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**OXFORD ARCHAEOLOGY, 2019. STATION
HILL NORTH PLOTS A, B, C, D AND G
READING, ARCHAEOLOGICAL
WATCHING BRIEF REPORT**



Station Hill North Plots A, B, C, D and G Reading Archaeological Watching Brief Report

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Prepared by: Elizabeth Kennard and Rachael Daniel (Supervisor)
Checked by: Ben Ford (Senior Project Manager)
Edited by: Ben Ford (Senior Project Manager)
Approved for Issue by: Dave Score (Head of Fieldwork)
Signature:

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OA South

Janus House
Osney Mead
Oxford
OX2 0ES

t. +44 (0)1865 263 800

OA East

15 Trafalgar Way
Bar Hill
Cambridge
CB23 8SG

t. +44 (0)1223 850 500

OA North

Mill 3
Moor Lane Mills
Moor Lane
Lancaster
LA1 1QD

t. +44 (0)1524 880 250

e. info@oxfordarch.co.uk

w. oxfordarchaeology.com

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Station Hill North, Plots A, B, C, D and G, Reading

Archaeological Watching Brief Report

Written by Rachael Daniel and Elizabeth Kennard

With contributions from John Cotter, Elizabeth Kennard

and Ian Scott

and illustrations by

Magdalena Wachnik and Conan Parsons

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Summary

Oxford Archaeology (OA) was commissioned by Waterman Infrastructure & Environment (Waterman IE) on behalf of SH Reading Master LLP to undertake an archaeological watching brief to monitor geotechnical site investigations to be carried out in Plots A, B, C, D and G at Station Hill North in central Reading.

Evidence of 20th century levelling and/or land reclamation was seen in all interventions.

Where the Boreholes (BHs) achieved full depth they all observed in-situ chalk bedrock with overlying gravel drift geology having been sealed by alluvial/fluviol deposits.

The presence of redeposited worked flint attests to pre-historic activity during in the vicinity of the site.

Investigations at Station Hill North had the potential to reveal occupation and structural evidence for Victorian and post-Victorian buildings as seen on historical maps as well as geoarchaeological deposits and features.

The brick structures in TP202, TP204, and possible surfaces in BH205c and WS203 attest to the known structures dating from the late 19th century. The potential undated archaeological layers in BH202 and TP209 show that there may have been some limited outlying activity extending into the marginal lands north of the medieval burgage plots.

The potential palaeochannels in BH203, BH204 and BH205c and the alluvial sequences across the site attest to an open wetland landscape with minimal occupation prior to Victorian development.

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The project was managed for Oxford Archaeology by Ben Ford MCIFA. The fieldwork was undertaken by Elizabeth Kennard and Rachael Daniel. Thanks are also extended to the teams of OA staff that cleaned and packaged the finds under the management of Leigh Allen, and prepared the archive under the management of Nicola Scott.

1 INTRODUCTION

1.1 Scope of work

1.1.1 Following on from an archaeological Watching Brief during Site Investigation (SI) works at Station Hill in the area of land south of Garrard Street, Station Hill South (OA, 2019), Oxford Archaeology (OA) were commissioned by Waterman Infrastructure & Environment (Waterman IE) on behalf of SH Reading Master LLP to undertake an archaeological watching brief to monitor SI works at Station Hill in the area north of Garrard Street, hereafter Station Hill North in central Reading.

1.1.2 The current consented scheme (Reading Borough Council Planning Application Reference: 151426 & 151427) includes the demolition of all the remaining disused buildings and structures within the development area including Telecom House, Friars Walk Shopping Centre, and Xafinity House (the former Bus Station and Bingo Hall, Western Tower and Retail Parade have already been demolished) and the construction of new residential and commercial buildings. Under the consented scheme the existing multi storey NCP car park will be reconfigured and refurbished. The development comprises the construction of four new commercial buildings (referred to as Building Plots A - D with the carpark in Plot G) and two new, primarily residential, buildings referred to as Building Plots E and F. The commercial buildings and NCP car park (Building Plots A - D and G) form the area of Station Hill North whilst the residential buildings (Building Plots E and F) form the area of Station Hill South.

1.1.3 The overall development is located to the south of Reading Railway Station and cover an area of approximately 2.6ha. It encompasses land between Station Hill, Greyfriars Road, Friar Street and Station Road. Garrard Street, an east to west aligned highway, bisects the development area into a north side and a south side. The works, subject to this report, were undertaken to the specification of the WSI (Waterman IE, Nov. 2018) at Station Hill North (NGR: SU 7132 7364 - Fig. 1). The watching brief was undertaken between 8th May 2019 and 12th June 2019.

1.1.4 Station Hill North was subject to two previous phases of archaeological evaluation undertaken by Foundations Archaeology in 2009 (FA, 2009) and Archaeology South-East in 2016 (ASE, 2016), from which Waterman IE developed a WSI for archaeological mitigation (Waterman IE, June 2017). These works related to former RBC Planning Application 130436.

1.2 Location, topography and geology

1.2.1 The wider Station Hill development area sits on land that to the south, at c 46mOD, occupies the northern edge of an east-west promontory of higher ground formed of chalk, overlain by terrace gravels and brickearth which sits between the floodplains of the River Thames to the north and the River Kennet to the south. The central part of the development area covers the north facing slopes of the Thames Valley and it's northern limit finishes in the alluvial (and colluvial) fill of the southern edge of the Thames floodplain, at c 38mOD. The Site itself is limited to the lower ground of the former Thames floodplain in the northern part of the wider development area.

1.2.2 The underlying geology of the Site consists of the Seaford Chalk Formation and Newhaven Chalk Formation, with the superficial deposits being recorded as Alluvium, consisting of clay, silt, sand and gravel (BGS 1:50,000 New Series Sheet No. 268).

1.2.3 The overall Station Hill development is located to the south of Reading Railway Station, east of Greyfriars Road, and immediately to the north of Friar Street (a principal retail street), on the northern edge of Reading's medieval and historic centre, which developed on the promontory between the Thames and Kennet rivers. Station Hill North, subject to this report, is bounded to the north by Station Hill and to the south by Garrard Street. It is currently occupied by the disused Xafinity House and the multi storey NCP car park. The former Bus Station and Bingo Hall, Western Tower and Retail Parade have already been demolished, and have been replaced with a publically accessible Temporary Events Space outside the construction hoardings and open ground inside.

2 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND AND POTENTIAL

2.1 Archaeological and historical background (incl. Previous Archaeological Investigations)

2.1.1 A number of archaeological exercises have been conducted for the Station Hill area;

- Desk Based Assessment, Foundations Archaeology, 2003
- Desk Based Assessment, Foundations Archaeology, 2009
- Desk Based Assessment, Great Western Main Line (GWML), Reading, Berkshire, including the remodelling of the Reading Station Area (RSA), Ove Arup and Partners Ltd
- Archaeological Evaluation Report, Station Hill and Friars Walk, Friar Street, Reading: Foundations Archaeology, 2009
- WSI for Phase 2 Evaluation and Watching Brief Station Hill, Reading - Foundations Archaeology, 2014
- Environmental Impact Assessment submitted to RBC by Waterman IE in 2015, which contained an Archaeological Desk Based Assessment - Station Hill, Reading by Foundations Archaeology, (Foundations Archaeology, 2015), as well as an Environmental Statement Archaeology Chapter (Chapter 8) also by Foundations Archaeology
- WSI for an archaeological Evaluation at Station Hill and Friars Walk (Plots B & D), Friar Street, Reading, Berkshire, Archaeology South-East, 2015
- Evaluation Report: Land at Station Hill, Plots B & D, Reading, Berkshire, Archaeology South-East (ASE) Report No: 2016009 March 2016
- Watching Brief Report: Station Hill South, Plots E and F, Reading. Oxford Archaeology June 2019

2.1.2 A summary of the historical background and of previous archaeological investigations from the 2015 DBA (Foundations Archaeology, 2015) is outlined below, along with a summary of the 2009 and 2016 evaluations (Foundations Archaeology, 2009 and ASE, 2016). The MRD numbers in the text are the reference numbers used in Reading Borough Councils' Historic Environment Record.

Prehistoric

2.1.3 There is evidence of prehistoric activity from the Palaeolithic to the Iron Age within the area surrounding the development site. This is not surprising considering that the river terrace gravels of the Kennet are known to have been utilised for prehistoric settlement. Two handaxes were found at Station Road [MRD9047], approximately 125m east of the Site, and at Vachel Road [MRD9047], approximately 181m to the west of the site. Neolithic activity is represented by flint axes [MRD11209], a flint net sinker or loomweight and a bone needle [MRD11197], all found between c 270-330m south-east from the site.

2.1.4 A single sherd of Bronze Age pottery [MRD15735] at Friar Street (c 330m south-east of the site) points towards Bronze Age activity, and only a selection of isolated finds including

a brooch [MRD11254] and coins [MRD11245] recorded at varying distances between 150m to 400m from the site suggest use of the area during the Iron Age period.

Roman

2.1.5 Roman occupation within Reading lay within the hinterland of *Calleva Atrebatum* (Silchester), a major Roman political and administrative centre, or *civitas* and the area may have been a suitable site for a quay for Thames river trade bound for *Calleva*, although no evidence has yet been found. Possible Romano-British settlement was recorded c 490m to the south-east of the site in the form of brick and tile remains [MRD15664]. In general, further remains consisting of pottery and coins have been noted between Friar Street and Broad Street.

Early-medieval and medieval (AD410-1540)

2.1.6 Reading was first documented in the Anglo-Saxon chronicle of AD 870-871 as the site of a Danish winter camp [MRD3906]. Station Hill North falls within an area of the Thames floodplain historically known as Vastern Meadows, an original meaning of 'vastern' is 'stronghold'. Previous investigations c 120m east of the site revealed two Anglo-Saxon sunken-feature buildings.

2.1.7 Old Market, c 430m to the south of the site, may have been the site of a Late 10th century Anglo-Saxon settlement. The Site lies c 150m to the north of the possible extent of the Anglo-Saxon settlement (Astill, 1978).

2.1.8 The Domesday record refers to a pre-Conquest market at Reading [MRD3913] and finds of coins imply that a mint operated during the early 11th century. Furthermore, numerous burials have been found within the area, including one near the engine sheds at Reading Railway Station [MRD3891].

2.1.9 The foundation, by Henry I in 1121, of the Benedictine Abbey, led to a significant expansion of the town. The Benedictines established Friar Street (as well as Broad Street – parallel and to the south of Friars St) in the 12th century (first documented in 1186). The eastern end of Friar Street led to the western gateway of their precinct as well as a new market place, c 350m east of the site. Friar Street was developed with narrow burgage plots (characterised by buildings on the street-frontage with open back-plots behind) along both its north and south sides. This pattern of urban settlement probably extended west along the northern side of Friar Street into the southern part of the site, with the burgage plots probably extending down the north facing slopes forming the southern edge of the Thames Valley.

2.1.10 A Franciscan Friary (MRD3938) was founded at Reading in 1233. Initially located outside the town along the road to Caversham on marshy ground, there were severe problems from flooding, and so in 1285 they were granted additional drier land at the western end of Friar Street to which they moved their conventual precinct. This friary (some extant fabric still remains) lay on the other side of Greyfriars Road c 80m west of the Site. At Greyfriars Day Nursery an evaluation by John Moore Heritage Services [ERM1267] recovered articulated skeletal remains and pottery of probable medieval date.

2.1.11 The DBA (Foundations, 2015) notes that there are at least 76 non-designated heritage assets of medieval date within 500m Study Area surrounding the Station Hill development area.

2.1.12 Previous investigations within the development area have revealed medieval / post-medieval pits [MRM16558] and large cut features [MRM17581].

Post-medieval to modern (1540 - present)

2.1.13 Reading was the largest town in Berkshire in the 16th century and by 1611 had a population of over 5,000 principally due to its' successful role in the cloth trade. Evidence suggests that Civil War defences [MRD15703] may run through the southern part of the site (through Telecom House/Plot E).

2.1.14 Historic mapping shows that Plot E was urbanised by 1899 and that the northern part of the site became enclosed by both commercial and private development. Late 1890s development within and to the north of the site is well documented and the station was constructed during that time. Previous investigations within the Site and an approximate 500m Study Area reveal a wealth of post-medieval evidence including, but not limited to, pits and ditches [MRM16016], wall foundations [MRD15503], a possible tile-built hearth [MRD15505] and a Victorian well [MRD7368] at Friar Street.

2.1.15 Evidence for modern activity primarily consists in the form of 20th century floors [MRD15507 and MRD15508] at Friar Street, a stall [MRD5503] in Hosier Street and two memorials [MRM16508 and MRM16206].

2.1.16 At Greyfriars Road (just outside the site) an evaluation at Number 5 [ERM449] did not reveal significant archaeological deposits, however, during works at 25-26 Friar Street [ERM483] animal bone and charred cereal grains (medieval to post-medieval) were recorded.

Previous evaluation in 2009 and 2016 (Figure 2)

2.1.17 During an archaeological evaluation within the Station Hill North area in 2009, Foundations Archaeology (FA, 2009) revealed a medieval or early Post-medieval feature in the northern end of Trench 1 which cut into the top of the natural gravel at a truncated depth of 1.6m b.g.l (36.12m OD) and was filled with dark organic rich material. Similar organic rich silts were also observed in Trench 4 but were considered to be general layers (rather than feature fills) of similar date.

2.1.18 Modern overburden was recorded to depths of 1.63m b.g.l (36.12mOD) in Trench 1; 2.62m b.g.l (35.13m OD) in Trench 2, 2.20m b.g.l (35.37m OD) in Trench 3 and 0.45m (37.37m OD) and 1.20m b.g.l (36.62m OD) to the top of gravel in Trench 4 (*ibid.*).

2.1.19 In 2016, Archaeology South East added a further evaluation trench within the Station Hill North area (Trench 5), and recovered evidence for similar alluvial deposits as those recovered in the 2009 work, plus a medieval or possibly Post-medieval north-south orientated feature in the northern end of the trench. This was filled with organic silts and probably represents a former boundary and/or drainage ditch (ASE, 2016). This feature may be the same as that recorded in the northern end of Trench 1 in 2009 (see Figure 2).

3 EVALUATION AIMS AND METHODOLOGY

3.1 Aims

General

3.1.1 The aims of the Watching Brief were laid out in the WSI (Waterman IE, 2018):

- To determine the presence and / or absence of archaeological remains, and if remains are present, to make a full record to current standards;
- To determine the approximate extent, condition and state of preservation of any remains;
- To confirm the approximate date or range of dates of the remains; and
- To prepare a Watching Brief report outlining the results.

3.2 Methodology

Scope of works

3.2.1 An archaeological Watching Brief was undertaken to monitor site investigations:

3.2.2 Site investigations within Station Hill North comprised:

- 7 mechanically excavated Trial Pits to depths varying from 0.6m to 4.5m below ground level (b.g.l),
- 5 Windowless Sample (WS) probes depths varying from 0.35m to 5m b.g.l,
- 12 Boreholes (BH) three of which to the depth of 40m b.g.l.

Site specific methodology

3.2.3 The Watching Brief was undertaken by an appropriately experienced and qualified archaeological contractor.

3.2.4 Mechanical excavations were, where possible and applicable, undertaken using a toothless ditching bucket under constant supervision by the attending archaeologist. Mechanical excavations proceeded until the required level for the ground investigation had been reached or until the top of archaeological deposits were revealed, depending on which was encountered first.

3.2.5 Where appropriate, the attending archaeologist halted the ground-work for sufficient time to enable an archaeological record to be made in accordance with the guidelines contained within the ClfA current *Standard and Guidance for an archaeological watching brief*.

3.2.6 Significant archaeological deposits were sampled and recorded in accordance with the methodology for recording as described in Section 3 (Waterman IE, 2018).

3.2.7 The Watching Brief was maintained throughout the programmes of site investigations.

3.2.8 Test Pits and boreholes (and thus) archaeological features and deposits were located manually using scaled print-outs of the pre-site measured survey, these were digitised into the CAD version of the pre-site survey and then positioned within the Ordnance Survey grid.

3.2.9 A digital photographic record was maintained during the watching brief works. The photographs were captured as jpg images, over 10MPixels in quality, on RICOH Caplio500Gwide and RICOH WG-30 digital cameras. A photographic index (initially an analogue on site list) for archiving purposes was produced the index contained the following fields, which reiterates and expands on the photographic metadata: File name, the photograph ID number issued to the image in the archive set; Site Number, the photograph ID number issued on site; Caption, the subject of the photograph; Location, site reference name and address; Easting and Northings, position in Ordnance Survey coordinates; Date, the date photograph was taken on; and the initials of the photographer.

4 RESULTS

4.1 Introduction and presentation of results

4.1.1 A total of 12No. Boreholes (BHs), 5No. Window Samples (WSs), and 7No. Test Pits (TPs) were excavated at the Site (i.e. Station Hill North).

4.1.2 Due to practical constraints of the original proposed Test Pits, two were omitted (TPs 211 and 207), and TP211 was swapped for a Window Sample.

The results have been tabularized below for quick reference and are followed by written summary descriptions of the deposits and archaeological remains.

Boreholes					
BH No.	Size (m)	Depth (m)	Depth to chalk (m)	Depth to gravel	Potential or real archaeology
201		35	7.3	2.4	-
202		1.2	-	-	-
202a		0.65	-	-	-
202b		0.6	-	-	-
202c		0.1	-	-	-
202d		40	8.7	4.3	Organic archaeological layer (781)
203		40	7.75	-	Potential palaeochannel fills (414)-(425) – (418) contained 20 th C brick (intrusive?), 2x worked flint flakes of general Prehistoric date (one each in (413) and (416))
204		40	5.4	3.35	19 th C made ground (439) overlying potential archaeological layer/channel fill, organic silt (441)
205		0.65	-	-	-
205a		1	-	-	-
205b		0.4	-	-	-
205c		37	8.25	3.6	20 th C brick wall/surface (512) overlying 18-19 th C made ground (513). Potential palaeochannel (516? intrusive 19-20 C brick) (517 intrusive 19 th C brick) (518)
Window Samples					
WS No.	Size (m)	Depth (m)	Depth to chalk (m)	Depth to gravel	Potential or real archaeology
201		1.1	-	-	-
202		5	-	2.9	-

203		5	-	3.75	19 th C made ground (572) overlying 19-20 th C layer (574) overlying potential red brick surface (576) Geoarchaeological layers with organics/palaeochannel fills (571), (578)
204		0.35	-	-	-
211		1.05	-	-	-
211a		1	-	-	-
Test Pits					
TP No.	Size (m)	Depth (m)	Depth to chalk (m)	Depth to gravel	Potential or real archaeology
202	3.3 x 0.9	1.35	-	-	Modern wall (762) running E-W, Plate 1, Figure 3
203	2.8 x 0.9	5	-	3.5	19-20 th C made ground (712) overlying 20 th C organic silt layer (713), redeposited terrace gravels (714), Plate 2, Figure 4
204	2.7 x 1.6	0.6	-	-	Modern (?) building foundation / wall (732), Plate 3, Figure 5
205	2.5 x 0.9	1.3	-	-	
206	2.5 x 0.9	1.35	-	-	-
208	2.4 x 0.9	1.7	-	-	-
209	2.6 x 0.9	2.5	-	-	Archaeological layer (741), Plate 4, Figure 6

4.2 Description

4.2.1 A total of seven Test Pits (TP202, 203, 204, 205, 206, 208, 209), six Window Samples (WS201, 202, 203, 204, 211, 211a) and twelve Boreholes (BH201, 202, 202a, 202b, 202c, 202d, 203, 204, 205, 205a, 205b, 205c) were located to the north of Garrard Street. Of these, BH202d, BH203, BH204, BH205c, WS203, TP202, TP203, and TP204 contained the potential for archaeology.

4.2.2 BH201 (surface at 38.3mOD) contained 0.35m of concrete overlaying four deposits (371, 372, 373, 374) measuring a total depth of 1.65m which were made up of compacted made ground, with frequent inclusions of brick and concrete fragments. At 2m b.g.l, 0.4m of bluish grey alluvium was found over 4.9m of terrace gravels. Chalk was reached at 7.3m b.g.l.

4.2.3 BHs 202, 202a, 202b and 202c all hit concrete obstructions overlain by modern deposits at depths between 0.10 - 1.20m b.g.l.

4.2.4 BH202d (surface at 39.2mOD) had modern made ground to a depth of 2.20m b.g.l, which overlay 0.20m of a blackish brown soft clay, which contained waterlogged organic

components and a strong smell of hydrocarbons. Underlying this, at 2.40 - 3m b.g.l was a mid greyish-brown alluvial clay, which overlay 1m of pale orangey grey alluvial clay. At 4m b.g.l there was a void for 0.30m and then from 4.30 - 8.80m b.g.l the terrace gravels were reached. At 8.80m b.g.l the chalk was seen.

4.2.5 BH203 (surface at 38.74mOD) consisted of 0.55m of tarmac with a concrete bed and levelling deposits over 1.45m of made ground, from which two pieces of redeposited prehistoric worked flint were recovered. The deposits from 2.00 - 2.70m b.g.l a mid-dark grey blue alluvium (414) was seen with organic matter, ceramic building material (CBM) and flint inclusions over 0.12m of black grey silty clay alluvium (415). A second organic layer, (417) at 4.00 - 4.15m b.g.l was seen overlying a gravel layer (416) which contained a single flint flake. From 4.15 - 4.32m b.g.l a gravel deposit (418) with washed out black blue alluvial clay traces was seen containing brick dating from AD 1900 - 1950, although given the depth of this deposit and the overlying sediments it is possible these brick fragments might have been introduced from higher up the strata during the drilling process. From 4.32m the deposits become predominantly flint gravel derived from the terrace material, with thin layers of alluvial clays interspersed between them. At 7.15m b.g.l two deposits with degraded/weathered chalk inclusions were seen over 0.30m of weathered chalk in a light brown beige sandy clay matrix. Solid chalk bedrock was seen at 7.75m b.g.l.

4.2.6 BH204 (surface at 46.35m OD) had 0.05m tarmac overlaying 2.15m of made ground containing brick, slag, metals and glass, with the earliest layer, (439) containing pottery dating to c 1820-1900s. Below this was 0.55m of orange brown silty garden/worked soil, overlaying 0.20m of soft dark black blue alluvium/possible channel fill (441) with chalk inclusions. At 3.00m b.g.l a light blue grey clayey silt with abundant chalk inclusions and measuring 0.20m thickness was seen overlaying 1.80m terrace gravels. Chalk was seen at 5.40m with a 0.25m thick interface consisting of discoloured/contaminated chalk. A strong smell of hydrocarbons permeated all deposits from 2.70 - 5.4m b.g.l.

4.2.7 BHs 205, 205a, and 205b all hit concrete obstructions between 0.20 - 0.40m b.g.l before they were abandoned.

4.2.8 BH205c (surface at 38.35m OD) had 0.30m of concrete overlying 0.10m of made ground. At 0.40 - 0.70m b.g.l there was a c 1900-1950 red unfrosted brick surface (512) with pale beige/yellow sandy mortar. From 0.70m b.g.l to 1.50m b.g.l there was a soft dark greyish brown clayey silt with pottery dated to c 1850-1900s alongside slate, wood, and flint pebble inclusions which may have been a fairly modern garden soil deposit. From 1.50 - 1.7m b.g.l there was a mid orangey-grey clayey alluvial silt with flint and chalk inclusions, likely representing the upper fill of a channel. From 1.70 - 2.00m b.g.l there was a mid greyish-brown soft clayey silt channel fill with flint and waterlogged wood inclusions. This overlay a mid greyish-brown clayey silt (516) which contained CBM fragments dating from 19th-20th century as well as flint and stone inclusions, and lay 2.00 - 2.5m b.g.l. From 2.50 - 2.70m b.g.l there was a soft, dark brownish black silty clay (517) which was organic rich with a peat smell and a fragment of c 1820-1900 red brick. After a void of 0.30m, at 3.00 - 3.40m b.g.l a dark brownish black clayey silty gravel fill with frequent flint inclusions was found. From 3.40 - 3.60m b.g.l there was a clear interface between the terrace gravels which came in at 3.60m OD, then at 8.25m b.g.l the chalk was reached.

4.2.9 WS201 (surface at 40.80m OD) featured concrete to 0.20m b.g.l and made ground to 1.10m b.g.l. The drilling rig refused at 1.10m b.g.l and the window sample was finished.

4.2.10 WS202 (surface at 38.66m OD) had 0.1m of tarmac overlying 1.55m of modern made ground, comprising two layers. At 1.65m b.g.l until 2.30m b.g.l there was a dark greenish black compact clayey silt with small stone and organic inclusions, as well as small broken fragments of modern glass and pockets of gravel inclusions. This overlay 0.6m of compact pale bluish grey/gleyed silty clay alluvium. From 2.90m b.g.l there was the natural gravel terrace (aside from a void from 3.65 - 4.65m b.g.l) until the end of the window sample at 5.00m b.g.l.

4.2.11 WS203 (surface at 39.07m OD) consisted of several layers of made ground measuring a total of 2m. deposit (574) at 1.70m - 1.85m b.g.l contained 19th -20th century red brick and glass. At 2.00 - 2.18m a potential red brick surface (576) was seen, though this was hard to determine as the bricks were heavily fragmented during drilling. Deposit (572) at 0.27-1.00m b.g.l yielded three pottery sherds dating to c 1830-1900. This overlay 1.57m of alluvium which contained organic traces. Terrace gravels were seen at 3.75m b.g.l. Chalk was not reached at 5.00m b.g.l.

4.2.12 WS204 (surface at 39.62m OD) consisted of 0.05m concrete over 0.30m of made ground and terminated at 0.35m b.g.l due to concrete obstruction.

4.2.13 WS211 (surface at 39.17m OD) had 0.10m of paving slab and concrete bed over 0.95m of backfill. A modern drain pipe was seen at 1.05m b.g.l and the hole was terminated at this point.

4.2.14 WS211a (surface at 39.11m OD) consisted of 0.10m of paving slab and concrete bed over 0.90m backfill. At 1.00m b.g.l the hole was terminated due to the same drain pipe as seen in WS211.

4.2.15 TP202 (surface at 38.86m OD) (Plate 1, Figure 3) consisted of 0.70m modern demolition crush overlying 0.65m demolition deposit. The test pit finished at 1.35m b.g.l with a WNW-ESE Victorian or later red brick wall.

4.2.16 TP203 (surface at 39.08m OD) (Plate 2, Figure 4) had three layers of made ground measuring in total 0.85m, of which (712) contained 20th century pottery. From 0.85 - 2.65m b.g.l a 1.55m thick greenish black clay was encountered with a strong cess odour which had pottery dating from c 1920-1950. At 1.35m a 0.10m band of possibly redeposited yellow terrace gravel was seen. Underlying this was 1.10m of alluvium over 1.00m of loose sand. Terrace gravels were seen at 4.50m b.g.l.

4.2.17 TP204 (surface at 39.17m OD) (Plate 3, Figure 5) consisted of 0.75m of made ground over a modern wall foundation and terminated at this depth.

4.2.18 TP205 (surface at 38.33m OD) consisted of 0.60m made ground with demolition material overlying 1.10m of soft dark grey brown silty clay with occasional brick inclusions. At 1.70m b.g.l a 0.30m pale orange brown modern rubble deposit was seen overlying 0.90m of reddish brown clay with occasional brick inclusions. The pit finished at 3m due to water ingress in a dark grey clay containing brick organics, metal and modern debris (plastics) and pottery dating to c 1780-1840.

4.2.19 TP206 (surface at 38.92m OD) had 0.05m of tarmac overlaying 0.90m of pale greyish brown modern made ground and 0.4m of dark brown grey made ground. The pit finished at 2.30m b.g.l due to lack of space to spoil.

4.2.20 TP208 (surface at 39.01m OD) had 1.60m of modern made ground overlaying 0.10m of dark grey black silty clay and was finished at 1.70m b.g.l due to a large iron service pipe located in the northern section of the pit.

4.2.21 TP209 (surface at 39.24m OD) (Plate 4, Figure 6) consisted of 1.80m of modern demolition material overlaying 0.70m of dark grey brown/green deposits possibly containing cess material. The pit was finished at 2.50m b.g.l due to water ingress.

5 FINDS REPORTS

5.1.1 A small quantity of artefacts was recovered; these are reported on below. No animal bones were recovered and no soil samples were taken.

5.2 Post-Roman Pottery by John Cotter

Introduction and Methodology

5.2.1 A total of 22 sherds (1258g) of pottery were recovered from five contexts. Nearly all of this is of 19th and 20th century date, and nothing earlier than (possibly) c 1750 was identified.

5.2.2 All the pottery was scanned during the present assessment and spot-dates were provided for each context. Each context group was quantified by sherd count and weight and recorded on a spot-dating spreadsheet. The pottery is mainly fragmentary but some large fresh sherds are present.

5.2.3 The context spot-date is the date-bracket during which the latest pottery types or fabrics are estimated to have been produced or were in general circulation. Comments on the range of fabrics were recorded, usually with mention of vessel form (jugs, bowls etc.) and any other attributes worthy of note (e.g. decoration). Post-medieval fabric codes referred to are those of the Museum of London (MoLA 2014). The range of pottery is described in some detail in the spreadsheet (table below) and is therefore only summarised below.

Description

Context	Location	Spot-date	Sherds	Weight	Comments
513	BH205c	c1750-1900	1	3	Small body sherd of late-looking post-medieval red earthenware (Fabric code: PMR). Dark brown glaze all over internally with brown speckling. Fabric light orange, fine sandy, with pale brown ext. surface
572	WS203	c1830-1900	3	11	1x rim sherd from wide dish in transfer-printed whiteware (TPW) with brown floral transfer-printed decoration and with a notched or scalloped rim edge. 2x body sherds refined whiteware (REFW, c1805-1900), both with rusty brown post-deposition staining
712	TP203	c1875-1950?	3	16	2x body sherds from 2 separate vessels in coloured glazed refined whiteware (COLGE, c 1800-1900+), one with dark green glaze and the other with a turquoise blue-green glaze; both very late-looking and probably 20C rather than earlier? 1x body sherd REFW

Context	Location	Spot-date	Sherds	Weight	Comments
713	TP203	c1920-1950?	12	1098	Nearly all types of refined whitewares from a minimum of 6 vessels - mainly TPW. Includes TPW oval dish profile with very late- or modern-looking border of green vine leaves on a light grey border background, black rim tip/edge border and inner gilded or faux-gilded border of light brown lacework - possibly 1920s or 1940s? 3 joining sherds from TPW dish profile c1900 with green ivy leaf border and printed maker's mark underside - an oval belt device with word 'IVY' at top of belt and part of the name 'WEDG[WOOD]' below the belt, the belt enclosing a large letter 'N'. Profile L19C TPW soup tureen with dark blue swag decoration border on shoulder (3 sherds). 1x sherd REFW (804g) = complete base (diameter 200mm) from a large ceramic barrel with imitation barrel staves moulded above a lower border of hooping - probably c1900 (possibly a display piece from a public house?). 3 other sherds REFW including 1 from a fluted vessel. 1x footring base and lower part of a bone china (BONE) teacup - L19/20C.
754	TP205	c1780-1840	3	130	Joining sherds from a Pearlware (PEAR) chamberpot with a broad flanged rim
TOTAL			22	1258	

5.2.4 The pottery mostly comprises ordinary domestic kitchen and tablewares typical of almost any 'Victorian' site in southern England, with mass-produced Staffordshire-type whitewares ('Willow Pattern' etc.) comprising the bulk of the assemblage. There is a strong dating emphasis on the late 19th and first half of the 20th century (i.e. the 'modern' period). Part of a large whiteware (spirits?) barrel from Context (713) might have been used as a display piece in a public house, or a perhaps a shop? Similar vessels can still be seen in many old pubs to this day. A Pearlware chamberpot from (754) has a potential date-range of c 1780-1840. A small piece of post-medieval red earthenware (PMR) from (513) is of late appearance - probably of 18th- or 19th-century date - but is not capable of close dating (unlike the Pearlware chamberpot). It is quite possible, therefore, that these two earliest items also date from the 19th century.

Recommendations regarding the conservation, discard and retention of material

5.2.5 The pottery here has some potential to inform research through re-analysis - particularly when reviewed alongside further assemblages from any future excavations in the area of the present watching brief. It is therefore recommended that the pottery be retained.

5.3 Post Roman ceramic building material (CBM) by John Cotter

Introduction and Methodology

5.3.1 The site produced a total of 8 pieces of post-Roman CBM weighing 3368g from six contexts. This is all of late post-medieval date - and probably confined to the 19th and 20th centuries. The assemblage is in a fragmentary and fairly abraded condition and of little interest aside from its use for dating purposes.

5.3.2 All the CBM was scanned during the present assessment, in a similar way to the pottery, and spot-dates were provided for each context. Each context group was quantified by fragment count (or pieces) and weight and recorded on a spot-dating spreadsheet. The two large brick fragments from Context 512 were separately recorded. The material is described in some detail in the spreadsheet (Table 1) and is therefore only summarised below.

Table 1. Description of post-Roman CBM by context

Context	Location	Spot-date	Pieces	Weight	Comments
418	BH203	c1900-1950 intrusive to context	2	277	2x bricks. 1x corner fragment from brick in white fireclay with evidence of a frog; complete thickness = 59mm, probably machine-made, possibly a refractory firebrick - although the frog is a bit unusual for latter type of brick - so it may just be a decorative facing brick? Fairly abraded/battered. 1x abraded corner frag from a red housebrick, fairly rough, probably 19/20C? Discard?
439	BH204	c1820-1900+	1	20	Body sherd from a brown salt-glazed stoneware drainpipe or services pipe. The outer surface missing. Discard?
512	BH205C	c1900-1950	1	1646	Brick. Complete end fragment (or approx. half a brick). Modern-looking very regular machine-made red brick in a fine orange-red fabric. Unfrogged. Width = 112mm, Thickness = 72mm. Probably 20C. Discard?
512	BH205C	c1900-1950	1	1006	Brick. Damaged end fragment from an unfrogged brick. Width = 112mm, Thickness = 58mm. Possibly handmade - but fairly neat - probably 19C? Light orange fabric with swirls of cream clay and a few small flint inclusions. Fairly abraded. Discard?
516	BH205C	19-20C	1	24	Brick? Flattish frag of abraded brick with a smooth surface surviving on one side. Underside abraded/worn but flattish and almost tile-like. Fabric and colour identical to brick in 517 below. Date probably the same as latter. Discard?

517	BH205C	c1820-1900	1	348	Brick. Side frag from a handmade brick with evidence of a shallow frog on top. Fairly soft sand-free, light orange-brown fabric with a lumpy texture caused by abundant pellets and streaks of cream and red clay up to 12mm across. Side face creased. Thickness = 73mm. Fairly abraded. Discard?
574	WS203	19-20C	1	47	Brick. Flattish frag of abraded brick with a smooth surface surviving on one side. Underside worn/abraded but flattish (possibly used for path or yard metalling?). Presently c23mm thick. Fabric and colour identical to brick in 517 above - and also to 516 above - possibly part of the same brick as in 516? Discard?
TOTAL			8	3368	

Discussion

5.3.3 The CBM assemblage comprises seven pieces of 19th- and 20th-century brick and a single piece of a stoneware drainpipe of similar date.

Recommendations regarding the conservation, discard, and retention of material

5.3.4 The CBM assemblage here has little or no potential for further research and could be discarded if so desired.

5.4 Glass by Ian Scott

5.4.1 The single piece of glass is the neck and part of the shoulder of a late 19th or early 20th-century bottle from context 574. The bottle was probably used for condiments, but have been used from medicines or coffee

Context 574 WS203	Condiment bottle with square or near square cross section body and short vertical neck with rim of square section. Comprises part of slightly curved square shoulder and complete neck. The bottle was mould-made but the rim was hand finished. Pale blue green glass. Ht extant 32mm. Late 19th-early 20th-century.
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Recommendations regarding the conservation, discard, and retention of material

5.4.2 The glass assemblage here has little or no potential for further research and could be discarded if so desired.

5.5 Flint by Elizabeth Kennard

Introduction

5.5.1 A small assemblage of two residual struck flint and a modern piece was recovered, all from BH203. The pieces were undiagnostic flakes, one from made ground (413) found during hand excavation of the inspection pit, and one from potential channel fill (416) seen whilst inspecting the cores.

5.5.2 The assemblage shows limited prehistoric activity in the area and it is not expected that further work would find any significant flint related activity.

Context	Type	Sub-type	Notes	Date
413 BH203	Flake x2	-Modern -Distal trimming	Distal piece with modern damage on distal	- PreH
416 BH203	Flake	Preparation	From thermal rolled core	PreH

Methodology

5.5.3 The artefacts were catalogued according to OA South's standard system of broad artefact/debitage type (Anderson-Whymark 2013; Bradley 1999), general condition noted and dating was attempted where possible. The assemblage was catalogued directly onto an Open Office spreadsheet. During the assessment, additional information on condition (rolled, abraded, fresh and degree of cortication), and state of the artefact (burnt, broken, or visibly utilised) was also recorded. Retouched pieces were classified according to standard morphological descriptions (e.g. Bamford 1985, 72-77; Healy 1988, 48-9; Bradley 1999). Technological attribute analysis was initially undertaken and included the recording of butt and termination type (Inizan *et al.* 1999), flake type (Harding 1990), hammer mode (Onhuma and Bergman 1982), and the presence of platform edge abrasion.

Recommendations regarding the conservation, discard, and retention of material

5.4.2 The flint assemblage here has little or no potential for further research and could be discarded if so desired.

6 DISCUSSION

6.1 Reliability of field investigation

6.1.1 The location of the site within the former Thames floodplain, at the base of the southern slopes of the valley edge is likely to have created a complex deposit sequence of alluvial and colluvial deposits, understanding such complexities was not possible given the limited scope of the works. However, alluvial-like deposits and possible paleo-channels, were present within many of the interventions where full depths were reached.

6.1.2 Boreholes and window samples only allow the observation of small diameter cores and should perhaps be considered as less reliable than the test pit observations. That said, where potential archaeological deposits were present at these locations they were recognised as each core was examined.

6.1.3 The test pits were limited in size, so, in most instances, where archaeological features were observed (whether potential or real) only part of their full extents were visible, therefore the interpretation as layers is less reliable than if their wider extents were visible.

6.2 Interpretation

Chalk bedrock, terrace gravels and brickearth/silty-sands

6.2.1 The true upper horizon of the chalk bedrock (interpreted as locations where in-situ overlying gravel and sand deposits were present) was observed in TP 203, BHs 201, 202d, 204, 205c, WSs 202, and 203. Where this was observed the interface between the two was seen to be variable with hollows and pockets of drift geology in the undulating surface of the chalk bedrock.

6.2.2 *In situ* overlying drift deposits (sands/ gravels, alluvial and colluvial deposits) were observed with varying degrees of truncation, and survived with combined thicknesses varying from 3.25m in the south to 7.2m in the north of the Site.

6.2.3 It is reasonably safe to assume that truncation from the construction of the existing and recently demolished buildings on the site has impacted on any former buried soils, though in BH205c below the potential surface one was observed at 0.7m – 1.5m b.g.l.

6.2.4 Four possible paleo-channels were observed in BHs 203, 204, 205c and WS203. These are likely to represent natural features within the valley base. This is to be expected within the floor of the Thames floodplain, which throughout earlier pre-history would have been characterized by a multi-braided riverine system, with islands and islets.

Prehistoric to Roman

6.2.5 Two prehistoric worked flint artefacts were recovered as redeposited artefacts in much later modern made ground deposits. Their presence indicates low level prehistoric activity in the vicinity.

6.2.6 No other artefacts or features from these periods were revealed during this phase of work, although it is possible that some of the deposits indicating the presence of paleo-channels may be Prehistoric or Roman.

Medieval

6.2.7 No artefacts or features from the medieval period were revealed during this phase of work. The 2009 and 2016 evaluations encountered a possible NNE-SSW ditch whose position coincided with a Post-medieval ditch on the 1802 Coates map which may have originated in the medieval period and it is possible that deposits encountered in TP202, TP203 and BH205c are related to the same feature. If true, then the brick in the potential channel deposits in BH205c is probably intrusive.

Post-medieval

6.2.8 Many of the artefacts recovered from this phase of work were CBM (brick) and pottery dated to the 19th and 20th centuries, a period when Reading expanded, the railway embankment, railway station and Station Road were constructed and other buildings started to appear in this area. Some of the CBM is directly associated with the *in situ* remains of these structures (TP202, TP204, BH205c and WS203) whilst others were recovered from general deposits of made ground (TP203, BH204).

Undated

6.2.9 It is possible that the organic layer in BH202d, and the archaeological organic layer in TP209 are related, and could date from the medieval or later periods – perhaps related to drainage/boundary ditches.

6.2.10 A similar ditch or channel may have been encountered in WS203.

6.3 Conclusions

6.3.1 The Site lies on the artificially raised but level ground of the southern edge of the Thames Valley floodplain. Where boreholes (BHs) achieved full depth they all observed *in situ* chalk bedrock with overlying drift geology sealed by alluvial/fluvial deposits.

6.3.2 The presence of small numbers of redeposited pre-historic worked flint attest to low level activity during the prehistoric periods in the vicinity of the site.

6.3.3 The potential palaeo-channels in BH203, BH204 and BH205c and the alluvial sequences across the site attest to an open wetland landscape which has had minimal apparent occupation prior to Victorian development.

6.3.4 The potential undated archaeological layers in BH202d, TP209 and WS203 showing there may have been some limited outlying activity extending into the marginal lands north of the medieval burgrave plots.

6.3.5 The brick structures in TP202, TP204, and possible surfaces in BH205c and WS203 record the below ground remains of known structures dating from the late 19th century.

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Waterman IE 2018 Station Hill, Reading: Written Scheme of Investigation – Watching Brief

APPENDIX B

SITE SUMMARY DETAILS

Site name:	Station Hill North, Reading
Site code:	RESHSS18
Grid Reference	SU 7132 7364
Type:	Watching Brief
Date and duration:	8 th May 2019 and 12 th June 2019
Area of Site	2.14ha
Location of archive:	The archive is currently held at OA, Janus House, Osney Mead, Oxford, OX2 0ES, and will be deposited with the Museum of Reading in due course, under the following accession number: tbc
Summary of Results:	<i>Oxford Archaeology (OA) was commissioned by Waterman Infrastructure & Environment (Waterman IE) on behalf of SH Reading Master LLP to undertake an archaeological watching brief to monitor geotechnical site investigations to be carried out in Plots A, B, C, D and G at Station Hill North in central Reading.</i> <i>Evidence of 20th century levelling and/or land reclamation was seen in all interventions.</i> <i>Where the Boreholes (BHs) achieved full depth they all observed in-situ chalk bedrock with overlying gravel drift geology having been sealed by alluvial/fluviol deposits.</i> <i>The presence of redeposited worked flint attests to pre-historic activity during in the vicinity of the site.</i> <i>Investigations at Station Hill North had the potential to reveal occupation and structural evidence for Victorian and post-Victorian buildings as seen on historical maps as well as geoarchaeological deposits and features.</i> <i>The brick structures in TP202, TP204, and possible surfaces in BH205c and WS203 attest to the known structures dating from the late 19th century. The potential undated archaeological layers in BH202 and TP209 show that there may have been some limited outlying activity extending into the marginal lands north of the medieval burgage plots.</i> <i>The potential palaeochannels in BH203, BH204 and BH205c and the alluvial sequences across the site attest to an open wetland landscape with minimal occupation prior to Victorian development.</i>

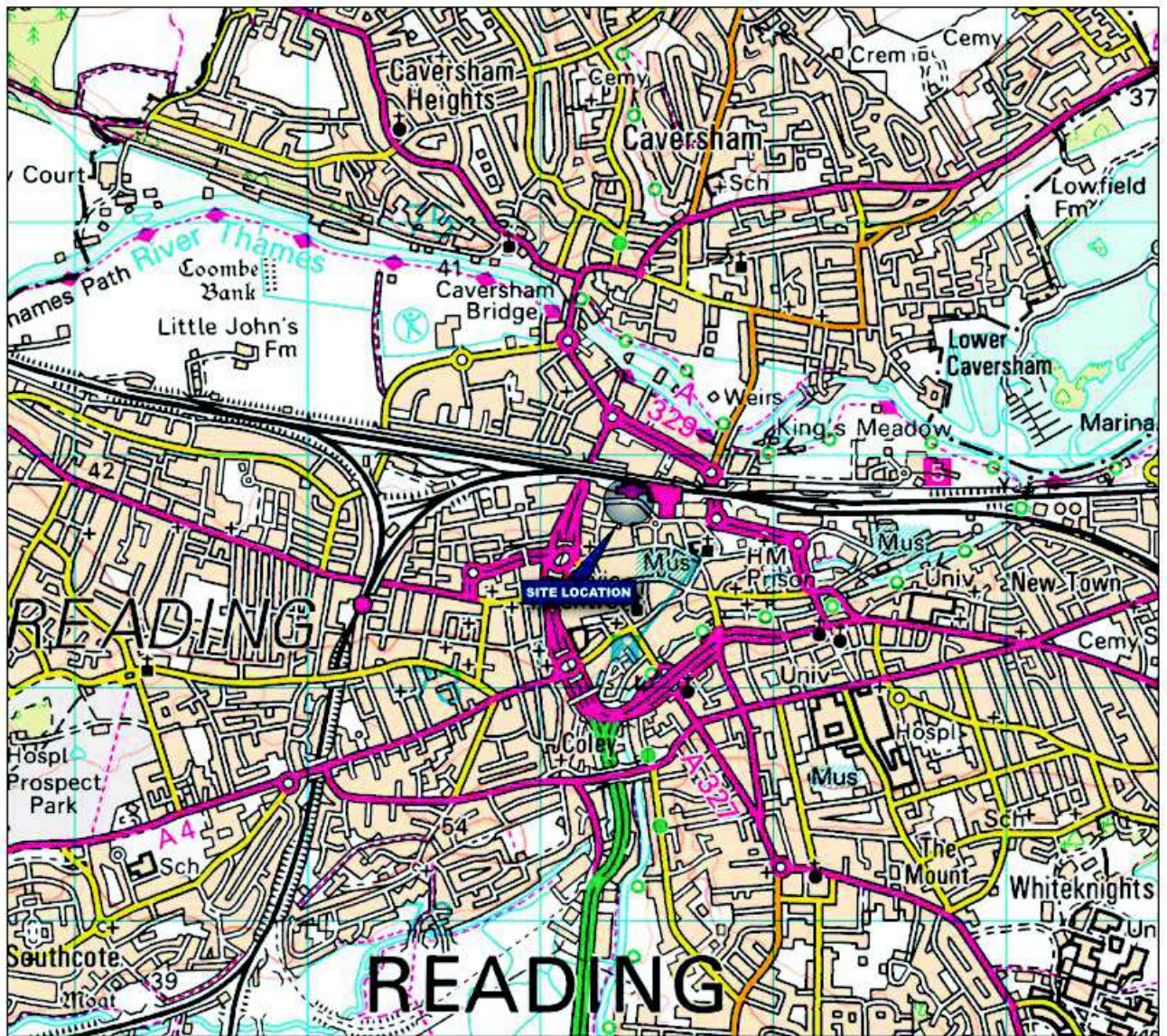


Figure 1: Station Hill Site location.

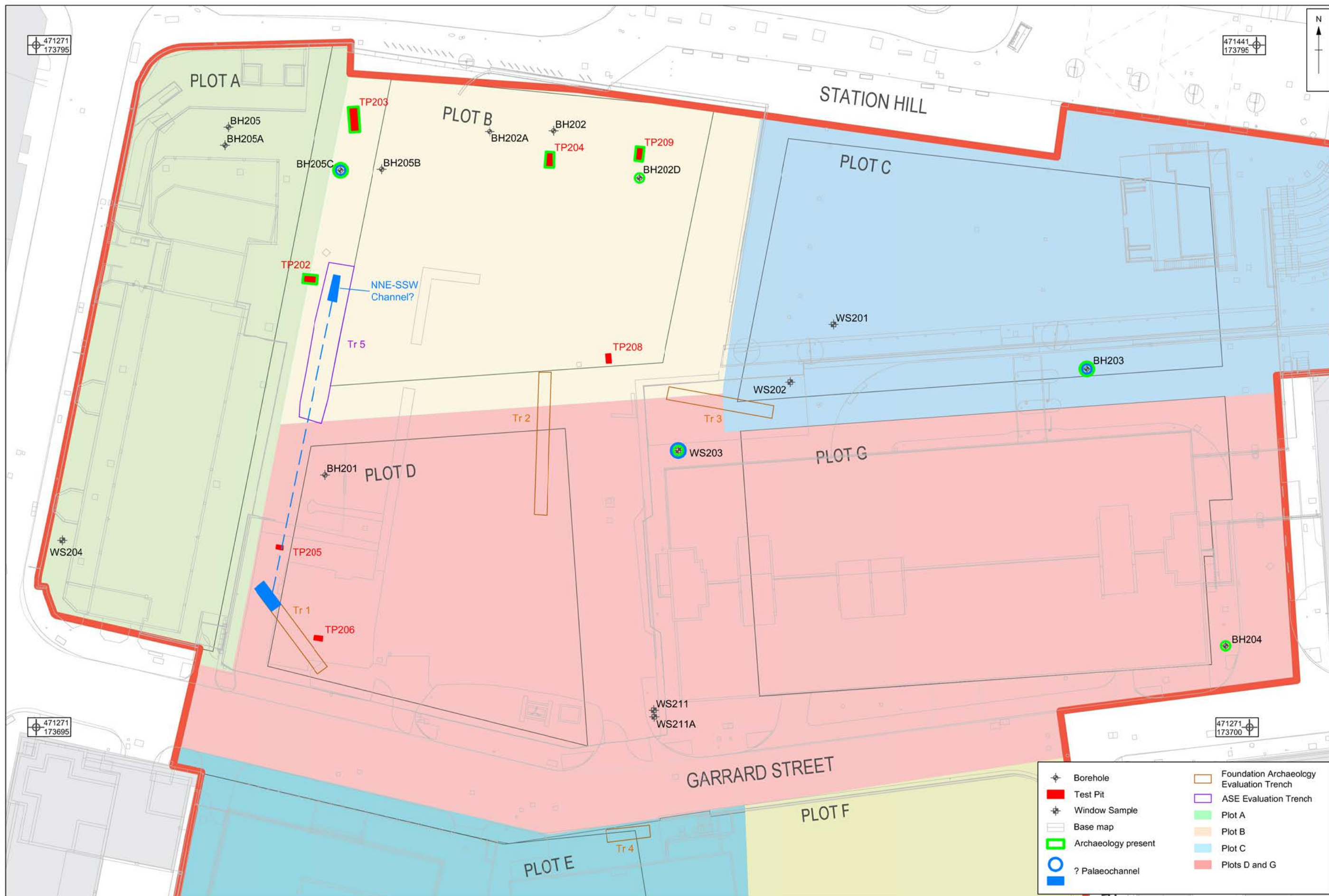
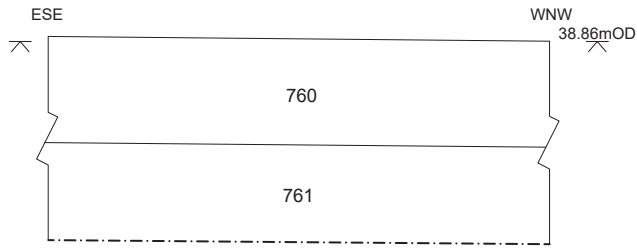
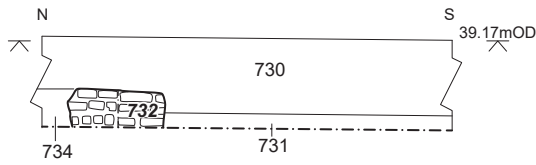


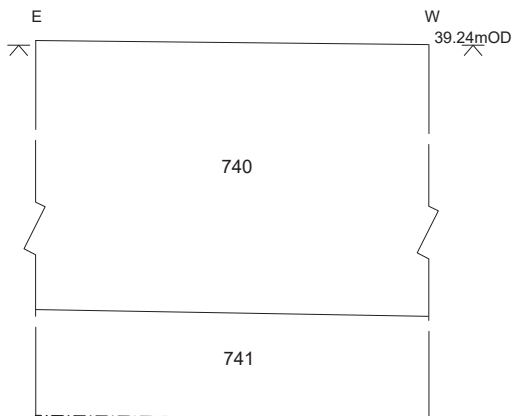
Figure 2: Test Pit, Window Sample and Borehole locations



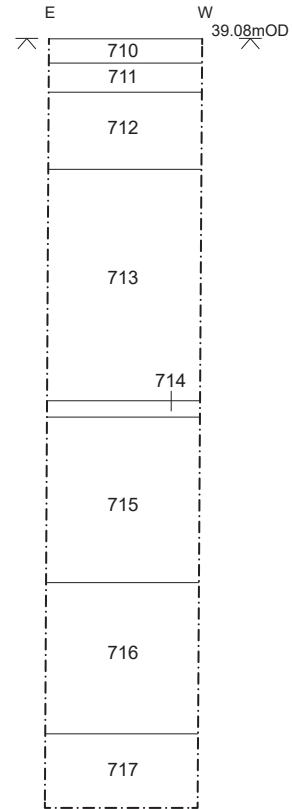
a) Test Pit 202, N-NE facing



c) Test Pit 204, west facing



d) Test Pit 209, south facing



b) Test Pit 203, north facing



Figure 3: Representative sections from Test Pits



Plate 1: View of TP202 looking North



Plate 2: View of TP203 looking South



Plate 3: View of TP204 looking East



Plate 4: View of TP209 looking South



**Head Office/Registered Office/
OA South**

Janus House
Osney Mead
Oxford OX2 0ES

t: +44 (0) 1865 263 800
f: +44 (0) 1865 793 496
e: info@oxfordarchaeology.com
w: <http://oxfordarchaeology.com>

OA North

Mill 3
Moor Lane
Lancaster LA1 1QD

t: +44 (0) 1524 541 000
f: +44 (0) 1524 848 606
e: [oanorth@oxfordarchaeology.com](mailto: oanorth@oxfordarchaeology.com)
w: <http://oxfordarchaeology.com>

OA East

15 Trafalgar Way
Bar Hill
Cambridgeshire
CB23 8SQ

t: +44 (0) 1223 850500
e: [oaeast@oxfordarchaeology.com](mailto: oaeast@oxfordarchaeology.com)
w: <http://oxfordarchaeology.com>



Director: Gill Hey, BA PhD FSA MCIfA
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**OXFORD ARCHAEOLOGY, 2019. STATION
HILL SOUTH PLOTS E AND F READING,
ARCHAEOLOGICAL WATCHING BRIEF
REPORT**



Station Hill South, Plots E and F, Reading Archaeological Watching Brief Report

June 2019

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NGR: SU 7132 7364

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Edited by: Ben Ford (Senior Project Manager)
Approved for Issue by: Dave Score (Head of Fieldwork)
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OA South

Janus House
Osney Mead
Oxford
OX2 0ES

t. +44 (0)1865 263 800

OA East

15 Trafalgar Way
Bar Hill
Cambridge
CB23 8SG

t. +44 (0)1223 850 500

OA North

Mill 3
Moor Lane Mills
Moor Lane
Lancaster
LA1 1QD

t. +44 (0)1524 880 250

e. info@oxfordarch.co.uk

w. oxfordarchaeology.com

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Station Hill South, Plots E and F, Reading

Archaeological Watching Brief Report

Written by Christof Heistermann and Elizabeth Kennard

With contributions from Lee G. Broderick, John Cotter,

and Michael Donnelly

and illustrations by

Gary Jones and Charles Rousseaux

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Summary

Oxford Archaeology (OA) was commissioned by Waterman Infrastructure & Environment (Waterman IE) on behalf of SH Reading Master LLP to undertake an archaeological watching brief to monitor geotechnical site investigations and party wall inspection works to be carried out prior to the demolition of buildings and redevelopment at Station Hill in central Reading.

The existing buildings straddle a significant change in height from 46m OD in the south to 38m OD in the north, formed by the north facing slopes defining the southern edge of the Thames Valley. To rationalise floor levels for the construction of the existing buildings on the site there was evidence of significant earth-works and terracing. In the majority of observations, in situ chalk bedrock was present, but overlying drift geology although present, had been truncated to varying depths.

The presence of redeposited pre-historic worked flint attests to activity during these periods in the vicinity of the site.

The potential pit in TP18, and possible post-holes in TP11 although undated, may attest to activity towards the northern end of medieval burgage plots fronting onto the north side of Friar Street, however, such features are common from the Neolithic onwards.

Investigations from ground floor level on the Friar Street frontage (TP6, TP8 and WS313) where there does not appear to be any current basement levels, had the potential to reveal occupation and structural evidence for medieval and post-medieval burgage buildings. These only revealed modern deposits associated with the construction of the extant buildings, however this is probably due to the positions of the investigations, which were adjacent to significant foundations and their associated truncations. It should be noted that a basement wall for the neighbouring property was seen in TP8 and the presence of older basements along this frontage which may have truncated earlier archaeology cannot be ruled out.

The medieval E-W ditch in TP2 may indicate the base of the valley sides, indeed observations of alluvial deposits were confined to interventions broadly north of this latitude.

Archaeological features, where present, were horizontally and vertically truncated. The lack of archaeological features may relate to the position of the interventions adjacent to large concrete foundations with their associated construction truncations. Areas of site away from foundations but under floor slabs may have better preservation and potential for archaeological features/deposits.

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The project was managed for Oxford Archaeology by Ben Ford MCIFA. The fieldwork was undertaken by Elizabeth Kennard and Christof Heistermann. Thanks are also extended to the teams of OA staff that cleaned and packaged the finds under the management of Leigh Allen, processed the environmental remains under the management of Rebecca Nicholson, and prepared the archive under the management of Nicola Scott.

1 INTRODUCTION

1.1 Scope of work

1.1.1 Oxford Archaeology (OA) was commissioned by Waterman Infrastructure & Environment (Waterman IE) on behalf of SH Reading Master LLP to undertake an archaeological watching brief to monitor geotechnical site investigations and party wall inspection works to be carried out prior to the demolition of buildings and redevelopment at Station Hill in central Reading.

1.1.2 The proposed redevelopment (Reading Borough Council Planning Application Reference: 151426 & 151427) includes the demolition of all the remaining disused buildings and structures within the development area including Telecom House, Friars Walk Shopping Centre, and Xafinity House (the former Bus Station and Bingo Hall, Western Tower and Retail Parade have already been demolished), whilst the existing multi storey NCP car park will be reconfigured and refurbished. The development comprises four new commercial buildings (referred to as Building Plots A - D) and two new primarily residential buildings (referred to as Building Plots E and F). Plots E and F are situated to the south of Garrard Street and are intended for residential accommodation with Plot F consisting of 12 storeys and Plot E being split between 6, 10 and 12 storeys.

1.1.3 The overall development is located to the south of Reading Railway Station and covers an area of approximately 2.6ha. It encompasses land between Station Hill, Greyfriars Road, Friar Street and Station Road. Garrard Street, an east to west aligned highway, bisects the development area into north and south sites. The works subject to this report were undertaken in the south of the development area, Station Hill South, Building Plots E and F (between Garrard Street and Friars Street), henceforth the Site (NGR: SU 7132 7364 - Fig. 1).

1.1.4 An archaeological watching brief WSI was compiled by Waterman IE, (Waterman IE, Nov. 2018) for an archaeological watching brief during Site Investigation works including Building Plots E and F. This report details the results of the watching brief on the Site, Station Hill South - Building Plots E and F. The watching brief was undertaken between 14th November 2018 and 16th March 2019.

1.1.5 Building Plots B and D were subject to archaeological evaluation and watching brief by Archaeology South-East in January 2016 (ASE, 2016), from which Waterman IE developed a WSI for archaeological mitigation (Waterman IE, June 2017). These works related to former RBC Planning Application 130436.

1.2 Location, topography and geology

1.2.1 The wider Station Hill development area sits on land that to the south, at c 46mOD, occupies the northern edge of an east-west promontory of higher ground formed of chalk, overlain by terrace gravels and brickearth between the floodplains of the River Thames to the north and the River Kennet to the south. The central part of the development area covers the north facing slopes of the Thames Valley and the northern limit finishes in the alluvial (and colluvial) fill of the southern edge of the Thames floodplain, at c 38mOD. The Site itself extends from the higher ground, down the slopes and extends for a limited distance into the floodplain.

1.2.2 The underlying geology of the Site consists of the Seaford Chalk Formation and Newhaven Chalk Formation, with the superficial deposits being recorded as Alluvium (Clay, Silt, Sand and Gravel) within the northern extent of the Site, and as Taplow Gravel Member (Sand and Gravel) within the southern extent (BGS 1:50,000 New Series Sheet No. 268).

1.2.3 The overall Station Hill development is located to the south of Reading Railway Station, east of Greyfriars Road, and immediately to the north of Friar Street (a principal retail street), on the northern edge of Reading's medieval and historic centre, which developed on the promontory between the two rivers. The Site, subject to this report, is bounded to the north by Garrard Street and to the south by Friar Street. It is currently occupied by the disused Friars Walk Shopping Centre and Telecom House, a former office block.

2 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND AND POTENTIAL

2.1 Archaeological and historical background (incl. Previous Archaeological Investigations)

2.1.1 A number of archaeological exercises have been conducted for the Station Hill area;

- Desk Based Assessment, Foundations Archaeology, 2003
- Desk Based Assessment, Foundations Archaeology, 2009
- Desk Based Assessment, Great Western Main Line (GWML), Reading, Berkshire, including the remodelling of the Reading Station Area (RSA), Ove Arup and Partners Ltd
- Archaeological Evaluation Report, Station Hill and Friars Walk, Friar Street, Reading: Foundations Archaeology, 2009
- WSI for Phase 2 Evaluation and Watching Brief Station Hill, Reading - Foundations Archaeology, 2014
- Environmental Impact Assessment submitted to RBC by Waterman IE in 2015, which contained an Archaeological Desk Based Assessment - Station Hill, Reading by Foundations Archaeology, (Foundations Archaeology, 2015), as well as an Environmental Statement Archaeology Chapter (Chapter 8) also by Foundations Archaeology
- WSI for an archaeological Evaluation at Station Hill and Friars Walk (Plots B & D), Friar Street, Reading, Berkshire, Archaeology South-East, 2015
- Evaluation Report: Land at Station Hill, Plots B & D, Reading, Berkshire, Archaeology South-East (ASE) Report No: 2016009 March 2016

2.1.2 A summary of the historical background and of previous archaeological investigations from the 2015 DBA is outlined below, along with a summary of the Archaeology South East evaluation in 2016 (ASE, 2016). The MRD numbers in the text are the reference numbers used in Reading Borough Councils' Historic Environment Record.

Prehistoric

2.1.3 There is evidence of prehistoric activity from the Palaeolithic to the Iron Age within the area surrounding the Site. This is not surprising considering that the river terrace gravels of the Kennet are known to have been utilised for prehistoric settlement. Two handaxes were found at Station Road [MRD9047], approximately 125m east of the Site, and at Vachel Road [MRD9047], approximately 181m to the west of the Site. Neolithic activity is represented by flint axes [MRD11209], a flint net sinker or loomweight and a bone needle [MRD11197], all found between c 270-330m south-east from the Site.

2.1.4 A single sherd of Bronze Age pottery [MRD15735] at Friar Street (c 330m south-east of the Site) points towards Bronze Age activity, and only a selection of isolated finds including a brooch [MRD11254] and coins [MRD11245] recorded at varying distances between 150m to 400m from the Site suggest use of the area during the Iron Age period.

Roman

2.1.5 Roman occupation within Reading lay within the hinterland of *Calleva Atrebatum* (Silchester), a major Roman political and administrative centre, or *civitas* and the area may have been a suitable site for a quay for Thames river trade bound for *Calleva*, although no evidence has yet been found. Possible Romano-British settlement was recorded surrounding the Site c 490m to the south-east of in the form of brick and tile remains [MRD15664]. In general, further remains consisting of pottery and coins have been noted between Friar Street and Broad Street.

Early-medieval and medieval (AD410-1540)

2.1.6 Reading was first documented in the Anglo-Saxon chronicle of AD 870-871 as the site of a Danish winter camp [MRD3906]. The northern part of the Site falls within an area of the Thames floodplain historically known as Vastern Meadows, an original meaning of 'vastern' is 'stronghold'. Previous investigations c 120m east of the Site revealed two Anglo-Saxon sunken-feature buildings.

2.1.7 Old Market, c 430m to the south of the Site, may have been the site of a Late 10th century Anglo-Saxon settlement. The Site lies c 150m to the north of the possible extent of the Anglo-Saxon settlement (Astill, 1978).

2.1.8 The Domesday record refers to a pre-Conquest market at Reading [MRD3913] and finds of coins imply that a mint operated during the early 11th century. Furthermore, numerous burials have been found within the area, including one near the engine sheds at Reading Railway Station [MRD3891].

2.1.9 The foundation, by Henry I in 1121, of the Benedictine Abbey, led to a significant expansion of the town. The Benedictines established Friar Street (as well as Broad Street – parallel and to the south of Friars St) in the 12th century (first documented in 1186). The eastern end of Friar Street led to the western gateway of their precinct as well as a new market place, c 350m east of the Site. Friar Street was developed with narrow burgrave plots (characterised by buildings on the street-frontage with open back-plots behind) along both its north and south sides. This pattern of urban settlement probably extended west along the northern side of Friar Street into the southern part of the Site, with the burgrave plots probably extending down the north facing slopes forming the southern edge of the Thames Valley.

2.1.10 A Franciscan Friary (MRD3938) was founded at Reading in 1233. Initially located outside the town along the road to Caversham on marshy ground, there were severe problems from flooding, and so in 1285 they were granted additional drier land at the western end of Friar Street to which they moved their conventual precinct. This friary (some extant fabric still remains) lay on the other side of Greyfriars Road c 80m west of the Site. At Greyfriars Day Nursery an evaluation by John Moore Heritage Services [ERM1267] recovered articulated skeletal remains and pottery of probable medieval date.

2.1.11 The DBA (Foundations, 2015) notes that there are at least 76 non-designated heritage assets of medieval date within 500m Study Area surrounding the Station Hill development area.

2.1.12 Previous investigations within the development area have revealed medieval / post-medieval pits [MRM16558] and large cut features [MRM17581].

Post-medieval to modern (1540 - present)

2.1.13 Reading was the largest town in Berkshire in the 16th century and by 1611 had a population of over 5,000 principally due to its' successful role in the cloth trade. Evidence suggests that Civil War defences [MRD15703] may run through the southern part of the Site (through Telecom House/Plot E).

2.1.14 Historic mapping shows that Plot E was urbanised by 1899 and that the northern part of the Site became enclosed by both commercial and private development. Late 1890s development within and to the north of the Site is well documented and the station was constructed during that time. Previous investigations within the Site and an approximate 500m Study Area reveal a wealth of post-medieval evidence including, but not limited to, pits and ditches [MRM16016], wall foundations [MRD15503], a possible tile-built hearth [MRD15505] and a Victorian well [MRD7368] at Friar Street.

2.1.15 Evidence for modern activity primarily consists in the form of 20th century floors [MRD15507 and MRD15508] at Friar Street, a stall [MRD5503] in Hosier Street and two memorials [MRM16508 and MRM16206].

1.24. At Greyfriars Road (just outside the Site) an evaluation at Number 5 [ERM449] did not reveal significant archaeological deposits, however, during works at 25-26 Friar Street [ERM483] animal bone and charred cereal grains (medieval to post-medieval) were recorded.

3 EVALUATION AIMS AND METHODOLOGY

3.1 Aims

General

3.1.1 The aims of the Watching Brief were laid out in the WSI (Waterman IE, 2018):

- To determine the presence and / or absence of archaeological remains, and if remains are present, to make a full record to current standards;
- To determine the approximate extent, condition and state of preservation of any remains;
- To confirm the approximate date or range of dates of the remains; and
- To prepare a Watching Brief report outlining the results.

3.2 Methodology

Scope of works

3.2.1 An archaeological Watching Brief was undertaken to monitor two separate elements of site investigations carried out prior to the demolition of buildings within the Site:

3.2.2 Site investigations within the South Side comprised:

- A minimum of 2 no. of mechanically excavated trial pits to the depth of 4.5m below ground level (bgl) and 16 no. of windowless sample (WS) probes to the depth of 6m bgl;
- 4 no. of cable percussion boreholes (BH) with rotary follow on, three of which to the depth of 25m bgl and one to the depth of 18m bgl.

3.2.3 Party wall inspection works within the South Side comprised:

- Trial pits (TP) to ascertain existing foundation levels to assist in planning safe demolition;

Site specific methodology

3.2.4 The Watching Brief was undertaken by an appropriately experienced and qualified archaeological contractor.

3.2.5 Mechanical excavations were, where possible and applicable, undertaken using a toothless ditching bucket under constant supervision by the attending archaeologist. Mechanical excavations proceeded until the required level for the ground investigation had been reached or until the top of archaeological deposits were revealed, depending on which was encountered first.

3.2.6 Where appropriate, the attending archaeologist halted the ground-work for sufficient time to enable an archaeological record to be made in accordance with the guidelines contained within the ClfA current *Standard and Guidance for an archaeological watching brief*.

3.2.7 Significant archaeological deposits were sampled and recorded in accordance with the methodology for recording as described in Section 3 (Waterman IE, 2018).

3.2.8 The Watching Brief was maintained throughout the programmes of site investigations and party wall investigations, except for TP12 which was replaced with a BH (borehole records were sent to OA subsequently).

3.2.9 Test Pits and boreholes (and thus) archaeological features and deposits were located manually using scaled print-outs of the pre-site measured survey, these were digitised into the CAD version of the pre-site survey and then positioned within the Ordnance Survey grid.

3.2.10 A digital photographic record was maintained during the watching brief works. The photographs were captured as jpg images, over 10MPixels in quality, on RICOH Caplio500Gwide and RICOH WG-30 digital cameras. A photographic index (initially an analogue on site list) for archiving purposes was produced the index contained the following fields, which reiterates and expands on the photographic metadata: File name, the photograph ID number issued to the image in the archive set; Site Number, the photograph ID number issued on site; Caption, the subject of the photograph; Location, site reference name and address; Easting and Northings, position in Ordnance Survey coordinates; Date, the date photograph was taken on; and the initials of the photographer.

4 RESULTS

4.1 Introduction and presentation of results

4.1.1 A total of 3No. Boreholes (BHs), 14No. Window Samples (WSs), and 14No. Test Pits (TPs) were excavated at the Site (i.e. Station Hill South between Friar Street and Garrard Street).

4.1.2 Due to practical constraints of the original 19No. proposed Test Pits, four were omitted (TPs 7, 13, 14, 15), and 2No. (TPs 5 and 12) were swapped for boreholes. TP1 was initially relocated and excavated inside Friars Walk Shopping Centre and then subsequently reinstated into its original location as TP1a outside Telecom House, thus providing an additional TP.

4.1.3 The results have been tabularized below for quick reference. Descriptions of the deposits, and archaeological remains encountered follow and have been divided into three zones; investigations within buildings adjacent to Friar Street at ground level, investigations within buildings at basement level, and those external to existing buildings and can be seen in Figure 2.

Summary table of site and party wall Investigations

Boreholes					
BH No.	Size (m)	Depth (m)	Depth to chalk (m)	Depth to gravel	Potential or real archaeology
301		4.5	3	-	-
302	Omitted				
303			0.98	-	-
304		3.00	1.8	-	-
Window Samples					
WS No.	Size (m)	Depth (m)	Depth to chalk (m)	Depth to gravel	Potential or real archaeology
301		1	0.7	-	-
302		6	1.77	0.5	-
303		6	2.65	1.7	-
304		6	2.65	2.15	-
305	Omitted				
306		1.03	-	-	-
307		6	1.15	0.33	
308	Omitted				
309		1.15	-	0.41	-
310		6	0.98	-	-
311		6	1.7	1.25	Possible Natural features (121), (122), (123)
312		0.45	-	-	-
313		1.05	-	-	-
314		6	2.65	-	-
315		6	0.8	0.55	-

316		0.97	-	-	-
Test Pits					
TP No.	Size (m)	Depth (m)	Depth to chalk (m)	Depth to gravel	Potential or real archaeology
1	1.7 x 1.9	1.8	0.95	0.7	-
1a	2.8 x 2.2	0.85	-	-	-
2	2.3 x 1.2	1.8	-	1.4	E/W Medieval ditch(?) [194] Fig.3, Plate 1 (redeposited EPA flint)
3	2.1 x 1.15	1.3	1	0.9	-
4	2.3 x 1.2	1.02	0.72	0.72	-
5a (replaced by core)	152mm diameter core	1	0.7	-	-
5b (replaced by core)	152mm diameter core	1	0.3	-	-
6	2.8 x 1.8	2.2	-	-	-
7	Omitted				
8	2 x 1.3	1.95	-	-	-
9	1.9 x 1.2	1.65	1.65	0.65	-
10	1.9 x 1.3	1.3	0.45	0.45	-
11	2.5 x 1.5	1.56	1.4	0.88	Potential posthole, N/S Palaeochannel [287], [289] Fig. 8, Plate 6
12 (replaced by cores)	2No. 152mm diameter cores	200mm and 300mm	-	-	-
13	Omitted				
14	Omitted				
15	Omitted				
16	3.5 x 3.4	2.67	1.08	0.53	1 x worked flint in terrace gravels (325) Fig. 5, Plate 3
17	2.59 x 2.06	1.6	1.6	0.8	Potential geo/archaeological deposit (336) Fig. 6, Plate 4
18	4.45 x 2.7	1.7	0.85	0.6	Potential Pit (?) [345], Fig. 7, Plate 5
19	1.75 x 1.25	1.77	-	1.05	-

4.2 Investigations within buildings adjacent to Friar Street at ground level

4.2.1 TP6, TP8 and a single Window Sample WS313 were excavated inside the shops fronting onto Friar Street and although they would appear to have the most potential for medieval occupation and structural archaeology none was observed due to the heavy truncation of the modern foundations.

4.2.2 WS313, located inside Telecom House, was hand dug to 1.05m and finished at that level due to access constraints. It had 0.36m of concrete over 0.69m made ground.

4.2.3 TP6 (Fig 3, Plate 1) located at the western extent of site consisted of 0.30m of concrete, 1m of made ground and 1.2m construction backfill containing early 20th century demolition material. The pit finished at 2.20m in backfill within the foundation construction cut.

4.2.4 TP 8 (Fig 4, Plate 2) at the eastern extent had 0.50m of concrete over 1.45m of early 20th century demolition material within the modern construction cut and finished on the concrete foundation pad. A core was taken through the concrete pad measuring 0.70m thick, though the deposits underlying were undetermined. A horizontal sondage was excavated though the eastern edge of the pit and a cellar wall for the adjoining building was observed which looked to be disturbed by the modern construction.

4.3 Investigations at basement level

4.3.1 A total of eight Window Samples (WS303, 305, 309, 310, 311, 312, 315, 316) and six Test Pits (TP1, 9, 10, 11, 17, 18) were located in the former Friars Walk Shopping Centre, with a further two Window Samples (WS302, 307) and three Test Pits (TP5a/b, 16, 19) within Telecom House. Of these WS311 and TPs 11, 17, and 18 contained potential archaeological features.

4.3.2 WS302 contained 0.50m of concrete over 1.27m of terrace gravels. Chalk was seen at 1.77m below ground level (bgl).

4.3.3 WS303 had 0.40m of concrete over 1.30m of made ground containing animal bone and CBM and 0.95m of terrace gravels. Chalk was seen at 2.65m bgl.

4.3.4 WS305 had 0.42m of concrete over 0.45m of made ground containing angular black quartzite, chalk and metals, and had a strong hydrocarbon odour. A black fabric membrane was seen at 0.87m covering quartzite aggregate. Concrete was seen at 1.03m. The sample finished at this level due to the concrete obstruction.

4.3.5 WS307 saw 0.33m concrete over 0.82m of terrace gravels. Chalk was seen at 1.15m bgl.

4.3.6 The inspection pit for WS309 contained 0.41m of concrete over 0.74m of terrace gravel. The sample finished at this level due to revised plans.

4.3.7 WS310 had 0.4m of concrete over 0.58m of made ground. Chalk was seen at 0.98m bgl.

4.3.8 In WS311 0.40m of concrete overlay three deposits (121, 122, 123) measuring a total of 0.85m which were either made up of or contained rounded weathered chalk possibly indicating an archaeological feature or palaeochannel. These deposits lay over 0.45m of terrace gravels with chalk at 1.70m bgl.

4.3.9 WS312 contained 0.30m of concrete over 0.15m of made ground. Further concrete was seen at 0.45m bgl causing the pit to finish at this level.

4.3.10 WS315 had 0.40m of concrete over 0.15m of made ground. Two layers of terrace gravels were seen, measuring 0.25m. Chalk was seen at 0.80m bgl.

4.3.11 WS316 consisted of 0.52m of concrete, 0.45m of made ground with early 20th century demolition rubble, and concrete at 0.97m bgl. The pit was finished at this level.

4.3.12 TP1 had 0.70m of concrete over 0.24m of terrace gravels at the southern end of the pit. The northern half of the pit was entirely concrete, the depth of which wasn't reached. The pit was finished at 1.80m bgl.

4.3.13 TP5 was located in a basement room below the alley between Telecom House and Sainsburys and was replaced by two 6" Boreholes due to accessibility. 5a was through the floor of the basement and showed 0.70m of concrete on top of chalk. 5b was located 1.50m above 5a horizontally through the western wall and showed 0.30m of concrete backing onto chalk.

4.3.14 TP9 had 0.45m of concrete over 0.85m of terrace gravels which was truncated on the eastern extents by modern foundations. The southern end had a dubious cut filled by material derived from the terrace gravels, though this was likely related to the installation of an electrical grounding rod which was still present. Chalk was reached at 1.65m bgl.

4.3.15 TP10 had 0.43m of concrete over a thin skim of terrace gravels filling natural depressions in the chalk and was 0.10m - 0.26m thick. Chalk was at 0.50m bgl.

4.3.16 TP11 (Fig. 9, Plate 6) had a potential posthole, 289, measuring 0.28m diameter by 0.14m depth filled by mid grey brown firm sandy silt. It was observed truncating the upper fill of N/S palaeochannel, 287, on its eastern edge. The channel truncated terrace gravels and was >2.5m wide and 0.89m deep, with the western edge not seen. Two fills were observed. The main fill 282 was a firm pale beige brown fine sandy silt measuring 0.89m thickness and extending the width of the channel. Fill 283 was a banded yellow and orange, very fine sandy silt on the eastern edge measuring 0.30m thickness and 1.80m width. Chalk was seen at 1.40m bgl.

4.3.17 TP16 (Fig 5, Plate 3) located in the car park below Telecom House had 0.30m of concrete over 0.23m of made ground. Three layers of terrace gravels followed, with the upper band, 325, yielding a single early prehistoric flint blade with light edge damage. Chalk was reached at 1.08m bgl.

4.3.18 TP17 (Fig. 6, Plate 4) had 0.50m of concrete over 0.10m of made ground. Below which was a deposit made up from redeposited chalk with gravels measuring 0.65m, indicating either an archaeological feature or a palaeochannel, though further work would be needed to determine the nature of this deposit properly. A layer of pale beige brown fine- medium terrace sand measuring 0.30m was seen above chalk at 1.80m bgl.

4.3.19 One potential archaeological feature, 345, was observed in TP18 (Fig.7, Plate 5) seen in the southern section below 0.46m of concrete and made ground, and was filled by a dark orange brown firm sandy silt with flint gravel. The deposit measured 1.00m (E/W) by 0.80m depth, though no edges were seen due to modern truncations on the east and west sides. No dating material was recovered. The western section was truncated by modern service pipes

and a brick manhole, truncating chalk at its base at 1.70m. The northern end of the trench had 0.6m of concrete and made ground above 0.25m of terrace gravels. Chalk was reached at 0.85m bgl.

4.3.20 TP19 had 1.05m of concrete over 0.72m of terrace gravels. Chalk was not reached.

4.4 Investigations located outside existing buildings

4.4.1 External investigations consisted of three Boreholes (BH301, 303, 304), three Window Samples (WS301, 304, 314), and three Test Pits (TP2, 3, 4), and TP12 (on the eastern side of site) was replaced with a 6" Borehole. The other boreholes were located in the alley between Telecom House and Friars Walk Shopping Centre. Two window samples were located next to Garrard Street, with the third in an alley west of Telecom House along with the three test pits. The investigation showed a fairly consistent northward slope in the bedrock with steep drop off between the locations of TP2 and TP3, and the build-up of alluvial and hill slope deposits as seen in WS304 and WS314.

4.4.2 BH301 consisted of 0.10m of tarmac over 1.60m of made ground. At 1.70m bgl natural reddish brown clayey silts measuring 0.15m were seen above the weathered chalk.

4.4.3 BH303 had 0.15m of tarmac over 0.24m of made ground and 0.60m of concrete. Chalk was seen at 0.98m bgl.

4.4.4 BH304 had 0.64m of tarmac and concrete foundation over 0.60m of made ground containing demolition rubble. A further 0.70m of made ground, likely derived from terrace gravels, containing rare inclusions of CBM was seen. Chalk was seen 1.80m bgl.

4.4.5 WS301 contained 0.10m of tarmac and 0.60m of made ground above chalk bedrock at 0.70m bgl.

4.4.6 WS304 had 0.30m of concrete over 0.15m of made ground. Below this was dark grey brown clayey silt which was the possible edge of an alluvial deposit measuring 1.23m thickness. A 0.32m head deposit consisting of yellowish brown sandy gravelly clay lay above 0.41m of terrace gravels and 0.24m of fluvial sand. Chalk was seen at 2.65m bgl.

4.4.7 The deposits in WS314 were very similar to those seen on WS304 in that there was 0.5m of tarmac and made ground over 1.10m of dark grey brown clayey silt alluvium. A brick earth type deposit measuring 0.35m was seen above 0.95m of head deposit. Chalk was seen at 2.65m bgl.

4.4.8 In TP2 (Fig. 9, Plate 7) a medieval feature, 194, an E/W ditch running along the break of the slope was seen below 0.70m of concrete foundations and made ground containing demolition rubble. It measured >2.00m in width (extending beyond the limits of the Test Pit) and 1.10m depth. The fill, 195, was not seen as its southern edge extended under Sainsburys. It had a single secondary fill which was mid grey brown clayey silt containing animal bone, pottery, ceramic building material (CBM) and a worked flint flake. The ditch truncated 0.70m of alluvial silts and 0.40m. The base of the trench was made up of 0.40m of terrace gravels. Chalk was not seen at 1.80m showing a sharp drop off in the geology towards the north between TP2 and TP3.

4.4.9 TP 3 had 0.0.7m of modern foundations cutting 0.3m of made ground containing demolition rubble, below which lay bands of terrace gravel measuring a total of 0.55m. Chalk was reached at 0.95m bgl.

4.4.10 In TP4 chalk was seen directly below 0.72m of concrete and made ground. A shallow depression in the chalk, measuring 0.90m by 0.25m depth, was seen below the concrete and was filled by banded orange and yellow sand and pea gravel.

5 FINDS REPORTS

5.1 Post-Roman Pottery

By John Cotter

Introduction and methodology

5.1.1 A total of 12 sherds (81g) of pottery were recovered from three contexts. A range of medieval and post-medieval wares (after c 1480), are represented.

5.1.2 All the pottery was scanned during the present assessment and spot-dates were provided for each context. Each context group was quantified by sherd count and weight and recorded on a spot-dating spreadsheet. The pottery is fragmentary, rather than whole vessels, and although most are of a smaller size and have worn edges, some are fairly large fresh sherds, thus more likely to be deposited close to where they were discarded, (this contrasts with small abraded pieces which may have been disturbed or transported or rolled from elsewhere).

5.1.3 The context spot-date is the date-bracket during which the latest pottery types or fabrics are estimated to have been produced or were in general circulation. Comments on the range of fabrics were recorded, usually with mention of vessel form (jugs, bowls etc.) and any other attributes worthy of note (eg. decoration etc.). Fabric codes referred to for the medieval wares are those of the Oxfordshire type series (Mellor 1994) whereas post-medieval fabric codes are those of the Museum of London (MoLA 2014). The range of pottery is described in some detail in the spreadsheet (Table 1) and is therefore only summarised below.

Description

Context	Spot-date	Sherds	Weight	Comments
195 fill of ditch (TP2)	c1150-1350?	10	67	10x body sherds, mostly quite fresh. Mostly coarse orange sandy ware including some with glaze, probably Ashampstead-type ware (Fabric code OXAG). Includes sherds from cooking pots with external sooting and possibly jug sherds (with splashes of clear orange glaze). 1x body sherd in a reduced grey-firing variant from a globular cooking pot or jug with widely-spaced incised horizontal groove decoration ext and with a rough dark greenish-brown glaze allover int. 1 small body sherd in a fine dark grey sandy ware (reduced OXAG?). 2x small body sherds in a much coarser unglazed variant of the OXAG fabric with coarse rounded/polished quartz - possibly Camley Gardens kiln-type (CAMG, Maidenhead)?
243 modern made	c1780-1840	1	10	Pearlware (Fabric code PEAR). Dish rim with blue feathered-edge decoration & scalloped rim outline. Traces of mortar adhering

Context	Spot-date	Sherds	Weight	Comments
ground (TP6)				
246 modern made ground (TP6)	c1550-1700	1	4	Green-glazed Surrey/Hampshire Border ware (Fabric code BORDG). Worn body sherd from a jar/jug form with glaze inside and outside
TOTAL		12	81	

Table 1. Description of post-Roman pottery by context

Discussion

5.1.4 The pottery mostly comprises ordinary domestic kitchen and tablewares typical of the area. The medieval wares were probably produced fairly close to Reading. The post-medieval wares are regional imports.

Recommendations regarding the conservation, discard and retention of material

5.1.5 The pottery here has the potential to inform research through re-analysis - particularly when reviewed alongside further assemblages from any future excavations in the area of the present evaluation. It is therefore recommended that the pottery be retained.

5.2 Medieval and Post-medieval ceramic building material (CBM)

By John Cotter

Introduction and methodology

5.2.1 The site produced a total of 15 pieces of medieval and post-medieval ceramic building material (CBM) weighing 7392g from four contexts. This is a mixture of medieval and post-medieval material (after c 1480). The assemblage is mainly fragmentary condition and of little interest aside from its use for dating purposes.

5.2.2 All the CBM was scanned during the present assessment, in a similar way to the pottery, and spot-dates were provided for each context. Each context group was quantified by fragment count and weight and recorded on a spot-dating spreadsheet. The two complete bricks from Context 193 were separately recorded. The material is described in some detail in the spreadsheet (see Table below) and is therefore only summarised below.

Table: Description of post-Roman CBM by context

Context	Spot-date	Pieces	Weight	Comments
62 modern made ground (WS303)	16-19C	3	16	Shapeless scraps (2 joining) of orange sandy ?brick. Discard?

Context	Spot-date	Pieces	Weight	Comments
171 modern made ground (WS316)	c1930+	5	1541	Fragments from a minimum of 3 machine-made modern housebricks in light orange fabrics. The largest is a complete unfrogged brick end (Width 105mm, Thickness 65mm). The second is from the corner of a Fletton-style brick in granular fabric with a V-section frog. The third (3 scraps) has a grey core. Discard?
193 modern made ground (TP2)	c1920+	1	2736	Modern house brick. Near-complete (1 end missing). Machine-made, unfrogged. Fine, fairly soft, bright orange fabric with very fine vertical striations (combing or brushing?) on the sides and header end (typical of London houses from 1920s+). White paint or whitewash on one of the long sides. Width 110mm, Thickness 72mm. Discard?
193 modern made ground (TP2)	c1920+	1	2974	Complete late 19th- or 20th-century house brick with very thick yellowish mortar bonding covering upper and lower surfaces. Uncertain if frogged due to mortar. Sandy dark brown fabric with a large flint pebble visible where chipped. Bands of grey ash glaze on the long sides from other bricks stacked upon it in the kiln. Glaze traces on the header ends too. Length 215mm, Width 100mm, Thickness 60mm (without mortar). Discard?
195 fill of ditch (TP2)	13-14C?	5	125	Fresh and worn body fragments of rough orange-red to orange-brown medieval roof tile. No evidence of nail/peg holes. Probably from 5 separate tiles, some with grey cores. Mostly with roughly sanded undersides containing sparse flint inclusions embedded in underside surfaces. Discard?
TOTAL		15	7392	

Discussion

5.2.3 The CBM comprises a small group of medieval roof tile fragments and several large pieces of modern house brick.

Recommendations regarding the conservation, discard and retention of material

5.2.4 The CBM assemblage here has little or no potential for further research and could be discarded if so desired.

5.3 Flint

By Michael Donnelly

Introduction

5.3.1 A very small assemblage of just two struck flints was recovered from this watching brief. One fine distal trimming blade was recovered from context 325 while an inner flake was present in context 195. The blade is clearly early in date and represents part of an intentional blade-reduction strategy of Mesolithic or early Neolithic date. The flake is undiagnostic but may have signs of utilisation along its distal edge.

Methodology

5.3.2 The artefacts were catalogued according to OA South's standard system of broad artefact/debitage type (Anderson-Whymark 2013; Bradley 1999), general condition noted and dating was attempted where possible. The assemblage was catalogued directly onto an Open Office spreadsheet. During the assessment additional information on condition (rolled, abraded, fresh and degree of cortication), and state of the artefact (burnt, broken, or visibly utilised) was also recorded. Retouched pieces were classified according to standard morphological descriptions (e.g. Bamford 1985, 72-77; Healy 1988, 48-9; Bradley 1999). Technological attribute analysis was initially undertaken and included the recording of butt and termination type (Inizan *et al.* 1999), flake type (Harding 1990), hammer mode (Onhuma and Bergman 1982), and the presence of platform edge abrasion.

Table: presence of worked flint by context

Context	type	sub-type	notes	date
195 (TP2)	Flake	Inner	Some edge damage and micro-flaking distal that suggest it could be from a larger tool	
325 (TP16)	Blade	Distal trimming	Classic soft-hammer struck blade, very probably Mesolithic or early Neolithic in date	Early Prehistoric

Discussion

5.3.3 This indicates very limited flint-related activity here during prehistory. The blade form is probably a casual loss during early prehistory and indicates very occasional visits to this area by mobile groups. The valley systems in and around Reading contain numerous well known early prehistoric sites, many of which are Mesolithic. Further work in this evaluation area is unlikely to encounter significant flint-related activity.

Recommendations

5.3.4 The flint assemblage here has little or no potential for further research but should be retained with the archive.

6 ENVIRONMENTAL REPORTS

6.1 Animal bone

By Lee G. Broderick

6.1.1 A total of 23 animal bone specimens were recovered from the site (see Table below **Error! Reference source not found.**), all of which were collected by hand. Features on the site were dated on the basis of associated ceramic finds (seriation), mostly to the post-medieval period.

6.1.2 The material was recorded in full, with the aid of the Oxford Archaeology skeletal reference collection and standard identification guides, using a diagnostic zone system (Serjeantson 1996).

Description

6.1.3 Preservation on the site was moderate (Behrensmeyer 1978, stage 3), despite the assemblage being made up of small, broken, fragments. The only identifiable specimens were part of a sheep (*Ovis aries*) left astragalus and a loose domestic cattle (*Bos taurus taurus*) tooth, both from the Modern period (1700 or later).

Conclusions

6.1.4 Little can be read into such a small assemblage. Domestic cattle and sheep are the most common species found in archaeological assemblages from Britain.

Recommendations regarding the conservation, discard and retention of material

6.1.5 The assemblage should not be considered a priority for retention. Table 1: Total Number of Identified SPecimens (NISP) and Number of Specimens (NSP) figures per period from hand-collected material from the site.

Table: Total NISP (Number of Identified SPecimens) and NSP (Number of SPecimens) figures per period from hand-collected material from the site.

	C12-14 th AD	C18 th AD +
domestic cattle		1
caprine		1
medium mammal		1
large mammal	1	2
Total NISP	1	5
Total NSP	1	23

7 DISCUSSION

7.1 Reliability of field investigation

7.1.1 Although much of the work was conducted within existing buildings where only task lighting was available, this did not hamper the observations by the attending archaeologist which are considered to be accurate and relatively reliable representation of what was encountered.

7.1.2 The location of the site spanning promontory top, valley sides and floodplain are likely to have created a complex deposit sequence of alluvial and colluvial deposits, understanding such complexities was not possible given the limited scope of the works. However, broadly speaking alluvial-like deposits were present only within the northern part of Plots E and F.

7.1.3 Boreholes and window samples only allow the observation of small diameter cores and should perhaps be considered as less reliable than the test pit observations. That said, if archaeological deposits were present at these locations these would have been recognised as each core was examined.

7.1.4 The test pits were limited in size, so, in most instances, where archaeological features were observed (whether potential or real) only part of their full extents were visible, therefore the interpretation as a ditch/pit is less reliable than if their wider extents were visible.

7.1.5 The information that the engineers were seeking from these geotechnical and party wall investigations meant that the test pits were located adjacent to extant structural elements to examine the nature of their foundations. Therefore, it should be expected that these investigations are more likely to encounter deposits associated with modern construction truncations than archaeological features/deposits. The structures were seen to be built upon massed concrete foundations, with very large bases under the columns, and wide construction cuts for linear wall foundations.

7.2 Interpretation

Chalk bedrock, terrace gravels and brickearth/silty-sands

7.2.1 The true upper horizon of the chalk bedrock (interpreted as locations where in-situ overlying gravel and sand deposits were present) was observed in TPs 1, 2, 3, 9, 10, 11, 16, 17, 18 and WSs 301, 302, 303, 304, 306, 307, 309, 311, 314, 315 and BH 301. Where this was observed the interface between the two was seen to be variable with hollows and pockets of drift geology in the undulating surface of the chalk bedrock.

7.2.2 It is more difficult to ascertain the level of truncation affecting the overlying drift geology (sands/ gravels, alluvial and colluvial deposits), but no *in situ* buried soil that could be interpreted as a former soil horizon, overlying drift geology, was observed.

7.2.3 Only two locations in the southern part of Plot E recorded chalk bedrock and overlying drift geology WS315 and TP1, whereas the majority of the interventions, in the central and northern parts of Plots E and F, recorded these deposits. In the northern part of Plot E deposits of alluvium/colluvium were recorded e.g. WS301, 303, and 304 plus TP2 and BH301. In the central area of Plots E and F gravels and sands were recorded.

7.2.4 It is reasonably safe to assume that truncation from the construction of the existing buildings on the site has removed former buried soils, and varying, yet unverifiable depths of the overlying drift geology.

7.2.5 A possible paleo-channel, orientated N-S, was observed in TP11, this is likely to represent a natural feature near or at the base of the break of slope forming the valley sides. This is to be expected within the floor of the Thames floodplain, which throughout earlier pre-history would have been characterized by a multi-braided riverine system, with islands and islets.

Prehistoric to Roman

7.2.6 Two prehistoric worked flint artefacts were recovered, one redeposited Late Mesolithic-Early Neolithic blade within a medieval ditch/drainage channel in TP2, and one undiagnostic flake from the natural gravel in TP16. Both of these finds are *ex-situ*, one residual and one intrusive and indicate that some form of hunter-gatherer activity was taking place in the vicinity. This is not surprising given the abundance of natural resources that would have been available within the Thames floodplain during these periods.

7.2.7 There were no other artefacts or features from these periods revealed during this phase of work.

Medieval

7.2.8 A single dated E-W orientated medieval ditch was observed in TP2. This dated to 12-14th century, and contained small amounts of reasonably well preserved animal bone. This could represent a partially truncated drainage channel / ditch defining the southern extents of the floodplain meadow-land, running along or near, the break of slope where the floodplain floor meets the north facing valley slopes.

Undated

7.2.9 The potential pit in TP18 did not yield any finds, and neither did the possible post-holes in TP11, these type of features could belong to any period from the Neolithic to Post-medieval.

7.3 Conclusions

7.3.1 The existing buildings straddle a significant change in height from 46m OD in the south to 38m OD in the north, formed by the north facing slopes defining the southern edge of the Thames Valley. To rationalise floor levels for the construction of the existing buildings on the site there was evidence of significant earth-works and terracing. In the majority of observations, in situ chalk bedrock was present, but overlying drift geology although present, had been truncated to varying depths.

7.3.2 The presence of redeposited pre-historic worked flint attests to activity during these periods in the vicinity of the site.

7.3.3 The potential pit in TP18, and possible post-holes in TP11 although undated, may attest to activity towards the northern end of medieval burgage plots fronting onto the north side of Friar Street, however, such features are common from the Neolithic onwards.

7.3.4 Investigations from ground floor level on the Friar Street frontage (TP6, TP8 and WS313) where there does not appear to be any current basement levels, had the potential to reveal occupation and structural evidence for medieval and post-medieval burgage buildings. These only revealed modern deposits associated with the construction of the extant buildings, however this is probably due to the positions of the investigations, which were adjacent to significant foundations and their associated truncations. It should be noted that a basement wall for the neighbouring property was seen in TP8 and the presence of older basements along this frontage which may have truncated earlier archaeology cannot be ruled out.

7.3.5 The medieval E-W ditch in TP2 may indicate the base of the valley sides, indeed observations of alluvial deposits were confined to interventions broadly north of this latitude.

7.3.6 Archaeological features, where present, were horizontally and vertically truncated. The lack of archaeological features may relate to the position of the interventions adjacent to large concrete foundations with their associated construction truncations. Areas of site away from foundations but under floor slabs may have better preservation and potential for archaeological features/deposits.

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Waterman IE 2018 Station Hill, Reading: Written Scheme of Investigation – Watching Brief

APPENDIX B

SITE SUMMARY DETAILS

Site name:	Station Hill (South Side), Reading
Site code:	RESHSS18
Grid Reference	SU 7132 7364
Type:	Watching Brief
Date and duration:	14 th November 2018 and 16 th March 2019
Area of Site	2.14ha
Location of archive:	The archive is currently held at OA, Janus House, Osney Mead, Oxford, OX2 0ES, and will be deposited with the Museum of Reading in due course, under the following accession number: tbc
Summary of Results:	<i>Oxford Archaeology (OA) was commissioned by Waterman Infrastructure & Environment (Waterman IE) on behalf of SH Reading Master LLP to undertake an archaeological watching brief to monitor geotechnical site investigations and party wall inspection works to be carried out prior to the demolition of buildings and redevelopment at Station Hill in central Reading.</i> <i>The existing buildings straddle a significant change in height from 46m OD in the south to 38m OD in the north, formed by the north facing slopes defining the southern edge of the Thames Valley. To rationalise floor levels for the construction of the existing buildings on the site there was evidence of significant earth-works and terracing. In the majority of observations, in situ chalk bedrock was present, but overlying drift geology although present, had been truncated to varying depths.</i> <i>The presence of redeposited pre-historic worked flint simply attests to activity during these periods in the vicinity of the site.</i> <i>The potential pit in TP18, and possible post-holes in TP11 although undated, may attest to activity towards the northern end of medieval burgage plots fronting onto the north side of Friar Street, however, such features are common from the Neolithic onwards.</i> <i>Investigations from ground floor level on the Friar Street frontage (TP6, TP8 and WS313) where there does not appear to be any current basement levels, had the potential to reveal occupation and structural evidence for medieval and post-medieval burgage buildings. These only revealed modern deposits associated with the construction of the extant buildings, however this is probably due to the positions of the investigations, which were adjacent to significant foundations and their associated truncations. It should be noted that a basement wall for the neighbouring property was seen in TP8 and the presence of older basements along this frontage which may have truncated earlier archaeology cannot be ruled out.</i> <i>The medieval E-W ditch in TP2 may indicate the base of the valley sides, indeed observations of alluvial deposits were confined to interventions broadly north of this latitude.</i> <i>Archaeological features, where present, were horizontally and vertically truncated. The lack of archaeological features may relate to the position of the interventions adjacent to large concrete foundations with their associated construction truncations. Areas of site away from foundations but under floor slabs may have better preservation and potential for archaeological features/deposits.</i>

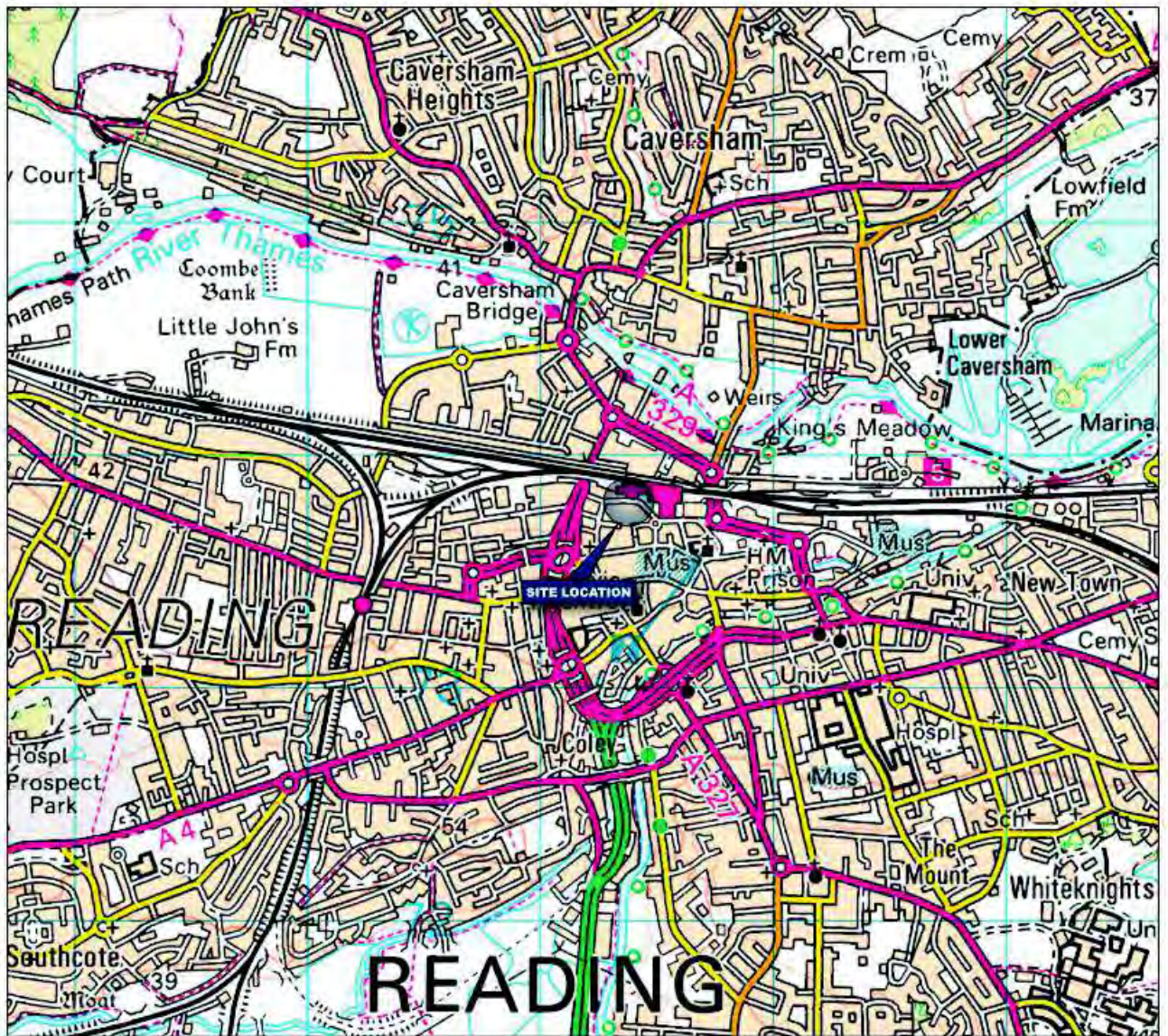


Figure 1: Station Hill Site location.

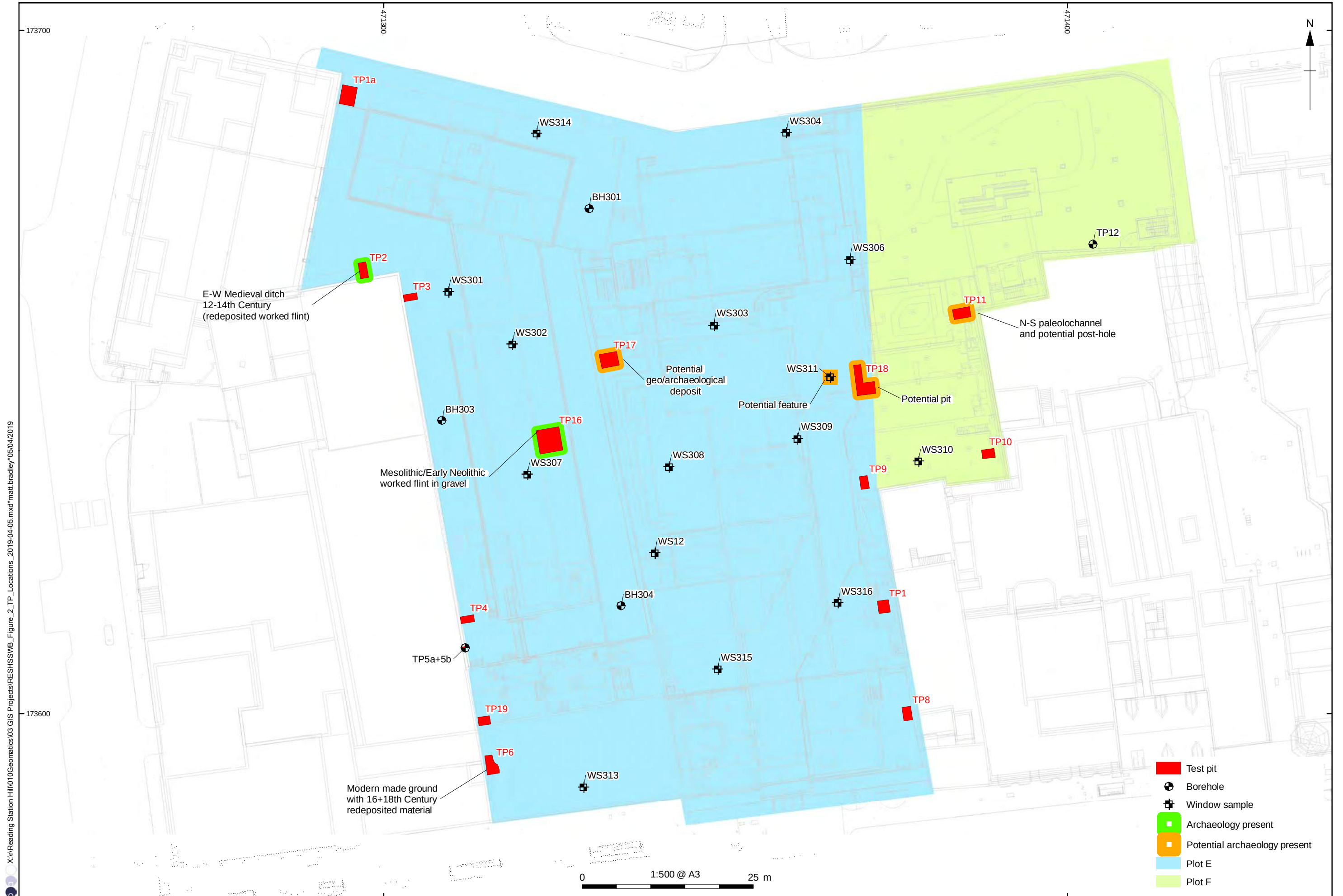


Figure 2: Location of test pits and geotechnical interventions

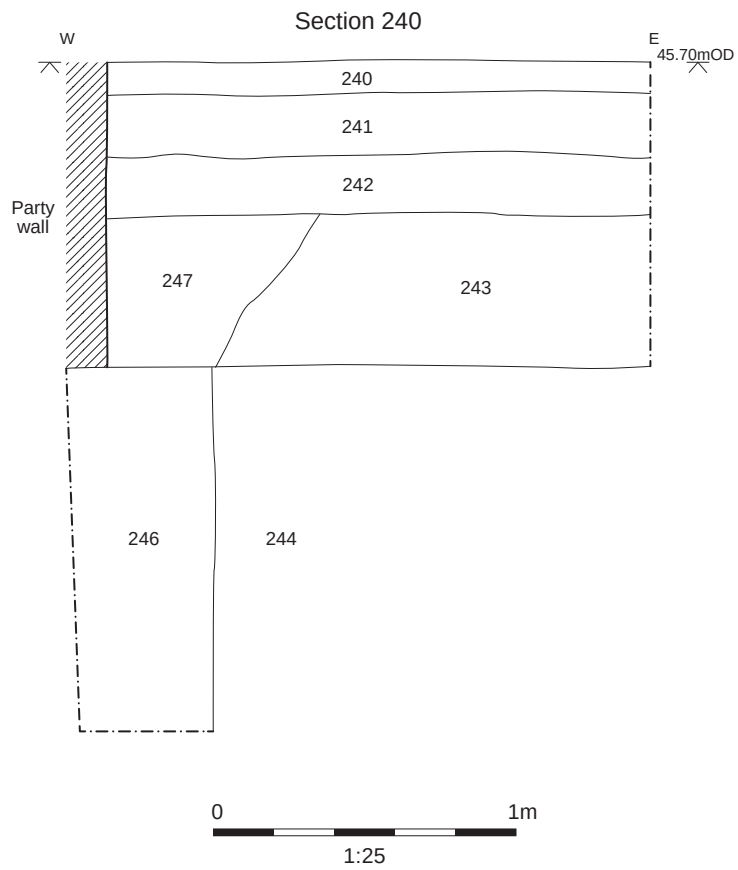


Figure 3: TP6, south facing section 240

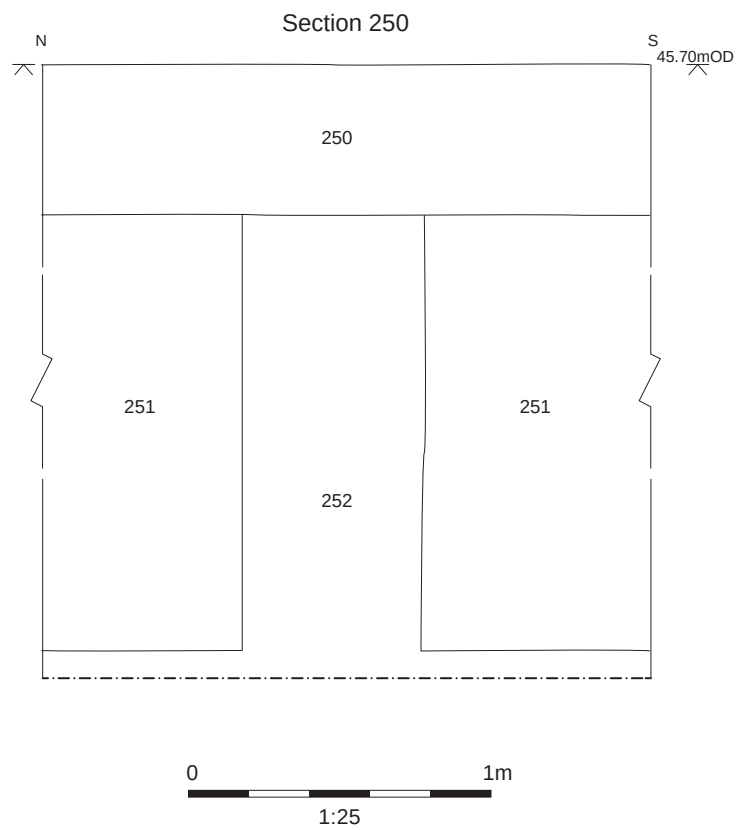


Figure 4: TP8, west facing section 250

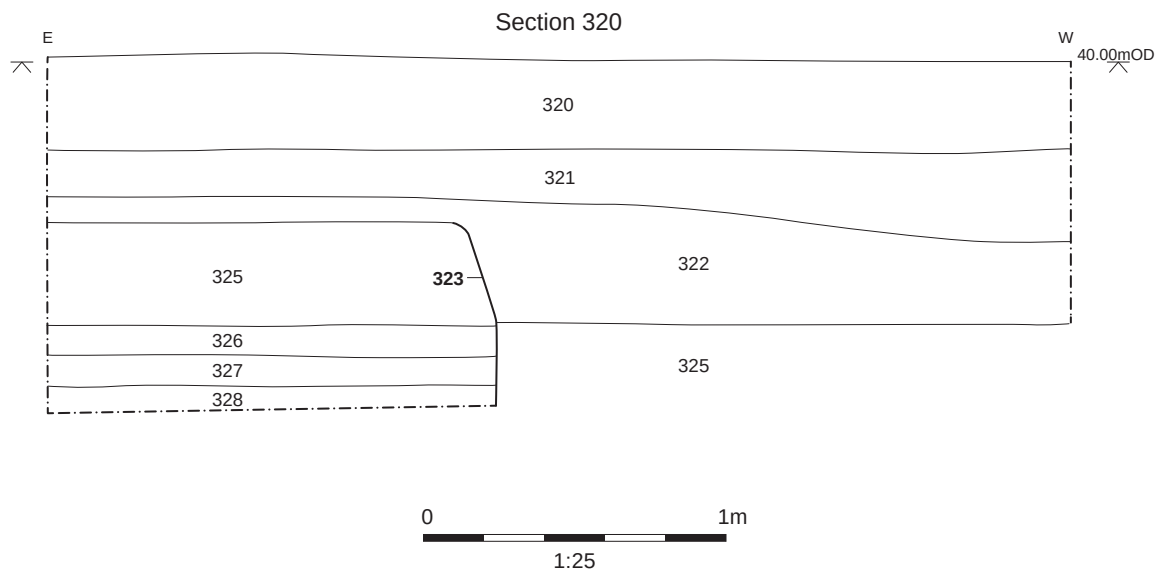


Figure 5: TP16, northfacing section 320

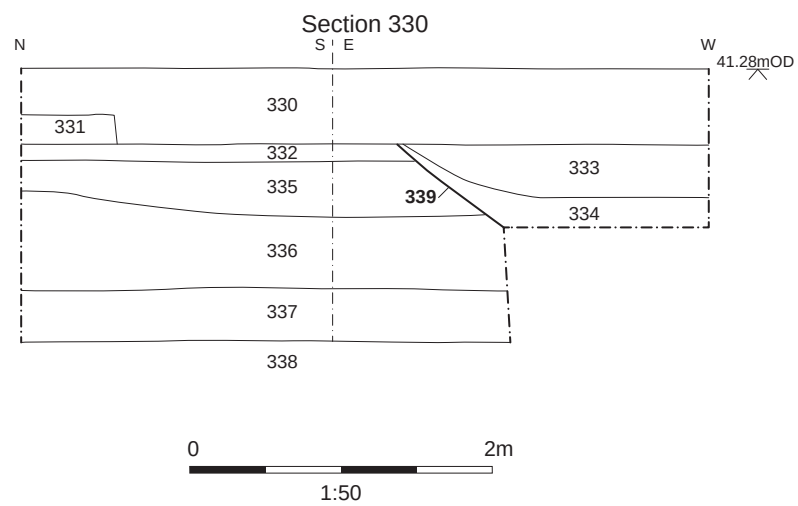


Figure 6: TP17, west facing section 330

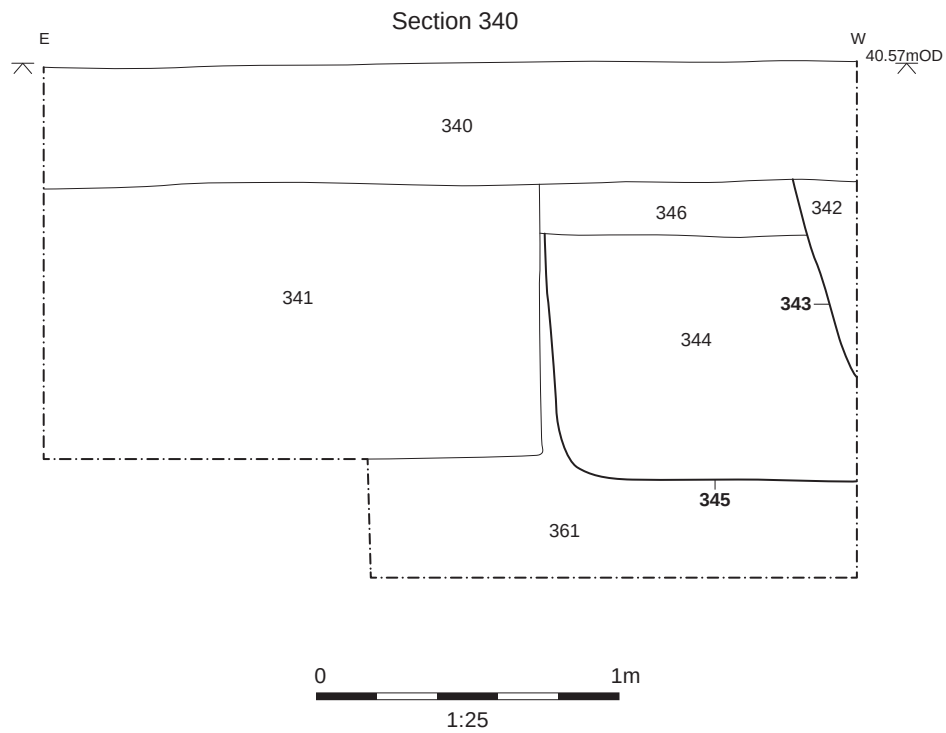


Figure 7: TP18, north facing section 340

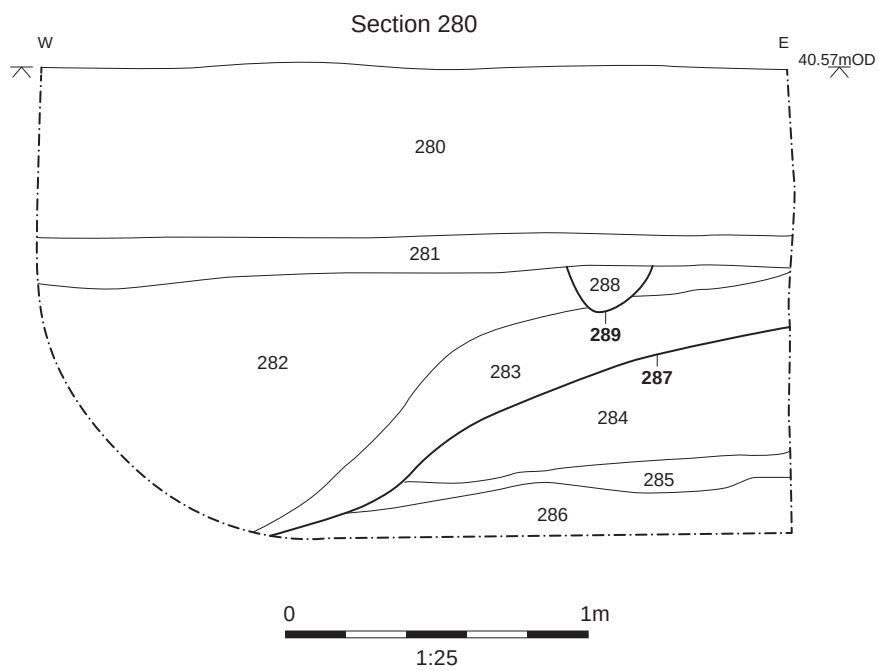


Figure 8: TP11, south facing section 280

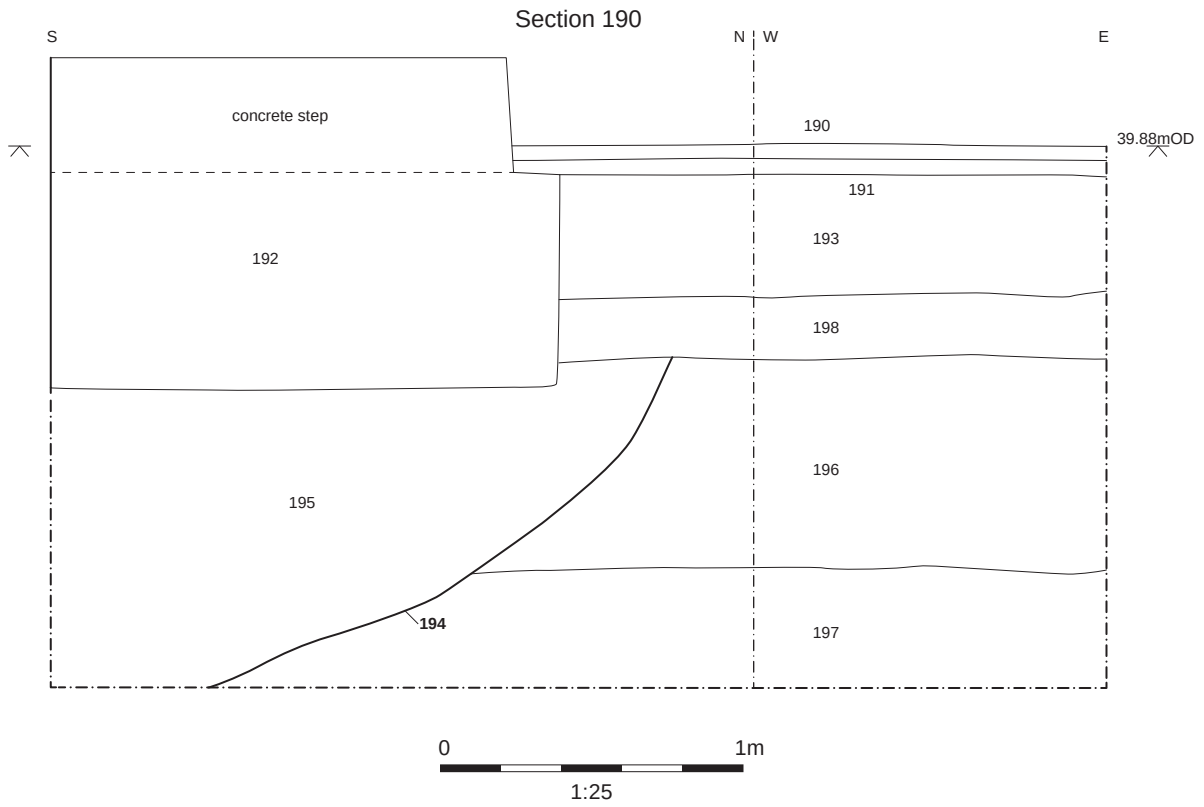


Figure 9: TP2, west facing section 190



Plate 1: View of TP 6 looking south



Plate 2: View of TP 8 looking east



Plate 3: View of TP 16 looking south



Plate 4: View of TP 17 looking east



Plate 5: View of TP 18 looking south



Plate 6: View of TP 11 looking south



Plate 7: View of TP 2 looking east



**Head Office/Registered Office/
OA South**

Janus House
Osney Mead
Oxford OX2 0ES

t: +44 (0) 1865 263 800
f: +44 (0) 1865 793 496
e: info@oxfordarchaeology.com
w: <http://oxfordarchaeology.com>

OA North

Mill 3
Moor Lane
Lancaster LA1 1QD

t: +44 (0) 1524 541 000
f: +44 (0) 1524 848 606
e: canorth@oxfordarchaeology.com
w: <http://oxfordarchaeology.com>

OA East

15 Trafalgar Way
Bar Hill
Cambridgeshire
CB23 8SQ

t: +44 (0) 1223 850 500
e: caeast@oxfordarchaeology.com
w: <http://oxfordarchaeology.com>



Director: Gill Hey, BA PhD FSA MCIfA
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10.1

AIR QUALITY ASSESSMENT DETAILED METHODOLOGY

Technical Appendix 10.1: Air Quality Assessment Detailed Methodology and Modelled Conditions within the Proposed Development

- 1.1 This appendix presents the technical information and data upon which the air quality assessment is based.

Operational Development Assessment

ADMS-Roads

- 1.2 In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; which requires a range of input data, which can include pollutant emissions rates, meteorological data and local topographical information.
- 1.3 The potential effects of the Proposed Development on local air quality was assessed using the advanced atmospheric dispersion model ADMS-Roads, considering the contribution of emissions from forecast road-traffic on the local road network for the assessment years (taken to be 2022 and 2026).
- 1.4 The ADMS-Roads model is a comprehensive tool for investigating air pollution in relation to road networks. On review of the Site, and its surroundings, ADMS-Roads was considered appropriate for the assessment of the potential long and short term effects of the Proposed Development on air quality. The model uses advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions of air pollutant concentrations. It can predict long-term and short-term concentrations, including percentile concentrations.
- 1.5 ADMS-Roads model is a formally validated model, developed in the United Kingdom (UK) by CERC (Cambridge Environmental Research Consultants). This includes comparisons with data from the UK's air quality Automatic Urban and Rural Network (AURN) and specific verification exercises using standard field, laboratory and numerical data sets. CERC is also involved in European programmes on model harmonisation and their models have been compared favourably against other E.U and U.S. EPA systems. Further information in relation to this is available from the CERC website at www.cerc.co.uk.

Model Scenarios

- 1.6 To assess future air quality conditions at the Site once the Proposed Development is complete and operational the future years of 2022, once Phases 1 and 2 are complete and operational (the Interim Development Scenario), and 2026, once all phases have been constructed (the Completed Development Scenario) were assessed. A 2026 Cumulative Scenario has also been modelled.
- 1.7 The year 2018 was also modelled to establish the existing baseline situation because it is the latest full year of existing monitoring data from Reading Borough Council (RBC) surrounding the Site against which the air quality model is verified (discussed further below). Base year traffic data for 2018 and meteorological data for 2018 were also used to be consistent with the verification year.

- 1.8 Considering recent analyses by Defra¹ showing that historical NO_x and NO₂ concentrations are not declining in line with emission forecasts, the assessment has used revised emissions data and background concentrations using the Air Quality Consultants Ltd Calculator Using Realistic Emissions for Diesels (CURED) spreadsheet². The spreadsheet has been designed to provide a reasonable worst-case assumption for future vehicle emissions.

Traffic Data

- 1.9 Traffic flow data comprising Annual Average Daily Traffic (AADT) flows, traffic composition (% Heavy-Duty Vehicles (HDVs)) were used in the model as provided by the project transport consultants (PBA part of Stantec) for the surrounding road network, inclusive of traffic flows for committed developments near the Site. **Table A1** presents the traffic data used within the Air Quality Assessment.

¹ <http://laqm.defra.gov.uk/faqs/faqs.html>: Measured nitrogen oxides (NO_x) and/or nitrogen dioxide (NO₂) concentrations in my local authority area do not appear to be declining in line with national forecasts.

² <http://www.aqconsultants.co.uk/News/January-2018/UPDATED-CURED-TO-V3A.aspx>

Table A1: 24-hour AADT Data Used within the Assessment

Ref.	Link Name	Speed (kph)	2018		2022				2026					
			Baseline		Baseline		Interim Development Scenario		Baseline		Completed Development Scenario		Cumulative Scenario	
			AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV
1	Castle Street west of IDR	39	26582	5.32	28611	5.31	28682	5.39	30356	5.31	30602	5.41	30602	5.41
2	Castle Street east of IDR	33	6316	8.38	6759	8.37	6853	8.26	7173	8.37	7378	8.14	7436	8.08
3	Queens Road	38	25366	8.27	27140	8.28	27278	8.34	28805	8.28	29182	8.29	29182	8.29
4	Forbury Road	43	22902	9.47	25171	9.47	25171	9.47	26674	9.47	26674	9.47	27913	9.12
5	Blagrave Road	21	6185	22.44	6615	22.44	6615	22.44	7021	22.44	7021	22.44	7021	22.44
6	Friar Street	26	4493	34.90	4805	34.89	4805	34.89	5100	34.89	5100	34.89	5195	34.48
7	Caversham Road under Railway bridge	39	32456	9.79	35099	9.80	35152	9.92	37230	9.80	37514	9.93	37906	9.85
8	Vastern Road	40	23905	8.43	26144	8.42	26205	8.47	27713	8.42	27912	8.47	29456	8.15
9	George Street	45	19137	5.77	20497	5.77	20679	5.81	21754	5.77	22215	5.79	22215	5.79
10	Station Road	17	4092	9.78	4377	9.77	4377	9.77	4646	9.77	4646	9.77	4646	9.77
11	Oxford Road	37	18625	6.91	20048	6.91	20168	6.96	21271	6.91	21594	6.94	21594	6.94
12	Wokingham Road	41	14900	6.09	16164	6.10	16299	6.13	17142	6.10	17483	6.10	17483	6.10
13	A4 London Road	40	31594	7.22	34251	7.22	34414	7.28	36325	7.22	36785	7.27	36785	7.27
14	Caversham Road north of IDR	39	30635	9.46	33150	9.46	33262	9.51	35162	9.46	35510	9.50	35597	9.48
15	Greyfriars Road	30	5955	7.94	6331	7.94	6338	10.30	6665	7.94	7204	10.64	7377	10.62
16	Garrard Street	26	3068	6.55	3262	6.56	3270	11.13	3434	6.56	3974	11.63	3974	12.36

Vehicle Speeds

1.10 To take into account the presence of slow moving traffic along the links in the area, the speed at the junctions were reduced to 20kph in accordance with the following criteria recommended within LAQM.TG(16)³:

- Traffic on the carriageway approaching the lights when red, e.g. 5-20 kph, depending on the time of day and level of congestion at the junction;
- Traffic approaching the lights when green, e.g. 20-50 kph; and
- Traffic on the carriageway approaching the lights when red, e.g. 5-20 kph, depending on the time of day and how congested the junction is.

Diurnal Profile

1.11 The ADMS-Roads model uses an hourly traffic flow based on the daily (AADT) flows. Traffic flows follow a diurnal variation throughout the day and week. Therefore, a diurnal profile was used in the model to replicate how the average hourly traffic flow would vary throughout the day and the week. This was based on data (the latest available at the time of the assessment) collated by Waterman from the Department for Transport (DfT) statistics Table TRA0307: 'Traffic Distribution by Time of Day on all roads in Great Britain', 2018⁴. **Figure A1** presents the diurnal variation in traffic flows which has been used within the model.

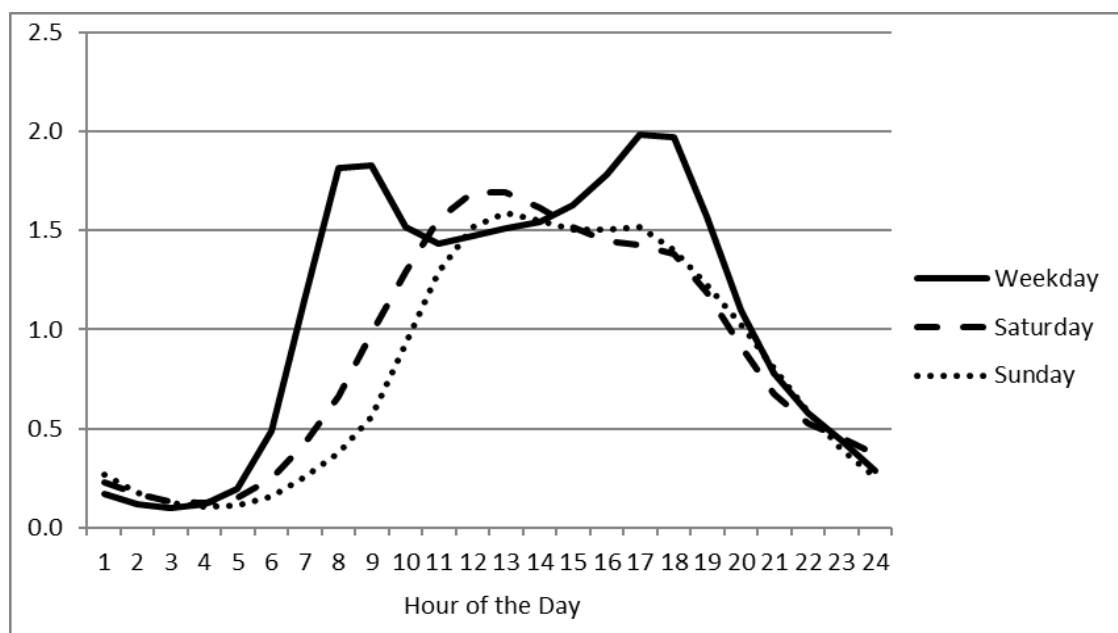


Figure A1: Department for Transport Diurnal Traffic Variation

Street Canyon Effect

1.12 Narrow streets with tall buildings on either side have the potential to create a confined space, which can interfere with the dispersion of traffic pollutants and may result in pollutant emissions accumulating in these streets. In an air quality model, these narrow streets are described as street canyons.

³ Defra, 2016, London Local Air Quality Management Technical Guidance LAQM.TG (16)

⁴ Department for Transport (DfT) Statistics, www.dft.gov.uk/statistics/series/traffic

- 1.13 ADMS-Roads includes a street canyon model to take account of the additional turbulent flow patterns occurring inside such a narrow street with relatively tall buildings on both sides. LAQM.TG(16) identifies a street canyon “as narrow streets where the height of buildings on both sides of the road is greater than the road width.”
- 1.14 Following a review of the road network to be included within the model, the roads within the network to be modelled are relatively wide and existing buildings are not considered to be tall. The proposed buildings within the Proposed Development Site, while being tall, do not cause any new canyons to be created with the existing buildings on the opposite side of Station Hill, Greyfriars Road, Garrard Street or Friar Street. Therefore, no canyons were included within the model for the existing or with Development scenarios.

Road Traffic Emission Factors

- 1.15 The latest version of the ADMS-Roads model (version 4.1.1.0) was used for the assessment. At the time of the assessment this includes the latest vehicle emission factors published by Defra in the Emission Factors Toolkit (EFT) (version 9.0, published in May 2019).
- 1.16 The EFT uses several parameters (traffic flow, percentage of HDV, speed and road type) to calculate road traffic emissions for the selected pollutants.
- 1.17 As stated previously, for the future year assessment revised NO_x and NO₂ emissions data using the CURED spreadsheet have been inputted into the model.

Emissions from Diesel Trains

- 1.18 LAQM.TG(16) provides guidance on assessing NO_x emissions from railways. The guidance states that there is only a requirement to “assess railway lines with a high usage of diesel locomotives” and where “there is potential for long term exposure within 30m of the edge of the tracks”. Table 7.2 of LAQM.TG(16) lists the lines with a heavy traffic of diesel passenger trains. The lines travelling through Reading Station are included within Table 7.2 of LAQM.TG(16) (Paddington to Swansea). However, there is no exposure in the Proposed Development within 30m of the edge of the tracks. As such, NO_x emissions from diesel trains have not been considered further within this assessment.

Background Pollutant Concentrations

- 1.19 The ADMS-Roads model requires background pollutant concentration data (i.e. concentrations not including local pollutant sources such as roads or stacks), that correspond to the year of assessment, to which the model adds contributions from the road sources.
- 1.20 RBC undertake background air pollutant monitoring at one automatic monitor within their administrative boundary. Table A2 shows the monitoring results for the automatic analyser located at New Town approximately 2km from the Site.

Table A2: Measured Concentrations at the RBC Urban Background Monitor (µg/m³)

Pollutant	Averaging Period	AQS Objective	2016	2017	2018
NO _x	Annual Mean (µg/m ³)	-	-	-	35
	Annual Mean (µg/m ³)	40µg/m ³	34	29	26
NO ₂	1-Hour Mean (No. of Hours)	200µg/m ³ not to be exceeded more than 18 times a year	4	0	0
	Annual Mean (µg/m ³)	40µg/m ³	13	12	13
PM ₁₀	24-Hour Mean (No. of Days)	50µg/m ³ not to be exceeded more than 35 times a year	3	3	1
	Annual Mean (µg/m ³)	40µg/m ³	13	12	13

Pollutant	Averaging Period	AQS Objective	2016	2017	2018
PM _{2.5}	Annual Mean (µg/m ³)	25µg/m ³	9	10	7

Notes: Data obtained from RBC_2019 Annual Status Report

- 1.21 In addition to the background monitoring undertaken by RBC, background concentrations of NO_x, NO₂, PM₁₀ and PM_{2.5} are available from the Defra Local Air Quality Management website⁵ for 1x1km grid squares, for years 2017 to 2030. **Table A3** presents the Defra mapped NO₂ background concentrations for the grid square the Site is located within (473500, 173500;) for 2018 to compare against the RBC New Town automatic monitor.

Table A3: Defra background maps in 2017 for the grid square at the Site

Pollutant	Annual Mean Concentration (µg/m ³)
	2018
NO _x	37.0
NO ₂	23.5
PM ₁₀	16.6
PM _{2.5}	11.6

- 1.22 Tables A2 and A3 show that in 2018 monitored urban background NO₂ concentration at the New Town automatic monitor (26µg/m³) is slightly higher than the Defra map (23.5µg/m³). The 2018 monitored concentrations of PM₁₀ (13µg/m³) and PM_{2.5} (7µg/m³) are slightly lower than the Defra maps (PM₁₀: 16.6µg/m³ and PM_{2.5}: 11.6µg/m³). Concentrations have been obtained from the New Town monitored data rather than the estimated Defra maps.
- 1.23 **Table A4** presents the background concentrations used within the air quality assessment. The future year NO₂ concentrations were calculated using the CURED methodology.

Table A4: Background concentrations used in the assessment (µg/m³)

Pollutant	2018	2022	2026
NO _x	35.0	30.0	27.9
NO ₂	26.0	23.1	21.7
PM ₁₀	13.0	12.4	12.0
PM _{2.5}	9.0	8.5	8.2

Meteorological Data

- 1.24 Local meteorological conditions strongly influence the dispersal of pollutants. Key meteorological data for dispersion modelling include hourly sequential data including wind direction, wind speed, temperature, precipitation and the extent of cloud cover for each hour of a given year. As a minimum ADMS-Roads requires wind speed, wind direction, and cloud cover.
- 1.25 Meteorological data to input into the model were obtained from the Farnborough Airport Meteorological Station, which is the closest to the Site and considered to be the most representative. The 2018 data were used to be consistent with the base traffic year and model verification year. It was also used for the 2022 and 2024 scenarios for the air quality assessment. **Figure A2** presents the wind-rose for the meteorological data.

⁵ <http://uk-air.defra.gov.uk/>

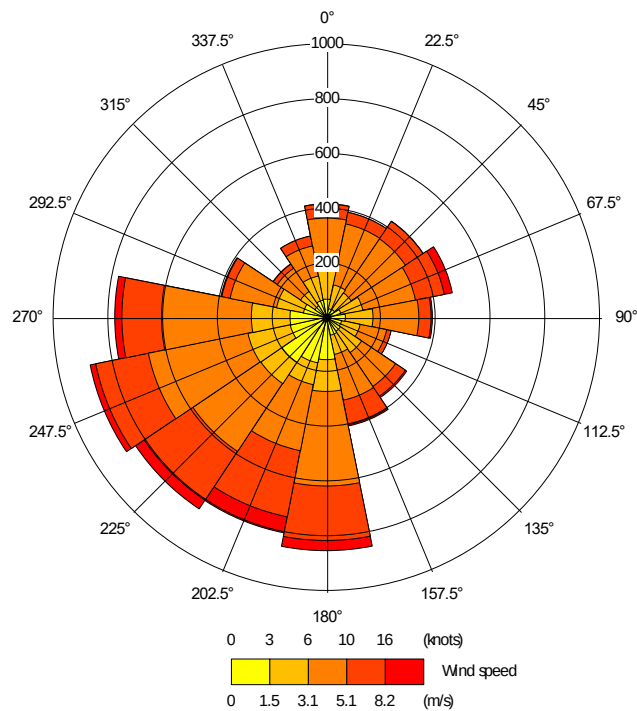


Figure A2: 2018 Wind Rose for the Farnborough Airport Meteorological Site

- 1.26 Most dispersion models do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75 m/s. It is recommended in LAQM.TG(16) that the meteorological data file be tested within a dispersion model and the relevant output log file checked, to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedances. LAQM.TG(16) recommends that meteorological data should only be used if the percentage of usable hours is greater than 85%. 2018 meteorological data from Farnborough Airport includes 8,197 lines of usable hourly data out of the total 8,760 for the year, i.e. 93.6% of usable data. This is above the 85% threshold and is therefore adequate for the dispersion modelling.
- 1.27 A value of 0.5 was used for the Farnborough Airport Meteorological Station, which is representative of parkland and open suburbia, and is considered appropriate following a review of the local area surrounding the Meteorological Station.

Model Data Processing

- 1.28 The modelling results were processed to calculate the averaging periods required for comparison with the Air Quality Strategy Objectives.
- 1.29 NO_x emissions from combustion sources (including vehicle exhausts) comprise principally nitric oxide (NO) and NO₂. The emitted NO reacts with oxidants in the air (mainly ozone) to form more NO₂. Since only NO₂ is associated with impacts on human health, the air quality standards for the protection of human health are based on NO₂ and not total NO_x or NO.

- 1.30 The ADMS-Roads model was run without the Chemistry Reaction option to allow verification (see below). Therefore, a suitable NO_x:NO₂ conversion was applied to the modelled NO_x concentrations. There are a variety of different approaches to dealing with NO_x:NO₂ relationships, a number of which are widely recognised as being acceptable. However, the current approach was developed for roadside sites, and is detailed within the Technical Guidance LAQM.TG(16).
- 1.31 The LAQM Support website provides a spreadsheet calculator⁶ to allow the calculation of NO₂ from NO_x concentrations, accounting for the difference between primary emissions of NO_x and background NO_x, the concentration of O₃, and the different proportions of primary NO₂ emissions, in different years. This approach is only applicable to annual mean concentrations.
- 1.32 Research⁷ undertaken in support of LAQM.TG(16) has indicated that the hourly mean limit value and objective for NO₂ is unlikely to be exceeded at a roadside location where the annual-mean NO₂ concentration is less than 60µg/m³. The hourly objective is, therefore, not considered further within this assessment where the annual-mean NO₂ concentration is predicted to be less than 60µg/m³.
- 1.33 To calculate the number of daily exceedances of 50µg/m³ PM₁₀, the relationship between the number of 24-hour exceedances of 50µg/m³ and the annual mean PM₁₀ concentration from LLAQM.TG (16) was applied as follows:

$$\text{Number of Exceedances} = -18.5 + 0.00145 \times \text{annual mean}^3 + (206/\text{annual mean})$$

Other Model Parameters

- 1.34 There are other parameters that are used within the ADMS-Roads model, which are described for completeness and transparency:
- The model requires a surface roughness value to be inputted. A value of 0.5 was used for the Site and Meteorological Station, which is representative of parkland and open suburbia; and
 - The model requires the Monin-Obukhov length (a measure of the stability of the atmosphere) to be inputted. A value of 30m (representative of A value of 30m (representative of large cities and towns, such as Reading) was used for the modelling ng; and
 - The model requires the Road Type to be inputted. 'Urban [Not London]' was selected and used for the modelling of the road links.

Model Verification

- 1.35 Model verification is the process of comparing monitored and modelled pollutant concentrations for the same year, at the same locations, and adjusting modelled concentrations if necessary, to be consistent with monitoring data. This increases the robustness of modelling results.
- 1.36 Discrepancies between modelled and measured concentrations can arise for several reasons, for example:
- Traffic data uncertainties;
 - Background concentration estimates;
 - Meteorological data uncertainties;

⁶ AEA, NO_x to NO₂ Calculator, <http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php> Version 7.1, 15 April 2019

⁷ Defra (2016), 'Local Air Quality Management Policy guidance PG(16)', DEFRA, London

- Sources not explicitly included within the model (e.g. car parks and bus stops);
- Overall model limitations (e.g. treatment of roughness and meteorological data, treatment of speeds); and
- Uncertainty in monitoring data, particularly diffusion tubes.

1.37 Verification is the process by which uncertainties such as those described above are investigated and minimised. Disparities between modelling and monitoring results are likely to arise as result of a combination of these aspects.

Nitrogen Dioxide

1.38 The ADMS-Roads model was run to predict annual mean NO_x concentrations at 22 diffusion tube locations within Reading Town Centre and the Caversham Road automatic monitor. These locations were chosen as the most representative of roadside locations within the Town Centre within the road study network with good data capture.

1.39 Box 7.15 in LAQM.TG(16) indicates a method based on comparison of the road NO_x contributions and calculating an adjustment factor. This requires the roadside NO_x contribution to be calculated. In addition, monitored NO_x concentrations are required, which were calculated from the annual mean NO₂ concentration at the diffusion tube site using the NO_x to NO₂ spreadsheet calculator as described above. The steps involved in the adjustment process are presented in **Table A5**. The background data for 2018, as presented in **Table A4**.

Table A5: Model Verification Result for Unadjusted NO_x Emissions (µg/m³)

Site ID	Monitored NO ₂	Monitored NO _x	Monitored Road NO ₂	Monitored Road NO _x	Modelled Road NO _x
DT1	32.0	47.2	6.0	12.2	15.4
DT7	40.0	64.7	14.0	29.7	15.6
DT9	30.0	43.1	4.0	8.1	4.6
DT18	35.0	53.6	9.0	18.6	11.0
DT19	42.0	69.3	16.0	34.3	22.8
DT20	37.0	58.0	11.0	23.0	17.8
DT30	39.0	62.5	13.0	27.5	7.9
DT31	34.0	51.5	8.0	16.5	15.4
DT32	42.0	69.3	16.0	34.3	9.0
DT34	42.0	69.3	16.0	34.3	8.7
DT35	32.0	47.2	6.0	12.2	11.4
DT36	31.0	45.2	5.0	10.2	10.7
DT37	38.0	60.2	12.0	25.2	7.9
DT39	35.0	53.6	9.0	18.6	9.6
DT42	42.0	69.3	16.0	34.3	10.4
DT43	44.0	74.0	18.0	39.0	18.6
DT47	41.0	67.0	15.0	32.0	17.3
DT48	34.0	51.5	8.0	16.5	12.8
DT51	37.0	58.0	11.0	23.0	24.3

Site ID	Monitored NO ₂	Monitored NO _x	Monitored Road NO ₂	Monitored Road NO _x	Modelled Road NO _x
DT52	42.0	69.3	16.0	34.3	21.0
DT53	33.0	49.4	7.0	14.4	18.5
RD1	35.0	53.6	9.0	18.6	14.0

1.40 **Figure A3** shows the mathematical relationship between modelled and monitored roadside NO_x (i.e. total NO_x minus background NO_x) in a scatter graph (data taken from **Table A6**), with a trendline passing through zero and its derived equation.

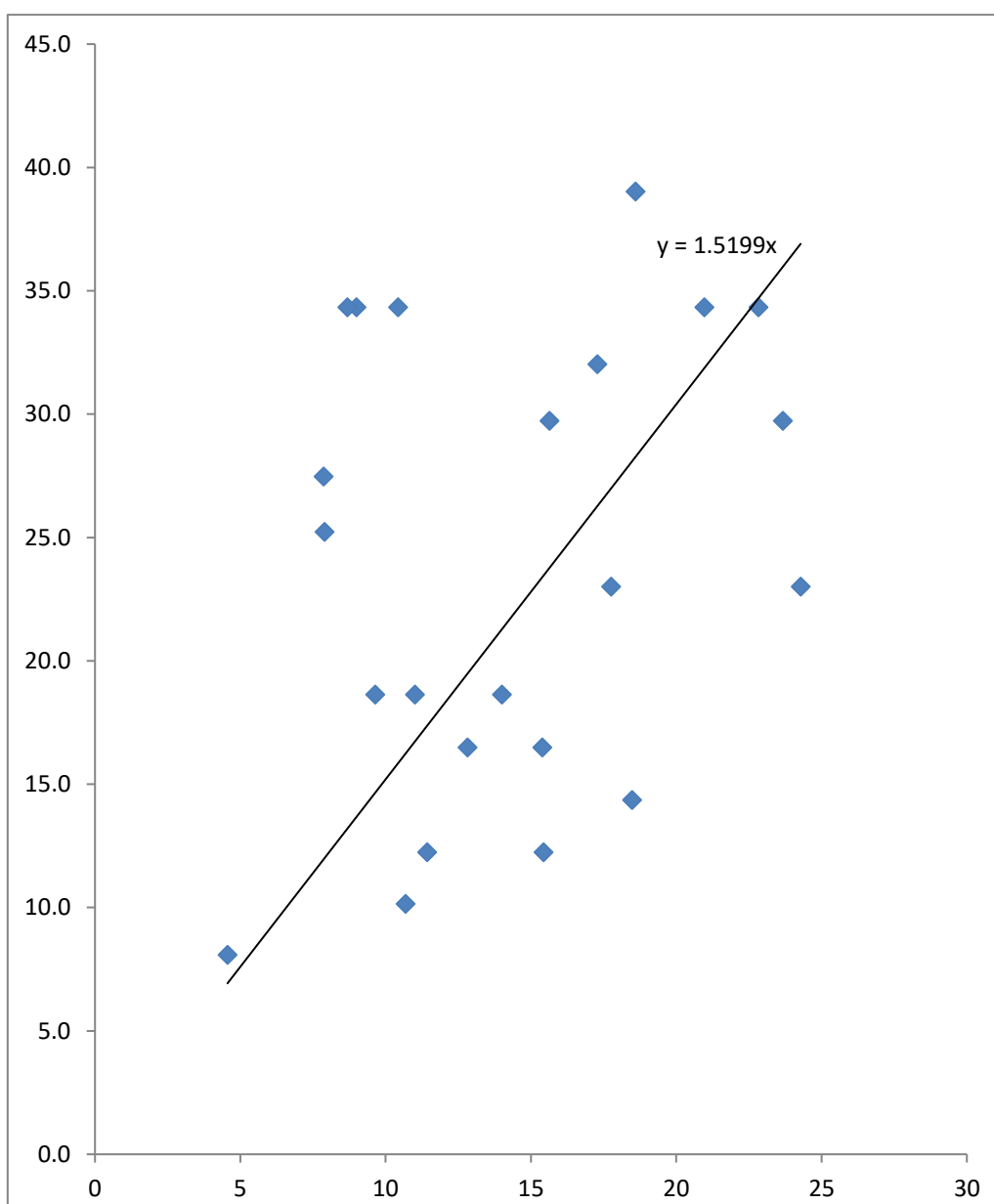


Figure A3: Unadjusted Modelled versus Monitored Annual Mean Roadside NO_x at the Monitoring Sites (µg/m³)

1.41 Consequently, in **Table A6** the adjustment factor (1.5199) obtained from **Figure A3** is applied to the modelled NO_x Roadside concentrations to obtain improved agreement between

monitored and modelled annual mean NO_x. This has been converted to annual mean NO₂ using the NO_x:NO₂ spreadsheet calculator.

Table A6: Model Verification Result for Adjustment NO_x Emissions (µg/m³)

Site ID	Adjusted Modelled Road NO _x	Adjusted Modelled Total NO _x	Modelled Total NO ₂	Monitored Total NO ₂	% Difference
DT1	23.5	58.5	37.2	32.0	16.3
DT7	23.8	58.8	37.3	40.0	-6.6
DT9	6.9	41.9	29.4	30.0	-1.9
DT18	16.7	51.7	34.1	35.0	-2.5
DT19	34.7	69.7	42.2	42.0	0.4
DT20	27.0	62.0	38.8	37.0	4.8
DT30	12.0	47.0	31.9	39.0	-18.3
DT31	23.4	58.4	37.2	34.0	9.3
DT32	13.7	48.7	32.7	42.0	-22.2
DT34	13.2	48.2	32.5	42.0	-22.7
DT35	17.4	52.4	34.4	32.0	7.5
DT36	16.2	51.2	33.9	31.0	9.3
DT37	12.0	47.0	31.9	38.0	-16.1
DT39	14.6	49.6	33.1	35.0	-5.3
DT42	15.9	50.9	33.7	42.0	-19.7
DT43	28.3	63.3	39.4	44.0	-10.6
DT47	26.3	61.3	38.5	41.0	-6.2
DT48	19.5	54.5	35.4	34.0	4.1
DT51	36.9	71.9	43.1	37.0	16.5
DT52	31.9	66.9	40.9	42.0	-2.5
DT53	28.1	63.1	39.3	33.0	19.0
RD1	21.3	56.3	36.2	35.0	3.5

- 1.42 The results of **Table A6** indicates a better agreement between monitored and modelled annual mean NO₂ results compared to the unadjusted/unverified model shown in **Table A5**.
- 1.43 Based on the results from **Table A5** and **Table A6**, the NO_x adjustment process was subsequently applied to all roadside NO_x modelling for the 2018, 2022 and 2026 scenarios, at the specific receptors locations assessed, before the predicted concentrations were converted to NO₂.

Particulate Matter (PM₁₀ and PM_{2.5})

- 1.44 PM₁₀ monitoring is also undertaken at the automatic monitoring site at Caversham Road, and therefore, a similar process to that above has been applied to PM₁₀. The steps involved in the adjustment process are presented in **Table A7**.

Table A7: Model Verification Result for Annual Mean PM₁₀ in 2018 at Caversham Road Automatic Monitor

Site ID	Monitored PM ₁₀	Background PM ₁₀	Monitored Road PM ₁₀ Contribution	Modelled Road PM ₁₀ Contribution	Ratio
Caversham Road	24.0	13.0	11.0	1.96	5.61

- 1.45 The adjustment factor (5.61) obtained in **Table A7** is applied to the modelled PM₁₀ Roadside concentrations, prior to the addition of the background concentrations and before the number of daily PM₁₀ exceedences was calculated, to obtain improved agreement between monitored and modelled annual mean PM₁₀.
- 1.46 No roadside PM_{2.5} monitoring data is undertaken to compare to the model output. Therefore, the adjustment factor (of 5.61) calculated in **Table A7** for the adjustment of PM₁₀ has been applied to all the roadside PM_{2.5} modelling results inside of the street canyon, before the addition of the appropriate background concentrations.

Verification Summary

- 1.47 Any atmospheric dispersion model study will always have a degree of inaccuracy due to a variety of factors. These include uncertainties in traffic emissions data, the differences between available meteorological data and the specific microclimate at each receptor location, and simplifications made in the model algorithms that describe the atmospheric dispersion and chemical processes. There will also be uncertainty in the comparison of predicted concentrations with monitored data, given the potential for errors and uncertainty in sampling methodology (technique, location, handling, and analysis) as well as processing of any monitoring data.
- 1.48 Whilst systematic under or over prediction can be taken in to account through the model verification / adjustment process, random errors will inevitably occur and a level of uncertainty will still exist in corrected / adjusted data.
- 1.49 Model uncertainties arise because of limited scientific knowledge, limited ability to assess the uncertainty of model inputs, for example, emissions from vehicles, poor understanding of the interaction between model and / or emissions inventory parameters, sampling and measurement error associated with monitoring sites and whether the model itself completely describes all the necessary atmospheric processes.
- 1.50 Overall, it was concluded that with the adjustment factors applied to the ADMS-Roads model, it is performing well, and modelled results are suitable to determine the potential effects of the Development on local air quality.

Assessor Experience

Name: Christopher Brownlie

Years of Experience: 11

Qualifications:

- BSc (Hons)
- MSc
- MIAQM (Member of the Institute of Air Quality Management)

Chris has over eleven years of experience in the assessment of air quality and odour for a variety of environmental impact assessment projects. Chris has knowledge and extensive experience of designing and undertaking ambient air quality monitoring programmes using real time equipment and passive diffusion tubes. This includes devising monitoring programs for dust deposition, typically to monitor levels of dust generated during construction activities in populated areas where there is the potential for nuisance to be caused.

Chris has been responsible for the technical delivery of a wide range of air quality projects for a variety of clients in both the public and private sector. These projects include consideration of emissions from both transportation and industrial sources, through both monitoring and modelling, and therefore he has an in depth understanding of the regulatory requirements for these sources and the published technical guidance for their assessment.

Conditions within the Development

Table A8: 2026 Annual Mean NO₂ Concentrations (µg/m³)

Floor	A	B	C	D	E	F	G
G	27.3	23.7	23.4	25.4	24.7	24.0	24.7
1	25.4	23.7	23.4	24.6	23.6	23.4	24.2
2	24.0	23.5	23.3	23.8	23.2	23.2	23.5
3	23.5	23.4	23.2	23.4	22.9	23.0	23.2
4	23.3	23.2	23.1	23.2	22.8	22.9	23.0
5	23.0	23.0	22.9	23.0	22.7	22.7	22.9
6	22.9	22.8	22.8	22.8	22.6	22.6	22.7
7	22.7	22.7	22.7	22.7	22.5	22.5	22.6
8	22.6	22.6	22.6	22.5	22.4	22.4	22.5
9	22.4	22.5	22.5	22.4	22.3	22.3	22.4
10	22.4	22.4	22.4	22.4	22.3	22.3	22.4
11	22.3	22.3	22.3	22.3	22.2	22.2	22.3
12	22.2	22.2	22.2	22.2	22.1	22.2	22.2
13	22.1	22.2	22.2	22.2	22.1	22.1	
14	22.1	22.1	22.1	22.1	22.1	22.1	
15	22.1	22.1	22.1	22.1			
16	22.0	22.0	22.0	22.0			
17		22.0	22.0	22.0			
18		22.0	22.0	22.0			
19		21.9	21.9	21.9			
20		21.9	21.9	21.9			
21		21.9	21.9	21.9			
22		21.8	21.8				
23		21.8	21.8				
24		21.8	21.8				
25		21.8	21.8				
26		21.8	21.8				
27			21.8				

Table A9: 2026 Annual Mean PM₁₀ Concentrations (µg/m³)

Floor	A	B	C	D	E	F	G
G	17.5	14.0	13.8	15.5	15.0	14.2	14.9
1	15.6	14.0	13.7	14.9	13.9	13.7	14.4
2	14.3	13.9	13.6	14.1	13.5	13.5	13.8
3	13.9	13.7	13.5	13.8	13.3	13.3	13.5
4	13.6	13.5	13.4	13.5	13.1	13.2	13.3
5	13.4	13.3	13.3	13.3	13.0	13.0	13.2
6	13.2	13.2	13.1	13.1	12.9	12.9	13.1
7	13	13.0	13	13.0	12.8	12.8	13.0
8	12.9	12.9	12.9	12.9	12.7	12.8	12.9
9	12.8	12.8	12.8	12.8	12.7	12.7	12.8
10	12.7	12.7	12.7	12.7	12.6	12.6	12.7
11	12.6	12.6	12.6	12.6	12.5	12.5	12.6
12	12.5	12.5	12.6	12.5	12.5	12.5	12.5
13	12.5	12.5	12.5	12.5	12.4	12.4	
14	12.4	12.4	12.4	12.4	12.4	12.4	
15	12.4	12.4	12.4	12.4			
16	12.4	12.4	12.4	12.4			
17		12.3	12.3	12.3			
18		12.3	12.3	12.3			
19		12.3	12.3	12.3			
20		12.3	12.3	12.3			
21		12.2	12.2	12.2			
22		12.2	12.2				
23		12.2	12.2				
24		12.2	12.2				
25		12.1	12.1				
26		12.1	12.1				
27			12.1				

Table A10: Daily Mean PM_{2.5} Concentrations >50µg/m³ (No. of Days)

Floor	A	B	C	D	E	F	G
G	1	0	0	0	0	0	0
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	1	1	0
6	0	0	0	0	1	1	0
7	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1
13	1	1	1	1	1	1	
14	1	1	1	1	1	1	
15	1	1	1	1			
16	1	1	1	1			
17		1	1	1			
18		1	1	1			
19		1	1	1			
20		1	1	1			
21		1	1	1			
22		1	1				
23		1	1				
24		1	1				
25		1	1				
26		1	1				
27			1				

Table A11: 2026 Annual Mean PM_{2.5} Concentrations (µg/m³)

Floor	A	B	C	D	E	F	G
G	11.2	9.3	9.2	10.1	9.9	9.4	9.8
1	10.2	9.3	9.2	9.8	9.3	9.1	9.5
2	9.5	9.2	9.1	9.4	9.0	9.0	9.2
3	9.2	9.1	9.1	9.2	8.9	8.9	9.0
4	9.1	9.0	9.0	9.0	8.8	8.9	8.9
5	9.0	8.9	8.9	8.9	8.8	8.8	8.9
6	8.9	8.8	8.8	8.8	8.7	8.7	8.8
7	8.8	8.8	8.8	8.8	8.7	8.7	8.7
8	8.7	8.7	8.7	8.7	8.6	8.6	8.7
9	8.6	8.6	8.6	8.6	8.6	8.6	8.6
10	8.6	8.6	8.6	8.6	8.5	8.5	8.6
11	8.5	8.5	8.5	8.5	8.5	8.5	8.5
12	8.5	8.5	8.5	8.5	8.5	8.5	8.5
13	8.5	8.5	8.5	8.5	8.4	8.5	
14	8.4	8.4	8.5	8.4	8.4	8.4	
15	8.4	8.4	8.4	8.4			
16	8.4	8.4	8.4	8.4			
17		8.4	8.4	8.4			
18		8.4	8.4	8.4			
19		8.4	8.4	8.4			
20		8.3	8.3	8.3			
21		8.3	8.3	8.3			
22		8.3	8.3				
23		8.3	8.3				
24		8.3	8.3				
25		8.3	8.3				
26		8.3	8.3				
27			8.3				

GLOSSARY OF ACOUSTIC TERMINOLOGY

Appendix 11.1: Glossary of Acoustic Terms

AAWT-18h	Annual Average Week Day Traffic over the time period 0600-0000. Only includes Monday to Friday data.																		
Ambient sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.																		
Assessment period	The period in a day over which assessments are made.																		
A-weighting	A frequency weighting applied to measured or predicted sounds levels in order to compensate for the non-linearity of human hearing.																		
Background noise	Background noise is the term used to describe the noise measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).																		
Broadband	Containing the full range of frequencies.																		
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. This instrument has been specifically developed to mimic the operation of the human ear. The human ear responds to minute pressure variations in the air. These pressure variations can be likened to the ripples on the surface of water but of course cannot be seen. The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound that is heard. The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping. Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels. The following are examples of the decibel readings of every day sounds: <table> <tr> <td>Four engine jet aircraft at 100m</td><td>120 dB</td></tr> <tr> <td>Riveting of steel plate at 10m</td><td>105 dB</td></tr> <tr> <td>Pneumatic drill at 10m</td><td>90 dB</td></tr> <tr> <td>Circular wood saw at 10m</td><td>80 dB</td></tr> <tr> <td>Heavy road traffic at 10m</td><td>75 dB</td></tr> <tr> <td>Telephone bell at 10m</td><td>65 dB</td></tr> <tr> <td>Male speech, average at 10m</td><td>50 dB</td></tr> <tr> <td>Whisper at 10m</td><td>25 dB</td></tr> <tr> <td>Threshold of hearing, 1000 Hz</td><td>0 dB</td></tr> </table>	Four engine jet aircraft at 100m	120 dB	Riveting of steel plate at 10m	105 dB	Pneumatic drill at 10m	90 dB	Circular wood saw at 10m	80 dB	Heavy road traffic at 10m	75 dB	Telephone bell at 10m	65 dB	Male speech, average at 10m	50 dB	Whisper at 10m	25 dB	Threshold of hearing, 1000 Hz	0 dB
Four engine jet aircraft at 100m	120 dB																		
Riveting of steel plate at 10m	105 dB																		
Pneumatic drill at 10m	90 dB																		
Circular wood saw at 10m	80 dB																		
Heavy road traffic at 10m	75 dB																		
Telephone bell at 10m	65 dB																		
Male speech, average at 10m	50 dB																		
Whisper at 10m	25 dB																		
Threshold of hearing, 1000 Hz	0 dB																		
dB(A): A-weighted decibels	The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the 'A' filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.																		
Façade Noise Level	A noise level measured or predicted at the façade of a building, typically at a distance of 1m, containing a contribution made up of reflections from the façade itself (+3 dB).																		
Free Field Noise Level	A noise level measured or predicted which is unaffected by reflections, generally taken as being 3m from any reflecting surface excepting the ground.																		
L_{Amax} noise level	This is the maximum noise level recorded over the measurement period.																		
L_{Amin} noise level	This is the lowest level during the measurement period.																		
$L_{Aeq,T}$ noise level	This is the 'equivalent continuous A-weighted sound pressure level, in decibels' and is defined in British Standard 7445 as the 'value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time'.																		

	It is a unit commonly used to describe construction noise, noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise.
L_{A90} noise level	This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise.
L_{A10} noise level	This is the noise level which is achieved for 10% of the monitoring period and is often used to describe road traffic noise.
Rating Level, L_{Af,Tr}	Specific sound level plus any adjustment for the characteristic features of the sound.
Specific Sound Level, L_{Aeq,Tr}	Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr.
PPV	Ground vibration is measured in terms of Peak Particle Velocity (PPV) with units in mm/s. It should be noted that the PPV refers to the movement within the ground of molecular particles and not surface movement. The displacement value in mm refers to the movement of particles at the surface (surface movement).

11.2 BASELINE NOISE SURVEY

Appendix 11.2: Baseline Noise Survey

A baseline noise survey was undertaken by Hoare Lea in September 2018, the details of which are presented within report document reference REP-1010695-5A-TH-20190711-Environmental Noise Survey-Rev00. A summary of the results is provided within this Appendix.

Weather conditions encountered between Monday 17th September and Saturday 22nd September were not conducive for valid noise measurements, with wind speeds regularly above 5 m/s. Also, during Monday 17th and Tuesday 18th September Greyfriars Road was closed resulting in atypical noise levels. Data during this measurement period has been removed from subsequent analysis.

Figure 11.2.1 to Figure 11.2.3 presents the time history plots of the measured noise levels at the following locations:

- LT1 – western boundary with Greyfriars Road (façade at 2nd floor level);
- LT2 – northern boundary with Station Hill (free-field above hoarding 2.5m agl); and
- LT3 – southern boundary with Friar Street (façade at 2nd floor level).

All locations exhibited typical diurnal variation in noise levels, with lower levels during the night-time period when road traffic and human activity is lower.

Figure 11.2.1: Time History Plot of Measured Noise Levels at LT1 Greyfriars Road

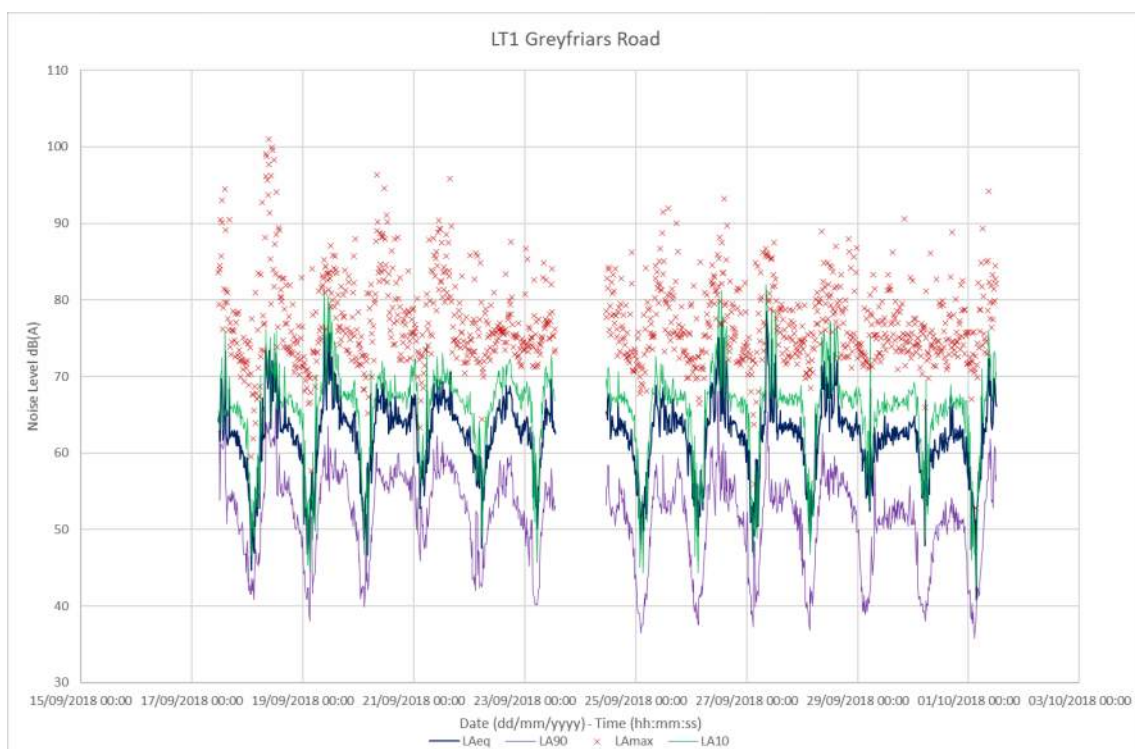


Table 11.2.1 presents a breakdown of the daily measured noise levels. The measured daytime (07:00-19:00) ambient (dB L_{Aeq}) noise levels during the weekend period were lower compared with the weekday levels, whereas the measured evening and night-time noise levels were comparable for both the weekend and weekday period.

Table 11.2.1: Daily Measured Noise Levels at LT1 Greyfriars Road (dB façade)

Day / Date	Period	LAeq ¹	LA90 ²	LAm ³	LA10 ²	LA90 Min	LA90 Mode
Sat 22nd Sept 2018	Day	65	55	80	68	48	59
	Eve	64	53	75	68	51	53
	Night	61	46	81	62	40	40
Mon 24th Sept 2018	Day (11:50-19:00)	64	54	83	68	51	53
	Eve	62	51	81	66	49	51
	Night	57	42	79	57	37	39
Tues 25th Sept 2018	Day	65	55	86	68	52	53
	Eve	63	53	76	67	49	57
	Night	58	43	79	58	38	42
Wed 26th Sept 2018	Day	69	57	86	71	52	56
	Eve	63	52	81	67	50	52
	Night	59	44	82	59	37	49
Thur 27th Sept 2018	Day	69	55	86	70	52	53
	Eve	63	52	79	67	50	54
	Night	59	44	79	59	37	40
Fri 28th Sept 2018	Day	68	57	84	71	52	56
	Eve	63	54	86	67	51	53
	Night	61	44	81	64	39	41
Sat 29th Sept 2018	Day	62	52	81	66	47	51
	Eve	63	52	81	67	50	53
	Night	61	44	77	62	38	40
Sun 30th Sept 2018	Day	62	50	80	65	42	51
	Eve	62	51	80	66	48	51
	Night	59	42	82	57	36	42
Mon 1st Oct 2018	Day (07:00-12:00)	68	57	85	70	53	54

Note: ¹ Logarithmic Average; ² Arithmetic Average; ³ 90th Percentile.

Figure 11.2.2: Time History Plot of Measured Noise Levels at LT2 Station Hill (dB free-field)

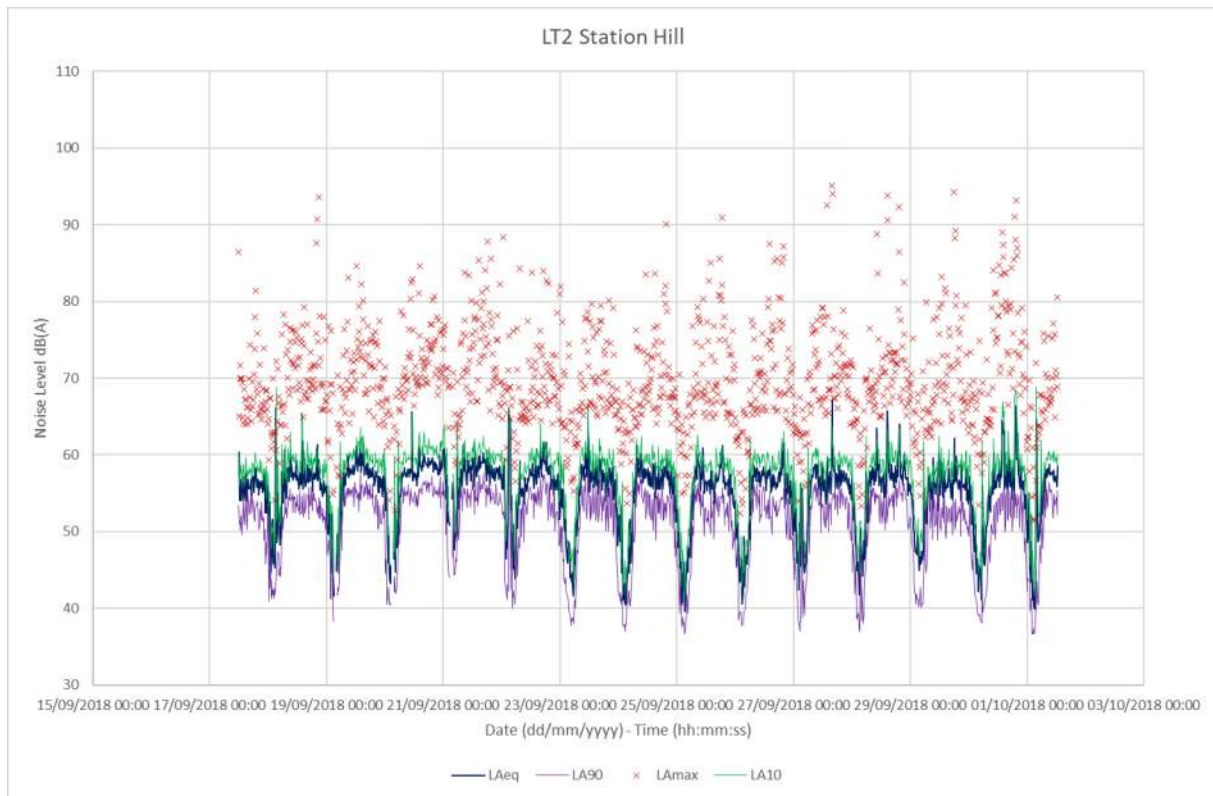


Table 11.2.2 presents a breakdown of the daily measured noise levels. Measured noise levels during the weekday and weekend period were comparable.

Table 11.2.2: Daily Measured Noise Levels at LT2 Station Hill (dB free-field)

Day / Date	Period	LAeq ¹	LA90 ²	LAm ³	LA10 ²	LA90 Min	LA90 Mode
Sat 22nd Sept 2018	Day	58	54	76	59	48	55
	Eve	57	53	73	59	50	54
	Night	52	44	77	52	38	39
Sun 23rd Sept 2018	Day	57	53	78	59	47	53
	Eve	57	53	77	59	49	56
	Night	50	43	67	51	37	42
Mon 24th Sept 2018	Day	58	54	76	59	49	54
	Eve	57	53	81	59	50	55
	Night	50	43	69	50	37	39
Tues 25th Sept 2018	Day	57	53	81	59	49	54
	Eve	56	53	76	59	50	54
	Night	51	44	71	51	38	45
Wed 26th Sept 2018	Day	57	54	80	59	50	54
	Eve	57	53	85	59	49	54
	Night	52	45	70	53	37	49
Thur 27th Sept 2018	Day	58	54	78	59	50	54
	Eve	57	54	76	59	50	55
	Night	52	44	71	53	37	50
Fri 28th Sept 2018	Day	58	54	76	59	50	55
	Eve	59	55	84	60	52	56
	Night	52	45	70	53	40	41
Sat 29th Sept 2018	Day	57	52	81	58	49	53
	Eve	56	52	79	59	49	53
	Night	52	44	70	52	38	39
Sun 30th Sept 2018	Day	58	52	84	59	42	54
	Eve	61	53	90	61	47	55
	Night	54	43	70	52	37	37
Mon 1 Oct 2018	Day (0700-1245)	57	54	76	60	52	55

Note: ¹ Logarithmic Average; ² Arithmetic Average; ³ 90th Percentile.

Figure 11.2.3: Time History Plot of Measured Noise Levels at LT3 Friar Street (dB facade)

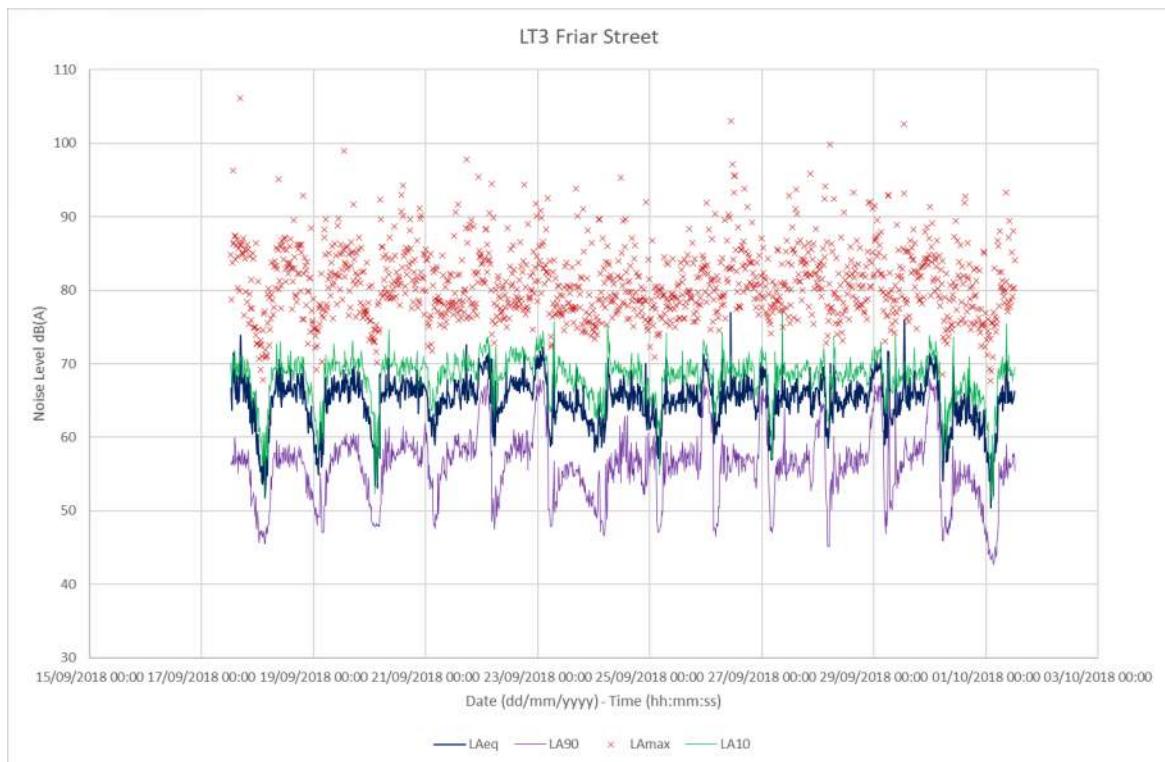


Table 11.2.3 presents a breakdown of the daily measured noise levels. Measured noise levels during the weekday and weekend period were comparable. In addition, although a diurnal variation in noise levels is exhibited, the period average noise levels (day, evening and night) were comparable.

Table 11.2.3: Daily Measured Noise Levels at LT3 Friar Street (dB facade)

Day / Date	Period	LAeq ¹	LA90 ²	LAm ³	LA10 ²	LA90 Min	LA90 Mode
Sat 22nd Sept 2018	Day	67	57	84	70	50	58
	Eve	67	59	84	70	56	58
	Night	69	60	90	70	48	67
Sun 23rd Sept 2018	Day	65	55	83	69	50	56
	Eve	63	52	87	66	51	51
	Night	64	51	86	66	47	48
Mon 24th Sept 2018	Day	66	57	86	69	54	56
	Eve	65	55	82	68	52	54
	Night	63	54	81	65	47	58
Tues 25th Sept 2018	Day	66	57	84	69	54	57
	Eve	66	58	84	69	54	56
	Night	67	58	87	68	47	63
Wed 26th Sept 2018	Day	67	57	93	69	54	57
	Eve	65	56	84	68	53	57
	Night	66	57	84	67	47	65
Thur 27th Sept 2018	Day	66	56	87	69	54	55
	Eve	66	56	86	68	53	57
	Night	66	57	88	68	45	62
Fri 28th Sept 2018	Day	66	56	86	69	52	58
	Eve	66	58	89	69	56	58
	Night	68	61	91	69	47	65
Sat 29th Sept 2018	Day	66	56	86	68	50	57
	Eve	66	59	86	69	56	58
	Night	68	60	87	68	46	67
Sun 30th Sept 2018	Day	64	53	86	66	47	55
	Eve	62	52	82	66	48	53
	Night	61	47	85	62	43	44
Mon 1 Oct 2018	Day (0700-1245)	66	56	88	70	53	56

Note: ¹ Logarithmic Average; ² Arithmetic Average; ³ 90th Percentile.

11.3

CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

Appendix 11.3 Demolition & Construction Assessment

Demolition & Construction Noise Assessment

The significance criteria for the construction noise assessment are based on 'The ABC Method' from BS 5228-1:2009. An extract describing this method is provided below.

Example Method 1 – The ABC Method

Table E.1 shows an example of the threshold of significant effect at dwellings when the total noise level rounded to the nearest decibel, exceeds the listed value. The table can be used as follows: for the appropriate period (night, evening/weekends or day), the ambient noise level is determined and rounded to the nearest 5 dB. This is then compared with the total noise level, including construction. If the total noise level exceeds the appropriate category value, then a significance effect is deemed to occur.

Table E.1 Example threshold of significant effect at dwellings

Assessment category and threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A ^{A)}	Category B ^{B)}	Category C ^{C)}
Night-time (23.00-07.00)	45	50	55
Evenings and weekends ^{D)}	55	60	65
Daytime (07.00-19.00) and Saturdays (07.00-13.00)	65	70	75
NOTE 1 A significance effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level.			
NOTE 2 If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity.			
NOTE 3 Applied to residential receptors only.			
^{A)} Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.			
^{B)} Category B: threshold values to use when the ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.			
^{C)} Category C: threshold values to use when the ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.			
^{D)} 19.00-23.00 weekdays, 13.00-23.00 Saturdays and 07.00-23.00 Sundays.			

(Source: BS 5228-1:2009, Page 119)

Table 11.3.1 presents the derived daytime threshold values for the selected representative SRs. Calculations have not been undertaken for the evening or night-time as given that the build out is phased over a number of years, it is assumed that evening and night-time construction work would only be undertaken in exceptional circumstances and not without prior approval. Exceptional circumstances may include concreting operations where the pumping of concrete to foundations has to be a continuous process which may require operations outside the daytime period.

Table 11.3.1: Construction Daytime Threshold Categories (BS85228 ABC Method)

NSR Ref.	NSR	Prevailing Daytime Noise Level dB L _{Aeq}	BS5228: Threshold Value
A	Three Guineas Public House, Station Hill, Grade II Listed Building	58 ^[1]	65
B	Summit House (Serviced Apartments), Greyfriars Road.	68 ^[2]	75
C	The Gateway Public House, Greyfriars Road	68 ^[2]	75
D	Stanshawe Road	61 ^[3]	65
E	Vachel Road	62 ^[3]	65
F	Novotel & Ibis, Friar Street	66 ^[4]	70
G	Malthouse Public House, Greyfriars Road	68 ^[2]	75
H	Garrard House, 30 Garrard Street	66 ^[4]	70
I	Merchant's Place (Projection East and West) and Icon House	64 ^[5]	70
J	Garrard House, 30 Garrard Street	62 ^[5]	65
K	Future Residential (Development)	65 ^[5]	70
L	Future residential 52-55 Friar Street and 12 Greyfriars Road (Application 162210)	66 ^[4]	70

Note: [1] Based on measured noise levels at LT2, Station Hill. [2] – Based on measured noise levels at LT1, Greyfriars Road Derived from LT3. [3] Derived from measured noise levels at LT1. [4] Based on measured noise levels at LT3, Friar Street. [5] Based on noise measurement undertaken by Hoare Lea at S4 presented within report REP-1010695-5A-TH-20190711-Environmental Noise Survey-Rev00.

Generic calculations were undertaken using the data and procedures set out in BS 5228:2009 for the noisiest construction phases, to derive indicative noise levels at selected NSRs. The highest noise levels tend to be associated with plant associated with, piling, earthmoving and construction of the substructure and superstructure. During the fit-out, construction noise would be significantly lower. The calculations assume that plant would be operating at the closest point to the NSR, such as the construction Site boundary (hoarding location), and do not take into account any existing or proposed screening. The noisiest construction phases and associated noise levels are as follows:

- Demolition 92 dB(A) at 10m
- Earthworks 84 dB(A) at 10m
- Piling CFA 85 dB(A); Sheet Driven 90dB(A); Sheet Pressed 69dB(A) at 10m
- Concreting 83 dB(A) at 10m
- Pavement 81 dB(A) at 10m
- Deconstructive Demolition 84 dB(A) at 10m

A maximum worst case noise level over a one hour period was calculated, assuming that plant would be operating at the closest point to the nearest NSRs in the absence of mitigation. In practice, noise levels would tend to be lower owing to greater separation distance as the works progress. They would also tend to reduce over a 10-hour working day owing to periods of plant inactivity.

Table 11.3.2: Generic Construction Noise Levels

Phase / Plant	BS5228-1:1997+A1:2014	LAeq @10m	Kh	(t/T)*100	Partial Exposure	Barrier Attenuation	Noise Level @ NSR LAeq,1h (dB)	Overall LAeq,1h (dB)
Demolition								90
High Reach Hydraulic Excavator	CAT 340F UHD	78	0	1	0	0	78	
Tracked Crusher (47t)	Table C1 ref 14	82	0	0.25	-6	0	76	
Breaker Mounted on Wheeled Backhoe (7.4t)	Table C1 ref 1	92	0	0.50	-3	0	89	
Dozer (11t)	Table C2 ref 13	78	0	0.25	-6	0	72	
Hand Held Pneumatic Breaker (concrete foundation)	Table C1 ref 6	83	0	0.25	-6	0	77	
Wheeled Backhoe Loader (8t)	Table C2 ref 8	68	0	0.5	-3	0	65	
Compressor	Table C5 ref 5	65	0	0.5	-3	0	62	
Lump Hammer	Table C1 ref 19	69	0	0.25	-6	0	63	
Hand-held circular saw (Petrol-cutting concrete blocks)	Table C4 ref 72	79	0	0.1	-10	0	69	
Scaffold poles and clips	Table D7 ref 1	80	0	0.2	-7	0	73	
Tracked Mobile Crane	Table C4 ref 50	71	0	0.5	-3	0	68	
Lorry x 2	Table C2 ref 34	83	0	0.1	-10	0	73	
Earthworks								84
Tracked Excavator (14t)	Table C2 ref 7	70	0	1	0	0	70.0	
Tracked Excavator (14t)	Table C2 ref 7	70	0	1	0	0	70.0	
Wheeled Backhoe Loader (8t)	Table C2 ref 8	68	0	1	0	0	68.0	
Hydraulic Vibratory Compactor (Tracked Excavator)	Table C2 ref 42	78	0	1	0	0	78.0	
Dozer (11t)	Table C2 ref 13	78	0	1	0	0	78.0	
Lorry (4-axle wagon)	Table C2 ref 34	80	0	1	0	0	80.0	

Phase / Plant	BS5228-1:1997+A1:2014	LAeq @10m	Kh	(t/T)*100	Partial Exposure	Barrier Attenuation	Noise Level @ NSR LAeq,1h (dB)	Overall LAeq,1h (dB)
CFA								85
Crawler mounted rig - Continuous Flight Auger Piling Cast In-Situ	Table C3 ref 21	79	0	1	0	0	79.0	
Tracked Excavator	Table C3 Ref 23	68	0	1	0	0	68.0	
Tracked Excavator Inserting Cylindrical Metal Cage	Table C3 Ref 24	74	0	1	0	0	74.0	
Truck Mounted Concrete Pump + Boom Arm	Table C4 ref 29	80	0	1	0	0	80.0	
Concrete Mixer Truck	Table C4 Ref 20	80	0	1	0	0	80.0	
Pump Boom + Vibrating Poker	Table C4 ref 36	71	0	1	0	0	71.0	
Pressed Sheet Piling								69
Piling	Table C3 ref 8	63	0	1	0	0	68	
Power Pack	Table C3 ref 9	68	0	1	0	0	63	
Driven Sheet Piling	Table D 4 ref 53	90	0	1	0	0	90	90
Concreting								83
Truck Mounted Concrete Pump + Boom Arm	Table C4 ref 29	80	0	1	0	0	80.0	
Concrete Mixer Truck	Table C4 Ref 20	80	0	1	0	0	80.0	
Pump Boom + Vibrating Poker	Table C4 ref 36	71	0	1	0	0	71.0	
Pavement Works								81
Road planer	Table C5 ref 7	82	0	0.25	-6	0	76.0	
Spreading chip and fill	Table C5 ref 12	77	0	0.25	-6	0	71.0	
Vibratory roller	Table C5 ref 20	75	0	0.25	-6	0	69.0	
Asphalt paver (+ tipper lorry)	Table C5 ref 30	75	0	0.25	-6	0	69.0	
Vibratory compactor (asphalt)	Table C5 ref 29	82	0	0.25	-6	0	76.0	

Phase / Plant	BS5228-1:1997+A1:2014	LAeq @10m	Kh	(t/T)*100	Partial Exposure	Barrier Attenuation	Noise Level @ NSR LAeq,1h (dB)	Overall LAeq,1h (dB)
Lorry (4-axle wagon)	Table C2 ref 34	80	0	0.25	-6	0	74.0	
Deconstructive Demolition								84
High reach excavator with hydraulic shear	Table C1 Ref 16	82	0	0.5	-3	0	79.0	
Dozer (11t)	Table C2 ref 13	78	0	0.25	-6	0	72.0	
Hand Held Pneumatic Breaker (concrete foundation)	Table C1 ref 6	83	0	0.25	-6	0	77.0	
Wheeled Backhoe Loader (8t)	Table C2 ref 8	68	0	0.5	-3	0	65.0	
Compressor	Table C5 ref 5	65	0	0.5	-3	0	62.0	
Lump Hammer	Table C1 ref 19	69	0	0.25	-6	0	63.0	
Hand-held circular saw (Petrol-cutting concrete blocks)	Table C4 ref 72	79	0	0.1	-10	0	69.0	
Scaffold poles and clips	Table D7 ref 1	80	0	0.2	-7	0	73.0	
Tracked Mobile Crane x 2	Table C4 ref 50	74	0	0.5	-3	0	71.0	
Lorry x 5	Table C2 ref 34	87	0	0.1	-10	0	77.0	

The distance attenuation applied to the overall noise level to calculation noise level at receptor is:

$20 \times \text{LOG} (\text{distance from works} / 10).$

Construction Traffic

Construction	2018						
Link	Volume 18h-AAWT	HGVs	2018 % HGVs	Additional HGV movements	% increase in volume	revised %HGV	Change in % HGVs
Friar Street	4253	1704	40.1	70	1.6	41.0	1.0
Station Road	3797	415	10.9	70	1.8	12.5	1.6
Greyfriars Road	5856	469	8.0	70	1.2	9.1	1.1
Garrard Street	3184	159	5.0	70	2.2	7.0	2.0