



# Chances Glassworks, Smethwick, Sandwell Report on Geophysical Survey, March 2022

Neil Linfoord

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# CHANCES GLASSWORKS, SMETHWICK, SANDWELL REPORT ON GEOPHYSICAL SURVEY, MARCH 2022

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## SUMMARY

A Ground Penetrating Radar (GPR) survey was conducted over accessible areas at Chances Glassworks, Smethwick, Sandwell, to locate and determine the likely survival of any remains associated with industrial glass making at the site. Since the foundation of the company in 1824 Chances Glassworks was responsible for considerable technological innovation in several major areas of glass manufacture including plate, scientific and coloured glass. Production at the site ceased in the 1980s and, with the exception of the extant listed buildings, the majority of the site has been levelled to a concrete slab used as a series of transport and storage yards. The GPR survey was conducted in response to a case work request to support the Chance Heritage Trust who wish to develop the site for beneficial reuse to secure its long-term future and remove it from the heritage at risk register. An area of 0.7ha was surveyed and successfully imaged the surviving regenerative furnace No. 7, although other anomalies found across the site were more difficult to fully interpret due to the keyhole nature of the accessible areas and complex history of the former buildings and structures associated with the glassworks.

## CONTRIBUTORS

The geophysical fieldwork was conducted by Neil Linford and Andrew Payne.

## ACKNOWLEDGEMENTS

The author is grateful to colleagues from the Chance Heritage Trust who arranged access to the site through the lease holder and tenants to allow the survey to take place.

## ARCHIVE LOCATION

Fort Cumberland, Portsmouth.

## DATE OF SURVEY

The fieldwork was conducted on 21-25<sup>th</sup> March 2022 and the report was completed on 9<sup>th</sup> January 2023. The cover image shows the survey in progress over the location of the former No. 3 and No. 4 furnaces with the M5 flyover visible in the background (photograph taken by N Linford).

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## CONTENTS

Introduction .....	1
Method .....	2
Results .....	3
Conclusions .....	5
List of Enclosed Figures .....	6
References .....	7

## INTRODUCTION

A Ground Penetrating Radar (GPR) survey was conducted over accessible areas at Chances Glassworks, Smethwick, Sandwell, (Listed building entry 1021387) to locate and determine the likely survival of any remains associated with industrial glass making at the site. Chances Glassworks was founded in 1842 and was responsible for technological innovation in several areas of glass manufacture including plate, scientific and coloured glass. Products used in the construction of the Great Exhibition ‘Crystal Palace’, the face of Big Ben’s clock, as well as the lenses of hundreds of lighthouses were manufactured and exported across the globe from Chances. During the second world war the glassworks developed and manufactured military optics such as gun sights, rangefinders and periscopes, together with cathode-ray tubes for radar systems (Chance 1919; Chance Brothers 1951; Encill 2006; Chance and Williams 2008; Encill 2014).

The site ceased production in 1981 after the company was acquired by its main rival Pilkington and has been designated as a scheduled monument owing to the survival of below ground of remains, including the bases of up to six glass furnaces and the major tunnels and flues. While eight listed buildings associated with the glassworks remain in an empty and derelict state, the majority of the site has been levelled to a concrete slab used as a series of transport and storage yards. The site is currently on the Heritage at Risk register (HAR) and the Chance Heritage Trust (see <https://chanceht.org/>), working with the lease holder and tenants, has undertaken various studies of the site and listed buildings, to explore ways for them to be conserved through a proposed mixed-use residential, commercial and light industrial development celebrating the industrial heritage of the glassworks. The current GPR survey was a casework request from colleagues in the Historic England Midlands region to assist the Chance Heritage Trust with the long-term goal of removing the site from the HAR. A previous unreported GPR survey was conducted in the vicinity of the canal basin on the site by the University of Wolverhampton proved unsuccessful due to a high level of signal attenuation.

The bedrock geology is Warwickshire Group Siltstone and Sandstone with subordinate Mudstone, a sedimentary rock formed in the Permian and Carboniferous Periods. This is overlain by Diamicton superficial deposits of Quaternary Till. Soils at the site are unmapped, however, nearby in West Bromwich soils are of the CLIFTON 711n association (Soil Survey of England and Wales 1983; Geological Survey of Great Britain (England and Wales) 2002). The site is covered in a concrete slab and rubble base of made ground with significant resurfacing and levelling that may well influence GPR signal attenuation. Weather conditions were sunny and dry throughout the week of the field work.

## METHOD

A 3d-Radar MkIV GeoScope Continuous Wave Step Frequency (CWSF) Ground Penetrating Radar (GPR) system was used to conduct the survey collecting data with a vehicle towed DXG1820 (Linford *et al.* 2010; Eide *et al.* 2018). A Trimble S5 tracking total station and active reflector prism mounted on the GPR array was used to provide continuous positional control for the survey collected along the instrument swaths shown on Figure 1. Control points for the total station were established using a Trimble R8s Global Navigation Satellite System (GNSS) receiver adjusted to the National Grid Transformation OSTN15 using the Trimble VRS Now Network RTK delivery service. This uses the Ordnance Survey's GNSS correction network (OSNet) and gives a stated accuracy of 0.01-0.015m per point with vertical accuracy being half as precise.

Data were acquired at a 0.075m by 0.075m sample interval across a continuous wave stepped frequency range from 40MHz to 2.99GHz in 2MHz increments using a dwell time of 3ms. A single antenna element was monitored continuously to ensure data quality during acquisition together with automated processing software to produce real time amplitude time slice representations of the data as each successive instrument swath was recorded in the field (Linford 2013).

Post-acquisition processing involved conversion of the raw data to time-domain profiles (through a time window of 0 to 75ns), adjustment of time-zero to coincide with the true ground surface, background and noise removal, and the application of a suitable gain function to enhance late arrivals. Representative profiles from the GPR survey are shown on Figure 3. To aid visualisation amplitude time slices were created from the entire data set by averaging data within successive 2.5ns (two-way travel time) windows (e.g. Linford 2004). An average sub-surface velocity of 0.096m/ns was assumed following constant velocity tests on the data and was used as the velocity field for the time to estimated depth conversion. Each of the resulting time slices therefore represents the variation of reflection strength through successive ~0.12m intervals from the ground surface, shown as individual greyscale images on Figures 2, 4 and 5. Further details of both the frequency and time domain algorithms developed for processing this data can be found in Sala and Linford (2012).

Due to the size of the resultant data set a semi-automated algorithm has been employed to extract the vector outline of significant anomalies shown on Figure 6. The algorithm uses edge detection to identify bounded regions followed by a morphological classification based on the size and shape of the extracted anomalies. For example, the location of possible pits is made by selecting small, sub circular anomalies from the data set (Linford and Linford 2017).

## RESULTS

A graphical summary of the significant GPR anomalies, [gpr1-37] discussed in the following text, superimposed on the base OS map data and 1960s utility plan is provided in Figure 6.

Reflections have been recorded throughout the 75ns two-way travel time window, although there are few significant later responses beyond ~60.0ns (2.97m), and some of the later anomalies may be due to near-surface multiples. The very near-surface data from between 0.0 and 5.0ns (0.0 to 0.25m) contains responses due to visible features such as extant wall-footings [gpr1], expansion gaps between concrete rafts [gpr2], wood covers [gpr13], steel sections [gpr16], rails [gpr12] and rubble in-fill [gpr15].

A former wall line is visible immediately to the north of the Hartley Bridge and is replicated by [gpr1] between 0.0 and 37.5ns (0.0 to 1.86m). While initially a response to the visible surface feature, [gpr1] continues with depth beneath the concrete raft to the east and most likely represents the original extent of the buildings adjacent to the Fiesta warehouse and traffic office shown on the 1960s utility plans for the site. More shallow anomalies [gpr2] between 0.0 and 5.0ns (0.0 to 0.25m) are associated with the expansion gaps between the concrete rafts over regenerative furnace No. 7. Two further short linear anomalies [gpr3] appear to correlate with a rectangular structure recorded by the utility plan in this area close to the current entrance to the furnace shaft. A similar, smaller rectangular structure is also found on the utility plan is partially replicated by [gpr4] immediately to the west.

The north exterior wall-footing of the 'bending and micro' workshops [gpr5], together with a freestanding structure [gpr6] to the west appear from approximately 5.0ns (0.25m) onwards. There is more internal detail with [gpr6] than is shown on the utility plans and rectilinear anomalies at [gpr7] suggest the buildings here were at one time conjoined with the 'bending and micro' workshops. As [gpr1] also appears to extend to the west beyond the recorded extent of known buildings it seems likely that access from the Hartley Bridge may well have been directly into a workshop building or covered way.

Evidence for the regenerative furnace No. 7 begins with two parallel high-amplitude anomalies at [gpr8] found in the data from 7.5ns (0.37m) onwards. The response changes quite suddenly at 12.5ns (0.62m) to become a wider rectilinear anomaly, approximately 7m x 6m, with a series of parallel linear north-south orientated striations (Figure 3(B)). A double linear anomaly [gpr9] appears to join [gpr8] from the south from between 32.5 and 37.5ns (1.61 to 1.86m), possibly an entrance tunnel or conduit, although these also partially correlate with [gpr3] in the near-surface data. In the deeper time slices the footprint of the furnace becomes slightly narrower and a more distinct sub-

circular anomaly [**gpr10**] with a diameter of approximately 2m is found to the north. Although a series of linear anomalies [**gpr11**] are found in the vicinity of [**gpr8**] it is unclear whether these are directly related, perhaps flues or conduits, or represent earlier structural phases.

The largest open area available during the survey was found immediately to the north of the access road and is marked by a change in elevation of approximately 1m from the road level. It is unclear whether this represents the original level across the site or reflects the demolition and possible rubble deposits established after the clearance of the glassworks buildings. The very near-surface data between 0.0 and 5.0ns (0.0 to 0.25m) shows evidence for tram rails [**gpr12**] to the east, visible wooden shuttering [**gpr13**] and the footprint [**gpr14**] of a former structure built against the north wall of the site. There are also a number of anomalies [**gpr15**] associated with rubble infill levelling depressions visible on the surface. Two east-west orientated series of individual discrete anomalies [**gpr16**] are found between 0.0 and 15.0ns (0.0 to 0.74m) and correlate with visible sections of architectural steel on the surface, apparently following the extension of the rolled-plate line from the No. 4 furnace.

An east-west orientated low amplitude anomaly [**gpr17**] is found across the southern extent of this area and passes through the centre of the wooden shuttering visible on the surface, between the offices marked on the 1960s utility plan and the No. 4 rolled plate furnace line. It is possible that [**gpr17**] may represent the location of an earlier furnace structure. Other narrow east-west aligned anomalies [**gpr18**] across this area seem most likely to be associated with expansion gaps between the concrete rafts visible on the surface or the location of former buildings, although [**gpr19**] may correlate with the location of a compressed air main marked on the 1960s utility map. Three parallel diagonal anomalies [**gpr20**] are found between 7.5 and 25.0ns (0.37 to 1.24m) and seem most likely to be associated with some form of utility, although no buried services appear to be recorded in this location.

There is some evidence for further structural remains positioned against the north wall of the site at [**gpr21**], but very few anomalies other than [**gpr22**] associated with the No. 3 rolled plate furnace. While the majority of both the No. 3 and No. 4 furnaces appear to lie to the east beyond areas of the site available for survey, two rectilinear anomalies visible from the surface at [**gpr23**] and [**gpr24**] could represent the opening of the furnace onto the rolled plate lines. Further, less well-defined anomalies [**gpr25**] are found between 17.5 and 60.0ns (0.87 to 2.97m) and it is unclear whether these are related to the later rolled plate furnaces or, perhaps form the predominant north-south orientation, to the earlier historic No. 3 and No. 5 furnaces. If the anomalies at [**gpr25**] are associated with the earlier historic furnaces then these elements of the structures appear to be offset to the west of the location derived from the

1858 map of the site, and possibly associated with historic furnace No. 4. When viewed in profile on Figure 3 anomaly [gpr26] shows some similarity in depth and form to the response recorded over the surviving No. 7 furnace at [gpr8].

As there was only limited access available in the building works compound immediately to the west it is difficult to determine whether the No. 4 rolled plate line continues into this area. The majority of anomalies here are comparatively near-surface [gpr27], although there is a slightly deeper linear response [gpr28] that appears to share the same orientation as the furnace line and possible compressed air line [gpr19].

The western most extent of the site was relatively clear of obstructions but had several changes in level and expansion joints in the concrete rafts that appear as anomalies in the near-surface data [gpr29]. There is also a deeper linear anomaly [gpr30] associated with the wall footing of the former building shown on the utility plan here, and a potentially more significant rectilinear response at [gpr31]. Anomalies [gpr29] and [gpr31] share an alignment with the perimeter of the glassworks shown in this area on the utility plan, suggesting these are in part associated with structural remains of the factory.

Access to the haulage yard to the east in the immediate vicinity of the Seven Storey building was also partially restricted due to parked vehicles and current operations of the tenants. A group of parallel closely spaced linear anomalies [gpr32] is found between 0.0 and 25.0ns (0.0 to 1.24m) and possibly represents a cover or reinforced concrete raft over the forecourt of a bayed structure shown on the utility plan. This would appear to be associated with the fuel oil storage tanks, pumps and heaters used to operate furnaces No. 3 and 4. Other anomalies in this area appear to be associated with a former circular stack feature on the utility plan [gpr33], possible expansion gaps in underlying concrete rafts [gpr34] and fragmented walls at [gpr35] and [gpr36]. An amorphous anomaly [gpr37] is found in the former canal basin and is possibly related to the later use of this area as a sand store for the glassworks.

## CONCLUSIONS

While the GPR survey has produced successful results over the location of the surviving No. 7 furnace results from the wider area have proved more difficult to interpret. This is in part due to the key-hole nature of the currently accessible areas and the overburden and rubble used to level the site. Elements of the two rolled plate furnaces No. 3 and 4 have been revealed, although the full extent of these could not be covered in the available survey area. Very near-surface features, such as the expansion joints between concrete rafts visible across the site have produced strong anomalies that may potentially indicate the floor plan of former buildings across the site.

## LIST OF ENCLOSED FIGURES

- Figure 1* Location of the GPR instrument swaths superimposed over the base OS mapping data (1:750).
- Figure 2* Greyscale image of the GPR amplitude time slice over the south lawn from between 27.5 and 30.0ns (1.36 to 1.49m) superimposed over the base OS mapping data. The location of representative GPR profiles shown on Figure 3 are also indicated (1:750).
- Figure 3* (A) Representative profiles from the GPR survey shown as greyscale images with annotation denoting significant anomalies, together with (B) an isovolume visualisation of high amplitude reflectors from the area over the No. 7 furnace. The location of the selected profiles and the area shown in the isovolume view can be found on Figures 1, 2 and 6.
- Figure 4* GPR amplitude time slices between 0.0 and 30.0ns (0.0 to 1.49m) (1:1750).
- Figure 5* GPR amplitude time slices between 30.0 and 60.0ns (1.49 to 2.97m) (1:1750).
- Figure 6* Graphical summary of significant GPR anomalies superimposed over the base OS and mapping and 1960s utility plan (1:750).

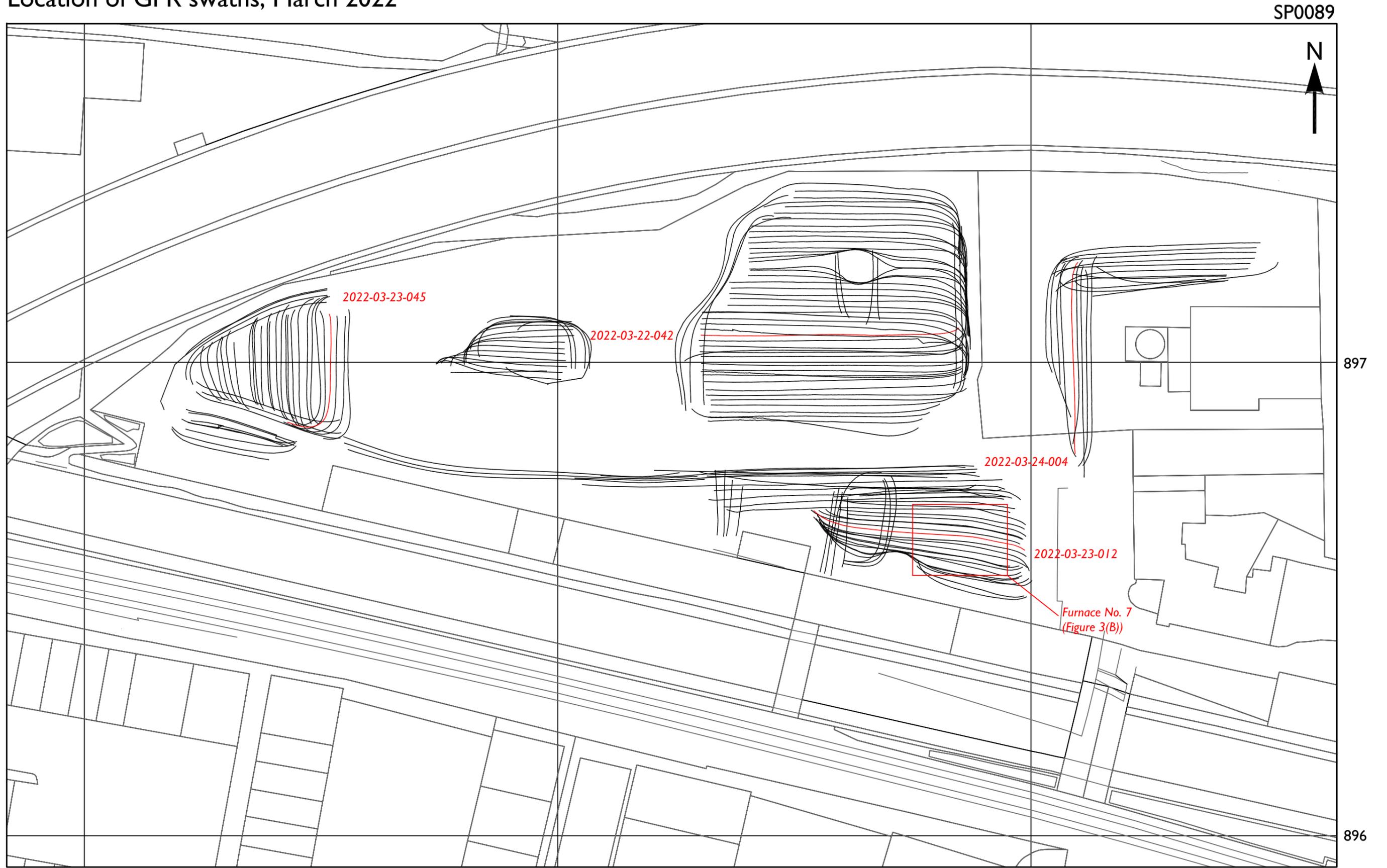
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# CHANCES GLASSWORKS, SMETHWICK, SANDWELL

## Location of GPR swaths, March 2022



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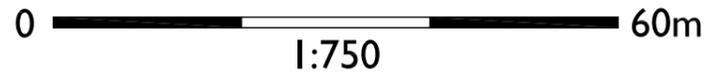
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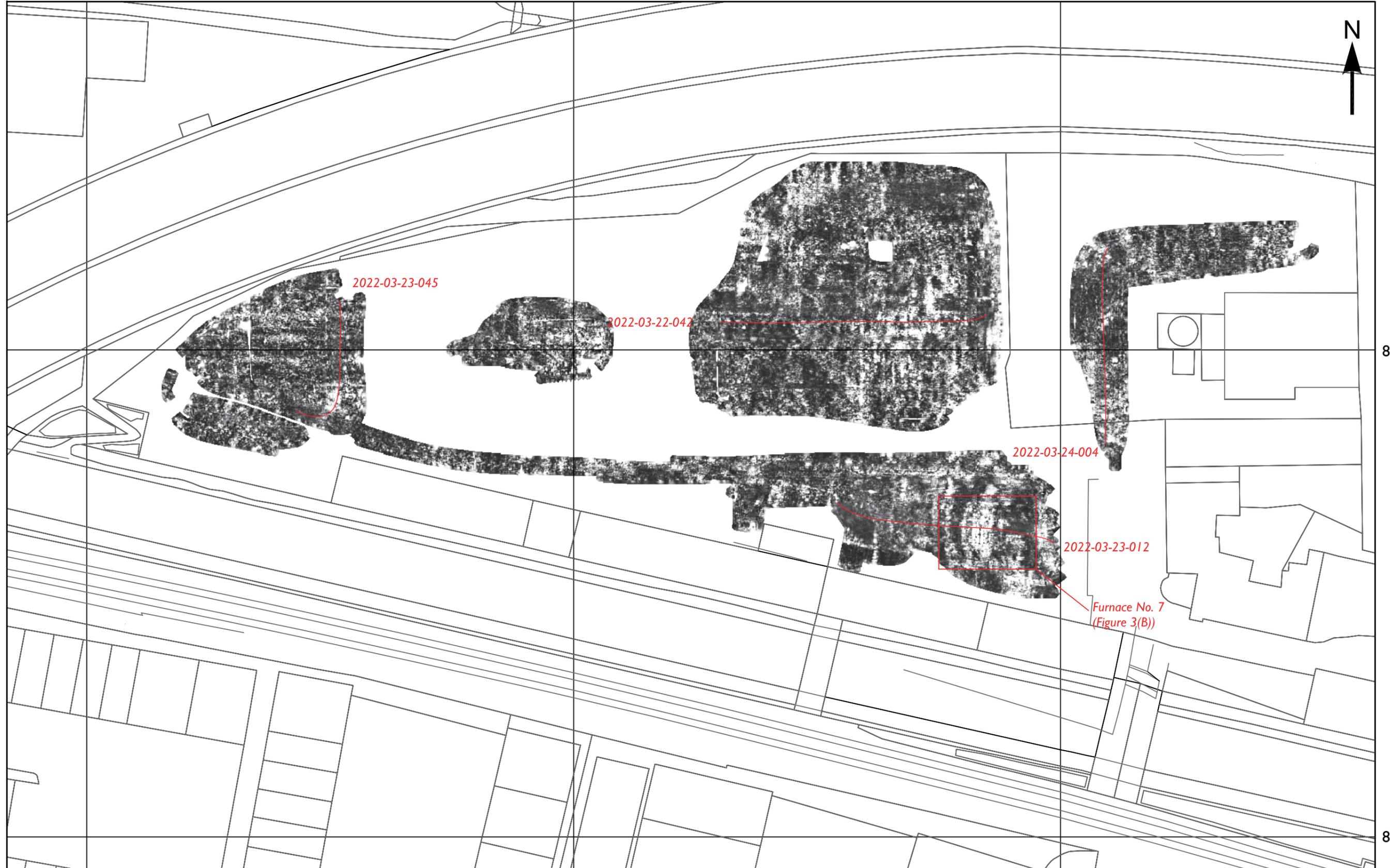


- Ground Penetrating Radar survey swaths
- Location of selected GPR profiles shown on Figure 3

# CHANCES GLASSWORKS, SMETHWICK, SANDWELL

GPR amplitude time slice between 27.5 and 30.0ns (1.36 to 1.49m), March 2022

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1:750

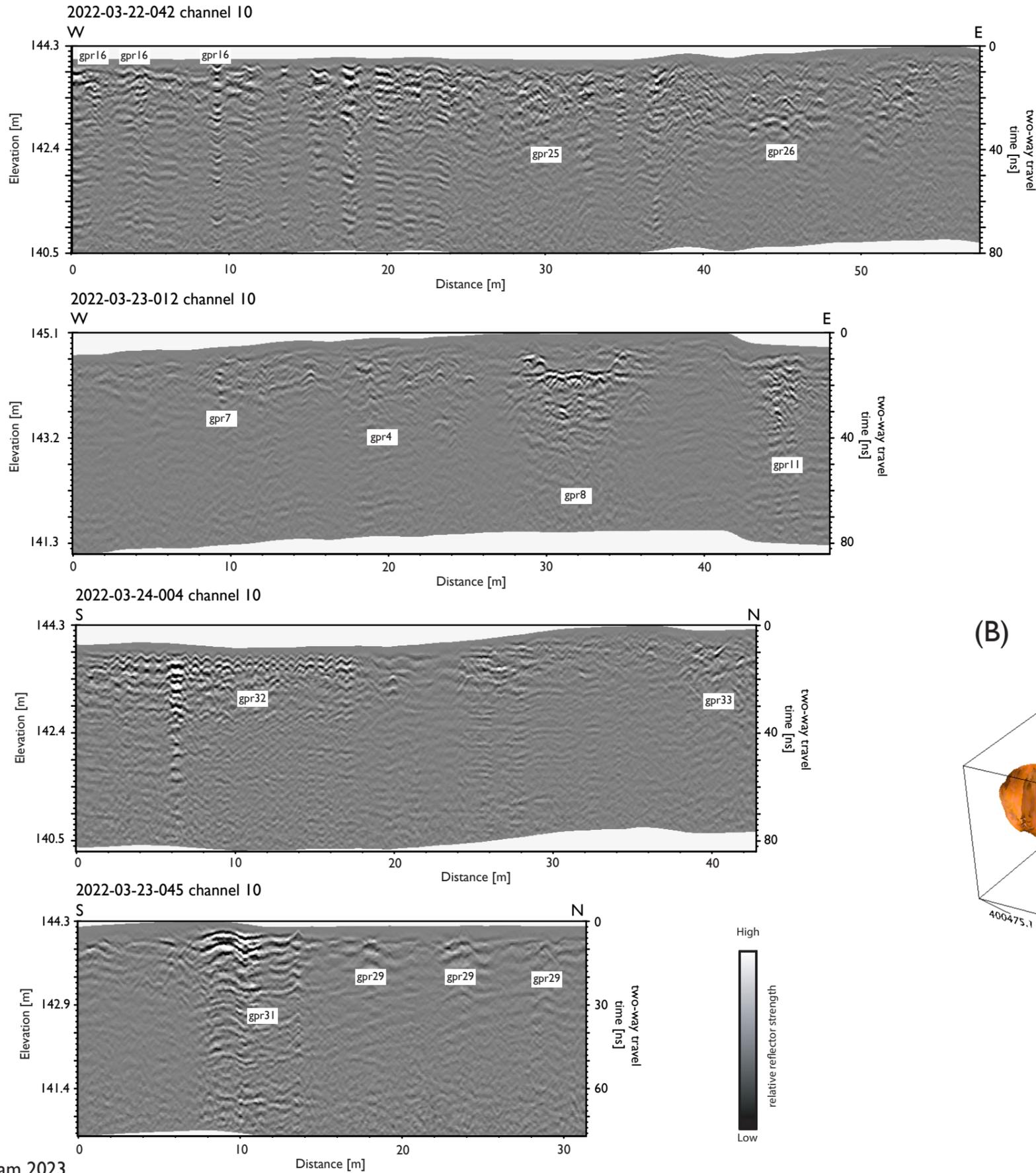
Low High  
relative reflector strength

Location of selected GPR profiles shown on Figure 3  
2021-10-19-001

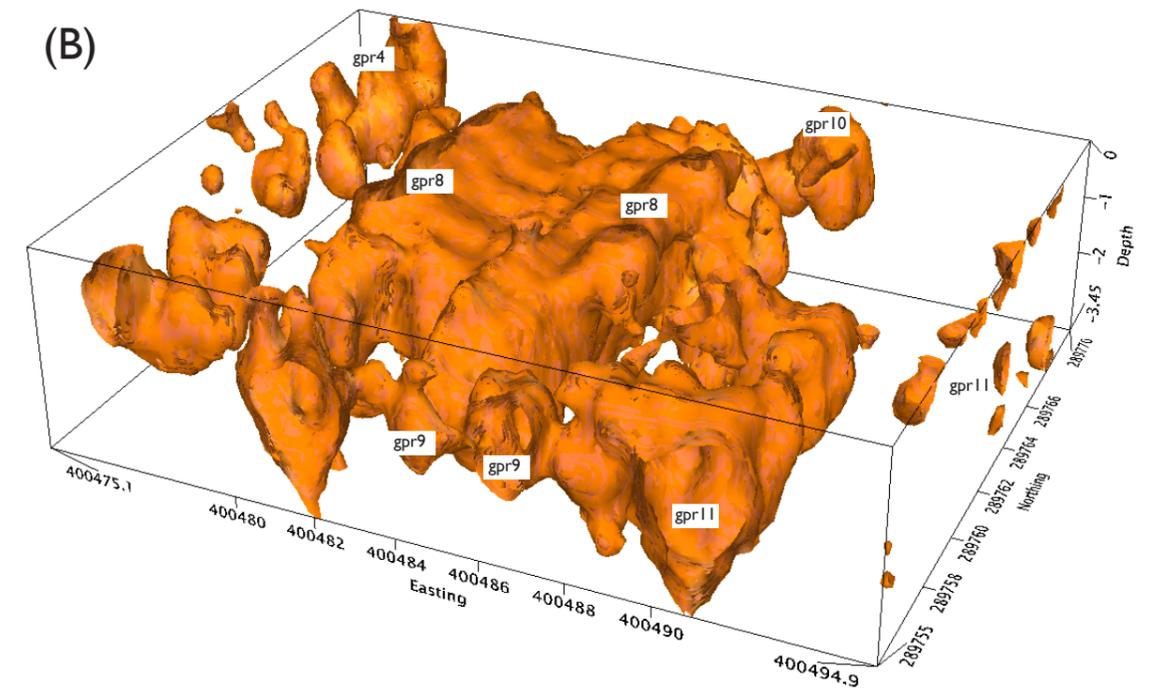
CHANCES GLASSWORKS, SMETHWICK, SANDWELL  
 Topographically corrected GPR profiles, March 2022

Figure 3

(A)

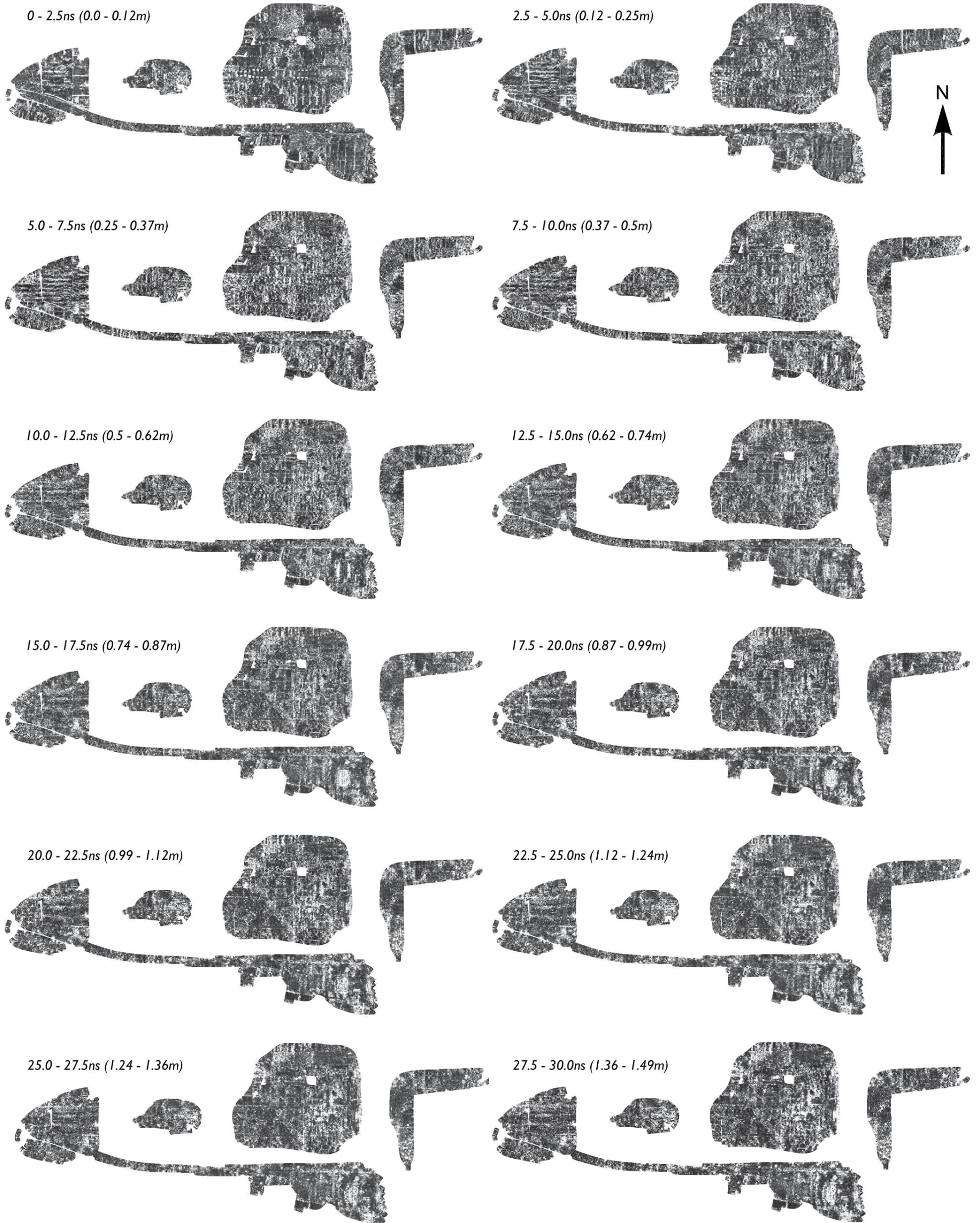


(B)



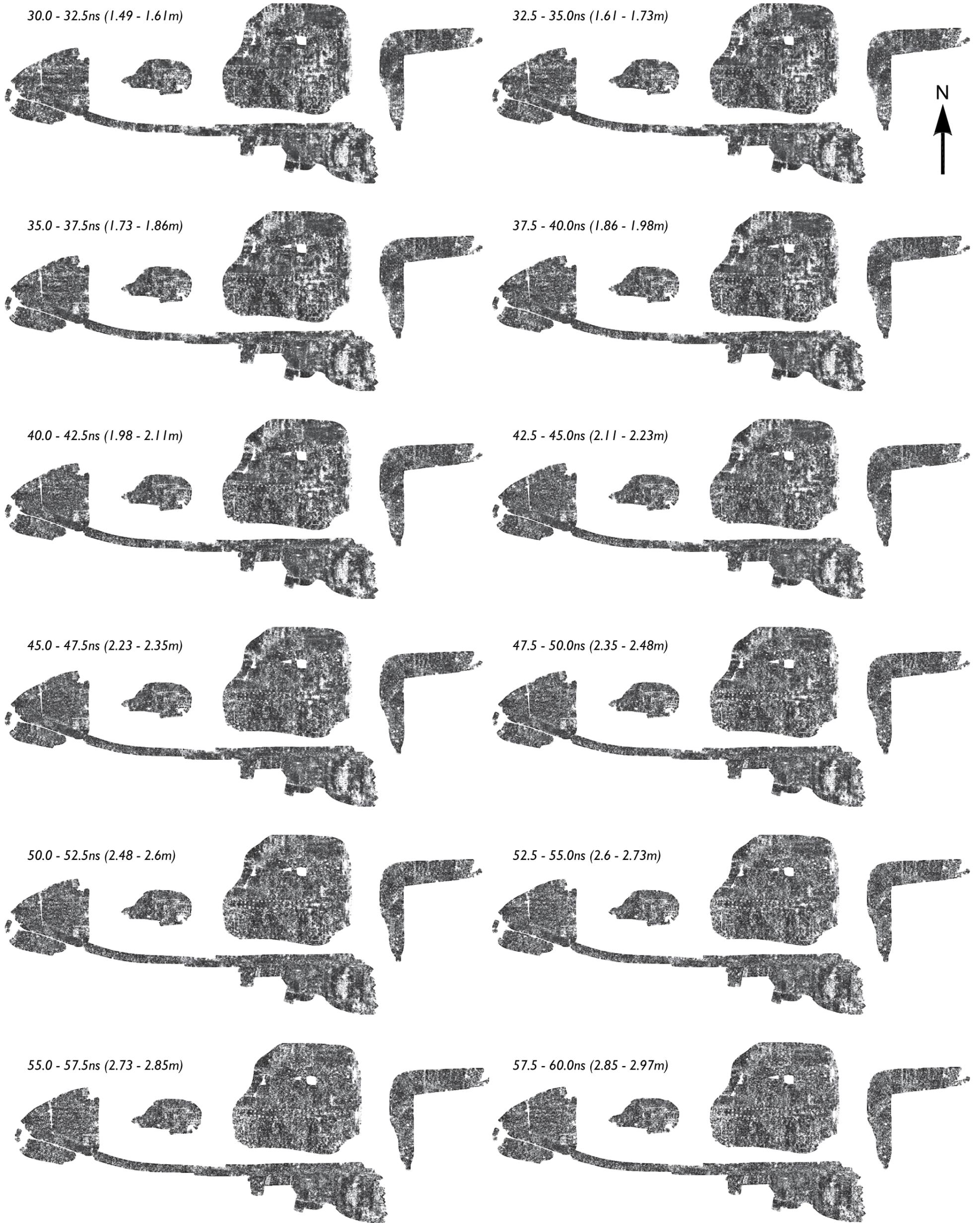
# CHANCES GLASSWORKS, SMETHWICK, SANDWELL

## GPR amplitude time slices between 0.0 and 30.0ns (0.0 to 1.49m), March 2022



# CHANCES GLASSWORKS, SMETHWICK, SANDWELL

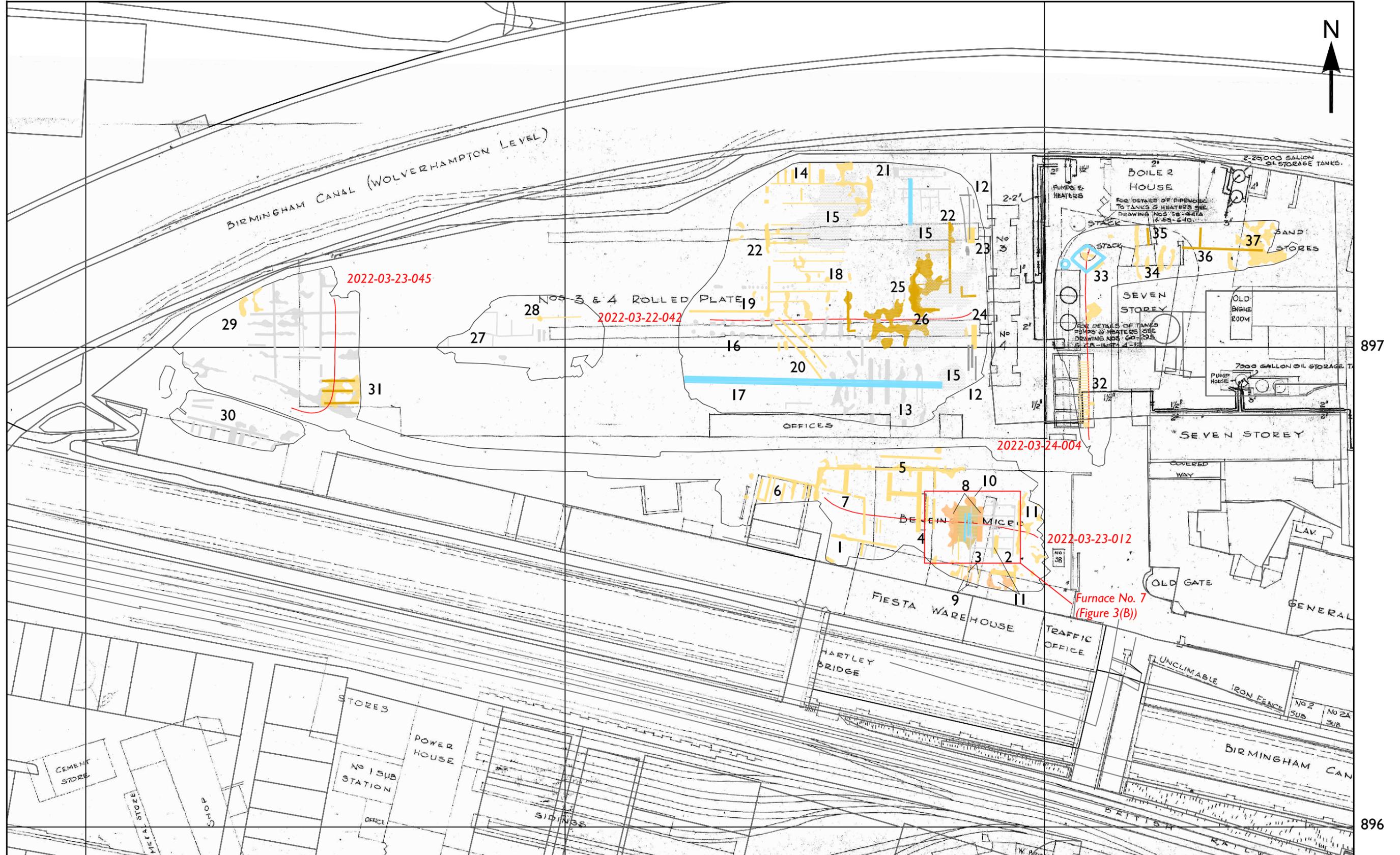
GPR amplitude time slices between 30.0 and 60.0ns (1.49 to 2.97m), March 2022



# CHANCES GLASSWORKS, SMETHWICK, SANDWELL

## Graphical summary of significant GPR anomalies, March 2022

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low amplitude reflectors

high amplitude reflectors

anomalies of known or recent origin

Location of selected GPR profiles shown on Figure 3  
2022-03-22-001



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