Brunton Wireworks, Inveresk

Archaeological excavation:

Data Structure Report

AOC 20462

March-April 2009

AOC Archaeology Group

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Brunton Wireworks, Inveresk:
Excavation Data Structure Report

On Behalf of:	**Santon Retail Limited, Tesco Stores Limited and Royal Bank of Scotland Limited**
National Grid Reference (NGR):	**NT 342 724**
AOC Project No:	**20462**
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This document has been prepared in accordance with AOC standard operating procedures.

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Summary

This report represents the results of an archaeological excavation undertaken by AOC Archaeology Group at the site of the former Brunton Wireworks, Inveresk, Musselburgh. The work was commissioned by Goodson Associates on behalf of their client, Tesco Stores Ltd, in advance of development, and follows on from an archaeological evaluation completed during November 2008.

Prior to the these works, an archaeological Desk-Based Assessment was undertaken of the development area which also included a standing building assessment to identify what, if anything, remained of the former Wireworks.

The archaeological excavation comprised the excavation of seven trenches around specific key structures and elements identified during the evaluation. The work was carried out carried out during February and March and was conducted according to the terms of an agreed *Written Scheme of Investigation* (AOC 2009) approved by East Lothian Council Archaeology Service (ELCAS) who advise the East Lothian council on archaeology matters.

The archaeological excavation demonstrated the potential of the remains underlying the existing ground surface, recording the underground network of the heating and steam distribution system. Artefactual evidence for the use of the development site as a dumping ground for the 19th century Newbigging potter was identified through the recovery of waster material marmalade jars and ginger beer bottle.

Based on the positive results of the work, a programme of post-excavation analyses and limited publication will be required.

1 INTRODUCTION

1.1 Background

1.1.1 Goodson Associates on behalf of Tesco Stores Ltd commissioned AOC Archaeology Group to undertake a programme of archaeological excavation in respect to a planning application (06/007769/FUL) for a proposed supermarket, car-park, petrol filling station, ATM pod, car washes, landscaping, road modifications and boundary treatments.

1.1.2 The excavation works were designed to meet the requirements of East Lothian Council, as advised by the East Lothian Council Archaeology Service, as set out in the Addendum to the Written Scheme of Investigation (AOC 2009). The excavation works were designed to fully record a series of features previously identified during evaluation works (AOC 2008). All works undertaken were in accord with the policies set out within SPP23 (SG 2008) and PAN42 (SOEnD 1994).

1.2 Location

1.2.1 The proposed development area, totalling 3.2 hectares, is located to the south of the town of Musselburgh in East Lothian (Figure 1). The site is centred at National Grid Reference NT 3412 7236 and is bounded by Olive Bank Road to the north, St Michael's Kirk Burial Ground to the south, derelict ground and housing to the east and small industrial units and rough ground to the west.

1.2.2 The underlying drift geology of the area is characterised by water-modified tills with sandy or gravelly upper layers underlain by sandy clay loam derived from Carboniferous sandstones and shales (Soil Survey for Scotland 1971). The soils are moderately developed loamy brown forest soils of the Rowanhill/Giffnock/Winton Associations. The proposed development area slopes gradually downhill from south to north.

2 OBJECTIVES

2.1 The objectives of the archaeological works were:

i) to determine the character, extent, condition, quality, date and significance of the features identified during the evaluation phase;

ii) to advise and implement an appropriate form of archaeological mitigation, such as excavation, post-excavation analyses and publication, should significant archaeological remains be encountered that cannot be preserved *in situ*.

3 METHODOLOGY

3.1 Seven machine excavated trenches totalling approximately 2,338 m^2 were excavated across the proposed development area. All trenches varied in size and orientation (Figure 2).

3.2 Stripping of the overburden was undertaken by means of a 360˚ tracked excavator equipped with a toothless ditching bucket approximately 2 m in width. Excavation was undertaken in shallow units/spits until the first significant archaeological horizon or natural subsoil was reached. All machine excavation was supervised by an experienced field archaeologist.

3.3 All excavation was undertaken according to AOC Archaeology Group's standard operating procedures as was the palaeoenvironmental sampling strategy (AOC Archaeology 2008b).

3.4 The location of the trenches was altered in the field due to the identification of unmarked services, piles of demolition debris and the steep gradient of the southern portion of the site.

3.5 All potential archaeological features were cleaned and fully defined. These were then investigated in order to determine their character, function, nature, date and significance.

4 HISTORICAL BACKGROUND

4.1 Introduction

4.1.1 The archaeological potential of the proposed development area was identified as part of the desk-based assessment which included both a walkover survey and standing building assessment (AOC Archaeology 2008c).

4.2 Prehistoric and Roman evidence within the development area

4.2.1 The remains of a Bronze Age cemetery were unearthed within the development area in the 19th century (Lowe & Anderson 1894, 66). The area occupied by this cemetery was later subsumed by the Bruntons Wireworks.

4.2.2 The northern defensive line of the Roman fort at Inveresk, as determined by Richmond (1980, 294), lies immediately to the south of the development area. The fort has produced abundant evidence of two phases of occupation during the middle of the 2nd century AD, and was closely associated with a large civil settlement and wider rural hinterland. Excavations and chance finds confirm that the civil settlement was occupied for a similar period. The available evidence, although limited, suggests that an approach road to the Fort may have traversed the development area, nominally running up from 'Old Bridge', which tradition recalls as being Roman, but appears in fact to be early 16th century. This is not to say, of course, that the actual crossing place is not Roman. The Roman fort and civil settlement at Inveresk lies near the end of a ridge overlooking the mouth of the River Esk. It is generally held by scholars to have been known as "*Coria*" in Roman times (Rivet & Smith 1979). The fort was situated at the point of convergence of the two main north/south Roman roads in Scotland and was therefore of strategic importance to the Roman occupation of Scotland. Inveresk was ideally located to act as a supply base and port for the Antonine Wall (Breeze 1982, Hanson & Maxwell 1983) and its hinterland. The fort would thus have been a focus for both military and civil activity in the region. It was perhaps for this reason that it attracted the presence of the chief provincial financial official, the procurator Quintus Lusius Sabinianus, who dedicated at least two altars at Inveresk, one of them to Apollo Grannus (Hassall & Tomlin 1977).

4.2.3 In July 1985, workmen excavating a trench through the factory floor at Brunton Wireworks discovered quantities of human and animal bone. The factory floor lay directly over a layer of brown sand which included five U-shaped features one of which contained fragments of bone, pottery and oyster shell and a red matrix suggesting the presence of a body stain. The similar appearance of the five features visible in section, along with their regular spacing, suggests orderly burial in a cemetery. The pottery was all of a 2nd century AD date and as such it is probable that the burial dates from that time. The site of the burials lies NNE of the fort at Inveresk. Although the line of the road from the north gate is unknown, if the plan suggested by Richmond (1980, 294) is followed, the burials would

lie close to a line projected at right-angles from the north gate of the fort, at a distance of approximately 300 m from its rampart. The position of the grave may therefore have been in accordance with the standard Roman practice of burial alongside roads (Gallagher & Clarke 1993, 316).

4.2.4 Elsewhere, aerial photographs of cropmarks in the vicinity have produced evidence for the wider landscape within which the fort and its civil settlement were situated. To the east of Eskgrove, enclosures and a possible aqueduct have been identified. Enclosures associated with the line of a Roman road have been observed near the present railway line and it is perhaps in this context that Stevenson's observations near the railway station belong (Hanson and Maxwell 1983, Plate 9.5). In 1995, excavations at Park Lane Hospital revealed traces of what may have been part of a timber amphitheatre. This investigation also examined some of the above mentioned linear features (Neighbour 1995; Denison 1997).

4.3 Medieval (AD 410-1600)

4.3.1 Although abandoned by the Romans comparatively shortly after its construction, the site of the fort at Inveresk appears to have been re-used by the first church of St Michael's **(**Moir 1860). The church evidently incorporated Roman building material with such a circumstance paralleled at a number of places, including Chester-le-Street (Rainbird 1971). Evidence of medieval activity was unearthed during a programme of archaeological survey and excavation in January 1993 on the site of a proposed food market development (Ewart & Triscott 1993). The results of this brief exercise demonstrated that the Brunton Wireworks was erected on a greenfield site, which in turn sealed medieval deposits. Artefactual evidence suggests a hiatus between the 15th to 16th century and 19th century, which may be connected with the presence of a French fort built in 1548. The excavated medieval deposits appear to be agriculturally derived, covering a period from the 13th to 15th century and probably relate to the backlands associated with the river frontage occupation (*ibid*). Subsequent investigation in 2001, albeit of limited scale again but spread over a wider area at the Wireworks, predominantly exposed reworked mixed sediments incorporating industrial waste material overlying a natural sand and gravel. The material recovered was almost exclusively post-medieval in origin, but works east of the proposed development area revealed a single sherd of medieval pottery in a buried soil horizon. The pottery sherd was East Coast White Gritty Ware, dated from the 12th to 15th century, and was found in a layer with oyster shell and animal bone, which probably represent reworked medieval midden material within an agricultural/horticultural horizon (Rankin & Rees 2001).

4.4 Post-medieval (1600-1900) (see also AOC 2008b)

4.4.1 Musselburgh is situated on the north side of the main Edinburgh road and there is no indication of any habitation in the area in this period. Adair's map of 1682 (Figure 3) similarly marks Inveresk and Musselburgh and shows the meander of the River Esk, in which the proposed development area is located, to be unoccupied. Slezer's (Figure 4, 1693) view of Musselburgh from Stonyhill shows Inveresk Church in the right of the picture and the proposed development area in the foreground as unoccupied ground.

4.4.2 The early 18th century map evidence is almost identical and it is only by the mid-18th century that the first signs of industrial activity are depicted with a mill lead shown on Roy's map of 1747-55 (figure 5). John Laurie's map of 1763 (Figure 6) shows the first buildings associated with the mill lead and also shows a building within the proposed development area. The line of this mill lead appears now covered by Olive Bank Road and was partially excavated during water mains renewal (Kimber 2004).

A road is shown connecting the Old Bridge to Inveresk Kirk, on a similar alignment to the modern Inveresk Road.

4.3.3 Maps of the late 18th century show expanding development of buildings around the mill lead. The presence of two fields in the study area, noted as 'No 20' and 'No 15', appear for the first time on *Johnston's Plan of the fields of Pinkie & Inveresk (including Musselburgh), 1778*. Along their shared field boundary a legend of a small circle marked 'pond' indicates a probable well or cistern.

4.4.4 Thomson's map of 1821 (Figure 7) provides further indication of industrial development in the vicinity of the proposed development area. Land south and east of the proposed development area is marked as a bleachfield associated with two small buildings and a Waulk Mill. Within the proposed development area, two rectangular buildings are depicted adjacent to Inveresk Road to the north-east. The natural slope of the proposed development area from the elevated Kirk and Roman fort to the south towards the River Esk in the north is also shown. Hay's *New Plan of Musselburgh and its Environs* (1824), also shows buildings within the proposed development area, along the southern side of the mill lead as it traverses Station Road. Hunter & Anderson's map of 1834 (Figure 8) shows the area between the Wauk mill and Inveresk church to comprise of two enclosed fields and the two buildings shown on Hay's and Thompson's earlier map are no longer apparent.

4.4.5 Ordnance Survey maps from 1853 (Figure 9) show the majority of the proposed development area as enclosed fields with the exception of the north-east corner. Sited at the northern end of Inveresk Road, a two compartment rectangular structure noted as '*Sheepfield Cottage'* is shown on the First Edition Ordnance Survey map. Another building lies approximately 50 m to the west of Sheepfield Cottage in the same enclosure and there is also an additional three compartment structure denoted as Tan Pits in between the two. A third, final, structure is also shown to lie within the proposed development area, at a location that corresponds to Kirk Park House, as shown on the Ordnance Survey 1895 map (Figure 11).

4.4.6 It is thus notable that until the late 19th century the majority of the proposed development area remained as unoccupied agricultural land. The mid-late 19th century witnessed the development of small scale industry along the banks of the Esk associated with tanning and gravel extraction which was focused in the north and east of the development area. An archaeological watching brief undertaken during the excavation of site investigation pits in the east of the site in 2001 revealed saggars and wasters of 19th century date relating to the Newbigging Pottery and suggested that the area may have been a dump for the waste from the pottery (Rankin & Rees 2001).

4.5 The establishment of Brunton Wireworks and the history of wire making and modern development (1876-present)

4.5.1 A wireworks or mill was first erected within the proposed development area in 1876 by Ward and Fraser a partnership of wire manufacturers from Musselburgh. Ward and Fraser did not actually draw wire but rather bought it in then galvanised or tinned it for lemonade bottle stoppers. In 1878 the buildings of Ward and Fraser were acquired by the Musselburgh Wiremills Co Ltd headed by William Nelson Brunton, the principle shareholder and Director (Smith 1995, 1).

4.5.2 A plan of the wireworks held in the National Archives (RHP 13380) shows the works to consist of a single building in the north-east of the proposed development area. The building was divided into eight main work areas which comprised a steam engine, wiremill with rope walk, wire mill with jigger blocks, galvanising area with reeling machine, gally tank, wood swifts shop and goods shed. This

plan does not show the remainder of the proposed development area which is likely to have remained as undeveloped land during this time.

4.5.3 In 1893, Mr John Dixon Brunton the son of Mr W N Brunton reached the age of 21 and took up the post of Managing Director of the firm, W N Brunton and Son. Ordnance Survey maps of the wireworks from this date show the wireworks to have been extended to include a large extension to the south–east as well as two '*wire mill cottages*' to the west of the main works building. East of the wiremill, a bowling green is shown and numerous unlabelled structures adjacent to the mill lade in the north are also shown. The north of the proposed development area now occupied by Olive Bank Road contained an Engine Shed and railway sidings associated with the nearby Musselburgh Station. The south of the proposed development area remained as open agricultural land on this edition and on the Ordnance Survey 1895 map. Kirk Park House is shown south of Inveresk Road in the east of the site and a gravel pit is shown in the south of the proposed development area.

4.5.4 As Managing Director, J D Brunton, implemented a number of changes within the company primarily revolving around research into new products and innovations. He set up a laboratory and part of his research was one of the earliest, if not the first, attempt at wire fatigue testing. In the late 19th century Bruntons was responsible for the invention of numerous innovative wire products and processes. For example, in 1894 Bruntons became the first firm to draw Sir Robert Hadfield's manganese steel into wire and in 1898 they developed 'Bruntonised Anti-corrosive wire' and in 1899 Bruntons were the first company in Britain to produce nickel iron resistance wire for Electrical Rhesotats (Smith 1995, 2).

4.5.5 The early 20th century witnessed rapid development of the wireworks. In 1901, the first rope stranding machine was installed followed by a six bobbin and twelve bobbin closing machine. High speed steel was first drawn into wire by Bruntons in 1907 and by 1908 the Ropery department had a total of 20 machines and produced 50 tons of wire per month (Smith 1995, 2). The expansion of the ropeworks is demonstrated by the Ordnance Survey 1908 map which shows the expansion of the main wireworks complex in the north of the development area and the addition of a number of residential properties along Inveravon Terrace in the west. The wire and rope works is also shown to have expanded south and east on this edition to include five buildings on the west side of Inveresk Road. Attempts to level the site are also shown on this map which shows the southern extension of the wire and wire rope works buildings to have been built into the sloping ground as is also reflected by the benchmark noted on the map indicating that the centre of the site was a foot lower in 1908 than in 1895.

4.5.6 In 1909 J D Brunton introduced the first streamline or lenticular wire by drawing it through a split die and offered it to the War Office. On receiving rejection from the War Office, Brunton returned to developing other wire types and did not patent its design. The Royal Aircraft Factory re-invented Brunton's lenticular wire in 1912 as RAF wire (Forder 2004, 1).

4.5.7 The outbreak of the First World War in 1914 brought many changes to the site. The Royal Aircraft Factory commissioned Bruntons to make the 'RAF' wires and as the only firm in Britain making aeroplane wires they were also commissioned to make the fittings for the wires necessitating further expansion of the workshops to include light engineering workshops. The production of wires for the War Office necessitated the introduction of new machines for testing wire and wire ropes. Further expansion of the wireworks is demonstrated by Ordnance Survey maps from 1914 which show the bowling green in the east of the development area to have been replaced by new workshop buildings

and further extension to the workshops and testing ranges in the south. A new 100 ton Testing Machine was installed on the ground floor of the main wire drawing workshop. The first aeroplane to cross the Atlantic by direct flight was fitted throughout with wires made by Bruntons in 1919 (Forder 2004).

4.5.8 The Armistice in 1919 brought a rapid change from war to normal production at Bruntons. Whilst the Aero Department continued to thrive with the production of streamline wires for training aircraft, the smaller light machine departments had to diversify and among the many unsuccessful ventures were a cinema projector called the Bruntte and automatically sparking plugs. In 1925 Prelay Wire Rope was first manufactured in Britain by Bruntons and in 1927 the H.M Airship R.100 was braced throughout with 63 miles of wire and 17 miles of wire rope entirely manufactured by Bruntons (Smith 1995, 3). In 1929, owing to an increase in trade from the Admiralty on the manufacture of wire ropes for Aircraft Catapults, Bruntons established a pre-stressing range 900 feet long and with a capacity for 20 tons (Smith 1995, 3).

4.5.9 In the 1930s several important changes were made at the factory which were integral in its later role in the manufacture of materials for the war effort. A new ropery was built at Kirkpark in the south of the site, and many new stranding and closing machines purchased or made at the works. New offices had been erected on the site of the old ropery. Plans of the proposed alterations to the offices dating from 1938 (DPM 1930/143/16/3) show the addition of a new Display hall and stage, new receptions rooms, private office and boardroom, all of which reflect the increasing prosperity and expansion of the business. Plans for a new Cold Rolled Strip Department are also shown and new non-slip continuous machines had been installed. The equipment necessary for taking part of the power supply from the National Grid was complete in 1939 (Smith 1995, 3).

4.5.10 In 1939 Bruntons became a Public Company under the name of Bruntons (Musselburgh) Limited and was asked by the Air Ministry to consider establishing a shadow factory due to its vital role in the production of aeroplane wires. However, a second factory was never established and the production of wires for aeroplanes in Britain throughout the Second World War remained the sole responsibility of Bruntons. The fact that Musselburgh was never bombed during the Second World War was thus fundamental to the success of Britain's air campaign (Tully-Jackson & Brown 2001, 54). In addition to aircraft wires, other articles produced for provision to the Air Ministry were Bomb Slings, Aero Cable Fittings, Wire Aerials and high tensile wire ropes for the balloon barrage. Brunton's wire ropes were used in the Mulberry Harbours used on D-day landing (Smith 1995, 4).

4.5.11 After the war, the pre-stressing range at Kirkpark was employed in fabricating the sealing strips for steam catapults developed by Brown Brothers in 1948. This vital component went on to be supplied by Bruntons for all Aircraft Carriers in the world except those of the U.S. Navy. Bruntons continued to specialise in the production of aircraft wires and fittings throughout the second half of the 20th century.

4.5.12 In the winter of 1951 a fire started in Bruntons wire drawing shop and spread through the engineers', electricians and joiners' shops completely destroying the main offices and all of the company's original paperwork. The company was forced to rely on the honesty of its customers in paying their outstanding bills and its suppliers in providing copies of invoices (The Old Musselburgh Club 2000, 28). Detailed plans from 1952 (DPM 1930/143/2/1) demonstrate that the new layout was largely based on the pre-existing layout with the addition of extra office space, engineering workshops and rope testing facilities. The offices were located in the north-east of the site aligned east/west along

Station Road, with the smiths and engineering workshops in the north-west of the site along Station Road. The bulk of the factory in the south of the site was thus taken up with manufacture and rope testing.

4.5.13 A decrease in the demand for haulage ropes after the Second World War led to a requirement for diversification in the ropery department with the manufacture of wire ropes for coal ploughs and cable belt conveyors. Bruntons made all the wire ropes used in the construction of the Forth Road Bridge and these ropes were pre-stressed on the 100 ton testing range. However, with this new field of bridge ropes opening up in different parts of the world and the requirements of pre-stressed stay ropes for the tall masts used in Radio, Radar and Television transmission some of which are over 1000 feet high, the necessity for laying down a pre-stressing range was apparent. This was realised and commissioned in 1964 with a 500 ton maximum load. The new 500 ton rope testing range is depicted in the south of the proposed development area on Ordnance Survey maps from 1967.

4.5.14 Bruntons continued to supply wire rope to major companies worldwide throughout the 20th century securing large contracts for shaft ropes for mining for the National Coal Board and for elevator ropes in Hong Kong. A plan of the works dating to 1990 (D7431; not shown) indicates the diverse range of functions carried out within the rope works towards the end of the millennium. The line of the mill lead is still shown in the west of the development area on these plans. The layout of the factory reflects the processes and runs from offices and engineering units in the north, to shapes department and design in the centre through to manufacture furnaces, cleaning and despatching in the centre. The south of the proposed development area was in use for research and included the patent shop and wire rope testing range. Kirkpark manse and garden continued to occupy the west of the proposed development area until the demolition of the wider factory. The factory continued in operation until 1997 when it closed and the company sold off surplus rope making equipment and machinery and the majority of the works were demolished. The wire rope testing range in the south of the site and the wire drawing office remained on site and were demolished in 2000.

5 RESULTS

5.1 Introduction

5.1.1 The archaeological excavation was undertaken between 2nd February and 13th March 2009, with cold weather conditions throughout. The following should be read in conjunction with the data presented in Appendices 1 - 3, Figures 1-23 and Plates 1-15.

5.1.2 The entire development area was covered in a thick layer of concrete, which formed the foundation layer or floor of the now demolished Brunton Wireworks. Despite being built into a slope, the entire development area was flat, the underlying natural subsoil being removed to create a level building surface. The area was then built up using two distinct deposits of building debris (including brick and metal) and waster material (ash and ceramic) from the nearby Newbigging Pottery (Haggarty and McIntyre 1996).

5.1.3 A series of previously unrecorded red brick-built flues or tunnels identified across the development area during the evaluation formed the main focus of the subsequent excavation (AOC 2008a). The flues, all identified underlying the existing ground surface, and located on various alignments, were constructed of a combination of mortar bonded red brick and fire brick.

5.1.4 The flues varied in size, shape and form, strongly indicating a variation in function, chronology or age. The main objective of the archaeological excavation was therefore to attempt to establish the function, chronology or age of the structures and try to relate them to any known structural evidence.

5.2 Structure [101]

5.2.1 Structure [101] was the general number given to all of the associated features identified within Trench 1 (Figure 15; Plate 1; [102] to [118]).The entire structure was constructed of a combination of red bricks, fire bricks and some concrete and was built in to the natural sand, at least 1.0 m below the (existing) ground surface.

5.2.2 The largest and perhaps most important structure recorded within the trench comprised a group of features identified as a furnace [111] (Plate 2). The structure comprised a red brick-built room [113], measuring 2.0 m by 2.0 m in plan by up to 1.03 m in depth. The room provided access to the furnace [116], itself a large feature measuring at least 1.0 m by 0.70 m in plan (Plate 2). The furnace comprised a metal grate and associated access point, both of which were coated in a thick residue of slag/ore/ash [117] (Plate 2), suggesting intense heat. Further evidence of the burning process was identified in large deposits of ash within two pits recorded to the north [114] and south [112] of the main room [113].

5.2.3 Two parallel air vents [108] and [110]) aligned north to south were located to the south-east of the main furnace structure (Plate 3). The features were constructed of the same large flat fire bricks (individually measuring 0.25 m by 0.23 m by 0.07 m) identified during the evaluation. It is clear that the features shared a similar function; the occurrence of fire bricks indicates that the vents would have been subject to high temperatures and therefore they are likely to have formed part of the heating/energy system of the wireworks.

5.2.4 Two brick tunnels were identified to the south of the furnace structure (Plate 4). Tunnel [103], aligned east to west, sloping down to the west, measured 1.48 m in length, by 0.60 m (internally) in width. The tunnel was constructed of *Whitehill* bricks. A second tunnel [105], located at the western end of [103], was aligned north to south, sloping down to the south. The tunnel measured 2.45 m in length by 0.52 m in width (internally). The two tunnels would have originally been connected but the insertion of a later blocking wall [104] divided the two. The creation of the wall [104] would have controlled access to tunnel [105] (Plate 5) and further demonstrates phasing within the structure

5.2.5 A series of non-specific red brick settings/compartments were recorded around Structure [101]; although assigning function is problematic (Plate 1). Some at least appear to be storage compartments [106], whiles others may be the foundations of overlying structures ([102] and [109]).

5.3 Structure [201]

5.3.1 Structure [201] was the general number given to all of the associated features identified within Trench 2 (Figure 16; Plate 6; [202] to [206]). The entire structure was constructed of a combination of red bricks, fire bricks and some concrete and was built into the natural sand at least 1.0 m below the (existing) ground surface. Generally, the features were identified as foundations only, the overlying structures having been removed by previous development within the works.

5.3.2 Three red brick-built tunnels were identified within Trench 2 (Plate 7). Tunnel [203] comprised a curvilinear east to west aligned tunnel, (internally) 0.48 m in width by 3.40 m in length. The tunnel abutted a red brick platform constructed using *Preston Grange* bricks. Tunnel [204] comprised a north to south aligned tunnel, (internally) 0.96 m in width by (surviving) 3.40 m in length and was constructed using *Whitehill* bricks. Tunnel [204] sloped downwards to the north. The two tunnels were connected at one end, although due to later truncation their relationship is unclear. A third

tunnel [206] was identified aligned east to west at the edge of the trench. The tunnel was constructed of red brick and measured 1.88 m in width.

5.3.3 A red brick surface [202] and red brick service setting/duct, both constructed of *Preston Grange* bricks were also recorded within the trench (Plate 6).

5.4 Structure [401]

5.4.1 Structure [401] was the general number given to two adjoining red brick, mortar bonded tunnels within Trench 4 ([402] to [405]; Figure 17; Plate 8). The tunnels were identified just below the (present) ground surface and were capped by concrete.

5.4.2 Tunnel [402], aligned east to west measured (internally) 0.60 m in width by 1.0 m in depth (Plate 9). The tunnel floor was lined with bricks. The internal surface was coated with a thick, compact grey residue, but generally the tunnel showed no obvious signs of function. The tunnel was connected to tunnel [403] to the south.

5.4.3 Tunnel [403], was aligned east to west before curving in to tunnel [402]. The tunnel measured (internally) 0.65 m in width by 1.0 m in depth. The tunnel floor was lined with bricks. Although the internal surface appeared to be clean, the whole of the tunnel had been backfilled by a combination of brick, rubble and ash [405].

5.4.4 Both tunnels were surrounded by a red, heat affected sand [404]. The origin of the material is unclear, but it seems likely that the material was heat affected during the life of the structures, caused by the processes taking place within them. Alternatively, the sand could have been deposited prior to the construction to seal the structures and prevent gases escaping?

5.5 Structure [501]

5.5.1 Structure [501] was the general number given to all of the associated features identified within Trench 5 (Figure 18; Plate 10; [502] to [511]). The entire structure was constructed of a combination of red bricks, fire bricks and some concrete. The structure appears to have been built into deep made ground comprising waste material from local industry. The features were identified just below the (existing) ground surface.

5.5.2 The majority of features recorded within the trench comprise a series of interconnecting red brick built tunnels ([502] to [506] and [508). The tunnels compare in size, shape and therefore presumably function, generally measuring (internally) 1.80 m in depth by 0.85 m in width. The tunnels appear to from a rectilinear shape in plan, perhaps following the shape of an overlying building.

5.5.3 A smaller brick tunnel [509] identified running north-east from tunnel [504] measured 0.50 m in width. The difference in size implies the tunnel may have served a different function to the other examples recorded.

5.5.4 A circular feature [507] constructed using *Preston Grange* bricks connected to tunnel [506] (Plate 10). The feature measured (internally) 0.90 m in width by 1.30 m in depth and was surrounded by 1.30 m thick walls. The feature contrasts to all other features on site through its sheer size and probably represents the foundation of a much larger chimney, identified on the 1947 OS Map (Figure 19).

5.6 Structure [601]

5.6.1 Structure [601] was the general number given to all of the associated features identified within Trench 6 (Figure 20; Plate 11; [602] to [617]).The entire structure was constructed of a combination

of red bricks, fire bricks and some concrete. The depth of the features varied to between 0.50 m below the (existing surface) to up to 2.5 m below. It is clear that the remains represented features from at east two different floor levels. Structure [601] was the largest and most complex set of features on site, containing evidence not only for both the differing processes and functions performed, but also differing phases of the site construction.

5.6.2 The main feature comprised a rectangular brick feature [602], constructed using both red (*Preston Grange*) and fire bricks, measuring 3.0 m by 1.70 m in plan and up to 1.70 m in depth (Plate 12). Generally, the feature appeared to be hollow, with a small fire brick-lined flue [603] located in the south-west corner. A brick archway was identified in the south-facing wall of the structure (Plate 13). That such a feature was inserted in to the wall suggests that the structure may have required additional strengthening and as such may have supported a substantial structure.

5.6.3 A red brick walled, concrete floored room [604] was located to the south of feature [602] (Plate 13). The room measured 4.0 m by 2.10 m in plan and up to 0.80 m in depth. Internally, the room contained a machine base [605] and an associated pipe [623].

5.6.4 The majority of features present within Structure [601] comprise a variety of inter-cutting tunnels which appear to truncate each other (Plate 14). Tunnels [611] and [613] would have originally formed part of the same feature, the former aligned north to south and the latter east to west, but meeting in a corner point. Both measured 1.27 m in depth by 0.60 m in width (internally). Tunnel [611] later went out of use, with the insertion of a red brick wall and concrete chute [612] at its end, restricting access to tunnel [613] (Plate 14).

5.6.5 A secondary tunnel [614], apparently contemporary with [611], was also truncated by the construction of [612] (Plate 15). Tunnel [614] was smaller measuring only 0.60 m by 0.60 m (internally) and partially filled with a combination of wood and silt. The feature previously appeared to run towards feature [602], but was cut by [612].

5.6.6 Tunnel [616], a north to south aligned red brick-built feature, ran parallel to tunnel [611] and similarly must have gone out of use as it had been backfilled with brick, rubble and debris. The tunnel measured (internally) 0.75 m in width by 1.05 m in depth.

5.6.7 A large area of hard standing [610] was located to the south of room [604]. The majority of the area and its associated features comprised of fire brick. The area abutted room [604] and the relationship between the two is confused by later truncation. However, the presence of three interconnecting fire brick tunnels ([607], [608] and [609]) certainly reflects the area's association with intense heat. The tunnels, constructed using *Preston Grange* bricks, measured (internally) 0.60 m in width by 0.45 m in depth. Several deposits of molten lead were identified in and around the tunnels.

5.6.8 A series of red brick settings ((617), [619], [620], [621]) were identified just below the surface of the excavation area overlying tunnels [613] and [614] and represent a combination of service ducts, machine bases and building foundations.

5.7 Structure [701]

5.7.1 Area 7 was excavated in an attempt to further identify waster material from the Newbigging Pottery, recorded during the previous evaluation (Cook 2008b). A selection of material was recovered from in and around the area and is discussed below (Section 5.8).

5.7.2 Structure [701] comprised the remnants of a building (Figure 21), identified from the 2nd Edition OS Map (Fig 10 and 22, 1893) as Kirk Park House. The cottage was only partially excavated and

comprised a simple lime mortar bonded sandstone cottage built directly on to the underlying natural sand. The cottage, aligned approximately east to west measured at least 8.0 m in length by 4.0 m in width. No internal features, floors nor furniture was identified, the building being demolished to its foundations.

5.8 Structures recorded in the evaluation only

5.8.1 A series of structures recorded during the original evaluation works were not investigated further but should be discussed in relation to the other structures, to provide a fuller narrative of the works.

5.8.2 Structures [1201] and [1202] (AOC 2008) comprised two abutting red brick-built structures aligned north-east to south-west across Trench 12. Although both archways were lined with fire bricks and contained signs of heat, their size and shapes varied. Structure [1201] comprised an arch 0.95 m in width by 1.10 m in depth, and was lined with a brick floor. The floor was overlain by a thick layer of ash and rubble. Structure [1202] comprised an arch 0.80 m in width by 1.10 m in depth. An iron stove identified at the base of the feature suggests that this may have been part of the boiler feeder system. It was unclear from the evaluation whether the arches were contemporary.

5.8.3 The furnace feature identified during the evaluation Structure [901] (AOC 2008) comprised a series of truncated red brick walls, pipes and air vents lined with fire bricks. Unfortunately, it is unclear as to how the features relate to each other. The large proportion of air vents may imply the structure formed part of the boiler system used on site.

5.9 Ceramic and Brick Assemblage

5.9.1 The majority of the small finds recovered from the site relate to its use as a dumping ground for the Newbigging Pottery (Haggarty and McIntyre 1996). These included waster fragments of stoneware jars and bottles and kiln furniture such as saggars as well as plate moulds. Contrary to the conclusions drawn from the evaluation, no specific waster pit was identified. Instead, the whole area appears to have been used as a dumping ground for the Newbigging Pottery. The amount of waste material produced by such industry would have been huge, and manufacturers would have dumped the waste product anywhere they could (Haggarty pers comm.).

5.9.2 A large selection of bricks used in the construction of the wireworks were identified and recorded. The vast majority of bricks comprise local examples, bought from local companies such as the *Niddrie, Whitehill* and *Preston Grange* Brickworks. All of these brickworks were located next to existing collieries and used the fire-clay removed from the coal workings to produce the bricks.

5.9.3 A more specialised fire brick was identified within Structure [101]. The brick was double the size of the more usual red brick, measuring 0.23 m by 0.23 m in size and 0.07 m in depth. The brick is stamped with '*Stevenson Patent, Gibbons Brothers, Dudley'*. Clearly, when local companies were unable to provide the relevant high-quality material, goods had to be exported from further afield.

5.10 Miscellaneous Artefacts

5.10.1 A metal plaque was recovered form a piece of machinery associated with Structure [1201] (AOC 2008). The plaque was cast with the following inscription 'The Robot Stoker, No, Riley Stoker Co Ltd, London'. The plaque comes from a mechanical stoker, a device which automatically fed coal in to steam boilers (www.wpi.edu/Academics/Library/Archives/Riley). The stoker was developed and produced from 1911 onwards.

6 DISCUSSION

6.1 The archaeological excavation completed at the site of the Brunton Wireworks confirmed the results of the earlier evaluation and identified archaeological features relating to the late Victorian, Edwardian and later 20th century development of the site. That the evaluation failed to identify anything earlier than the Victorian remains of the Brunton Wireworks and residual material from the Newbigging Pottery is perhaps unsurprising considering the amount of truncation recorded across the site. Although previous investigations have identified both prehistoric and Roman remains, it is now clear that the subsequent development of the Brunton Wireworks has almost certainly destroyed any remaining features from this period.

6.2 Having previously established a comprehensive record of the history of the Brunton Wireworks (AOC 2008b) and identified any remaining up-standing structures relating to the buildings (Cook 2008), the excavation was wholly related to the identification and recording of the underground remains comprising the network of red brick-built tunnels and associated features. The archaeological excavation and subsequent survey and map regression shows the network of tunnels underlie the whole of the Brunton Wireworks (Figure 23), from the original structures to the north to the subsequent later development to the south of the site. Of course, the excavation revealed only key elements, but the age, function and chronology can be at least partly established.

6.3 The function of the tunnels is at least implied by their construction and association with known features/artefacts. As suggested from the results of the evaluation, the tunnels were used to contain and distribute hot air/steam/gas. All of the features are at least partially built of fire bricks and many contain evidence of burning/heat damage (for example [203, Plates 6 and 7]. In addition, the tunnels were found to be associated with at least two furnaces (Feature [111] and Feature [1201] (AOC 2008) and a chimney [507]. Perhaps the most obvious evidence for their use within a steam engine/system is the fragment of the 'Riley Stoker' recovered from Feature [1201]. The smaller, tunnels, unaffected by heat damage may have provided an air supply to the furnaces.

6.4 Specifically, the manufacture of wire would have involved several processes which would have required the use of both coal and gas furnaces as well as several machines powered by such systems. Wire manufacture involved billets of raw steel being fed into a furnace and heated to 1100 degrees centigrade. The heated billets were then be fed in to a roller machine and rolled into the required size, before being cleaned by immersion in an acid bath to remove all scale. After being washed with water at high pressure, the rods were then dried in a large oven. The rods were then pulled through a gas heated furnace for heat treatment (Bruntons Wire and Rope Works, Musselburgh, 1930, SSA).

6.5 The age and chronology of the network is also worth discussing. We know from the historical records that the factory was in use between 1876 and 1997. However, that at least some of the tunnels were backfilled by building debris, masonry and other rubbish demonstrates that they were not in use for the entirety of the lifetime of the factory. It therefore seems likely that at least part of the steam energy system went out of use, and was superceded by another system, probably using gas or electricity. That some of the tunnels remained in use may be due to the continued ability of the furnaces to heat the factory, among other functions.

6.6 The chronology of the tunnel network is similarly hard to establish, but also worth commenting on. Clearly, the age of the tunnels reflect the chronology of the overlying buildings, and as such the earliest fragments underlie the northern part of the site. The buildings to the south of the development were only constructed between the publication of the 3rd OS Map (1913) and the 4th OS Map (1949), and the tunnels almost certainly reflect this. That at least some of the tunnels were superceded by the later development of newer examples (for examples within Structure [601]),

implies a chronological sequence within their development. Unfortunately, we can only now guess at the precise dates.

6.7 The identification of further waster ceramic material associated with the nearby Newbigging Pottery is also of significance. The Newbigging Pottery was an important producer of ceramics between 1800 and the 1920s and any material recovered from the site would help define the chronology of the factory production. The ceramic assemblage recovered from the site will undoubtedly require cataloguing and analysis by a ceramics specialist.

7 CONCLUSION

7.1 The archaeological excavation completed at the site of the Brunton Wireworks was hugely successful, recording evidence for the previously unrecorded underground power system and confirming the use of the site as a dumping ground fro the Newbigging Pottery.

7.2 A programme of post-excavation analyses will be required, the full nature and remit of which will be confirmed by Mr. Andrew Robertson of ELCAS. The work is likely to involve the analyses of the ceramic assemblage recovered and the publication of the results of the work in a local journal or magazine.

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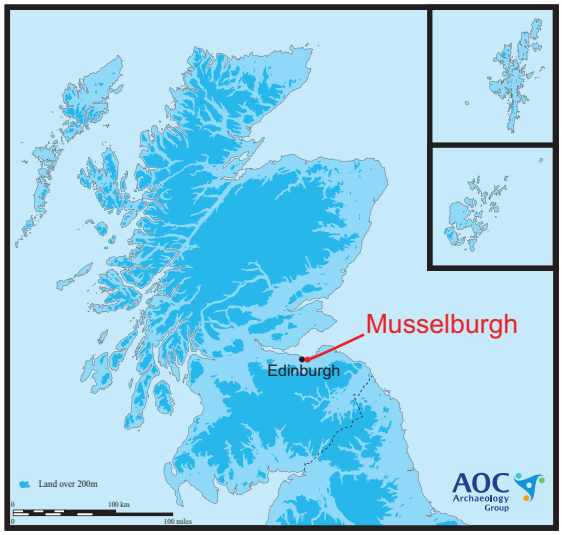


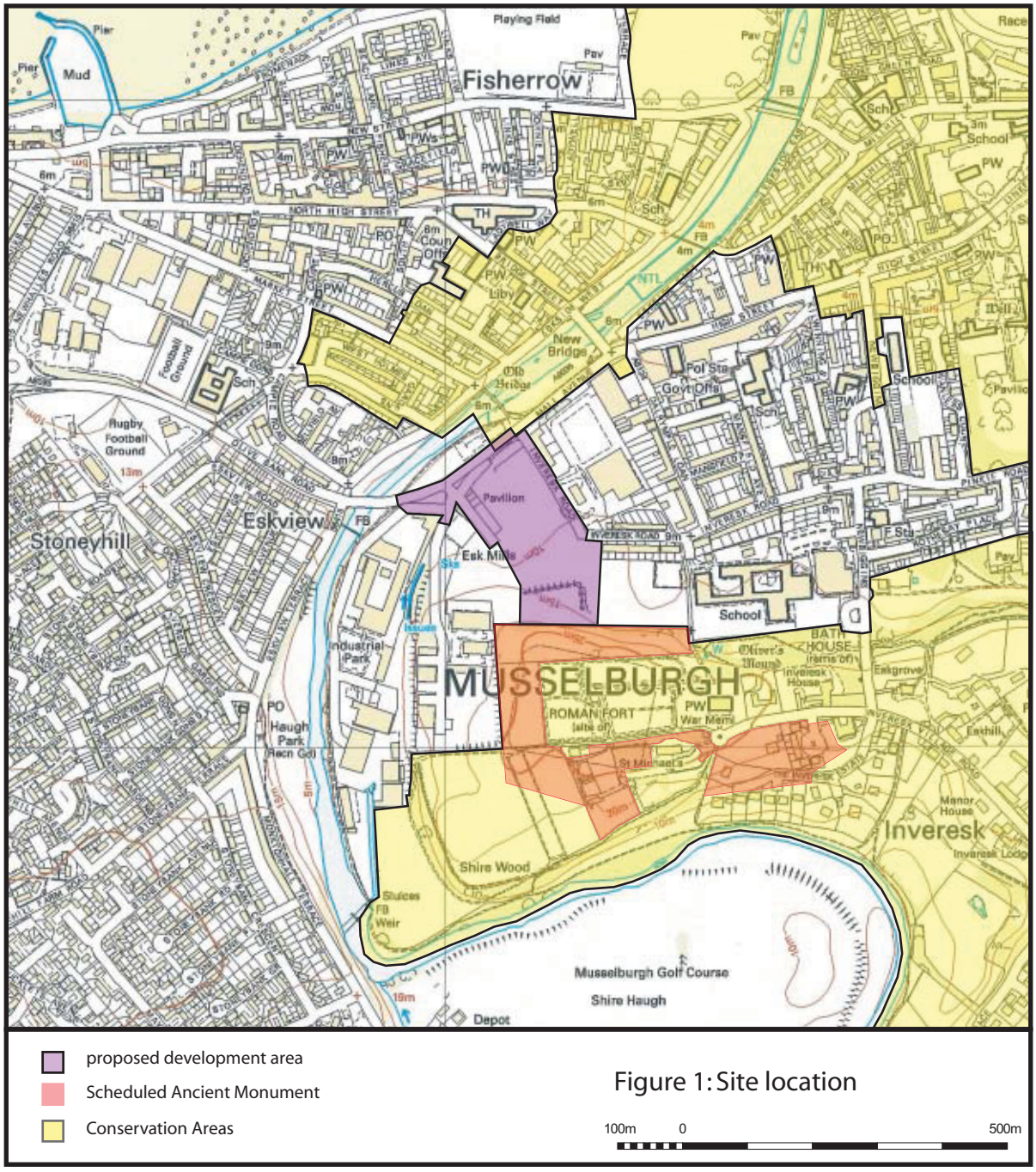
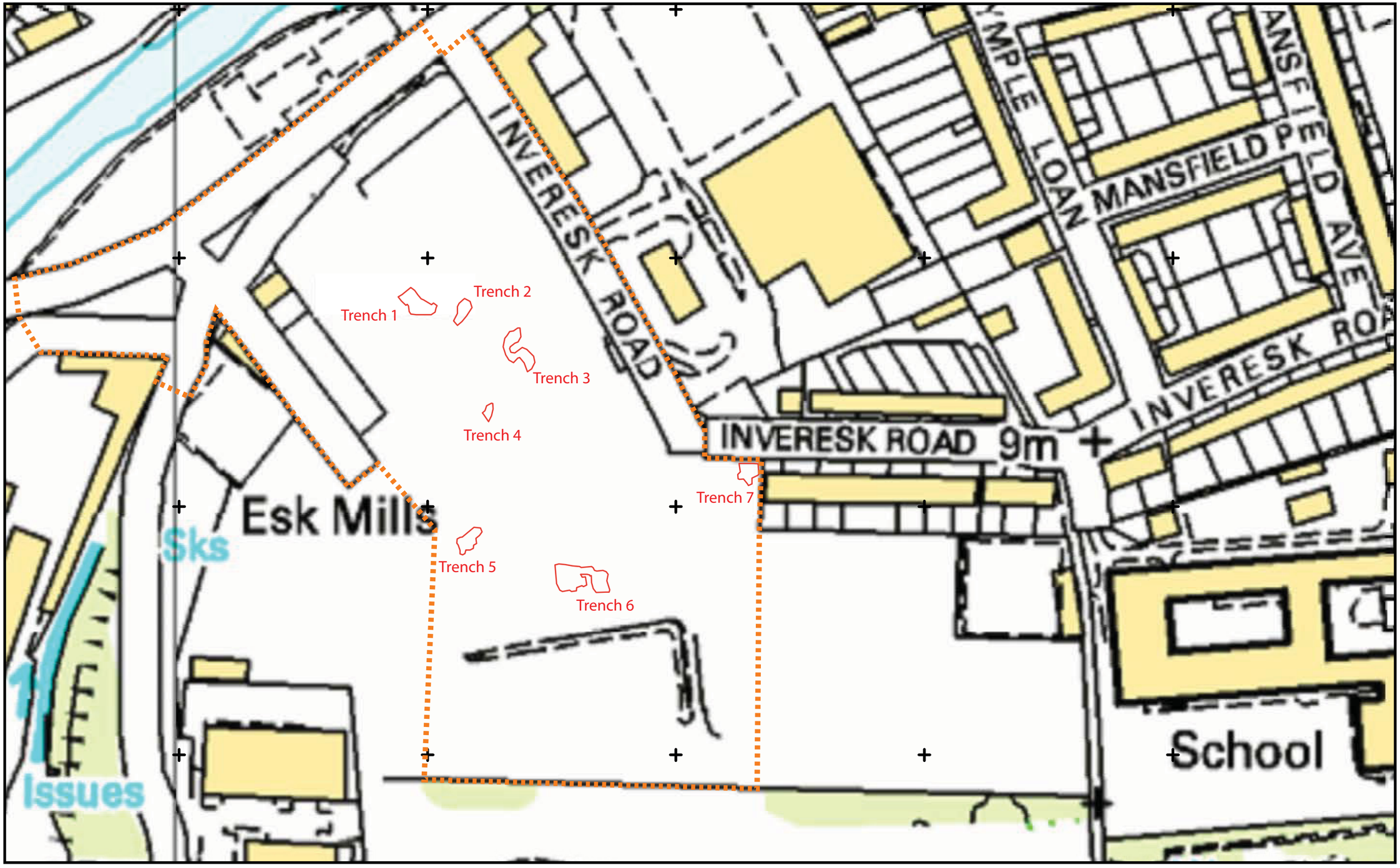


Figure 1: Site location



N

0m 100m

location of trenches

proposed development area

Figure 2: Trench location plan

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approximate location of proposed development area

Figure 3: Extract from map by Adair, 1682

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Figure 4: Extract from painting by Slezer, 1693

approximate location of proposed development area

Figure 5: Extract from map by Roy, 1747-55

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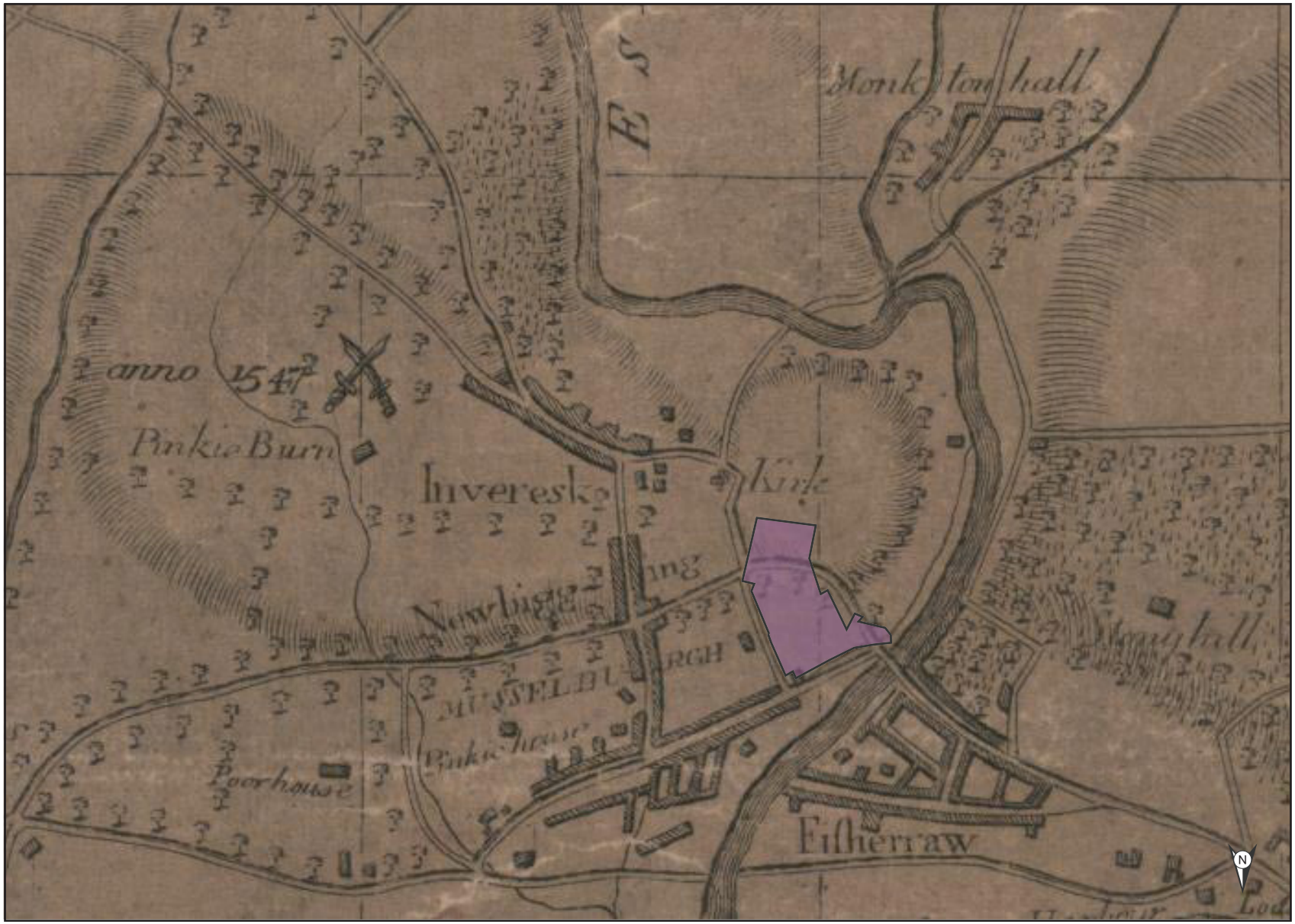

approximate location of proposed development area

Figure 6: Extract from map by Laurie, 1763

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Figure 7: Extract from map by Thomson, 1821

Figure 8: Extract from map by Hunter & Anderson, 1834

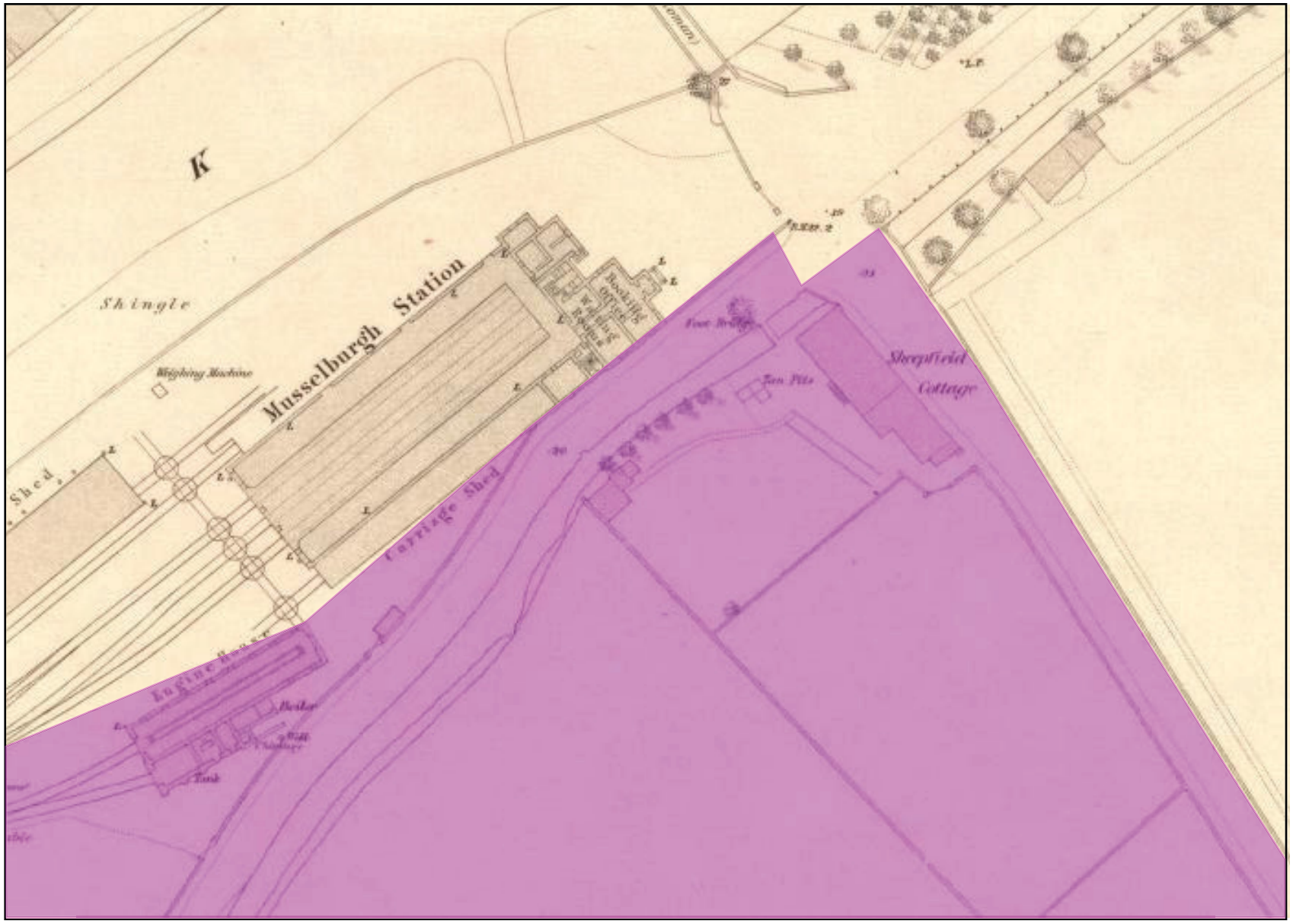

Figure 9: Extract from map by Ordnance Survey, 1853

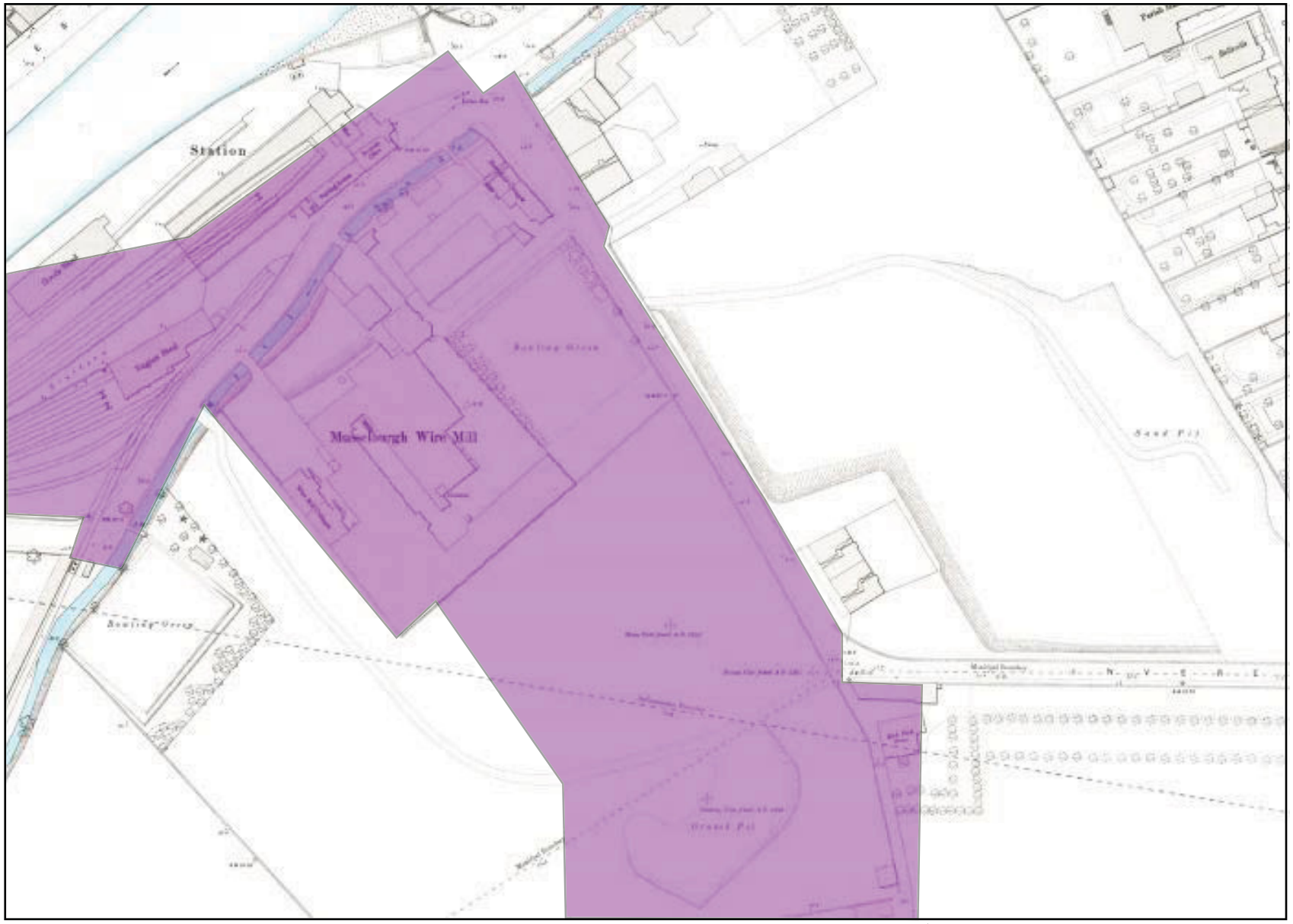

Figure 10: Extract from map by Ordnance Survey, 1895

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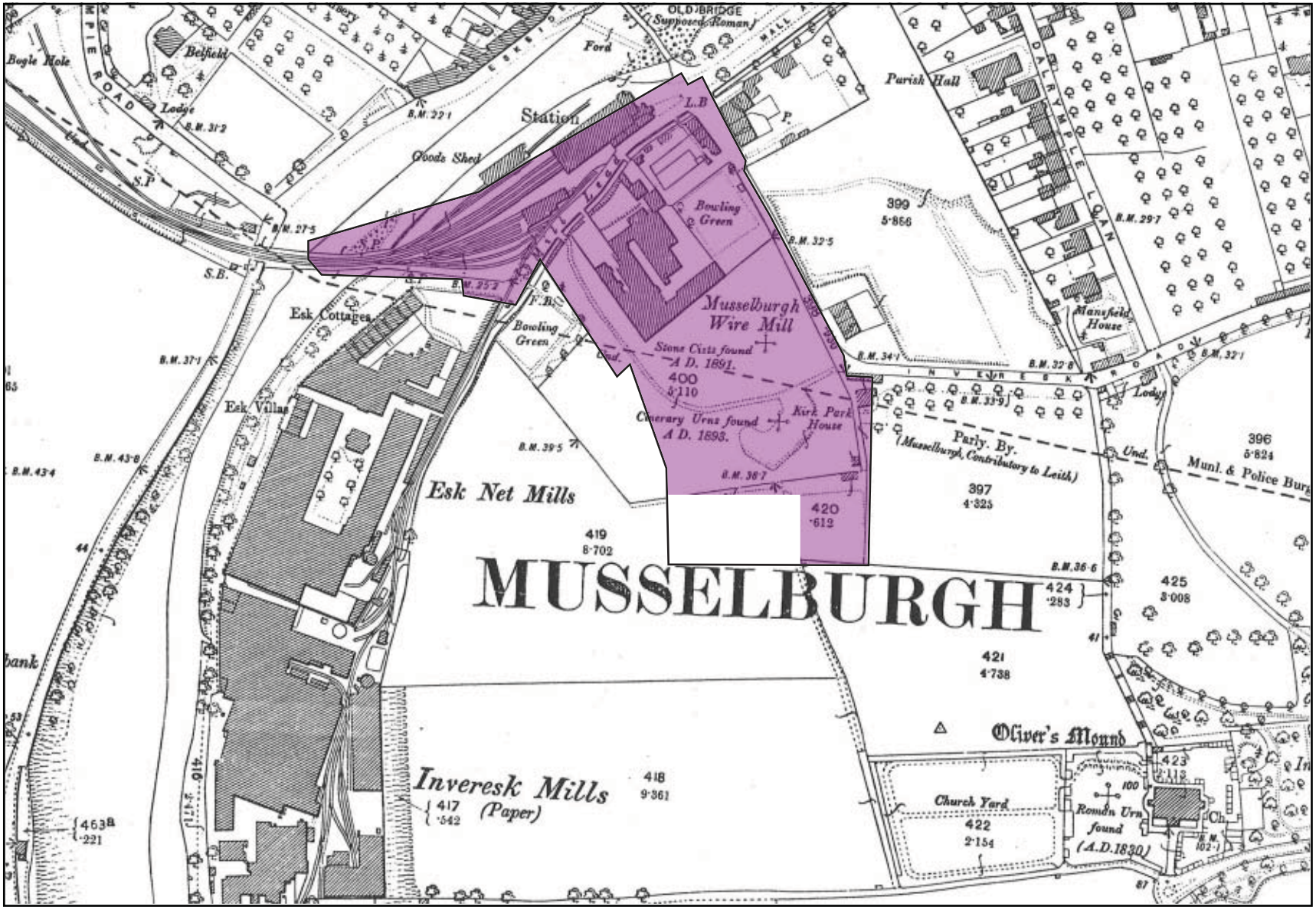

approximate location of proposed development area

Figure 11: Extract from map by Ordnance Survey, 1895

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