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25 Lavington Street London Borough of Southwark, London

Ground Penetrating Radar Survey Report



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**25 Lavington Street,
London Borough of Southwark, London**

Ground Penetrating Radar Survey Report

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Summary

A ground penetrating radar (GPR) survey was conducted over land at 25 Lavington Street, London Borough of Southwark (centred on NGR 531980,180120). The project was commissioned by Gaterule Ltd on behalf of Gaterule Ltd (the Client) with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features in advance of a planning application associated with development of the site.

The Site comprises an area of tarmac hard standing used as a yard, car parking and access and covers an area of c. 0.05 ha. The geophysical survey was undertaken on 27th April 2016. The GPR survey has demonstrated the presence of a number of high amplitude features.

Many of the high amplitude responses visible in both the 400 MHz and 200 MHz data are generated from reflections off of metallic services and apparent reinforced concrete. The 200 MHz, however, has also revealed a number of high amplitude responses that may be indicative of possible archaeological features in the western part of the survey area. The area in which these responses have been recorded had two former structures; a Starch Works (OS 1863-1873) and a Printing Works (OS 1893-95) as well as earlier evidence from the Romano-British period and medieval periods recovered during excavations (Mon ID: ELO14216; WA2016). It is unclear what period these features data from and further intrusive investigation would be required to ascertain a definitive interpretation.



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The fieldwork was undertaken by Nick Crabb and Alistair Salisbury. Elizabeth Richley processed and interpreted the geophysical data and wrote the report. The geophysical work was quality controlled by Lucy Learmonth. Illustrations were prepared by Elizabeth Richley. The project was managed on behalf of Wessex Archaeology by Mark Williams.



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1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Gaterule Ltd to carry out a geophysical survey at 25 Lavington Street, London Borough of Southwark, London (hereafter “the Site”, centred on NGR 531970,180120) (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of development of the area.

1.1.2 This report presents a brief description of the methodology followed, the detailed survey results and the archaeological interpretation of the geophysical data.

1.2 The Site

1.2.1 The Site ownership comprises a sub-rectangular parcel of land approximately 0.65ha located within the London Borough of Southwark. The planning boundary shown on Figure 1 is 0.94ha. It lies 400 m to the south of the River Thames, 800 m to the west of London Bridge, 650 m west of Borough High Street and 540 m to the south east of Blackfriars Bridge.

1.2.2 The survey area consists of 0.05 ha of tarmacked hard standing currently utilised as a yard and car park. The Site is bound to the north by an office block, to the east by properties to the east of Ewer Street, to the south by buildings and a railway line beyond and to the west by a mix of commercial and residential properties that front Great Suffolk Street.

1.2.3 The Site is situated within a relatively flat area of land at an elevation of approximately 9-11 m above Ordnance Datum (aOD). Local geography falls gently to the north towards the banks of the River Thames.

1.2.4 The underlying bedrock geology throughout the Site is mapped as the London Clay Formation clay and silt. This is overlain by alluvium of a mixture of clays, silts, sands (British Geological Survey).

1.2.5 The soils underlying the Site are listed as being of the soil scape 21 (LandIS 2016) and are loamy and clayey, naturally wet soils. The Site lies in close proximity to the River Thames (lying c. 400 m north of the Site) and it is likely to have been influenced by the river over the course of its history and as such the soils are likely to consist of alluvial deposits consisting of clay, sand and/or silt.

1.3 Development proposals

1.3.1 The proposals comprise a mixed use scheme, consisting of 174 residential units and 15,270 sq. metres (GIA) of commercial floorspace.

1.3.2



- 1.3.3 171 residential apartments will be provided across three residential buildings of 8, 12 and 20 storeys in height located in the western part of the site. A further three 'mews' houses are proposed in the south-western corner of the site. The residential accommodation includes on site affordable housing.
- 1.3.4 The commercial floorspace will be provided in a ground plus 8 storey block in the eastern part of the site and provides 10,024 sqm (NIA) offices. A further 872 sq. metres (NIA) of flexible commercial use (B1/ A1/ A3) is proposed in three separate units, at the base of the office building and one of the residential blocks.
- 1.3.5 Two separate basement areas are proposed - one beneath the office building and one beneath the three residential buildings and mews houses. The basements will house plant, storage areas and parking facilities. A total of 18 disabled vehicle parking spaces and 282 cycle parking spaces will be provided in the basement below the residential units, while a total of 174 cycle spaces will be provided in the office basement.
- 1.3.6 The proposals also include extensive landscaping, creation of new pedestrian routes and public realm through the site and environmental enhancements along the adjoining roads, together with associated access works.

2 ARCHAEOLOGICAL BACKGROUND

2.1 Introduction

- 2.1.1 An Archaeological Desk-Based Assessment (DBA) undertaken by Wessex Archaeology (2016) examined the potential for the survival of buried archaeological remains within the development area and a 500 m Study Area. This DBA used information provided by the Greater London Historic Environment Record (GLHER), the National Heritage List for England (NHLE), national heritage datasets including Images of England, Archaeological Data Service (ADS), OASIS, PastScape, Viewfinder, National Record of Historic Environment (NRHE) Excavation Index and Parks and Gardens UK. Historic manuscripts, surveyed maps and Ordnance survey maps held at Southwark Local Studies and Archives were also consulted alongside relevant primary and secondary sources held at Southwark Local Studies and Archives and in Wessex Archaeology's own library. The following background is summarised from the DBA. Where relevant the findings of the DBA will be referred to during the interpretation of the geophysical data.
- 2.1.2 The Site lies within a Class II Archaeological Priority Zone (APZ); Farnham Place APZ54 that categorises the level of significance and potential of archaeological remains. Within the Site, Southwark Local Studies group has indicated that The Kirkaldy Testing Machine was built there in the 1860's before moving to its current location in 99 Southwark Street.
- 2.1.3 There are no designated historical assets within the Site and there are no World Heritage Sites, Scheduled Monuments, Registered Parks and Gardens, Conservation Areas or Historic Battlefields identified within the Study Area however two Grade II listed buildings are recorded.
- 2.1.4 The Site lies within an archaeological rich area in particular dating to the Romano-British period. A number of burials and complete vessels once perhaps associated with burials have been recovered from the surrounding area. This corresponds with the Roman Roads which also traverse this area. The Roman Settlement at Southwark was an important centre and is thought to have been located within the north eastern section of the Study Area.



- 2.1.5 Prehistoric evidence within the Study Area is also common but to date no prehistoric remains have been recorded within or adjacent to the Site. Similarly, during the medieval period the focus of the settlement was towards the bank of the Thames and as such it is likely that the Site was within the agricultural area to the South of this.
- 2.1.6 The map regression exercise undertaken as part of the DBA indicated that the Site was used as a 'tenter ground' associated with the dying process and later industries such as stables, Iron Liquor Manufacture and a printing works which continued into the 19th century and modern period within the Site.
- 2.1.7 The DBA has identified that there is a high potential for Romano-British, Post-medieval and 19th Century to modern features within the Site with a moderate to low potential for Prehistoric, Saxon and medieval finds.

2.2 Recent investigations in the area

- 2.2.1 An archaeological evaluation was undertaken within the Site in 1991 by the Department for Greater London Archaeology comprising a single trench within the western part of the Site. This evaluation revealed remains including 17th century features filled with dump layers as well as 17th century made ground layers. A Roman flagon was found within water-lain deposits within what is through to be a water channel present in the area during the Romano-British period.
- 2.2.2 An excavation in America Street to the immediate south of the Site revealed a Romano-British cemetery containing at least 68 burials aligned both north to south and east to west. To the west of the Site an excavation was undertaken in 2001-2 that revealed 151 burials (WA2016).
- 2.2.3 A watching brief was undertaken in Ewer Street within the eastern part of the Site in 1987 by the Department for Greater London Archaeology, this revealed a post-medieval inhumation burial that is through to have originally been buried within the known post—medieval burial ground to the south of the Site. Excavations at Ewer Street revealed post-medieval pits and also a construction cut for a brick building (WA2016).
- 2.2.4 Recently, in 2016 WA has undertaken an archaeological evaluation in the northern part of the Site (2016 in progress) which forms a part of the program of works that this report supports.



3 METHODOLOGY

3.1 Introduction

3.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team on the 27th April 2016. Field conditions at the time of the survey were good throughout the period of survey. An overall coverage of 0.05 ha was achieved.

3.2 Aims and objectives

3.2.1 The aims of the survey comprise the following:

- to conduct a detailed survey covering as much of the specified area as possible, allowing for artificial obstructions;
- to clarify the presence/absence and extent of any buried archaeological remains within the site;
- to determine the general nature of the remains present.

3.3 Fieldwork methodology

3.3.1 A Leica TCR307 Total Station Theodolite was used to establish survey grid nodes across the site in order to accurately locate the GPR lines. This is precise to approximately 0.02 m and therefore exceeds Historic England recommendations (2008).

3.3.2 The GPR survey was conducted using a GSSI SIR 3000 control unit with both a 400 MHz mounted on a tricycle cart with odometer to record horizontal distance and 200 MHz antenna with a survey wheel to record the horizontal distance. Both antennas were deployed across the Site with data collected along traverses spaced 0.5 m apart. Data with the 400 MHz antenna were collected at 60 scans per unit (1 unit = 1 m) with an effective time window of 50 ns. Data with the 200 MHz antenna were collected at 50 scans per unit with an effective time window of 100 ns. The GPR survey was undertaken in accordance with Historic England guidelines (English Heritage 2008) and data were collected in the zigzag method.

3.4 Data processing

3.4.1 Data from the survey were subject to common radar signal correction processes. These comprise amplitude and wobble correction of the radar profile to correct for variance in temperature and soil moisture content, background and bandpass filtering to remove noise in the data from the surrounding area and XYZ mean line to correct for mosaic effects from variance in the day to day conditions during the survey. These steps were applied on both datasets collected at the Site.

3.4.2 The approximate depth conversion for the 400 MHz antenna is shown in **Table 1** below and the 200 MHz antenna is shown in **Table 2**. These have been calculated on the assumption that the GPR pulse through the ground is 0.119 m/ns for the 400 MHz antenna and 0.119 m/ns for the 200 MHz antenna. It is possible to determine more precisely the average velocity of the GPR pulse through the ground is excavated features at a known depth can be identified in the data. Radargrams were analysed for suitable hyperbolic reflections, which can be used to determine the velocity of the GPR pulse through the subsurface deposits.

3.4.3 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.



Table 1 - Relative velocity to depth conversion based on a dielectric constant of 6.36 for the 400 MHz antenna

Time Slice	Time (ns)	Depth (cm)
1	0-2.27	0-2.7
2	2.27-4.52	14-27
3	4.54-6.79	27-40
4	6.81-9.06	41-54
5	9.08-11.33	54-67
6	11.35-13.6	68-81
7	13.62-15.87	81-94
8	15.89-18.14	95-108
9	18.16-20.41	108-121
10	20.43-22.68	122-135
11	22.71-24.95	135-148
12	24.98-27.22	149-162
13	27.25-29.49	162-175
14	29.52-31.76	176-189
15	31.79-34.03	189-202
16	34.06-36.3	203-216
17	36.33-38.57	216-230
18	38.6-40.84	230-243
19	40.87-43.12	243-257
20	43.14-46.39	257-270



Table 2 - Relative velocity to depth conversion based on a dielectric constant of 6.36 for the 200 MHz Antenna

Time Slice	Time (ns)	Depth (cm)
1	0-4.49	0-27
2	4.54-9.03	27-54
3	9.08-13.57	54-81
4	13.62-18.12	81-108
5	18.16-22.66	108-135
6	22.71-27.2	135-162
7	27.25-31.74	162-189
8	31.79-36.28	189-216
9	36.33-40.82	216-243
10	40.87-45.36	243-270
11	45.41-49.9	270-297
12	49.95-54.44	297-324
13	54.49-58.98	324-351
14	59.03-63.53	351-378
15	63.57-68.07	378-405
16	68.12-723.61	405-432
17	72.66-77.15	432-459
18	77.20-81.69	459-486
19	81.74-86.23	489-513
20	86.28-90.77	513-540



4 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

4.1 Introduction

- 4.1.1 The GPR survey has identified a number of high amplitude responses at varying depths across the Site alongside a number of trends. Results are presented as a series of greyscale plots and archaeological interpretations at a scale of 1:500 (**Figures 2 to 9**).
- 4.1.2 The interpretation of the datasets highlights the presence of possible archaeological responses, high amplitude response, low amplitude responses and trends (**Figure 4, 5, 8 and 9**). Full definitions of the interpretation terms used in this report are provided in Appendix 2.
- 4.1.3 It should be noted that small, weakly contrasting and water logged features may produce responses that are below the detection threshold of ground penetrating radar. It may therefore be the case that more archaeological features may be present than have been identified through geophysical survey.
- 4.1.4 GPR survey may not detect all services present on Site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on Site.

4.2 Ground Penetrating Radar 400 MHz survey results

- 4.2.1 The 400 MHz dataset shows a number of high amplitude responses throughout the dataset (**Figures 2 to 5**). Data are presented in a series of greyscale images generated through overlay analysis. The overlay analysis is a binary process to show the relative strongest reflectors over the range of time slices chosen. As a result each greyscale represents approximately 40 cm slices through the ground and details the strongest reflectors. A full list of relative depths is provided in Table 1.
- 4.2.2 Time slices 1 to 3 (**Figures 2 and 4**) show several high amplitude responses on a north to south alignment across the survey area (**4000**). These responses display regular alignment, interval and shape and are likely to be reflections from metal rebars within the concrete or services. It is difficult to determine whether these are rebars or services from the GPR data alone. In the eastern part of the survey area a series of cut marks are visible on the ground surface (**Plate 1**) leading from the generators immediately to the south of the survey extent to the building on the northern survey extents. Such features are not visible on the surface in the western part of the survey area, it is, however, not possible to reject that possibility that the linear features in the western part of the Site are from the same type of feature. At **4001**, a high amplitude response follows the southern survey extent and is likely to relate to metal gratings evident on the ground surface within this area of the survey. A high amplitude response at **4002** extends south from the northern survey extent. This response is roughly rectangular and may relate to foundations of the current building or aspects of the basement structure.
- 4.2.3 At depth between 0.4 m and 0.8 m (time slices 4 to 6; **Figures 2 and 4**) the regular responses denoted at **4000**, in the preceding time slices can still be identified. This is expected as metallic objects will reflect most of the radar beam back when first encountered leaving little energy to penetrate further in to the ground. As such it is likely that these linear trends will be present throughout the time slices to a greater or less degree. At the western extent of the Site **4003** and **4004** indicate two areas of high amplitude reflections. **4003**, extends from the western edge of the survey area and exists in a slightly topographically raised area. This is likely to relate to heavily compacted, made ground. A similar

interpretation is given to **4004**, which consists of a slight mound of weed covered ground (**Plate 2**). At **4005** the high amplitude response noted in the previous time slices at **4001**, can still be identified, however further linear features can be seen extending north. These are approximately 0.25 m in width and extend 4 m to the northern survey extent. These features are likely to relate to drainage associated with the metal gratings. At **4006**, a high amplitude response continues from the earlier time slices (**4002**; time slices 1-3), however an area of weaker, high amplitude responses extends to the southern survey extent and then extends east. Visible on the ground at this point were a series of concrete and metal manhole covers (**Plate 1**), therefore it is likely that these high amplitude responses are related to modern services. At **4007**, a series of linear high amplitude linear responses have been identified.

- 4.2.4 Time slices 7 to 9 (**Figures 2 and 4**) continue to show the linear trends previously discussed, however a number of stronger, high amplitude linear responses can now be clearly identified. At **4008** a high amplitude linear anomaly measuring 0.25 m in diameter extends north to south across the survey area. This anomaly can be weakly identified in the previous time slices but is much stronger at this depth. This feature coincides with a line of metal grating visible on the ground surface and as such is likely to be related to a modern service. At **4009** a rectilinear response has been identified with a potentially related linear trend extending north. Due to the geometric form of this feature it is probably again another service. The high amplitude response at **4010** shows a continuation of the response seen at **4006** in time slices 4 to 6. This is modern in provenance. **4011**, shows continuation of the high amplitude responses initially identified at **4007** (time slices 4-6). At this depth they are more clearly defined with a north to south alignment segment and two parallel east to west segments. These lie in close proximity to a series of generators and pipes/services inserted in to the ground (**Plate 1**) and may be related.
- 4.2.5 Between 1.2 m and 1.6 m depth (time slices 10 to 12; **Figures 2 and 4**) there is a continuation of the responses identified in the preceding time slices. The high amplitude responses identified at **4004** (time slices 4 to 6; c 0.4 m to 0.8 m) remains present at this depth as seen at **4012**. A service at **4013** shows a slight increase in amplitude at this depth but has been largely present in all preceding time slices. Similarly **4014**, is a continuation of a linear high amplitude response identified as a trend in time slices 1 to 3 and as a larger feature (**4008**) in time slices 7-9. The linear trend extending from **4009** (time slices 7 to 9) is much stronger at this depth and appears to continue south, beyond the extents of the rectilinear feature that was first identified in time slices 7 to 9 but can be seen to continue at this depth. It is unclear whether these features intersect with each other or are separate features. Given the similarity of shape and alignment with other linear responses identified at the site is probable that this is a further modern service associated with the building. Further investigation would be required however to ascertain the full relationships and nature of detected features. The linear features at the far eastern area of the Site are still visible at this depth (**4016**) and can still be clearly delineated as two parallel sections and one north to south orientated section. It is possible that these relate to services associated with Ewer Street, located immediately east of the Site.
- 4.2.6 Time slices 13 to 15 (1.6 to 2 m) (**Figures 3 and 5**) show little new information about the Site with **4017**, **4018** and **4019** showing perpetuation of features identified in shallower time slices. Similarly, **4020** and **4021** in time slices 16 to 18 and responses **4022** to **4026** in time slices 19 to 20 (**Figures 3 and 5**) show the continuation of earlier responses. This perpetuation of response is likely caused by the material of the anomalies. Metals, as previously discussed, are considered to be a 'complete' reflector and do not allow any amount of signal to pass through. Materials beneath a metal sheet, fine metal mesh or other metallic features will not be visible. As such, archaeological features may be present in the

area and have not been detected through GPR survey due to the density of metallic features across the Site.

4.3 Ground Penetrating Radar 200 MHz survey results

- 4.3.1 The 200 MHz dataset shows a number of high amplitude responses throughout the dataset (**Figures 6 to 9**) Data are presented in a series of greyscale images generated through overlay analysis. The overlay analysis is a binary process to show the relative strongest reflectors over the range of time slices chosen. As a result each greyscale represents approximately 80 cm slices through the ground and details the strongest reflectors. A full list of relative depths is provided in Table 2.
- 4.3.2 Time slices 1 to 3 (**Figures 6 and 8**) show reflections between 0 m and 0.8 m from the ground surface. A high amplitude anomaly has been identified at the far west of the Site at **5000**; this coincides with an area of slightly increased topography. It is likely that this is related to modern development of the area. Across the survey area a number of parallel linear trends can be seen, such as at **5001** this area likely to be rebars in the concrete of modern services (*c.f.* **Plate 1** where linear pipes/services can be seen inserted in the concrete at the eastern extent of the survey area).
- 4.3.3 At a depth between 0.8 and 1.6 m (time slices 4 to 6) further high amplitude responses can be identified. In topographically higher western area a high amplitude amorphous response can be seen on the northern extent of the survey area (**5002**). This may be related to the response at **5000**, (time slices 1 to 3) however any clear interaction cannot be determined. The area appears to be largely disregarded land (**Plate 2**) with weeds and scrubs growing as such it are not possible to give these responses a clear interpretation.
- 4.3.4 In time slices 7 to 9 (**Figures 6 and 8**), showing responses from approximately 1.6 m to 2.4 m several linear high amplitude responses have been identified. **5005** to **5008** all show north to south aligned linear responses, with **5005** to **5007** showing similar dimensions of 0.25 m by 4 m and **5008** with dimensions of 1.5 m by 4 m. These can all be related to modern services with service access points visible at the ground surface. (Plates 1 and 2). At **5009**, an area of high amplitude responses has been identified; this is roughly rectangular in shape. It is likely, given the proximity to generators and known service points that these responses relate to further modern services. At **5010**, a 0.25 m x 4 m linear response can be identified on an east to west alignment. This has not been previously identified in earlier time slices; as such is a “new” feature in the 200 MHz data. It exists on the same orientation at as the survey transects (**Figure 7**) but its short length suggests that it is more than just a data collection trend. Historic mapping (OS 1863-73; OS 1893-95; OS 1914-16) shows the presence of structures within this area, (the earliest being a Starch Works and then, following a change in use and structure, a Printing Works. It is possible that the high amplitude response at **5010** may relate to remnants of these structures, however other interpretations are equally valid. For example excavations to the south of this area (Mon ID: ELO14216) recovered a number of Roman Burials, evidence for medieval drainage ditches and a post-medieval wall (WA2016). As this feature is isolated with no obvious related features therefore it is not possible to give it an absolute interpretation, but its presence at this depth within the timeslices is noteworthy.
- 4.3.5 Very few new responses have been identified in time slices 10 to 12, showing data from a depth between 2.4 m and 3.2 m. At the southern extents of the western part of the survey a number of weak high amplitude responses have been identified (**5011**). These responses may indicate features related to the east to west aligned linear response first identified at **5010**, and which is still present at this depth, albeit weaker. It is possible these responses are reflections off of aspects of the aforementioned buildings and earlier Romano-British or



Medieval activity. Given the amount of 20th century redevelopment in this area it is also possible these reflections are from rubble or compaction from the demolition of former buildings and made ground. **5012** to **5016** show a persistence of responses previously identified in earlier time slices.

- 4.3.6 Time slices 13 to 15 (approximately 3.2 m to 4 m depth; **Figures 7** and **9**) show a continuation of the east to west linear anomaly, however this is only visible now as a weak trend (**5017**) suggesting that this feature has the approximate dimensions of 0.25 m (W) x 4 m (L) x 1.5 m (D). This suggests that the feature may be structural in provenance, though further investigation would be needed to corroborate this interpretation. Further high amplitude anomalies visible in these time slices at **5018** to **5021** show a continuance of anomalies identified in earlier time slices and these are considered to be metal features of modern provenance.
- 4.3.7 Responses in time slices 16 to 18; **5022** to **5025** and responses **5026** to **5027** in time slices 19-20 (**Figures 7** and **9**) continue to show responses from the metallic modern services encountered at the ground surface in or in close proximity to the ground surface. No further responses were of note were identified at this level.



5 DISCUSSION

- 5.1.1 The combined use of a 400MHz and a 200 MHz antenna ground penetrating radar survey has been successful in detecting a number of high amplitude responses of possible archaeological interest at the Site alongside numerous responses from modern services and rebar.
- 5.1.2 The 400 MHz dataset is heavily influenced by the presence of numerous modern services and rebar across the Site. Buried metals can impede the penetration of the radar wave resulting in the detection of no further features beneath them, potential masking archaeological features, and can result in the perpetuation of metallic features throughout the whole GPR dataset. The numerous linear features across the Site that persist throughout all the time slices of the 400 MHz dataset are likely the result of the services present in this area and are noted in **Plates 1 to 3**. A number of high amplitude responses identified in the western part of the survey were also tentatively interpreted as modern made ground and caused by compaction.
- 5.1.3 The 200 MHz dataset shows corresponding information to the 400 MHz data, with several north to south aligned linear high amplitude responses related to the modern services. However, in the western extent, an east to west aligned linear response first noted in time slices 7 to 9 at an approximate depth between 1.6 m – 2.4 m (**5010**) may be of archaeological significance. Historic Ordnance Survey mapping from 1863-73, and from 1893-95 (OS 1863-1873; OS 1893-95) shows the presence of buildings here in the form of a Starch Works and later as a Printing Works. Furthermore, excavations to the immediate south (Mon ID: ELO14216; WA2016) revealed Romano-British Burials, medieval drainage ditches and a medieval Wall. As such there are a number of possible archaeological correlates for this response, and those in the proceeding time slices (**5011**; time slices 10-12 and **5017**; time slices 13-15) in this area. It is unclear whether they are related to the former Starch Works or Printing Work structures or earlier features of Romano-British or medieval date. Further investigation would be needed to confirm provide a more exact interpretation.
- 5.1.4 The eastern area of the Site has several modern services and subsequently little of archaeological note has been identified. The presence of these metal services may have destroyed or obscured archaeological features that may have been detectable by ground penetrating radar survey within this area.
- 5.1.5 All depths discussed in this report are approximate calculations based upon post-survey calculations undertaken within commercially available software. Depth measurements should be confirmed through further investigation.
- 5.1.6 A number of perceived modern services were identified during this survey. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on Site.



5.2 Recommendations

- 5.2.1 Following the results of the geophysical survey, it is considered that further archaeological investigations will be required by the Local Planning Authority.
- 5.2.2 In the first instance it is recommended that the GPR results be compared with documentary and historic mapping evidence in order to identify the most likely location for foundations of historic structures to be located.
- 5.2.3 It is anticipated that following this assessment a trial trenching strategy would be required by the Archaeological Advisor to Southwark Borough Council, but it is recommended that the anomalies identified as archaeology and probable archaeology are ground-truthed. However, given the number of services located at the Site, a targeted approach would be required.
- 5.2.4 Additionally, further data should be collected via trial trenching from the areas identified as superficial archaeology / potential spreads to ensure that these responses are not masking weaker and potentially archaeological responses. Trenches should also be planned to investigate areas where no anomalies of potential archaeological interest have been identified within the Site.



6 REFERENCES

6.1 Bibliography

English Heritage 2008 *Geophysical Survey in Archaeological Field Evaluation. Research and Professional Service Guideline No 1*. Swindon (2nd Edition)

WA2016 *Lavington Street, London Borough of Southwark: Archaeological Desk-Based Assessment* Unpublished Client report #111040

6.2 Cartographic and documentary sources

Ordnance Survey 1983 *Soil Survey of England and Wales Sheet 6, Soils of Midland and Western England*. Southampton.

1863-73 Ordnance Survey Map 25" London Sheet XLIV

1893 Ordnance Survey Map 60" Sheet VII.85

1893-95 Ordnance Survey Map 25" London Sheet XLIV

1914-1916 Ordnance Survey Map 25" London Sheet XLIV

6.3 Online resources

British Geological Survey Geology of Britain Viewer (accessed May 2016)

<http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

APPENDICES

APPENDIX 1: SURVEY EQUIPMENT AND DATA PROCESSING

Survey Methods and Equipment

The ground penetrating radar (GPR) data were collected using a cart-based shielded antennae with central frequencies suitable for the types of target being investigated. Lower frequency antennae are able to acquire data from deeper below the surface, whereas higher frequencies allow high resolution imaging of near-surface targets at the expense of deep penetration. The exact make and model of equipment varies.

The depth of penetration of GPR systems is determined by the central frequency of the antenna and the relative dielectric permittivity (RDP) of the material through which the GPR signal passes. In general, soils in floodplain settings may have a wide range of RDPs, although around 8 may be considered average, resulting in a maximum depth of penetration c. 2.5m with the GPR signal having a velocity of approximately 0.1m/ns.

The GPR beam is conical in shape, however, and whilst most of the energy is concentrated in the centre of the cone, the GPR signal illuminates a horizontal footprint which becomes wider with increasing depth. At the maximum depth of the antenna, it becomes impossible to resolve any feature smaller than the horizontal footprint for the corresponding depth. The size of the footprint is dependent upon central frequency, and its size increases as the central frequency decreases.

The vertical resolution is similarly dependent upon the central frequency; for the 300MHz antenna, features of the order of 0.05m may be resolved vertically. Antennae with lower frequencies can therefore penetrate more deeply but are less resolute in both horizontal and vertical directions. Choice of antenna frequency is guided largely by the anticipated depth to the target and the required resolution.

GPR data for detailed surveys are collected along traverses of varying length separated by 0.5m with cross lines collected running perpendicular to these traverses at wider separations. The data sampling resolution is governed by the data logger and a minimum separation of 0.05m between traces is collected for all surveys.

Post-Processing

The radar data collected during the detail survey are downloaded from the GPR system for processing and analysis using commercial software (GPR Slice). This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

Typical data and image processing steps may include:

- Gain – Amplifies GPR data based upon its position in the profile, which boosts the contrast between anomalies and background. A wobble correction is also applied during this step;
- Bandpass – Removes GPR data lying outside a specified range, which removes high- and low-frequency noise.
- Background Removal -

Typical displays of the data used during processing and analysis:

- Timeslice – Presents the data as a series of successive plan views of the variation of reflector energy from the surface to the deepest recorded response. The variation in amplitude is represented using a colour scale with red indicating high amplitude and blue indicating low amplitude responses.

- Radargram – Presents each radar profile in a vertical view with distance along the profile expressed along the x axis and depth along the y axis. The amplitude variation is expressed using a greyscale.

APPENDIX 2: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into four main categories: archaeological, modern, agricultural and uncertain origin/geological.

The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Possible archaeology – used for features which give a response but which form no discernible pattern or trend.

The modern category is used for anomalies that are presumed to be relatively modern in date:

- High Amplitude – used for responses showing strong reflectance properties. These anomalies can be structural, compacted soil or metallic.
- Low Amplitude – used for responses that conduct the EM energy away showing a lack of reflection and an area low contrast; Often these can represent voids or water logged areas.

The agricultural category is used for the following:

- Former field boundaries – used for ditch sections that correspond to the position of boundaries marked on earlier mapping.
- Ridge and furrow – used for broad and diffuse linear anomalies that are considered to indicate areas of former ridge and furrow.
- Ploughing – used for well-defined narrow linear responses, usually aligned parallel to existing field boundaries.
- Drainage – used to define the course of ceramic field drains that are visible in the data as a series of repeating bipolar (black and white) responses.

The uncertain origin/geological category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Trend – used for low amplitude or indistinct linear anomalies.

APPENDIX 3: OASIS FORM

Project Details:

Project name		25 Lavington Street, London Borough of Southwark, London			
Type of project		Ground Penetrating Radar Survey			
Project description		Ground penetrating radar survey over land at Lavington Street to ascertain the presence or otherwise and nature of detectable archaeological remains. The survey was conducted using a 400 MHz and 200 MHz antenna with a GSSI SIR 3000 interface. Surveys were conducted in accordance with HE guidelines.			
Project dates		Start: 27-04-2016		End: 27-04-2016	
Previous work		DBA			
Future work		Trial Trenching			
Project Code:	111041	HER event no.	If relevant	OASIS form ID:	e.g. wessexar1-220085
		NMR no.	N/A		
		SM no.	N/A		
Planning Application Ref.					
Site Status		None			
Land use		Office, car park and yard			
Monument type			Period	e.g. post-medieval to modern	

Project Location:

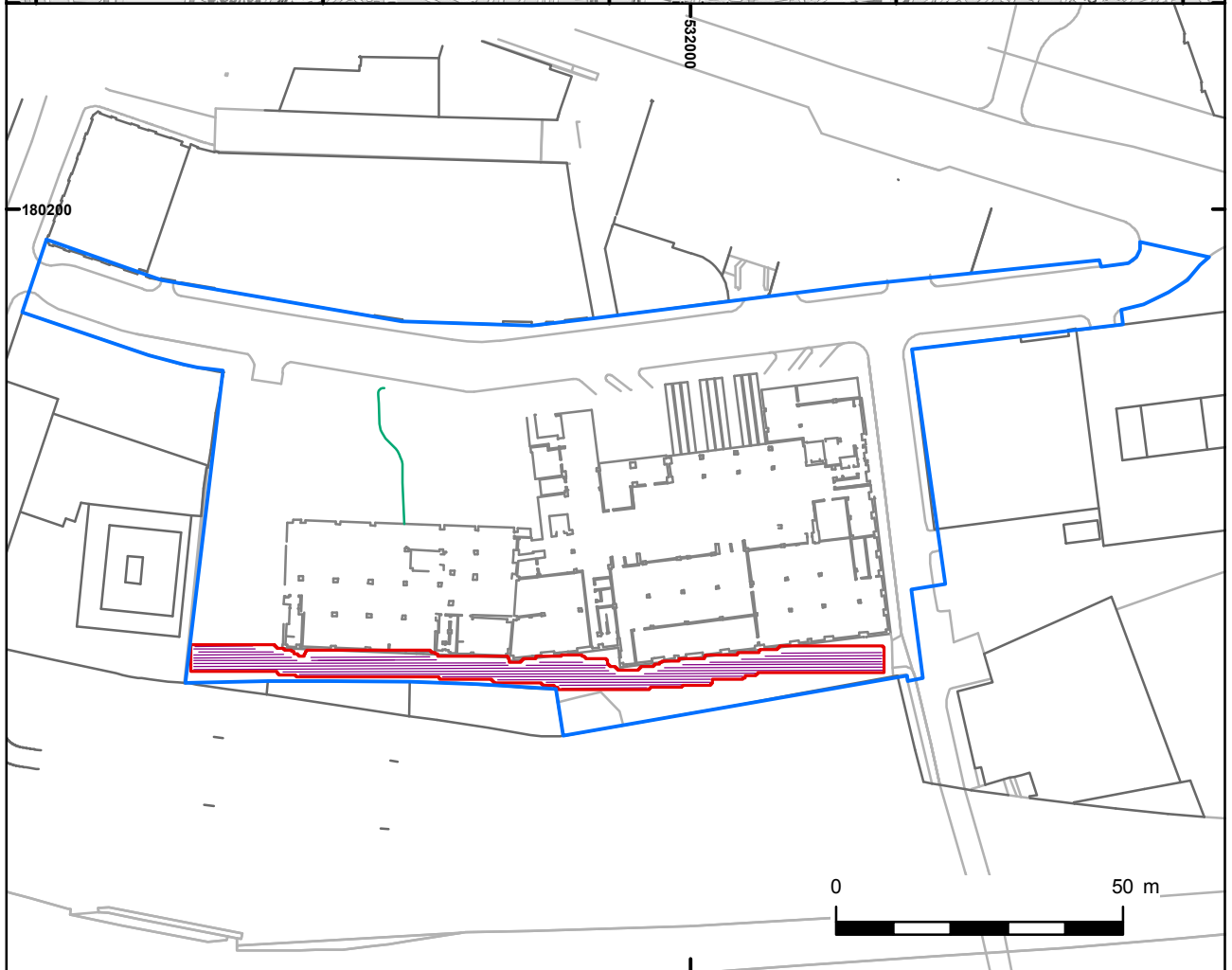
Site Address				Postcode	
County	London	District		Parish	
Study Area	0.05 ha	Height OD	20 – 25 m aOD	NGR	

Project Creators:

Name of Organisation	Wessex Archaeology				
Project brief originator	CBRE Ltd	Project design originator			
Project Manager	Mark Williams	Project Supervisor			
Sponsor or funding body	Type of Sponsor				

Project Archive and Bibliography:

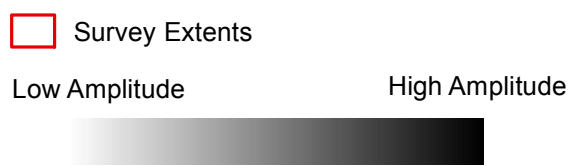
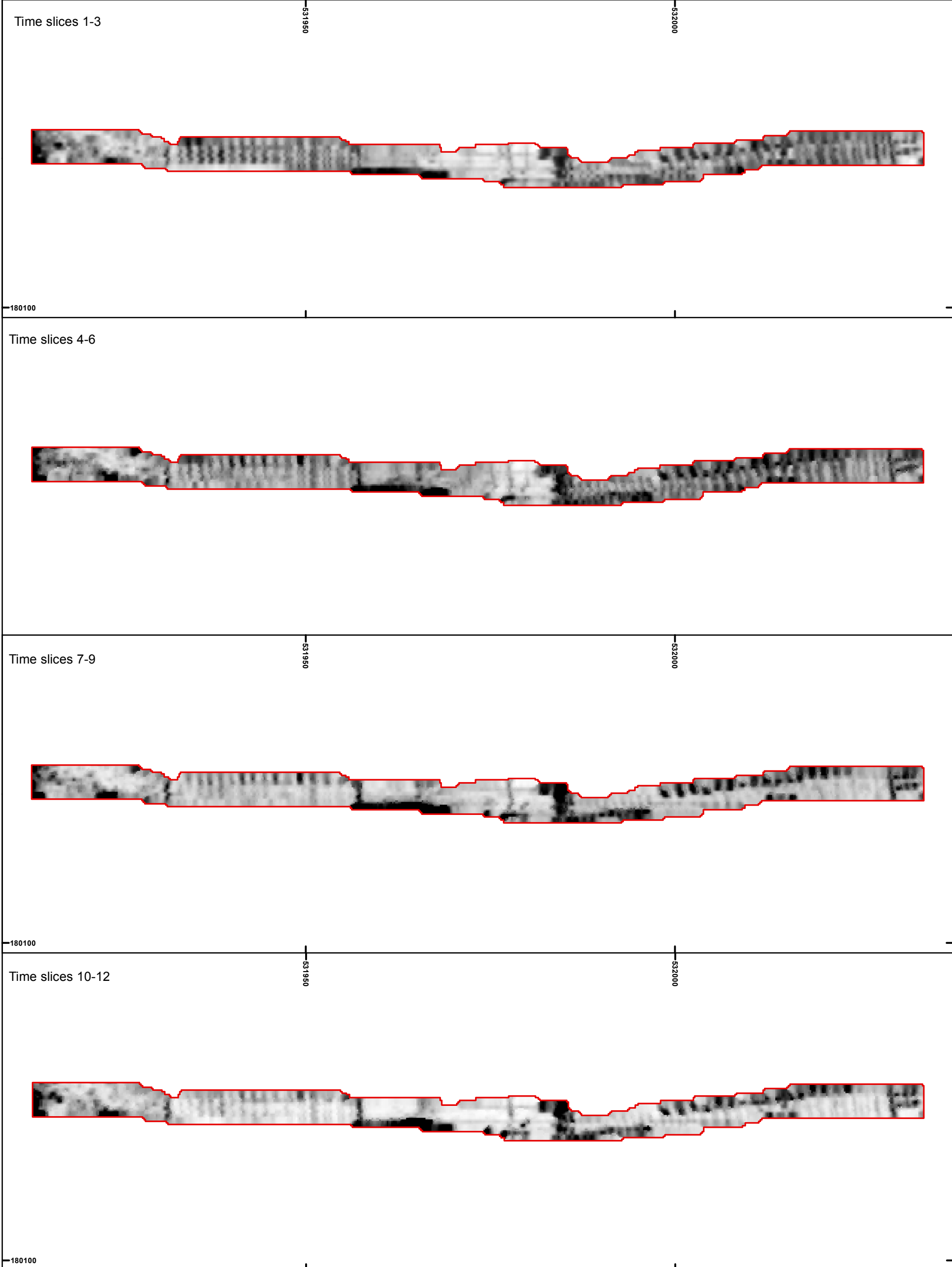
Physical archive	N/A	Digital Archive	Geophysics, survey and report	Paper Archive	N/A
Report title	25 Lavington Street, Southwark, London			Date	2016
Author	Wessex Archaeology	Description	Unpublished report	Report ref.	111041.02



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Site Location and detailed Survey Extents

Figure 1



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Time slices 13-15

531950

532000



180100

Time slices 16-18



Time slices 19-20

531950

532000



180100

531950

532000



180100

Survey Extents

GPR Transects

Low Amplitude

High Amplitude

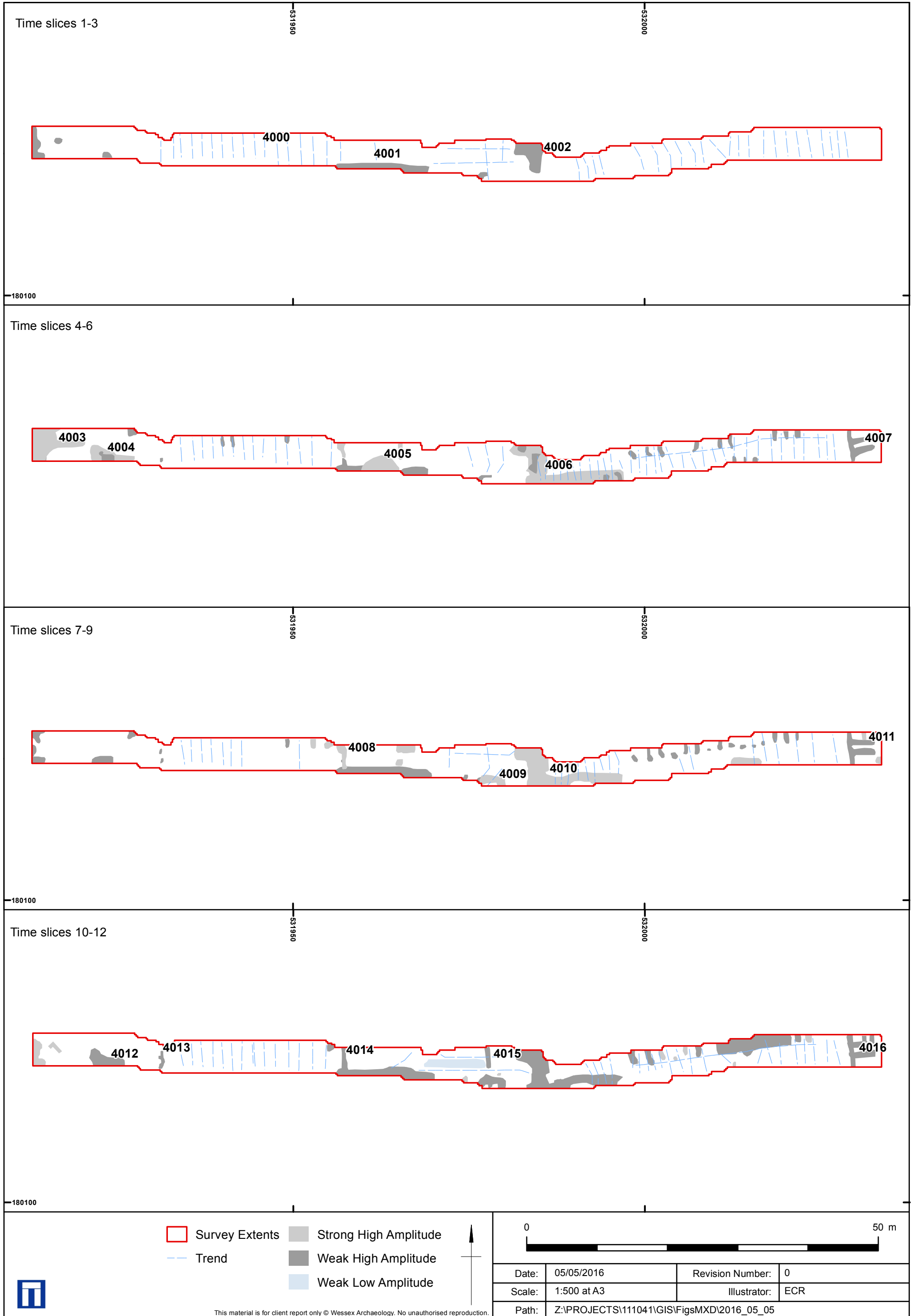


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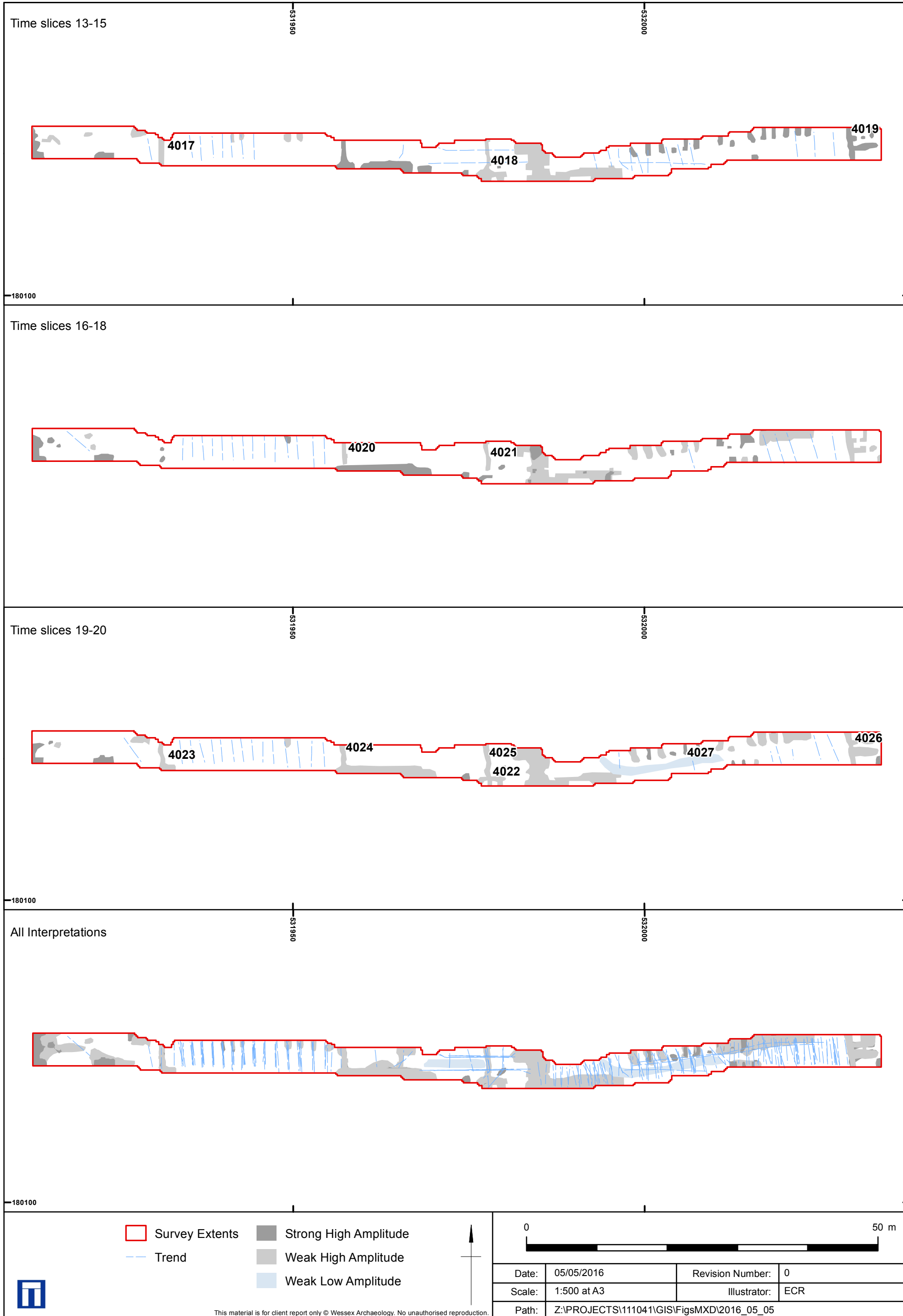
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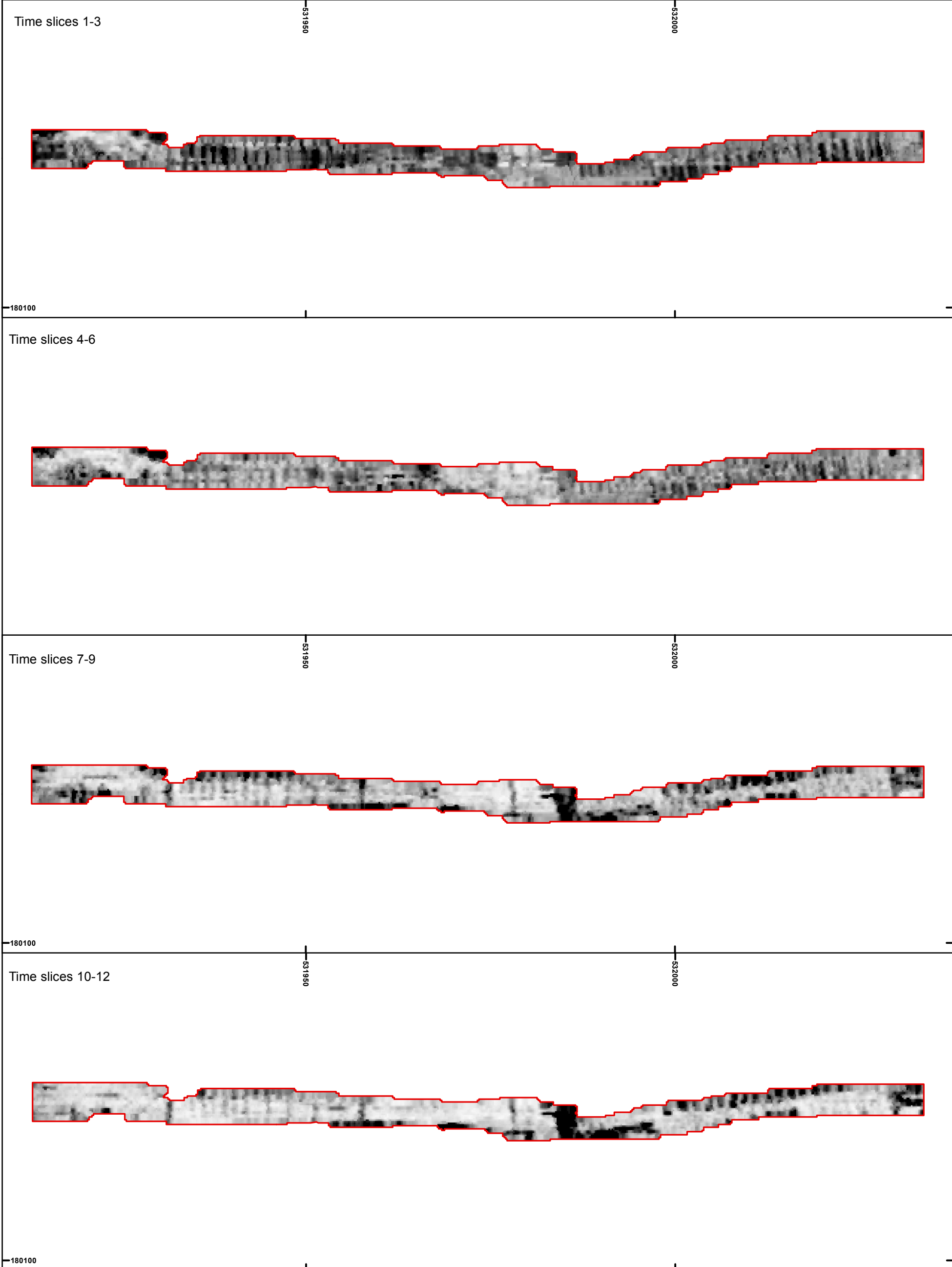
400 MHz Results - Archaeological Interpretations

Figure 4



400 MHz Results - Archaeological Interpretations

Figure 5



Survey Extents
 Low Amplitude High Amplitude



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Time slices 13-15

531950

532000



180100

Time slices 16-18



Time slices 19-20

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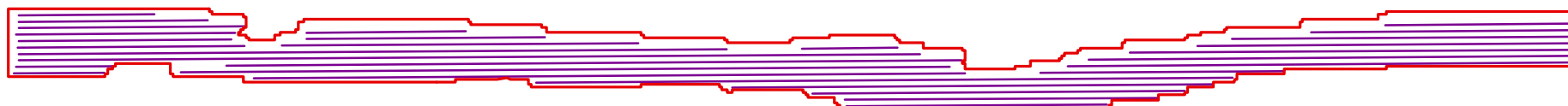
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532000



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Survey Extents

GPR Transects

Low Amplitude

High Amplitude

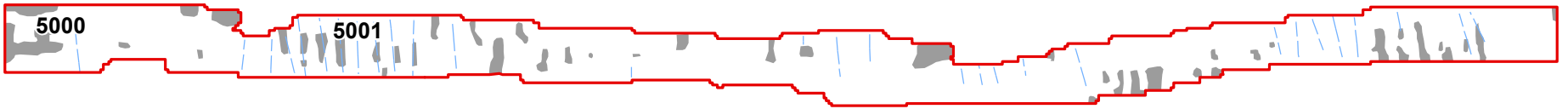


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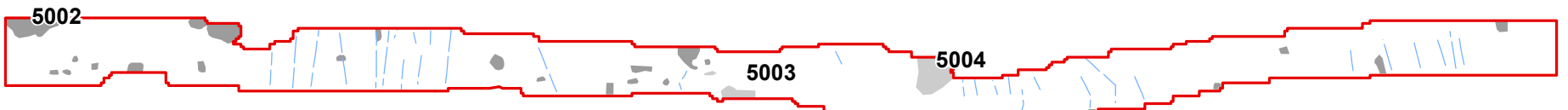
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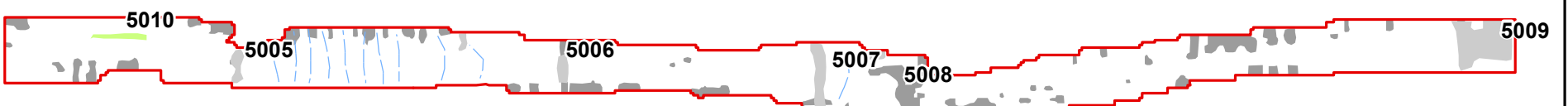
Time slices 1-3



Time slices 4-6



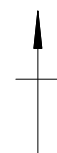
Time slices 7-9



Time slices 10-12



- Survey Extents
- Possible Archaeology
- Trend
- Strong High Amplitude
- Weak High Amplitude

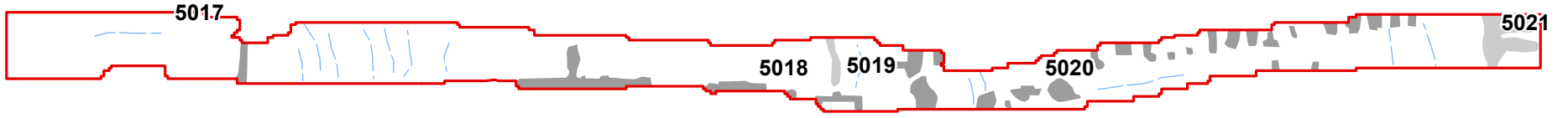


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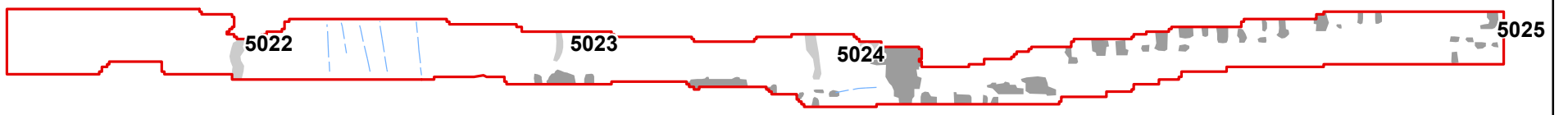


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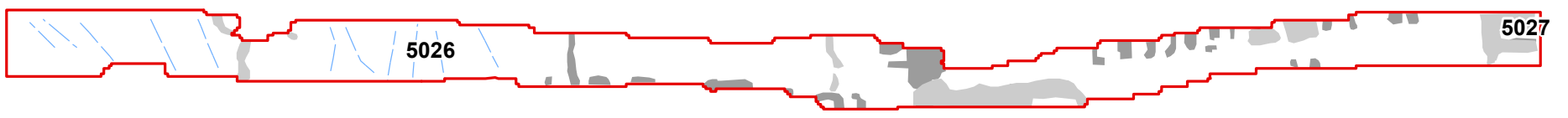
Time slices 13-15



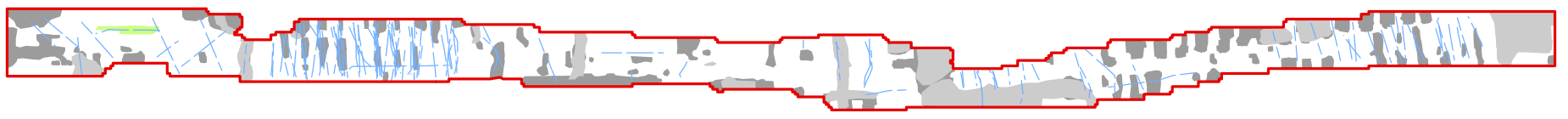
Time slices 16-18



Time slices 19-20



All Interpretations



- Survey Extents
- Trend
- Possible Archaeology
- Strong High Amplitude
- Weak High Amplitude



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Plate 1: Modern Services in the eastern part of the survey area leading from the generators to the building



Plate 2: Scrub land in the western part of the survey area

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