



ARCHAEOLOGICAL
MONITORING
OF
GROUND INVESTIGATIONS

TEES VALLEY ENERGY RECOVERY
FACILITY (TVERF)
REDCAR
TEESSIDE

prepared for
Stantec
on behalf of
The Councils

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District Redcar and Cleveland

Grid Ref NZ 54449 21337

**TEES VALLEY ENERGY RECOVERY FACILITY (TVERF), GRANGETOWN,
REDCAR, TEESSIDE**

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TEES VALLEY ENERGY RECOVERY FACILITY (TVERF), GRANGETOWN,
REDCAR, TEESIDE

ARCHAEOLOGICAL MONITORING OF GROUND INVESTIGATIONS

Summary

This document presents the results of a programme of archaeological monitoring during ground investigation (GI) works carried out at a former steel works site at Grangetown, Redcar, Teesside (centred on NZ 54449 21337) in preparation for an Energy Recovery Facility. The work was carried out between 13th and 24th July 2020 by Northern Archaeological Associates Ltd (NAA) on behalf of Stantec, representing its client The Councils.

Monitoring was undertaken during excavation of 68 trial pits, boreholes and window sample launch pits. This total included multiple attempts at some locations to break through thick concrete surfaces and substantial deposits of demolition rubble. The ground investigations were concentrated mainly within the northern and eastern parts of the site (Area A) where it is proposed to site the main buildings associated with the proposed Energy Recovery Facility. A smaller number of investigations were carried out in the south-western part of the site (Area C) which is planned as a biodiversity enhancement area. The works avoided Area B, an area in the centre of the site known to contain significant archaeological remains relating to the past industrial use of the site.

Although carried out under difficult conditions including unstable rubble deposits and severe groundwater flooding, archaeological monitoring of the ground investigation works largely achieved the objectives of the watching brief. The main aims of the archaeological monitoring as stated in the Written Scheme of Investigation were to identify the presence and location of any archaeological remains within the area of development, and establish their nature, extent, preservation and significance.

The level of natural clay and depth of overlying reclamation and demolition deposits was established across much of the proposed development area (PDA). Natural clay was encountered at depths of between 0.5m and 2.4m below ground level (bgl), although typically the surface seemed to lie at 1.5–2.2m bgl. This will have been affected by variations in the modern ground surface across the area, while some particularly shallow records may have represented redeposited material.

Above the clay, there was extensive evidence for land-reclamation in the form of ash and clinker dumping across all parts of the PDA. These deposits were up to 2m thick and all of the structures observed had been cut into them.

Substantial below ground remains of brick and concrete structures were encountered across most parts of the PDA, and many of the buildings associated with various phases of the steelworks contained basements, below-ground tanks and other structures that had caused significant localised truncation of earlier deposits, in some places to a depth of 3m bgl or deeper. However, in most areas between these deeper intrusions, the modern concrete services had served to protect the earlier deposits from modern disturbance. An exception was in the south-western corner of the site where no buried structures were identified in an area once covered by railway tracks. In addition, in situ railway lines were found buried in the northern and eastern parts of the area.

Within the northern part of Area A, monitoring recorded a concentration of brick-wall footings; whereas only a few of these were seen elsewhere across the PDA. These brick walls were not associated with the concrete slab floors commonly seen in later structures on the site. In the same area, several arched brick structures were encountered, which possibly represented furnace flues. The 1850s Eston Iron Works was in this area, to the north of the furnaces associated with the 1870s Cleveland Works which were located in Area B. It is therefore possible that some of the brick structures encountered in the northern part of the PDA were associated with the earlier ironworks. Given the relatively shallow depth of most of these remains, any remediation works associated with the development will have a significant/total impact on them.

1.0 INTRODUCTION

1.1 This document presents the results of a programme of archaeological monitoring during ground investigation (GI) works carried out at a former steel works site at Grangetown, Redcar, Teesside (centred on NZ 54449 21337; Fig.1) in preparation for an Energy Recovery Facility. The work was carried out between 13th and 24th July 2020 by Northern Archaeological Associates Ltd (NAA) on behalf of Stantec, representing its client on behalf of Hartlepool Borough Council, Darlington Borough Council, Stockton on Tees Borough Council, Middlesbrough Borough Council, Redcar & Cleveland Borough Council, Newcastle City Council and Durham County Council (The Councils). The work followed a Written Scheme of Investigation (WSI) which had been agreed in advance with North East Archaeological Research (NEAR) archaeological advisers to Redcar and Cleveland Borough Council in order that the archaeological monitoring constituted a scheme of works approved by the local planning authority (NAA 2020).

Planning background

1.2 The National Planning Policy Framework (NPPF 2019; MHCLG 2019) establishes that where a site on which development is proposed has the potential to include heritage assets with archaeological interest, local authorities should require planning applicants to describe the significance of any heritage assets affected. The level of detail should be proportionate to the assets' importance and sufficient to understand the potential impact of the proposal on their significance (para. 189).

1.3 Planning permission (Ref. R/2019/0767/OOM) was granted by Redcar and Cleveland Borough Council for the construction of the Energy Recovery Facility and associated development. Condition 6 requires the implementation of a programme of archaeological work in accordance with a WSI, as outlined in the consultation advice (NEAR 2020). In discussions between Stantec and NEAR, it was agreed that a WSI addressing section (i) of the condition would be submitted and enacted first, with a subsequent WSI for the remainder of the works to be submitted in the future (Neil Cookson, NEAR, pers. comm. to Dr. Barnett, Stantec). Condition (i) states that:

before remediation or development commences, archaeological evaluation of borehole and trenching data [should be carried out].

2.0 LOCATION, TOPOGRAPHY AND GEOLOGY

Location and topography

- 2.1 The site is adjacent to the settlements of South Bank and Grangetown on the south bank of the River Tees, at NZ 54449 21337 (Fig. 1), and comprises a rectangular plot of c.10ha, at c.10m above Ordnance Datum. The site is bounded to the north by the main Middlesbrough to Redcar railway line (Tees Valley Railway), with the Teesdale Way public footpath running parallel, and to the south of, the railway line alongside an above-ground pipeline. The site is bounded to the east by the site of Lackenby steel works, to the south by Bolckow industrial estate and beyond this the A66 road, and to the west by an above-ground pipeline, beyond which is South Tees Freight Park. The site comprises disused land and was originally the location of the Eston Iron Works (built c.1853) and later the Cleveland Steel Works (c.1874). The site was decommissioned during the 1990s.

Geology

- 2.2 The site lies on Mercia Mudstone, a sedimentary bedrock laid down over 200 million years ago in the Triassic period. It is overlain by Clay and Silt deposited up to two million years ago following glaciation of the area (BGS 2020). The drift geology comprises glacio-lacustrine clays and silts, with at least 1–2m of made ground above, from historic land reclamation during development of the iron- and steel-making industry along the Tees corridor (Daniels 2019, Stantec 2020). The made ground comprises concrete on top of blast-furnace slag, with overlying spoil heaps possibly in the location of historical blast-furnace bases (*ibid.*). The site is currently waste ground (Plate 1).

3.0 SUMMARY ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

Significance

- 3.1 The site was subject to an EA application, part of which (Chapter 10) focused on the cultural heritage of the site (Daniels 2019). The site is predominantly of industrial archaeological significance; the desk-based assessment summarises thus:

The extent of land reclamation means that there is little potential for archaeological finds of significance preceding the use of the site for iron and steel manufacture. While virtually all structures and plant have been cleared from the site there are sufficient remains to allow an understanding of the site and some of the processes which took place during its use in the production of iron and steel. There is a high

potential for remains of significance relating to the 19th and 20th century use of the site. (Daniels 2019, 11)

Industrial archaeology

- 3.2 Eston Iron Works (1853), the second set of blast furnaces built by Bolckow and Vaughan in the Middlesbrough area, comprised a line of six furnaces. The use of this set of furnaces led to the abandonment of earlier ones located in Middlesbrough because the Eston works were closer to the ironstone mines. In 1852, there were three just blast furnaces on Teesside; in 1853 a further 113 were built as the development of the iron and steel industry on Teesside gathered pace. The construction of the Eston Iron Works marks the start of the iron and steel industry in this area and of the settlements that served them. There are no visible signs above ground of these ironworks, but it is possible that remains survive below ground level.
- 3.3 In 1874, the original Eston Iron Works were demolished and replaced by the Cleveland Works (1874–76). Bolckow and Vaughan was the leading firm on Teesside in developing steel production, as opposed to iron, which initially used Bessemer conversion vessels. Four of these were located on 3.7m-high platforms in the north-western part of the development area but their precise location is unknown. They were served by a set of three 20m-high blast furnaces, which were orientated north–south. The development area was the first location on Teesside at which steel was produced in bulk (Daniels 2019, 7).
- 3.4 The original three furnaces of the Cleveland Works were replaced by two Bessemer furnaces between 1911 and 1913. These were known as ‘Yankee’ furnaces in that they copied American practice. One of these (No. 4) continued in use until 1993. The other was demolished after the First World War and a further furnace (No. 5) was constructed in 1937. The latter continued in use until 1986. The furnaces were served by a ‘Hi Line’ where the charge was run straight to the top off an elevated rail line. The surviving embankment was part of this rail line and it was carried to the blast furnaces on metal trestles (Daniels 2019, 8).
- 3.5 The blast furnaces had blast stoves attached to them to provide the hot gases needed to achieve the blast, the location of which also lies in the development area, as do the remains of later coke ovens (in the south-western part of the site), part of a rolling mill, and the laboratory and welfare facilities. To the immediate east of the furnaces were cooling towers (*ibid.*).

3.6 In 1913, Bolckow and Vaughan replaced the Bessemer converters with a set of open-hearth steel-making furnaces at the North Steel Plant; and a South Steel Plant was constructed during the First World War. The difficult economic circumstances after the war meant that they were shut down by 1928. In 1929, Bolckow and Vaughan was bought by Dorman Long and, as the economic situation improved prior to the Second World War, changes were made to the site. By 1940, rolling mills had been established to the east of the development area. Clearance of structures from the site took place from the late 1980s onwards and had been completed by the end of the 20th century (*ibid.*).

3.7 The northern boundary of the site comprises the line of the Middlesbrough to Redcar Railway, which began operating in 1846 and is still in use today. The south-western corner of the site is cut by the Eston Branch Railway (constructed in 1851), built by Bolckow and Vaughn to serve their ironstone mines at Eston (*ibid.*, 6).

4.0 AIMS AND OBJECTIVES

Scope of works

4.1 Three Areas (Fig. 2) have been identified within the site boundary (Stantec 2020):

- Area A: the proposed Energy Recovery Facility (ERF) development area in the northern and eastern parts of the site;
- Area B: area of archaeological interest in the centre of the site; and
- Area C: the proposed biodiversity enhancement area in the south-western part of the site.

4.2 Area B is an area measuring c.100m by 50m, which has been identified as containing the remains of the bases of blast furnaces related to the 1870s steel works (see below), as well as the physical evidence for the methods of charging and blowing the furnaces. On-site rail lines and concrete structures were also in evidence (Daniels 2019). This area was excluded from the ground investigation works and will be fenced and excluded from any plant movement (Stantec 2020).

4.3 The ground investigation works that were monitored comprised excavation across the site (excluding Area B) of a series of trial pits and starter pits for cable percussion boreholes and window samples (Fig. 2). Trial pits were excavated to 3m bgl. The boreholes and window sample launch pits were excavated to a depth sufficient to

determine the presence/absence of potential obstructions. Where locations were found to be unsuitable for excavation they were adjusted, resulting in multiple investigations (e.g. TP 16, TP 16a, TP 16b etc).

Standards and guidelines

4.4 The monitoring work was carried out with reference to the following published standards and guidelines of practice:

- *NPPF Planning Practice Guidance: Conserving and Enhancing the Historic Environment* (2019);
- *Standard and guidance for the collection, documentation, conservation and research of archaeological materials* (ClfA 2014a);
- *Standard and guidance for an archaeological watching brief* (ClfA 2014b);
- *Management of Research Projects in the Historic Environment: The MoRPHE Project Managers' Guide* (Historic England 2015a);
- *Managing Significance in Decision-Taking in the Historic Environment. Historic Environment Good Practice Advice in Planning: 2* (Historic England 2015b);
- *A Strategy for the Care and Investigation of Finds* (English Heritage 1995);
- *Conservation Principles, Policies and Guidance: For the sustainable management of the historic environment* (English Heritage 2008);
- *The Setting of Heritage Assets: Historic Environment. Good Practice Advice in Planning Note 3* (Historic England 2015c);
- *Yorkshire, the Humber & the North East: A Regional Statement of Good Practice for Archaeology in the Development Process* (South Yorkshire Archaeology Service 2018); and
- *First Aid for Finds* (Watkinson and Neal 2001).

Aims and objectives

4.5 The desk-based assessment requested that:

there should be archaeological analysis of the sequence of trial trenches and boreholes [...] to better understand the archaeology of the site and to attempt to identify the precise location and possible survival of the 1853 Eston Iron Works Blast Furnaces. (Daniels 2019, 12)

4.6 The aim of the archaeological monitoring as stated in the WSI (NAA 2020) was to identify the presence and location of any archaeological remains within the area of

development. Due to health and safety considerations, any remains identified were recorded from the edges of the trial pits in order to achieve their 'preservation by record', and no excavation was possible due to the depth constraints and contamination issues. The objectives of the monitoring were to:

- establish the presence, nature, extent, preservation and significance of any archaeological remains within the area of development;
- provide a detailed record of any such archaeological remains;
- recover and assess any associated structural, artefactual and environmental evidence, where safe to do so;
- undertake a programme of investigation that met with national and regional standards (Historic England 2015a; ClfA 2014b–d; South Yorkshire Archaeology Service 2018); and
- prepare an illustrated report on the results of the archaeological monitoring to be deposited with the Historic Environment Record for Redcar and Cleveland.

Methodology

- 4.7 The proposed development has the potential to disturb unrecorded archaeological remains, which means archaeological monitoring (a watching brief) is required to limit any potential loss of heritage significance. Therefore, the ground investigation works required archaeological monitoring.
- 4.8 A mechanical excavator was utilised. For preference it was fitted with a toothless bucket although in many instances the nature of the deposits (e.g. concrete demolition rubble) required use of a toothed bucket.
- 4.9 For health and safety reasons, and given the depth of the investigations and unstable nature of the deposits, personnel were required to remain at least 1m from the edge of excavation unless equipped with a fall-arrest device (not available to the monitoring archaeologist). As a consequence, an AEG engineer fitted with harness and fall-arrest device took photographs and measurements of depths on behalf of the monitoring archaeologist.
- 4.10 Where structures, features, deposits or finds of archaeological interest were exposed, mechanical excavation ceased in order to allow the monitoring archaeologist to assess and record these features and finds. Once archaeological observations were complete, the monitoring archaeologist allowed mechanical operations to recommence. Due to

flooding of many of the excavations from a shallow depth, many deeper deposits had to be recorded from excavated spoil and their depths estimated.

- 4.11 A written record was made of each deposit or structure encountered, and a photographic record made of each excavation. A register of all photographs was kept. The digital photographs will be submitted to the Archaeology Data Service (ADS) for long-term archive storage.
- 4.12 In the event, no finds were encountered that were considered worthy of retention. Site contamination conditions meant that no palaeoenvironmental samples were taken.

5.0 RESULTS

- 5.1 Three types of investigations were monitored, although the methodology employed for each was the same. In the following account, trial pits are designated as TP, borehole launch pits as BH, and window sample launch pits as DS.
- 5.2 Much of the site was covered in thick concrete slab. Breaking out this surface often disrupted underlying deposits meaning that undisturbed deposits were encountered c.0.5m below the base of the concrete.
- 5.3 The results of the investigations are presented below in four groups surrounding the central part of the PDA (Area B): the northern and eastern parts of the site (Area A), and the south-western part (Area C)

Area A: Northern part of the site

- 5.4 TP 1, BH 14 and DS 11 were excavated close together in the north-west corner of the site. In TP 1, mixed demolition rubble extended to a depth of more than 3m, suggesting that it had been excavated into an in-filled structure. BH 14 and DS 11 were excavated through a concrete slab that overlay industrial ash. An iron pipe ran from north to south in BH 14, while in DS 11 a concrete structure was found 1.1m bgl at the southern end of pit. Clay was encountered at 1.5m bgl in BH 14.
- 5.5 In BH 1 a short distance to the east, layers of industrial ash directly overlay clay at 1.5m bgl (Plate 2). Nearby TP 2 was cut through 1.2m of concrete and brick rubble. Brick foundations were visible cut into the clay, which at this location were 1.9m bgl overlain by a sandy deposit.

- 5.6 Also adjacent to the northern edge of the area, BH 2 was excavated through 2.1m of demolition rubble before being abandoned. A probable firebrick wall was observed in the southern end of the excavation. BHs 2a and 2b were excavated through 1.6m and 2m demolition rubble, respectively, before encountering a concrete slab and also abandoned. In BH 2c, however, industrial ash overlay clay at 0.9m bgl, indicating that the three previous attempts were probably located within a sunken structure. In BH 2c a brick culvert, or possibly a flue, was observed cut into the ash deposit.
- 5.7 Located nearby, an initial attempt to excavated DS 12 was obstructed by what may have been a drain or culvert running from north-west to south-east and constructed with brick walls and a concrete base and capping. DS 12a, excavated a short distance to the south-west of DS 12, almost immediately flooded which limited recording. Ashy black clinker overlay a deposit of brick rubble, wood, cabling and corrugated iron sheets and reinforcing bar. The trench was abandoned at 2.7m bgl due to flooding. In contrast, in DS 12b the 0.3m-thick reinforced concrete slab was bedded onto 0.2m of clinker directly overlying clay at 0.5m bgl (Plate 3).
- 5.8 At the north-eastern corner of the PDA, TP 16, 16a, 16b and 16c encountered concrete slab at depths of 0.3m, 1.6m, 1.2m and 1.1m bgl, respectively, and were abandoned. However, nearby BH 3 was successfully excavated to full depth. The top of a brick wall was identified at a depth of 0.6m bgl, and a pipe was found at 0.8m bgl. Both features were aligned from east to west and were cut into, or buried by, extensive ash dumping. Clay was encountered at 2.1m bgl.
- 5.9 DS 5, and DS 5a–d (DS 5c was also TP 4) each encountered the same concrete slab at 0.65–1.2m bgl, the variation being due to differing ground levels. The concrete slab was not present in DS 5e, which recorded clay at 1.2m bgl, covered by demolition rubble. In nearby DS 13, clay was found at a similar level (1m) overlain by a concrete-lined cavity of uncertain function.
- 5.10 BH 15/TP 3 encountered a considerable depth of ash. Flooding of the excavation prevented detailed recording, but a brick wall was identified at depths of between c.1.4m and 2.3m running approximately east-southeast to west-northwest. BH 15a encountered demolition rubble extending to a depth of more than 2.3m, presumably filling an unseen structure. BH 15b identified a brick wall at 0.6m bgl, and also an in situ railway line at c.1.1m bgl running approximately from north-northeast to south-southwest. BH 15c revealed ash and demolition rubble extending to the base of the

- excavation at 2.6m bgl. In BH 15d, the trench was crossed at a depth of 0.8m by two parallel walls or footings c.1.2m and running from east to west. Clay was encountered at 1.5m bgl.
- 5.11 Just to the south in DS 15, demolition rubble had buried a brick-built tunnel, possibly a flue, running from northwest to south-east (Plate 4). The top of the arch was c.0.9m bgl and it extended to more than 1.8m bgl. The tunnel walls were four courses thick and the internal cavity was 0.8m wide. Another brick wall was noted in section adjacent to the tunnel. DS 15a excavated nearby recorded demolition rubble to more than 2.5m bgl.
- 5.12 BH 4 and BH 4a–c were located at the western side of the site to the south of BH 14. In BH 4 a concrete slab was encountered at c.2.2m bgl, overlain by demolition rubble. BH 4a found a similar slab at 2.5m bgl and was also abandoned. In BH 4b, a brick wall was encountered at 1–1.3m bgl, running from north-northwest to south-southeast and resting on a concrete slab. BH 4c revealed a large iron pipe at a depth of c.1.5m, running from north-west to south-east. Clay was encountered at a depth of 1.6m in BH 4b and at 1.8m in BH 4c.
- 5.13 In TP 5, two large-diameter iron pipes ran from north-east to south-west c.2m apart but at depths of c.1m and 1.8m. They were cut through, and buried by, demolition rubble but the lower pipe rested on clay. At the location of BH 5 nearby, the clay lay at a similar depth of c.2m bgl. Above this was a thick sequence of ash dumping, within which was another brick tunnel or flue running from east to west, with its top at 1.2m bgl. The wall of another possible brick culvert or flue was also observed running from north-east to south-west.
- 5.14 Several attempts were made to excavate TP 6 but were mostly defeated by a concrete slab and other obstructions. However, TP 6b was excavated to a depth of 3m. This revealed another brick tunnel or flue at 0.35m bgl, running from north-east to south-west. This was more than 1.15m high and 1.2m wide. There was also a brick wall running at right angles to the flue (Plate 5). The structures were constructed within a mass of red brick (rather than fire brick) rubble which extended down to a concrete slab at 3m bgl, and which was therefore presumably in-filling an early structure that pre-dated construction of the brick flue.

5.15 DS 16 a short distance to the south was excavated 1.6m into a deposit of large concrete and brick demolition rubble. Below the concrete slab at BH 7 there was mixed ash deposits extending down to clay at a depth 2m bgl. Immediately below the slab, a brick wall was observed in the west side of the excavation which survived to a height of 0.8m (Plate 6).

Area A: Eastern part of the site

5.16 TP 7 encountered a considerable thickness of concrete and was abandoned. TP 7a, which was a short distance to the west, initially encountered part of a railway track and then a pipe c.1m bgl. To the east of these, made ground extended to a depth of at least 2.4m and there was a possibility that clay below this was also redeposited.

5.17 DS 1 encountered brick foundations and a substantial dump of demolition rubble into a deep cavity, probably part of a basement structure or service corridor. DS 1a was located c.15m to the south-east of DS 1 and was cut through a thick concrete slab. Below this, there was a dump of demolition rubble over a second concrete slab at a depth of c.1.9m bgl. DS 1b/TP 17 was excavated c.1.5m north of DS 1a in a bid to avoid the structure encountered in the previous excavation. DS 1b/TP 17 appeared to be located within a concrete chamber or tank with its base at 2.9m bgl. A chain attached to the wall may have been a handhold (Plate 7). The rubble-filled chamber also contained large electrical cables.

5.18 TP 13 was located at the eastern periphery of the site. Made ground, consisting of dumps of rubble, industrial ash and a deposit of clay, extended to a depth of 2.2m, overlying organic-smelling clay which probably represented the original ground surface at this location.

5.19 DS 2 encountered a concrete slab at 1.1m bgl and was abandoned. DS 2a found made ground above clay at a depth of 1.5m. Within the make-up a brick wall crossed the excavation from north-west to south-east (Plate 8). In BH 9b 0.5–0.7m of concrete overlay a deposit of ash and brick rubble, but the pit was excavated only to a depth of 1m.

5.20 TP 14 revealed a thick deposit of concrete and brick demolition rubble overlying clay at a depth of 1.5m. In DS 4, in contrast, a concrete pad overlay layers of ash, with clay encountered at a similar depth of 1.2m (Plate 9).

5.21 At DS 10, the concrete surface slab sealed dumps of clinker and rubble overlying another concrete slab at 1.9m bgl. In the replacement excavation DS 10a, demolition debris overlay a brick wall at 0.8m bgl, which continued downwards for at least 1m (Plate 10). Clay was encountered at 2.1m bgl. TP 15 encountered a thick (3m-plus) demolition deposit of wooden railway sleepers, metal ducting, steel structural elements, cabling, broken concrete and brick rubble.

Area C: South-western part of the site

5.22 BH 8 was excavated to a depth of only 1.1m through brick and concrete rubble. Within this deposit was a pipe and a brick wall orientated from east to west. DS 8 revealed deposits of demolition rubble and ash overlying a concrete slab which had been laid directly onto clay at 1.8m bgl. In TP 8 a little further to the south, layers of ash extended down to clay at 1.5m bgl.

5.23 Clay was encountered in DS 6 at a depth of only 0.8m bgl, covered by a deposit of ash containing cables and plastic ducting. A land drain was also noted at a depth of 0.5m running from east to west.

5.24 The area of TP 9 was covered in gravel to a depth of 0.2m, overlying ash and clinker. A deposit of yellow-brown impermeable clay was encountered at 1.1m and this darkened with depth suggesting that it was an undisturbed natural deposit. A concrete footing found at 2m bgl had presumably been cut through the clay. In DS 9, broken concrete and ash overlay a concrete slab at 0.8m bgl. Below this, made ground overlay clay at 2.2m bgl (Plate 11).

5.25 TP 11 and DS 7 were located at the south-western corner of the PDA close to (and west of) the foot of the railway embankment. In both TP 11 and DS 7, clay was encountered at 2.2m bgl, overlain by layers of ash and concrete rubble. In TP 11, a land drain was recorded within the clay at a depth of 2.6m, within the clay. Given its depth, this had presumably been laid prior to the ash and rubble dumping. TP 12 at the southern perimeter of the PDA was also adjacent to the railway embankment. Within the trial pit, 1.1m of ash and clinker directly overlay clay (Plate 12). The absence of structures at these three locations reflects their position on the opposite side of the railway embankment from the main steel works.

5.26 After initial attempts (BH 11 and BH 11a) were abandoned due to obstructions, BH 11b/TP 10 revealed c.1.9m of demolition rubble within a basement or service structure

with concrete block walls and a concrete slab floor (Plate 13). The rubble included a vibrating unit, typically used to agitate loads on conveyor belts (Plate 14). A fourth starter pit at this location, BH 11c, was abandoned after in situ structural elements formed of yellow fire-brick were encountered. At BH 11d, removal of the surface concrete slab revealed a sequence of dumps (top to bottom) of yellow firebrick rubble, black ash, red brick rubble and concrete rubble overlying natural clay at 2.4m bgl.

6.0 DISCUSSION

6.1 The monitoring recorded natural clay, representing the former floodplain of the River Tees, at depths of between 0.5m and 2.4m bgl, although typically the surface seemed to lie at 1.5–2.2m bgl. This will have been affected by variations in the modern ground surface across the area, and the natural surface of the water-deposited clay was presumably originally more level. Some (but not all) of the greater depths recorded were probably the result of truncation of the clay by later construction work. Some particularly shallow records, such as 0.5m bgl in DS 12b, may have resulted from mis-identification of redeposited clay as natural.

6.2 Above the clay, there was extensive evidence for land-reclamation in the form of ash and clinker dumping across all parts of the PDA. These deposits were up to 2m thick and, in general, all of the structures observed could be seen to have been cut into them.

6.3 Brick and concrete structures were absent from the investigations at the south-western corner of the PDA (DS 7, TP 11 and TP 12); however, this is unsurprising in an area once covered by railway tracks.

6.4 Small but substantially constructed brick-built arched tunnels, presumably flues, were encountered in TP 6b, BH 5 and DS 15. These interventions were located close to one another in an area just to the north of Area B and therefore beyond the area containing the later blast furnaces. This was, however, the location of the Eston Iron Works as shown on the 1857 Ordnance Survey map, and it is therefore possible that the flues represent remains of the earliest phase of furnaces on the site. Another possible brick flue or culvert was observed in BH 2c at the northern edge of the PDA, some distance from the other structures.

6.5 Substantial below-ground remains of brick and concrete structures were encountered across most parts of the PDA. Brick walls were noted primarily within the northern part of the site (TP 2, BH 2, BH 3, BH 15/TP 3, BH 15d, DS 15, TP 6b and BH 7) with only

occasional instances in the eastern and southern areas (DS 2a, DS 10a and BH 11c) and none to the south-west. Most of the recorded brick walls were not associated with concrete floors and therefore may represent an early phase of structures pre-dating the extensive use of poured concrete slab surfaces across the site during the 20th century.

6.6 There was extensive evidence for structures having been cut down into the reclamation deposits. In TP 1 and TP 6b, demolition rubble extended to a depth of more than 3m and must have been in-filling below-ground structures; a similar deposit in DS 1b/TP 17 appeared to be filling a concrete-lined tank or similar structure. In TP 6b, a concrete slab was encountered at 3m bgl, and at several other locations concrete slabs were found at depths greater than 2m. Some of the variation in recorded depth of these surfaces may have been because of differences in the depth of overlying demolition deposits.

6.7 There was formerly a complex network of railway tracks serving the steelworks, and therefore it is unsurprising that some evidence for this was recorded. In situ railway lines were recorded in BH 15b and TP 7, respectively located to the north and east of the former blast furnaces. Wooden railway sleepers were noted among demolition rubble in TP 15 to the south-east of the furnaces. The in-situ track in BH 15b was encountered at 1.1m bgl, covered by demolition rubble, indicating that extensive remains of these lines may survive within the northern part of the area.

7.0 CONCLUSION

7.1 Although carried out under difficult conditions, including unstable rubble deposits and severe groundwater flooding, archaeological monitoring of the ground investigation works largely achieved the objectives of the watching brief.

7.2 The level of natural clay and depth of overlying reclamation and demolition deposits was established across much of the area. It was also determined that many of the buildings associated with the later phase of the steelworks had contained basements, below-ground tanks and other structures which had caused significant localised truncation of earlier deposits, in some places to a depth of 3m bgl or deeper. However, in areas between these deeper intrusions, the modern concrete services had served to protect earlier deposits from modern disturbance.

7.3 Within the northern part of the area there was a concentration of brick-wall footings, with few seen elsewhere across the PDA. These brick walls were not associated with

the concrete slab floors commonly seen in later structures on the site. In the same area, several arched brick structures were encountered, which possibly represented furnace flues. The 1850s Eston Iron Works was located in this area, to the north of the furnaces associated with the 1870s Cleveland Works. Before the advent of mechanical excavators, it is likely that demolition of the earlier works in 1872 will have consisted merely of demolition down to the then ground surface, with any below-ground structures (such as flues) retained in situ. It is therefore likely that some of the brick structures encountered in this part of the PDA during the recent ground investigation works were associated with the earlier ironworks. Given the relatively shallow depth of most of these remains, any remediation works associated with the development may have a significant/total impact on them.

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APPENDIX A
MONITORED GROUND INVESTIGATIONS

BH = borehole launch pit; DS = window sample launch pit; TP = trial pit

Trial pits

TP 1

Located c.5m east of large brick circular structure bases, possibly condensing towers.

This encountered 3m of mixed demolition rubble.

A semi-circular cast-iron object in the rubble appeared to be part of a turbine with angled perforations c.10cm in from the rim and c.8.5cm wide. The inside of the hub-hole was threaded. Full diameter 1.52m, hub-hole internal diameter 375mm.

TP 2

Demolition rubble comprising broken concrete and bricks extended from the surface to 1.2m bgl at north end of trench in east-facing section. Clay and sandier overlying deposit observed at a depth of 1.9m. Flooding obscured deposits below this.

Layers of brick foundations were visible in the west-facing section, and the trial pit possibly clipped the edge of a demolished structure, extending southwards from north end of the pit for 2.1m before a construction cut through clay was visible.

TP 3 – see BH 15

TP 4 – see DS 5c

TP 5

Demolition deposits sealing two large-diameter parallel iron pipes aligned from NE–SW. These were located at a depth of c.1m bgl 1.7m from south end of trial pit, and 1.8m bgl 3.7m from south, c.2m apart.

Pipes sat above clay at c.2m bgl.

TP 6 and TP 6a

In TP 6, 0.3m of demolition rubble overlay a substantial concrete slab, and the attempt was abandoned. The slab had been cut for a cable running towards a circular concrete base to the west. Attempt TP 6a encountered the same slab and was also abandoned.

TP 6b

Concrete slab encountered in TP 6 and 6a broken through.

Brick wall foundations, top at 0.5m bgl, sealed by the concrete slab. There was a filled void to north with a metal stanchion to north of that. The trial pit was extended northwards away from large in situ steel sheet piles below concrete slabs and demolition debris.

A brick tunnel/flue and brick wall visible in west-facing section at the northern end of the trench, the tunnel running NE–SW and the brick wall running at a right angle.

Top of brickwork for tunnel at 0.35m bgl. The tunnel was 1.2m wide, with 1.15m height visible above standing water at 1.5m bgl. The tunnel had been bricked up c.0.8m back from trial pit edge (unable to measure safely), with the part of the tunnel in the trial pit looking demolished or collapsed. All brickwork within trench red brick rather than fire brick.

Trench excavated to 3m before striking another concrete slab overlain by demolition deposits.

TP 7

This had 0.1m demolition rubble overlying reinforced concrete which extended to a depth of more than 0.8m bgl. Attempt abandoned.

TP 7a

Part of railway track encountered so extended eastwards, then extended again when pipe encountered at c.1m bgl.

Mixed made-ground deposits including silty sand around pipe down to 1.1m (presumably pipe trench backfill) then silty clay.

The clay may have been made ground since fragments of timber were present at a depth of 2.4m bgl.

Trial pit excavated to 3m bgl.

TP 8

Layers of ashy clinker to 1.5m bgl, then clay to 3m bgl.

TP 9

Gravel to c.0.2m then ashy clinker.

Mid-yellow brown impermeable silty clay encountered at 1.1m bgl, darkening towards base so probably undisturbed. A concrete footing encountered at 2m bgl presumably cut into the clay.

Trench excavated to maximum depth of 3.1m.

TP 10 – see BH 11b

TP 11

Adjacent to railway embankment c.10m north of DS 7.

Layers of industrial ash and slag, with larger chunks of concrete found lower down.

Clay encountered at 2.2m bgl, with land drain at 2.6m cut into it.

TP excavated to depth of 3m.

TP 12

Adjacent to railway embankment, with rail lines visible on surface 10m to the east.

In addition, 1.1m of industrial waste overlay clay extending to more than 3m bgl.

TP 13

A 0.4m-thick concrete slab covered concrete and brick rubble, industrial ash and redeposited clay.

Organic-smelling clay (presumably natural) encountered at 2.2m bgl.

Trial pit excavated to 3m bgl.

TP 14

Slab 0.2m thick, then mixed ash, brick and concrete rubble. Probable wall foundations below concrete slab at S end of trial pit.

Clay encountered at 1.5m bgl.

Pit excavated to 3m, with standing water below 2.8m bgl.

TP 15

Thick industrial demolition deposit including wood (railway sleepers), metal ducting, structural steel elements, cabling, broken concrete and brick rubble.

Standing water below 1.5m bgl. Test pit excavated to depth of 3m.

TP 16

0.3m of demolition rubble and ash, then concrete slab encountered and attempt abandoned.

TP 16a

Excavated to depth of 1.6m then concrete slab encountered and attempt abandoned.

TP 16b

Excavated to depth of 1.2m then concrete slab encountered and attempt abandoned.

TP 16c

Excavated to depth of 1.1m then concrete slab encountered and attempt abandoned.

TP 17 – see DS 1b

Borehole launch pits

BH 1

Layers of ashy industrial waste down to 1.5m bgl, then clay.

Excavated to 1.8m bgl.

BH 2

This encountered demolition deposits including frequent bricks and a valve wheel.

At its southern end, the pit clipped what appeared to be a firebrick wall at 0.7 bgl.

Launch pit excavated to depth of 2.1m before being abandoned.

BH 2a

Below the surface concrete slab was a deposit of demolition rubble overlying a second slab at 1.6m bgl.

A possible drain ran from north to south at a depth of 1m bgl. Two concrete blocks were noted aligned NE–SW in the SW corner of the pit.

Pit abandoned at 1.6m bgl.

BH 2b

Trench excavated for 2m through ash and rubble before concrete slab encountered and attempt abandoned.

BH 2c

Ash overlay clay which was encountered at a depth of 0.9m bgl.

The cut for a brick drain/culvert just clipped in SW corner of launch pit, observed from depth of 0.7m bgl to 1.3m bgl. The drain was sealed by the ash deposit.

Launch pit excavated to 1.9m.

BH 3

Ash encountered at 0.5m bgl.

Within this, a brick wall 0.4m wide ran E–W alignment. Observed from 0.6m bgl to more than 1.3m then obscured by standing water. Parallel pipe at 0.8m bgl.

Clay encountered at 2.1m bgl.

BH 4a

Brick rubble then a concrete slab at 0.9–1.3m bgl.

Further brick rubble 1.3–2.5m bgl above a second concrete slab and attempt abandoned.

The rubble deposit included concrete slabs up to 0.4m thick, coherent brick wall sections, large structural 'I' beams, ducting and cables.

BH 4b

Rubble down to 0.4m, then concrete slab between 0.4m and 0.8m bgl. Below that, brick rubble extended down to clay at 1.6m bgl.

A brick wall 0.3m wide present at 1–1.3m bgl, rest on a concrete footing, running on NNW to SSE alignment on east side of pit. Large cables ran parallel to the wall within ducting.

Pit excavated to 1.8m.

BH 4c

Excavated as a result of BH 4b hitting obstruction during boring.

Demolition rubble overlay reinforced concrete slab at 0.3–0.6m bgl.

Then demolition rubble down to clay at 1.8m bgl.

Large diameter iron pipe on NW–SE alignment at depth of c.1.5m bgl.

Pit excavated to 2.6m bgl.

BH 5

Slab of concrete on surface above another slab, combined thickness of c.0.3m. Below this was a thick deposit of industrial ash.

A brick culvert/wall on a NE–SW alignment at the southern end of the pit. Another brick tunnel present on what appeared to be a E–W alignment, only visible in the east-facing section. Top of tunnel arch at 1.2m bgl. Pit badly flooded.

Clay encountered at c.2m bgl.

Pit excavated to 2.5m.

BH 7

Concrete slab just below surface. Below the slab on west side of the pit was brick wall 0.8m tall and visible for 1.3m from the north end of the launch pit.

Against and below this, rubble and ash extended down to clay at 2m bgl.

Pit excavated to 2.1m bgl.

BH 8

0.1m of turf overlay packed brick and concrete rubble.

A pipe present at 0.8m. A brick wall oriented from east to west was observed from 0.3m bgl to at least 0.6m bgl, but as a result of flooding the base was not visible.

Pit excavated to 1.1m bgl.

BH 9b

0.5–0.7m concrete above ashy grey clinker waste and red brick rubble.

Pit excavated to 1m bgl.

BH 11/BH 11a

Due to concrete slab BH 11 moved to second position (BH 11a), then moved back adjacent to original position for attempt BH 11b.

BH 11b/TP 10

Breaking through the concrete slab encountered a thick deposit of brick, concrete and steel demolition deposits, above a second concrete slab at c.1.9m bgl.

The rubble appeared to be filling some kind of basement/ service structure with large concrete blocks as walls.

A Locker (brand) vibrating unit used to agitate loads on conveyor belts was recovered from the rubble.

Although initially meant to be a launch pit for a borehole, it was decided due to use this pit as a surrogate for the planned TP 10. Abandoned as launch pit.

BH 11c

Abandoned and moved after in situ structural elements formed of yellow fire-brick encountered.

BH 11d

A concrete slab 0.2m thick overlay a deposit of yellow fire brick rubble extending to c.0.6m bgl. Below this was a black ash layer (to 1m bgl) and a deposit of red brick rubble down to a second concrete slab at 2–2.4m bgl.

The lower slab rested on clay (at 2.4m bgl) and excavation was terminated once this was shown to be natural.

BH 14

The concrete slab at this location overlay a deposit of industrial ash, within which was an iron pipe running from north to south and crossing the SW corner of the launch pit.

Clay encountered at a depth of 1.5m bgl, and the pit was excavated to 1.7m.

BH 15/TP 3

This was excavated into a thick deposit of fairly homogenous industrial ash.

The launch pit flooded below c.1.3m bgl, restricting recording.

Between c.1.4m and 2.3m bgl was a brick wall running from west-southwest to east-northeast, although very difficult to photograph or see due to the water.

BH 15a

Below c.0.4–0.5m of ash, this was excavated to a depth of 2.3m bgl into a deposit of brick and concrete rubble and metal beams.

Heavy water flooding. Abandoned.

BH 15b

Industrial ash sealed a brick built wall first seen at 0.6m bgl.

Launch pit flooded below 1m bgl.

In situ railway line found at c.1.1m bgl, probing with machine bucket below water suggested this was running NNE-SSW.

Launch pit abandoned.

BH 15c

Located just north of what appears to be a concrete circular structure covered by spoil, diameter c.18–20m.

Shoring/ shuttering as if for a retaining wall in south end of launch pit from c.1m bgl, possible for a tank or similar structure. Industrial ash down to 1.1m bgl, then mixed ash and brick demolition rubble.

Pit flooded from c.1.2m bgl.

Excavated to c.2.6m, then abandoned.

BH 15d

Ash sealed two parallel walls or foundations c.1.2m apart running from east to west. The southern wall was encountered at 0.6m bgl, the northern at 0.8m bgl, and both continued down below flooding at 1.3m bgl.

Clay was encountered at 1.5m bgl, and the pit was excavated to 1.75m.

Window sample launch pits

DS 1

This identified brick foundations of former buildings along with more obvious demolition rubble.

0.2m of concrete surface overlay 0.4m of brick rubble. Below this was a second concrete surface down to 0.8m bgl.

Below this was demolition rubble within a water-filled cavity, presumably part of a basement structure/service corridor etc.

Excavation abandoned at 2m bgl.

DS 1a

Located c.15m SE of DS 1.

Concrete slab c.0.3m thick above 1.6m of demolition rubble. Heavily flooded.

Second concrete slab found at c.1.9m and excavation abandoned.

DS 1b/TP 17

Located c.1.5m north of DS 1a, at the edge of the upper slab observed at DS 1a, attempting to miss lower slab if part of same structure.

The edge of the structure seemed to form the wall of some kind of chamber or tank. A chain attached horizontally to the wall may have been a hand-hold. Also large cables. The structure was filled with demolition rubble.

The concrete base of the structure was reached at 2.9m bgl.

Decision was made to use DS 1b as TP 17.

DS 2

Concrete rubble, ash and an iron pipe overlay a concrete slab at 1.1m bgl.

The edge of a concrete block or pad was observed at the southern edge of the pit.

Attempt abandoned.

DS 2a

Broken concrete was sealed by c.0.4m of industrial ash. Pit heavily flooded, but brick wall observed running SE–NW.

Copper cabling was present at a depth of 0.8m bgl.

Clay was encountered at 1.5m bgl and the launch pit was excavated to 1.7m.

DS 4

Below c.0.2–0.3m of demolition overburden was a concrete pad extending down to 0.5m bgl.

There was then a sequence of layers of ash dumping down to clay at a depth of 1.2m bgl.

The launch pit was excavated to 1.6m bgl.

DS 5

A thin skim of turf overlay a large concrete block against the N end of the launch pit extending to a depth of 1.2m bgl where another concrete slab extended across the full base of the excavation.

Attempt abandoned.

DS 5a

Located c.5m north of DS 5, at the northern edge of the concrete block encountered in DS 5. The same base slab as seen in DS 5 was found at c.0.65m bgl, the shallower depth being accounted for due to a difference in ground level at the two sites.

Attempt abandoned.

DS 5b

Similar result to DS 5/DS 5A, the concrete slab here found at 1m bgl.

Attempt abandoned

DS 5c/TP 4

This revealed what appeared to be a rubble-filled channel between two concrete blocks with a slab along the base at a depth of 1m bgl. The edge of the concrete block on the north side lined up with the edge of a visible structure c.10m to the east.

Attempt abandoned.

DS 5d

Demolition rubble containing a lot of metal waste (bars, plates, pipes, ducting) overlay a slab at a depth of 1m bgl.

Attempt abandoned.

DS 5e

Mixed rubble overlay clay at a depth of 1.2m.

DS 6

Layers of clinker, but containing cables and plastic, overlay clay at a depth of 0.8m bgl.

A land drain running east–west was found in the ash dumping at a depth of 0.5m.

Launch pit excavated to 1m bgl.

DS 7

Layers of industrial ash extended to a depth of 2.2m bgl, directly overlying clay.

Launch pit excavated to 2.5m.

DS 8

Layers of demolition rubble and ash overlay a concrete slab laid directly above clay which was found at 1.8m bgl.

Launch pit excavated to 2m bgl.

DS 9

Concrete rubble and ash overlay a concrete slab 0.8–1m bgl. Below this was dumped ash.

Clay was encountered at 2.2m bgl.

Launch pit was excavated to 2.5m.

DS10

A concrete slab 0.25m-thick overlay 1.65m of layers of ash and demolition rubble. A second concrete slab was found at 1.9m bgl.

Attempt abandoned.

DS10a

Layers of demolition rubble overlay brick wall foundations running from E to W, encountered at depth of 0.8m bgl. These continued down for over 1m but full depth obscured due to standing water.

Clay was encountered at 2.1m bgl, with excavation continued to 2.2m.

DS 11

Concrete slab 0.4m thick. On the west side of launch pit this overlay a second slab 0.3m thick. These overlay industrial ash.

A concrete structure was observed extending to a depth of 1.1m at the S end of the pit, which was excavated to a depth of 1.6m.

DS 12

Demolition rubble overlay brick foundations observed at a depth of 0.7m bgl, possibly a drain or culvert although flooding obscured the view. Concrete was present at c.1m bgl.

Excavation abandoned due to obstruction.

DS 12a

Located c.15-20m SW of DS12

Ash, brick and concrete rubble, wood, cabling, metal plates etc. appeared to be filling a basement (suggested to be the basement of the arc plant from Arcadis engineer plan).

Excavation flooded below 0.8m bgl. Corrugated sheets and rebar pulled from below water level.

Excavation abandoned at 2.7m due to slow progress and presence of significant rebar threatening machine's hydraulic hoses.

DS 12b

While initially breaking through the reinforced concrete slab the whole area felt more hollow, with more reverberation from the hydraulic 'pecker'.

Arcadis engineer commented that in previous phase of works they were unable to insert boreholes in this area due to extensive basement systems.

However, below the 0.3m-thick surface slab there was only 0.2m of ash.

Clay was encountered at 0.5m bgl, and excavation ceased at 0.7m bgl.

DS 13

A thin concrete slab 0.15m thick overlay a cavity c.1m wide walled with concrete blocks. Although flooded, clay was probably encountered at a depth of c.1m bgl.

DS 15

Brick and concrete rubble, metal debris included several large steel plates (1.2m x 1m x 0.02m).

Rubble covered an arched brick tunnel, top of arch at c.0.9m bgl. in south-facing section. Depth of tunnel unknown due to flooding at 1.8m bgl. Tunnel walls formed of four courses of brick and heading in line with blast furnace so possible flue. Cavity was 0.8m wide and more than 0.5m high. Tunnel seemed to be running NW-SE, western side seemed to have collapsed with more debris visible in the tunnel cavity.

Also large brick wall visible in west-facing section (but not in east-facing), all the way down to water (1.8m bgl.).

Launch pit excavated to 3.5m bgl.

DS 15a

Excavating to the south and away from the projected alignment of the tunnel found in DS 15.

Encountered layers of packed ash, concrete and brick rubble down to limit of excavation at 2.5m bgl.

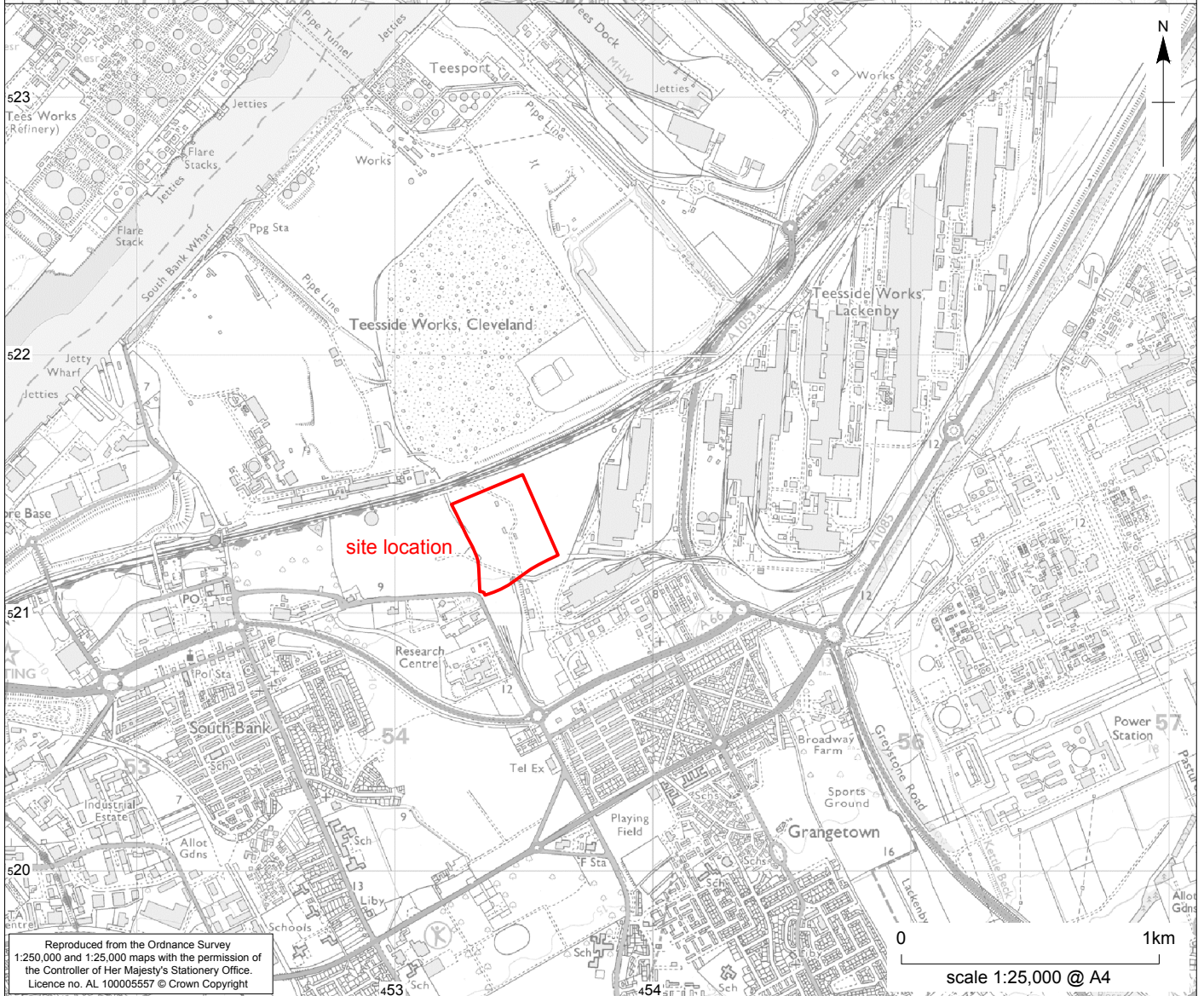
DS 16

Very mixed deposit of large lumps of broken concrete, ash and a, few bricks.

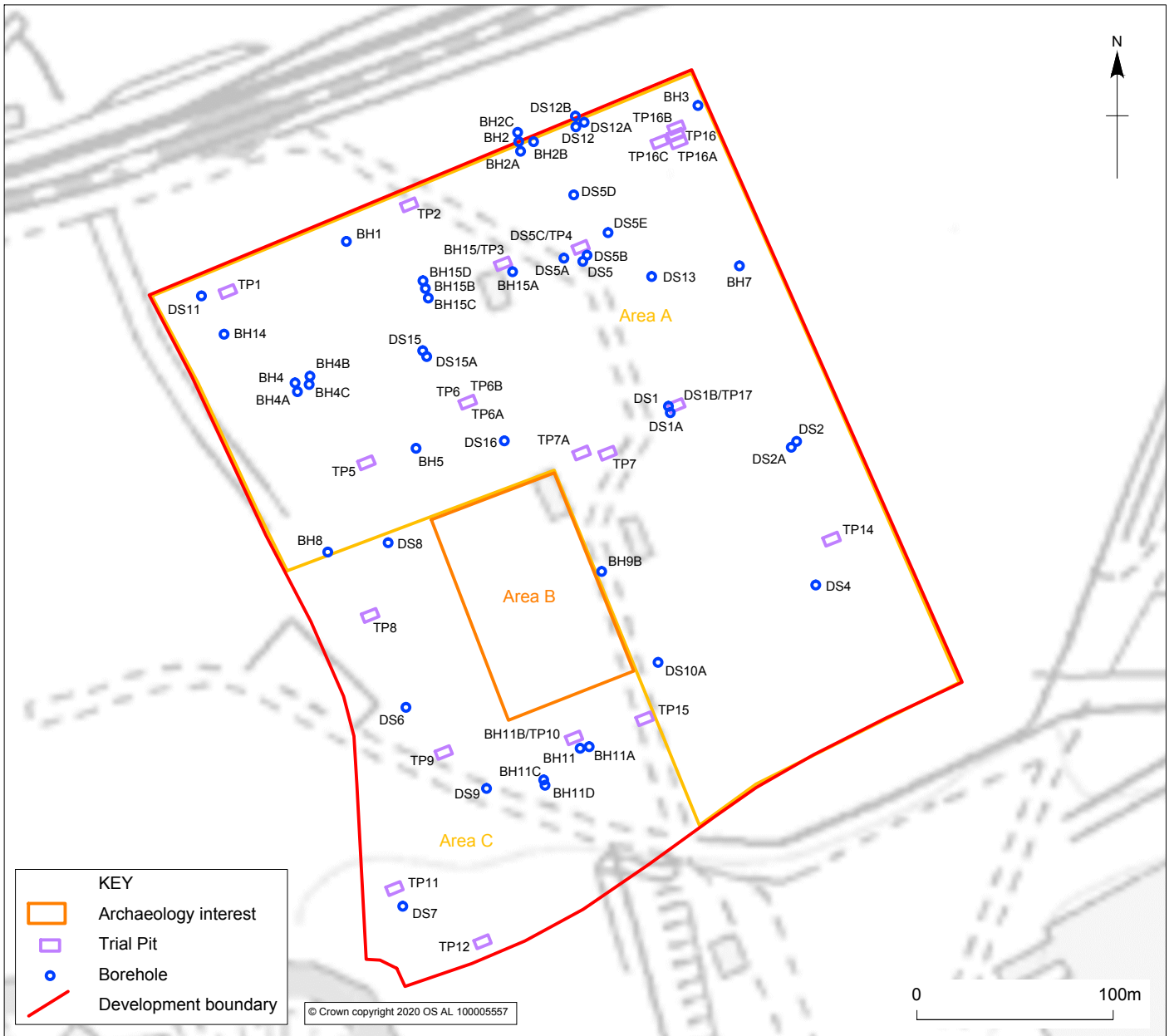
No concrete slab encountered.

Flooded from 1.4m bgl.

Excavated to 1.6m.



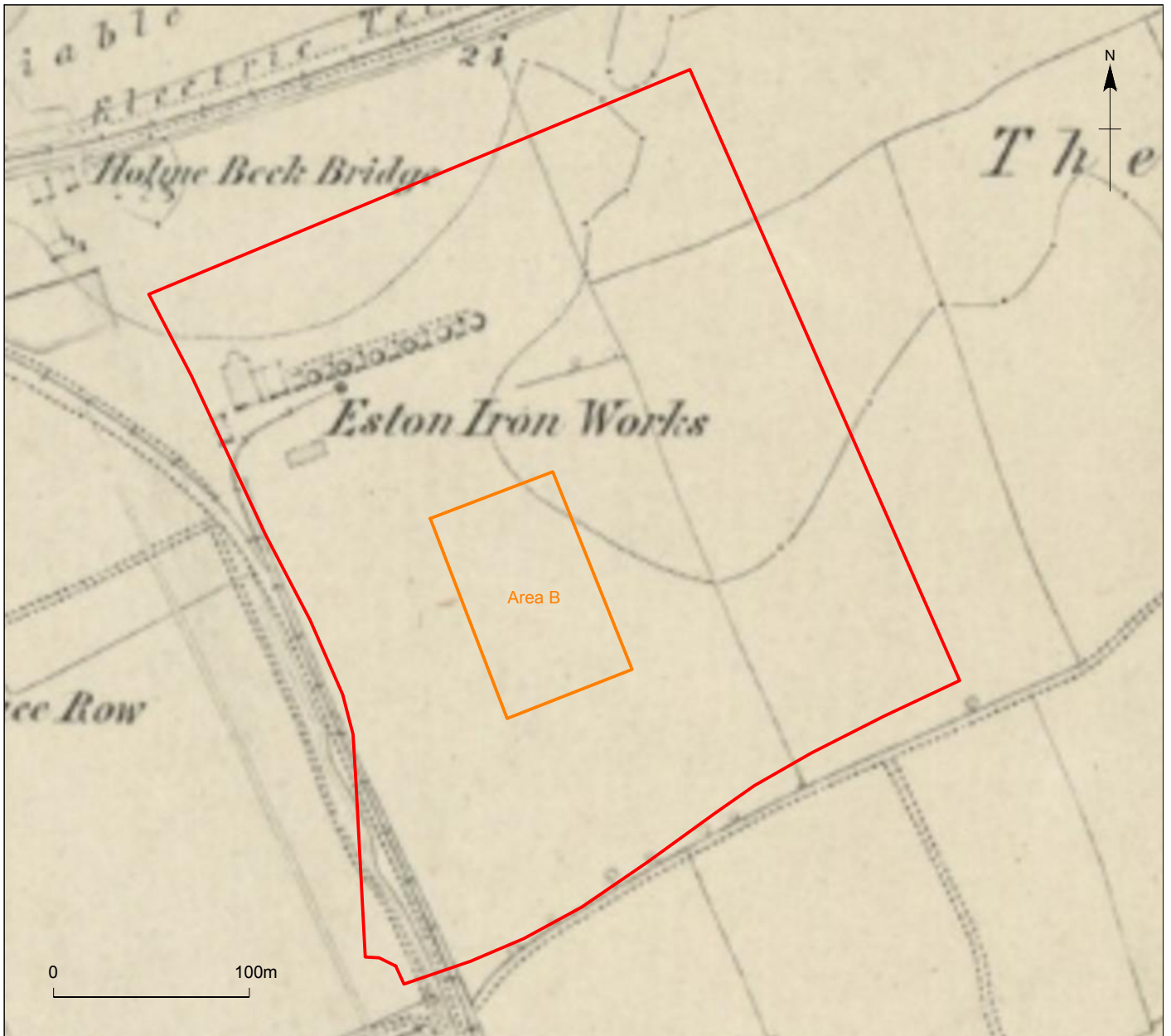
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TVERF, Grangetown: location of monitored ground investigations

Figure 2



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TVERF, Grangetown: Area B overlain on 1853 OS map

Figure 3



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TVERF, Grangetown: view across the proposed development area, facing south-east

Plate 1



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TVERF, Grangetown: BH1 showing industrial ash dumping directly over natural clay

Plate 2



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TVERF, Grangetown: DS12b showing industrial ash dumping directly over natural clay

Plate 3



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TVERF, Grangetown: DS15 showing brick-built tunnel or flue

Plate 4



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TVERF, Grangetown: TP6b showing brick-built tunnel or flue

Plate 5



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TVERF, Grangetown: BH7 showing brick wall

Plate 6



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TVERF, Grangetown: DS1b / TP17 showing concrete lining of possible chamber and chain

Plate 7



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TVERF, Grangetown: DS2 showing brick wall

Plate 8



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TVERF, Grangetown: DS4 showing industrial ash dumping directly over natural clay

Plate 9



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TVERF, Grangetown: DS10a showing brick wall

Plate 10



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TVERF, Grangetown: DS9 showing depth of made ground over natural clay

Plate 11



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TVERF, Grangetown: TP12 showing industrial ash dumping directly over natural clay

Plate 12



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TVERF, Grangetown: BH11b / TP10 showing concrete structures Plate 13



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*TVERF, Grangetown: vibrator unit recovered from
BH11b / TP10. Scale 1m*

Plate 14