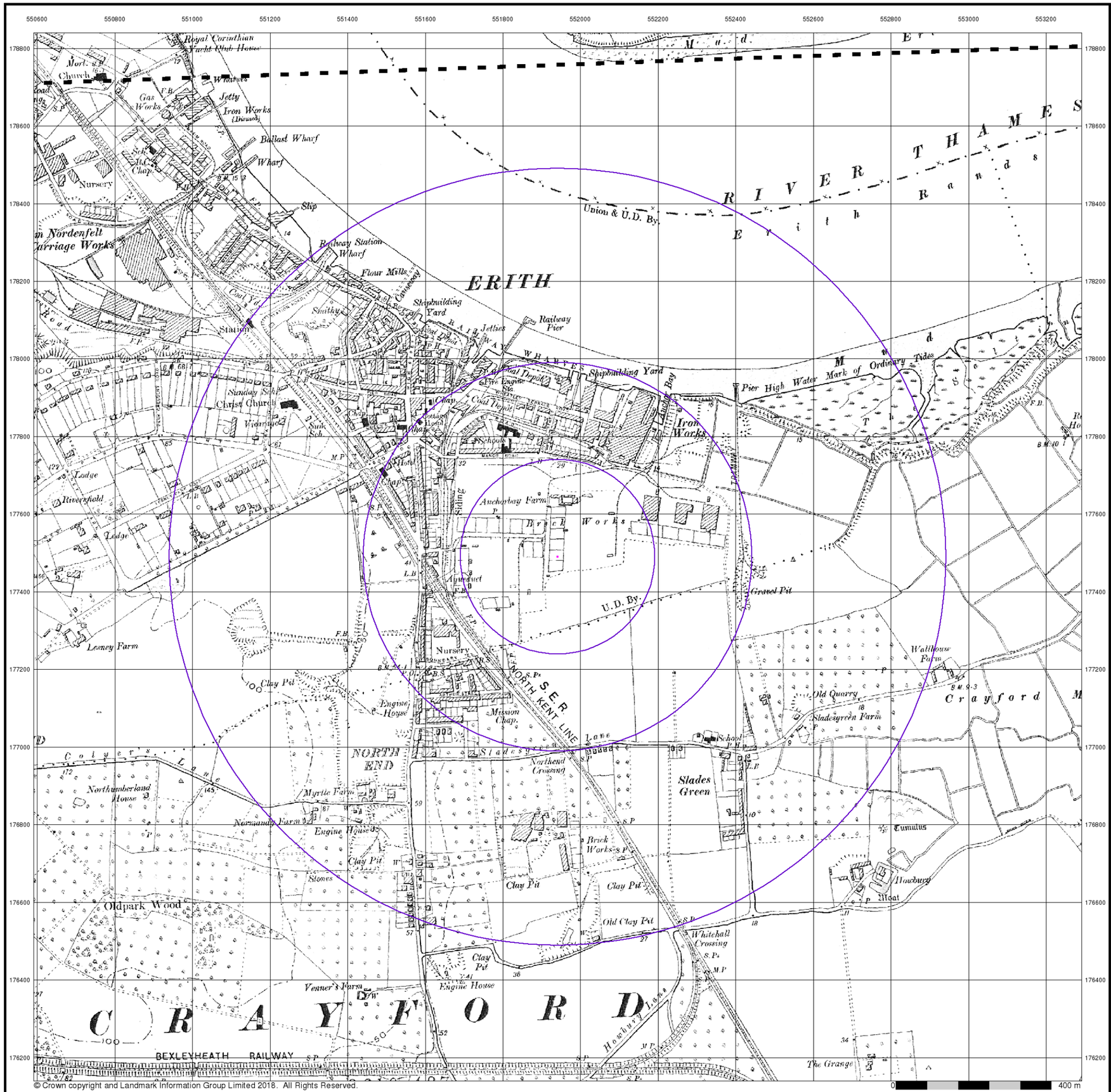

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Essex

Published 1898 - 1899

Source map scale - 1:10,560

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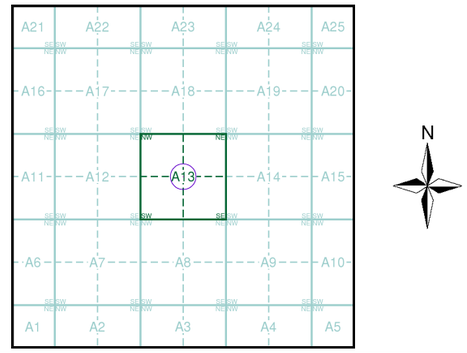
Map Name(s) and Date(s)

082NE
1898
1:10,560

082SE
1899
1:10,560

Historical Map - Slice A



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Kent

Published 1910

Source map scale - 1:10,560

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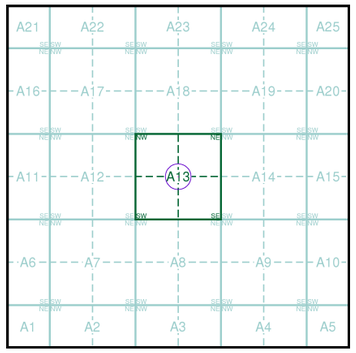
Map Name(s) and Date(s)

003SW
1910
1:10,560

Historical Map - Slice A



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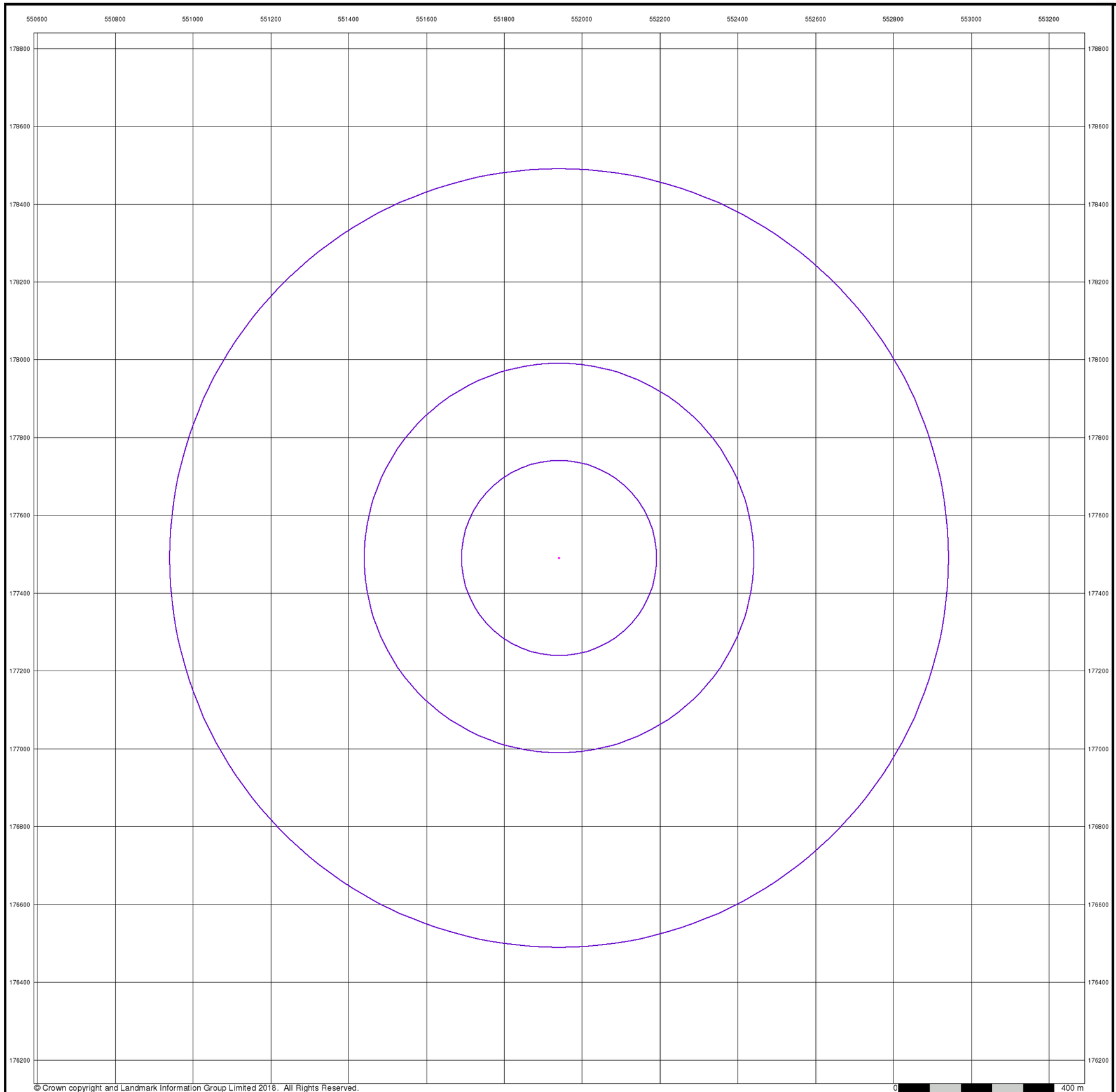

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London

Published 1920

Source map scale - 1:10,560

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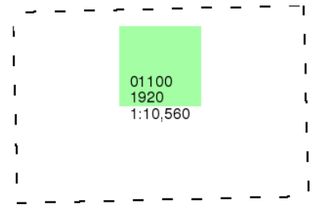
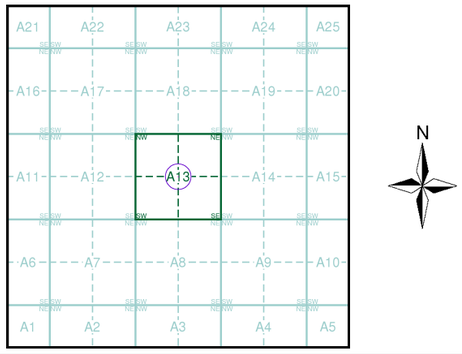
Map Name(s) and Date(s)



Historical Map - Slice A



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Slice:	A
Site Area (Ha):	0.01
Search Buffer (m):	1000

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Essex

Published 1921

Source map scale - 1:10,560

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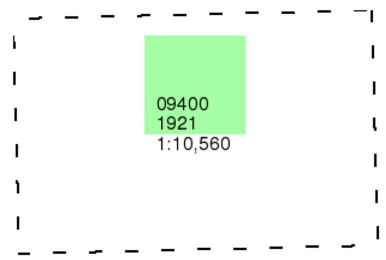
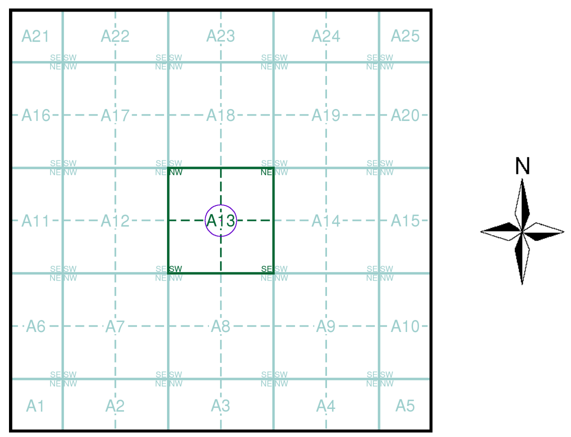
Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number:	159410216_1_1
Customer Ref:	42230
National Grid Reference:	551940, 177490
Slice:	A
Site Area (Ha):	0.01
Search Buffer (m):	1000

Site Details

Larger Extent

Landmark®
INFORMATION GROUP

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